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AIRFIELD DELAY SIMULATION MODEL

(ADSIM)

USER'S GUIDE

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ADSIM is a discrete event simulation model which can be used to study airport capacity and delay. The model calculates travel time, delay, and flow rate data to analyze components of an airport, airport operations, and operations in the adjacent airspace. This document provides the information necessary to use the ADSIM appropriately. It describes the modeling methodology and contains instructions for preparing the input data, applying the model, and interpreting the output.
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1.0 INTRODUCTION

The Federal Aviation Administration (FAA) conducted numerous studies and research and development efforts to improve airport capacity and reduce aircraft delay. Based on a preliminary study, the FAA realized in the early 1970's that even with applying the best engineering and development programs (e.g., metering and spacing and microwave landing systems), there was still no assurance that the ever-increasing airport demands could be met without operational changes and expansion. Therefore, the FAA and industry formed airport improvement task forces representing airport management, airport users, aviation experts, and analyses experts. These task forces studied individual airports and recommended planned alternatives to provide for the required increased capacity.

As computer simulation became a viable analysis tool, the FAA developed the Airfield Delay Simulation Model (ADSIM) to study airport capacity and delay. This discrete event simulation model calculates travel time, delay, and flow rate data to analyze components of an airport, airport operations, and the operations in the adjacent airspace. The FAA validated the model at Chicago O'Hare Airport in 1977. Since that time, the model was used in task force studies of major United States airports: Chicago, New York, St. Louis, Denver, Atlanta, Miami, Los Angeles, Dallas-Fort Worth, and Houston.

The ADSIM User's Guide provides the information necessary to use the ADSIM model appropriately. It describes the modeling methodology and contains instructions for preparing input data, applying the model, and interpreting the output.

1.1 BASIC MODELING CAPABILITIES

Using ADSIM as a tool for generating quantitative airport performance data, airport planners can determine optimum airport use strategies, expenditures for runway and other facilities and equipment, and research and development priorities. ADSIM can help the user achieve the following objectives in studying specific airports.

* Estimate current levels of airport capacity and aircraft delay.

* Identify causes of delay associated with operations in the airspace, on the airfield, and on the apron/gate systems.

* Estimate the potential benefits of reduced aircraft delay through alternative air traffic control procedures, airport use policies, and facility developments.

* Estimate current and future relationships between air traffic demand and aircraft delay to aid future planning.

* Estimate the potential benefits of increased airport capacity and reduced aircraft delay from proposed improvements in Air Traffic Control (ATC) systems.

* Determine requirements for new facilities to achieve specified capacity and delay levels.

Therefore, ADSIM utilizes user-specified input data (e.g., aircraft class, airport layout and operation, and ATC procedures) to generate the following output data for analyses of the airfield performance.

* Hourly (or quarter-hourly) delays caused by each user-specified ATC separation.

* Arrival and departure delays by hour (or quarter-hour), by aircraft class, by runway, by airfield components, and by airfield operations.

* Delays for runway crossing and taxiway queue links.

* Travel times for various segments of departure and arrival operations.

* Composite hourly (or quarter-hourly) flow rates, travel times, and delays for arrivals and departures.

1.2 NOTE TO PREVIOUS ADSIM USERS

The following enhancements to ADSIM improve the input and output processing and the overall implementation of the model.

* Comment cards in the source code provide in-line program documentation.

* Loops have variables as limits to simplify coding and improve documentation.

* The actual runway identification, up to 3 alphanumeric characters, can be input instead of the ordinal numbers previously used.

* The ADSIM input is echoed back as it is read and validity checks are conducted on each input value. If an error is found, a message is printed directly below the card in error and the erroneous value is flagged with a "$" for quick error location.

* An error summary indicates the number of input errors and their severity.

* The output reports have English-like headings for all data elements.

* Up to 99 aircraft can be waiting to arrive at or to depart from a runway.

* A different aircraft schedule can be read for each replication.

* Aircraft can takeoff from runway intersections.

* ADSIM can simulate more than 24 hours.

* The printing of individual output reports is optional.

* Fix-to-threshold travel time, or distance and speed, can be read.

1.3 MODEL AND DOCUMENTATION AVAILABILITY

The ADSIM model and the ADSIM User's Guide are available through the National Technical Information System (NTIS).

The following reports (ordered by date) provide some background information on the model's development.

* CACI, INC., -FEDERAL, "Airfield Delay Simulation Model (ADSIM) User's Guide," October 1981.

* Federal Aviation Administration, "Airfield Delay Simulation Model Implementation Instruction for the FAA Technical Center Honeywell Computer System," September 1981.

* Federal Aviation Administration, "Airfield Delay Simulation Model Implementation Instructions for the Boeing Computer System CDC 750 Computer," September 1981.

* CACI, INC., -FEDERAL, "Airfield Simulation Model Implementation Instructions," March 1981.

* Federal Aviation Administration, "Parameters of Future ATC Systems Relating to Airport Capacity/Delay," June 1978.

* Peat, Marwick, Mitchell & Co., "PMM & Co. Airfield Simulation Model User's Manual," April 1977.

* Federal Aviation Administration, "Technical Report on Airport Capacity and Delay Studies," June 1976.

* Federal Aviation Administration, "Techniques for Determining Airport Airside Capacity and Delay," June 1976.

* Federal Aviation Administration, "Report of the FAA Task Force on Aircraft Separation Assurance," January 1976.

2.0 MODEL METHODOLOGY

ADSIM simulates the significant aircraft movements on the airfield and in the adjacent airspace. The model traces the path of each aircraft through space and time on the airfield network. The airfield is represented by a series of links and nodes depicting the paths; the model traces each aircraft by continually advancing clock time and recording its new location. Then the model processes the records of aircraft movement and produces desired outputs such as delays, queue lengths, travel times, and flow rates.

ADSIM is a discrete event simulation model and employs Monte Carlo sampling techniques. Variable time increments are used as the time flow mechanism. Therefore, clock time advances by the amount necessary to cause the next most imminent event to take place.

To achieve a statistically significant result, a day of operations is simulated several times and the average results are presented along with their standard deviations. The number of model replications (maximum of 10) is controlled by the user and should reflect the variability in the input data. Each replication starts with a user-specified random number seed so it is possible to duplicate any particular cycle if desired.

Using Monte Carlo sampling techniques, the model simulates the day-to-day variations encountered in real life. A number of the model parameters are stochastic (random) and must be approximated by a normal distribution. For example, arrival approach speeds vary daily for any given aircraft depending on such factors as payload, wind, and pilot technique. ADSIM assigns arrival approach speeds by sampling values from a normal distribution with the mean and the standard deviation specified by the user. All types of probabilistic model parameters are listed below.

* Aircraft separations.
* Aircraft approach speed.
* Arrival runway occupancy time.
* Touch-and-go runway occupancy time.
* Departure runway occupancy time.
* Runway exit-taxiway (exit) choice.
* Gate service time.
* Arrival lateness distribution.
* Runway crossing delay limits.
* Runway interarrival gap.
* Intersection takeoff.
* Link transit time.

These following details of the model logic are described later in this report.

* Movement of aircraft -- the progress of an aircraft through the airfield.

* Runway and airspace operations -- the Air Traffic Control (ATC) algorithms that separate pairs of aircraft on the runways and in the airspace and switch aircraft to different runways.

* Taxiing operations -- the processing of aircraft on taxiways.

* Gate operations -- the processing of aircraft in the apron/gate area.

2.1 MOVEMENT OF AIRCRAFT

At the start of each replication's simulation, the model applies the optional user-supplied lateness distribution to each arrival's scheduled arrival time over the runway threshold. To assure proper aircraft separation, an arrival may be delayed before merging onto the runway's common approach path. Based on its aircraft class, an arrival is assigned a common approach path length and an approach speed from a normal distribution. For each arrival pair, interarrival separations and final approach speeds are checked so that sufficient separation exists on the common approach path. As an arrival crosses the threshold, it is assigned an exit and associated runway occupancy time from distributions (based on exit locations on the airfield and the runway, exit types, aircraft class, and runway operations). If the selected runway exit is already occupied, the next exit in the distribution is chosen.

The routing to the preferred gate or basing area is determined when an arrival exits the runway. An air carrier is always assigned to its preferred gate if that gate has infinite capacity. If the preferred gate has a limited capacity and the gate is full, the model searches for a gate large enough to accomodate the aircraft and belonging to the airline under consideration. If a gate is not available, the arrival is routed to a holding area until an appropriate gate becomes available. In the case of general aviation or military aircraft, which are designated by "GA", the route to the basing area (which has infinite capacity) is determined by the exit used and the location of the basing area.

Once the route to the gate or basing area is established, the aircraft moves from link to link along its route on the airfield network. At each link, the model determines whether the next link on the route is available. If the next link is already occupied, the aircraft is not moved until the link is vacated; its travel time is increased by the amount of time the aircraft is delayed. At each link, the model also decides if the next link is the first link of a two-way path. A two-way path must be clear of any aircraft traveling in the opposite direction before the aircraft under consideration can enter the two-way path.

When the aircraft reaches its gate, a gate occupancy time is selected from an empirical distribution and is added to the gate arrival time. If this revised time is greater than the scheduled departure time, the

departure is delayed by resetting the scheduled departure time to the arrival time on gate plus the gate occupancy time.

The preferred departure runway is obtained from the aircraft schedule; the lateness distribution is not applied to the scheduled departure time. Departures may take off from the runway end link or a runway intersection link, selected from a user-specified distribution. When a departure is ready to leave a gate with a limited capacity, the model ensures that the ramp area is clear for push-back. The preferred departure runway may be changed due to demand on the runway. Once the departure runway is chosen, the departure takeoff-point is selected; the route to the departure runway is determined by the aircraft's gate location and the departure takeoff link.

When a general aviation or military aircraft ("GA") reaches its basing area, the model assumes it parks and leaves the system because "GA" operations are unstructured. If the desired link is not occupied, the originating departure pushes back at the scheduled departure time. The location of the basing area and the departure takeoff link determine the route to the departure runway.

Whenever a departure reaches its takeoff link, ATC procedures are checked and confirmed before the departure is cleared for takeoff. If necessary, the departure is delayed to maintain proper separation between dependent arrivals and departures and to give arrivals priority over departures.

2.2 RUNWAY OPERATIONS

The user designates separations between aircraft on the same runway and on dependent runways: arrival-arrival (an arrival followed by an arrival), departure-arrival, departure-departure, and arrival-departure. The model maintains proper aircraft separations and ATC procedures.

In providing the proper separation between arrivals at the runway threshold, the model considers these items.

* The required ATC separation for the aircraft pair.

* The relative approach speeds of the arrivals. If the trail aircraft is faster than the lead aircraft, the required arrival separation is assured at the runway threshold. If the trail aircraft is slower than the lead aircraft, the required arrival separation is set up at the beginning of the common approach path; the amount of time the trail aircraft falls behind is included in the separation over threshold for the aircraft pair.

* Runway occupancy. Only one aircraft is permitted to occupy the runway at any given time.

The model determines the separation between a pair of successive departures based on the required ATC separation. When interleaving arrivals and departures, the model permits a departure to roll on a runway when all of the following conditions are fulfilled:

* The previous arrival left the runway.

* Sufficient separation from the next arrival exists, i.e., the next arrival is far enough from the threshold for the departure to clear the runway before the arrival crosses the threshold.

* Sufficient separation from the previous departure exists, i.e., the previous departure cleared the runway with sufficient time to avoid any possible interference.

For pairs of dependent runways, the user must also input arrival-departure (an arrival followed by a departure) separations. The model uses these separations to ensure the arrival clears the intersection before a departure is cleared on the intersecting runway.

The model has several special Air Traffic Control (ATC) features. One feature increases arrival spacings on final approach to allow departure queues to be dissipated. The user specifies the departure queue length (number of aircraft) at which the interarrival spacing is increased by a desired number of minutes.

2.3 TAXIING OPERATIONS

The model moves aircraft from link to link on a predetermined path defined as a series of links. The model ensures the next link on the path is not occupied by another aircraft before it moves an aircraft onto the link.

Taxiways on which aircraft may taxi in both directions are called two-way paths; they are defined by the user and may occur at several places on the airfield. If an aircraft is about to enter a two-way path, the model determines if there are other aircraft on this path which may conflict with this aircraft. If a potential conflict exists, the aircraft for which the check is made is delayed until the conflict condition no longer exists. If an aircraft is ready to cross an active runway, the model maintains ATC procedures before allowing the aircraft to cross the runway. Priority is always given to aircraft operating on the runway, unless the runway crossing delay limits are exceeded.

2.4 GATE OPERATIONS

After a gate is assigned to an arrival, the model moves the aircraft from link to link on the network to the gate; a first-come-first-served rule applies to conflicts except those in which taxiways cross active runways. A two-way path often serves the gates between any two pier fingers. Before an aircraft enters a two-way path, the model checks for aircraft moving either to or from a particular gate on that path. If an aircraft on the path is moving toward a gate (i.e., away from the arrival for which the check is performed), the model permits the arrival to continue on the path toward its gate. If a departure is leaving the gate or is pushing back, the arrival is held until the departure clears the two-way path.

If a departure is ready to push back from a gate onto a two-way path and an arrival is taxiing toward the area which the departure will occupy during push-back, the departure is delayed at the gate until the arrival clears the area in question.

3.0 ELEMENTS OF AN AIRPORT STUDY

ADSIM is applicable to all types of airfield configurations. Consequently, the model does not contain any airport specific or aircraft-class specific data; all data are input.

Although ADSIM can simulate a non-tower General Aviation airfield or Chicago O'Hare International Airport, model application is relatively expensive because of the model's complexity and the volume of input data required. Therefore, the model is most often applied at large airports.

By manipulating the input data, unusual events can be simulated. For example, the impact of a change in weather conditions or the effect of a storm passing through the area may be simulated by changing aircraft separations, runway usage, and aircraft operating characteristics in the middle of the model run.

A general description of the input data required for an airport study is given below. Section 4.0 describes in detail the format in which these data must be input to implement the model.

3.1 LOGISTICS

* Title -- a brief description of the model application.

* Random number seeds -- each random number seed varies a set of daily events. The number of random number seeds determines the number of model replications and thus the statistical validity of the results.

* Start and finish times -- the times when the run is to start and finish.

* Print options -- several options control the level of detail of output, debugging statements, etc.

* Airline names -- the two letter codes for each airline in the aircraft schedule (including code "GA" for general aviation or military aircraft).

* Processing options -- several options control the way input data are processed, e.g., only printing the input data.

* Truncation limits -- applies to the limits of the normal distribution used in the Monte Carlo sampling technique; it is defined as a number of standard deviations.

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3.2 AIRFIELD PHYSICAL CHARACTERISTICS

* Airfield network -- a description of the airfield as a network of taxiway links and nodes.

* Runway identification -- the number of runways and their three character identifiers.

* Departure runway end links -- the taxiway link(s) occupied by departures prior to taking off from the end of an active runway.

* Intersection takeoff links -- the taxiway link(s) occupied by departures prior to taking off from a runway intersection on an active runway.

* Runway crossing links -- the taxiway link(s) occupied by an aircraft prior to crossing an active runway; they are associated with clearance times for aircraft to cross the runway.

* Runway exit location -- the distance from the threshold to each exit, by runway.

* Holding areas -- those sections of taxiways or apron used for storing arrivals awaiting a gate.

* Airline gates -- the gates belonging to each airline.

* Fixes -- approach and departure fix identifications.

3.3 PROCEDURES

* Aircraft separations -- mean and standard deviation of separations (for each pair of aircraft classes) -- arrival-arrival, departure-arrival, departure-departure, and arrival-departure separations for each runway and pairs of dependent runways.

* Route data -- link sequences for all exit/gate and gate/takeoff-point combinations; plus link sequences for exit/holding area and holding area/gate combinations.

* Two-way path data -- link sequence for those sections of taxiway used by aircraft in either direction.

* Common approach path(s) -- length of the common approach (by aircraft class) to each runway.

* Departure runway queue control -- aircraft queue lengths (by runway) above which aircraft are diverted to a different departure runway.

* Gate hold control -- aircraft queue lengths (by runway) above which gate holds are initiated.

* Interarrival gap control -- departure queue lengths above which interarrival spacings are increased. The gap permits departures to takeoff between arrivals.

* Runway crossing gap control -- delay level of aircraft waiting to cross a runway above which a gap is inserted on the runway. The gap allows the aircraft to cross the runway.

3.4 AIRCRAFT OPERATIONAL CHARACTERISTICS

* Runway exit utilization -- distribution of runway exit usage is by aircraft class.

* Arrival runway occupancy times -- pairs of runway exit distance from threshold and arrival runway occupancy time are by aircraft class.

* Touch-and-go runway occupancy times -- mean and standard deviation are by aircraft class.

* Departure runway occupancy times -- mean and standard deviation are by aircraft class.

* Taxi speeds -- aircraft taxiing speeds are for each type of link and for towing operations.

* Approach speeds -- mean and standard deviation are by aircraft class.

* Fix travel times -- nominal travel times from approach fix to threshold and from threshold to departure fix are by aircraft class.

* Lateness distribution -- distribution of deviations from scheduled arrival times are applied to an aircraft schedule.

* Schedule -- detailed list of aircraft including scheduled arrival and departure times, aircraft class, desired arrival and departure runways and fixes, and preferred gate or basing area.

* Aircraft classes -- four classes of aircraft are used as model inputs. Table 1 contains an example of a possible definition of aircraft classes. In general, any definition of aircraft classes is possible provided that:

Class 1 aircraft are larger than class 2,
Class 2 aircraft are larger than class 3, and
Class 3 aircraft are larger than class 4.

TABLE 1

AIRCRAFT CLASSES

1	Heavy aircraft, e.g., B747 & DC10
2	Large aircraft, e.g., B727 & B707
3	Small twin engine aircraft
4	Small single engine aircraft

3.5 AIRFIELD GEOMETRY

Figure 1 provides a sample link node diagram representing the airfield geometry. The airfield is divided into a series of numbered links; link lengths are no shorter than the length of the largest aircraft which frequently uses the airport. Link lengths typically vary from 200 to 400 feet; however, each exit is defined as one link so only one aircraft at a time can occupy the exit.

The following notes will assist in developing an airfield network.

* A runway is always treated as a single link because it may be occupied by only one aircraft at a given time. However, a runway may be composed of several links.

* A runway can have only one departure end link, although it can have several intersection takeoff links.

* A runway exit should not be defined as a takeoff link.

* Even if identifiable holding areas (or penalty boxes) do not physically exist on the airport, some provision should be made for them on the airfield network to simulate holding arrivals on taxiways. If no holding areas are specified and all gates are occupied, the model terminates execution.

* The user must define a link node which represents the intersection of two taxiways.

3.6 AIRLINE GATES

When identifying the gates belonging to a particular airline, the user should list the gates in ascending order by aircraft size (i.e., list gates for aircraft class 4 first). This prevents smaller aircraft from being reassigned to a class 1 gate if the smaller aircraft's preferred gate is occupied. However, if a class 1 gate is the only gate available, it is assigned to the smaller aircraft.

3.7 ROUTE DATA

Taxiway routes for the airfield simulation model consist of paths which aircraft use between the runways and the gates. Specifically, routes must be defined for each exit and gate (or basing area) combination and for each gate (or basing area) and departure runway combination. In addition, routes must be defined to and from holding areas. Only one route between an origin and a destination point is allowed. If more than one route is specified between two points in an airfield, the first route defined is the input used.

3.8 TWO-WAY PATH DATA

For those sections of taxiways that are identified as two-way paths, the user must enter two-way path data for both directions.

3.9 AIRCRAFT SCHEDULE

The model requires the following input data for each aircraft in the schedule.

* Airline code or "GA" for general aviation and military aircraft.

* Preferred holding area.

* Preferred air carrier gate or "GA" basing area.

* Aircraft class.

* Arrival time at threshold.

* Departure push-back time.

* Arrival runway and fix.

* Departure runway and fix.

At air carrier airports, one of the best sources of demand information is the Official Airline Guide (OAG), which is available in hard-copy and magnetic tape formats. The OAG data contains several of the data items listed above. Demand data for general aviation, military, and other non-scheduled aircraft are combined with the OAG data to provide inputs to ADSIM.

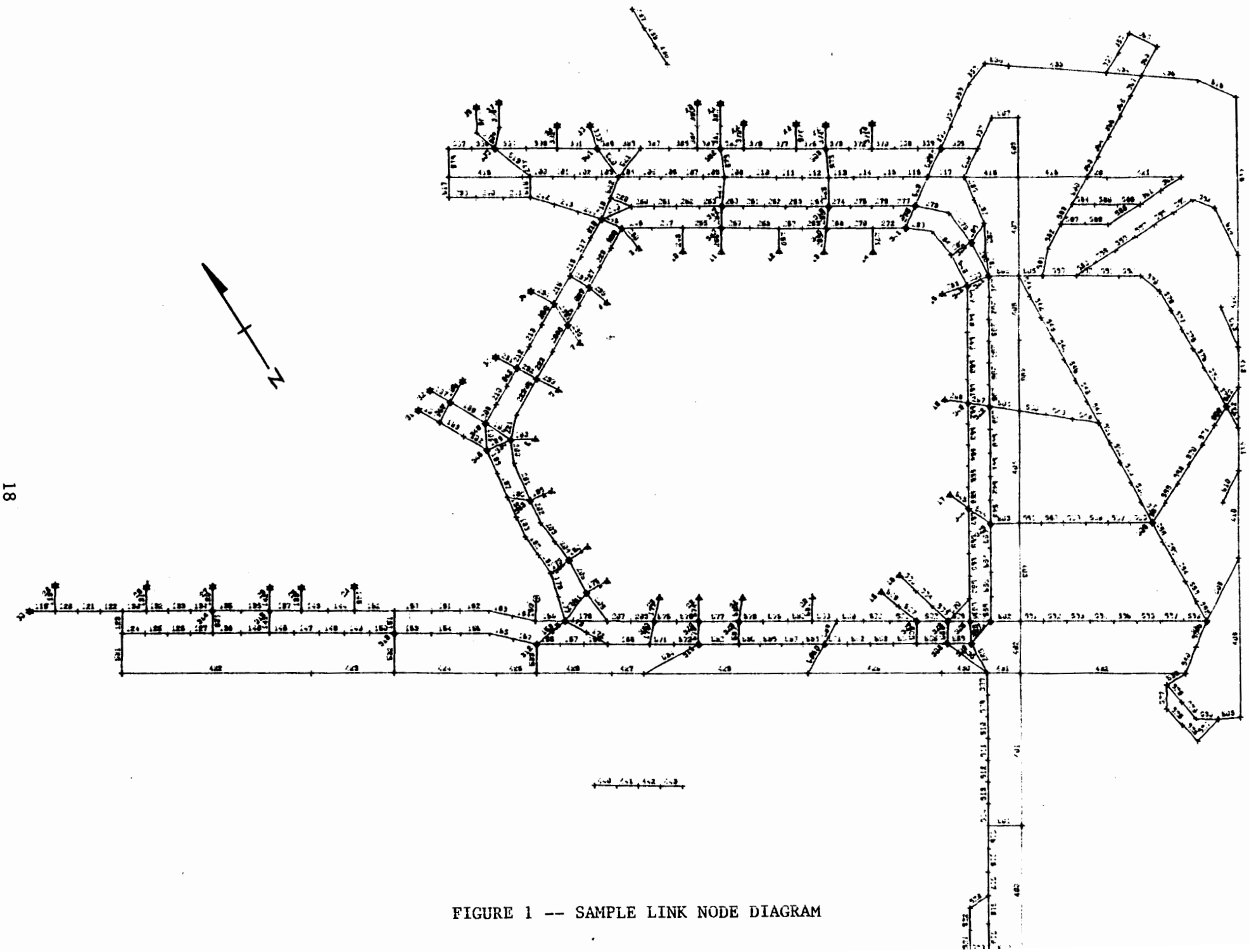

FIGURE 1 -- SAMPLE LINK NODE DIAGRAM

4.0 RUNNING ADSIM

Airfield simulation studies are primarily concerned with capacity and delay problems -- actual or perceived -- in the present or in the future. Although ADSIM does not find solutions to problems, it can simulate proposed solutions in order to provide the analyst with quantitative data on which to base recommendations. The airfield analysis should be conducted by modeling experts and personnel thoroughly familiar with the airport and its operation.

Appendix E contains the JCL (Job Control Language) and file descriptions required for running ADSIM on the Honeywell Series 60 (Level 66) Computer System at the FAA Technical Center.

5.0 ADSIM INPUTS

This section describes the model inputs: a brief discussion of each data type and its format specification, instructions for the ordering of the input data, and a sample of the model inputs.

5.1 INPUT DESCRIPTIONS

Title

The title appears at the top of every output report. It should contain a brief description of the simulation -- the airport name, the experiment number, the weather conditions, the demand level, and the runways used.

Start and Finish Times

The start time and finish time are entered using the 24 hour clock, e.g., 2330 instead of 11:30 PM. The start time must be greater than or equal to 0000 (midnight) and the finish time must provide enough time for all aircraft to go through the system. If the simulation ends before all aircraft are processed, the model lists the aircraft remaining at the end of every replication.

Random Number Seeds

The number of replications equals the number of random number seeds. One should use those seeds which produce long random number cycles. A satisfactory cycle length depends on the number of events in a simulation. For example, the FAA Technical Center felt the following seeds would produce a cycle (one million) long enough for experiments with one thousand aircraft.

82651 91921 69011 92157 14577 10493 27001 40961 15011 63661

Truncation Limits

A limit of three standard deviations, encompassing over 99% (percent) of a normal distribution, provides satisfactory results.

Print Options

The print options control the printing of the optional and standard output reports and evoke several run time options.

Number of Runways

A maximum of six runways is permitted during a model run. Only the runways used in the simulation must be defined. One piece of concrete with operations in both directions must be considered as two separate runways, e.g., 31R and 13L.

Runway Names

The three character runway names (e.g., 31R and 31L) must be right justified.

Fix Travel Times

The travel time from fix to threshold may be entered as either distance and speed or as time. If both are present, the time takes precedence; the speed and distance are ignored.

Taxiway Speeds

Enter six standard taxiway speeds and a towing speed in knots; the towing speed is always the seventh speed. The taxiway link data references each speed by its ordinal number.

Aircraft Service Times

Enter a cumulative probability distribution for each aircraft class. The gate service time, which an aircraft spends at a gate before departing, takes into account loading and unloading, fueling, etc.

Aircraft Approach Speeds

Enter a mean and a standard deviation in knots for each aircraft class. The speed is sampled from a normal distribution.

Aircraft Lateness Distribution

For each arrival, the aircraft lateness distribution is sampled and the result is added to the scheduled arrival time. The lateness may be a negative number to account for early arrivals. The distribution is cumulative and it must be defined, even if lateness is not applied.

Interarrival Gap

The model gives arrivals priority over deparures. This input allows a gap to be inserted in the arrival sequence when the departure queue reaches a certain level, thus allowing departures to takeoff.

Departure Runway Occupancy Times

Enter a mean and a standard deviation in minutes for each aircraft class; the departure runway occupancy time distribution is sampled from a normal distribution. The time for a given class applies to all runways.

Arrival Runway Occupancy Times

For each aircraft class, enter each exit-distance (number of feet from the threshold to the exit) and the arrival runway occupancy time in seconds. The distances must be in ascending order.

Runway Touch-and-Go-Occupancy Times (Optional)

Enter a mean and a standard deviation in minutes for each aircraft class; the time is sampled from a normal distribution. The occupancy time to a given class applies for all runways.

Probabilistic Link Transit Times (Optional)

Enter a cumulative probability distribution for taxiway links that can not be modeled using the standard taxiway speeds. Trigger this option with a speed code of "08" in the TAXIWAY LINKS input.

Departure Airspace Delays (Optional)

A percentage of flights departing over a fix can be delayed. The delay is sampled from a normal distribution with a user-specified mean and standard deviation in minutes.

Lengths of Common Approach Paths

For each runway and aircraft class, specify the length of the common approach path in nautical miles.

Taxiway Links

Define every taxiway link in this section. Gates, holding areas, general aviation basing areas, runway exits, runway crossings, taxiway intersections, takeoff links, and runway end links are all considered taxiway links and must be defined accordingly. With the exception of gates and holding areas, all taxiway links have a capacity of one aircraft regardless of the length of the link. For example, a link 5000 feet long and a link 350 feet long both have the same one aircraft capacity. Link lengths should be no shorter than the length of the largest aircraft that frequently uses the airfield.

Holding Areas

A maximum of 10 holding areas can be specified. Each holding area has a capacity of one aircraft, except the last holding area which has infinite capacity. If all gates have infinite capacity, only a dummy holding area is required. Holding areas must be defined in the TAXIWAY LINKS input.

Runway Exit Distances

For each exit, enter the distance from the threshold to the runway exit. All runway exits must be defined in TAXIWAY LINKS.

Runway Exit Selection

For every runway and every aircraft class, specify the probability of using a particular exit. To ensure that an arrival always has an available exit, put the probabilities in descending order. When an arrival crosses the threshold, the distribution is sampled and an exit

is picked. If that exit is occupied, the aircraft uses the next unoccupied exit listed. Any runway exit appearing in this section must be defined in TAXIWAY LINKS.

Departure Runway End Links

Specify a runway end link for each runway in the same order as the runway names, i.e., the fourth runway end link belongs to the fourth runway in RUNWAY NAMES. All runway end links must be defined in TAXIWAY LINKS.

Takeoff Probability (Optional)

An aircraft may takeoff from a runway intersection link on a runway instead of the runway end link. Enter the probability distribution only for those combinations of runway, gate, and aircraft class with a possible intersection takeoff.

Runway Crossing Links

Enter the clearance time (in seconds) for each link that crosses a runway. All crossing links must be defined in the TAXIWAY LINKS input.

Runway Crossing Delay Limits

When the delay associated with crossing a runway exceeds a certain level, a gap can be inserted to allow the aircraft to cross the runway. The time gap is selected from a normal distribution whose specified mean and standard deviation are in minutes.

Runway Crossing Occupancy Times

If a taxiway crosses a runway, enter the number of seconds it takes each aircraft class to cross the runway. These values apply to all runways.

Two-way Paths

There are certain paths on which aircraft can taxi in both directions. Before an aircraft enters such a path, the model ensures that no other aircraft is already on the path moving in the opposite direction. Specify the path in both directions, e.g., "103 104 105" and "105 104 103." When an aircraft enters the middle of a two-way path, the model does not check the path for aircraft moving in the opposite direction.

Taxiway Queue Links

Enter the link numbers for which the Taxiway Queue Links Report is desired. If no queue links are specified, no report is generated.

Airline Code Names

Specify a two-character code for each airline in the simulation schedule. Airline code "GA" must be used for general aviation and military aircraft.

Airline Gate Assignments

Enter the gates for each airline. An aircraft of one airline can not use a gate belonging to another airline.

Gate Hold Limits

If the length of the departure queue at the assigned departure runway exceeds the specified level, the departure is delayed at the gate for the specified time period before attempting push-back.

General Aviation Basing Areas

Enter a maximum of 10 general aviation basing areas. When an aircraft arrives at a basing area it leaves the system. The model does not keep track of aircraft in the basing area, which is considered to have infinite capacity. The basing areas must be defined in the TAXIWAY LINKS input.

Time Switch (Optional)

Specify a time when additional input cards may be read. Using this feature, it is possible to change the airport configurations at selected times of the day.

Departure Runway Reassignments (Optional)

When the departure queue at a runway reaches a certain level, aircraft can be reassigned to other runways.

Preferred Runway Changes (Optional)

This input allows the user to change all the arrival and departure runways on the schedule and simulate a different airfield configuration without changing the schedule. It is essential that all the new runway names as well as the old ones be defined in the RUNWAY NAMES input.

Pre-planning Runway Switch (Optional)

This input provides the capability of adjusting the runway use configuration based on the projected arrival and departure runway demand within the next 15 minutes.

Dynamic Runway Reassignment (Optional)

This allows the user to dynamically reassign arrivals and departures to a free runway if it is advantageous.

Runway Balancing (Optional)

Arriving aircraft can be switched from one runway to another on the expected arrival delay.

Aircraft Separations

Enter the mean and standard deviation of each aircraft separation. The separation, sampled from a normal distribution, is calculated at the point of closest approach.

Taxiway Routes

Enter a route between every origin and every destination where an aircraft may taxi. Generally, there should be routes between every runway exit and every gate (and basing area), between every gate (and basing area) and every takeoff-point (including runway end links), between every runway exit and every holding area, and between every holding area and every gate (and basing area). If there is any towing, there should be routes for the towing operations. If an aircraft must taxi between two points for which no route is specified, the simulation will halt with an error condition.

Aircraft Schedule

The aircraft schedule must be on File 09, while the rest of the input is on File 05. For towing operations, enter "TOW" as the departure runway name and enter the destination in place of the departure fix.

Processing Options

There are three processing options: "COMPUTE", "STOP", and "PRINT INPUT ONLY". The "COMPUTE" option, the most commonly used, executes ADSIM. The "STOP" option stops ADSIM after reading the input data. The "PRINT INPUT ONLY" option stops ADSIM after it reads the input and prints the verification report.

5.2 INPUT FORMATS

Table 2 lists all input data items in alphabetical order; it provides a quick cross reference to Table 3, which describes the header card and format specifications for each data type. All numeric items are right justified. All header cards must start in column 1 and be left justified. ADSIM uses only the first 16 columns of the header cards and ignores all information beyond column 16. The three character runway names must be right justified.

5.3 INPUT SEQUENCE

The input data can be ordered in a number of different ways; however, each data item must be defined before it is used as part of another input item. For example, the runway names must precede any data item that uses the runway names, e.g. the schedule. An explicit list of inputs which must be preceded by specific definition inputs is given in Table 4. The left column contains data items that must precede the items in the right column. The input sequence in Table 3 is valid.

5.4 SAMPLE INPUT DATA

Figure 2 contains a sample listing of ADSIM input data. There are two runways (31R and 31L), 44 gates, one "GA" basing area (1), and a dummy holding area (99). The gates, the basing area, and the holding area have infinite capacity.

TABLE 2

ALPHABETICALLLY SORTED LIST OF ADSIM KEYWORDS

DATA ITEM	ITEM NO. IN TABLE 3
AIRLINE GATES	32
AIRLINE NAMES	31
AIRSPACE DELAYS	18
A/C APPROACH SPEEDS	11
A/C LATENESS DISTRIBUTION	12
A/C SCHEDULE	43
A/C SEPARATIONS	41
A/C SERVICE TIMES	10
COMPUTE	45
DEDICATED RUNWAY USE	37
DYNAMIC RWY REASSIGNMENT	39
FIX TRAVEL TIMES	8
GATE HOLD LIMITS	33
G/A BASING AREAS	34
HOLDING AREAS	21
PRE PLANNING RUNWAY SWITCH	38
PRINT INPUT ONLY	44
PRINT OPTIONS	5
PROB TRANS TIME.	17
RANDOM NUMBER SEEDS	3
RWY ARRIVAL OCCUPANCY TIMES	15
RWY DEP. OCCUPANCY TIMES	14
RWY END LINKS	24
RWY EXIT DISTANCES	22
RWY EXIT SELECTION	23
RWY INTERARRIVAL GAP	13
RWY LENGTHS OF COMMON APPROACH	19
RWY NAMES	7
RWY T/GO OCCUPANCY TIMES	16
RWY XING DELAY LIMITS	27
RWY XING LINKS	26
RWY XING OCCUPANCY	28
RWYS NO. OF	6
SIDE TO SIDE BALANCING	40
STOP	46
TAKEOFF PROBABILITY	25
TAKE-OFF SWITCH	36
TAXIWAY LINKS	20
TAXIWAY QUEUE LINKS	30
TAXIWAY ROUTES	42
TAXIWAY SPEEDS (SEVEN STANDARD SPEEDS)	9
TAXIWAY TWO-WAY	29
TIME SWITCH	35
TIMES(START,FINISH)	2
TITLE	1
TRUNCATION LIMITS	4

TABLE 3

INPUT DATA DESCRIPTION

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
1	Title	1	1-5	"TITLE"
		2	1-80	Any heading data
2	Start and Finish Times	1	1-19	"TIMES(START,FINISH)"
		2	4-5	Starting hour (integer)
			7-8	Starting minute (integer)
			12-13	Finishing hour (integer)
			15-16	Finishing minute (integer)
3	Random Number Seeds	1	1-19	"RANDOM NUMBER SEEDS"
		2	7-8	Number of random number seeds
		3	1-80	Up to 10 (integer) seeds. One number every 8 cc.*
4	Truncation Limits for Normal Distribution	1	1-17	"TRUNCATION LIMITS" (decimal standard deviations)
		2	1-8	Upper truncation limit.
			9-16	Lower truncation limit.
5	Print Options	1	1-13	"PRINT OPTIONS"
		2	1	("T"or"F") OPTION 1 "T" prints aircraft movements.
			3	("T"or"F") Option 2 "T" prints debug statements.
			5	("T"or"F") Option 3 Not implemented.
			7	("T"or"F") Option 4 "T" causes printing of two-way path messages.
			9	("T"or"F") Option 5 "T" causes two-way path block control; i.e. it aborts the simulation if aircraft are nose-to-nose.
			11	("T"or"F") Option 6 "T" prints quarter-hour outputs. "F" prints hourly outputs.
			13	("T"or"F") Option 7 "T" indicates towing
			15	("T"or"F") Option 8 Not implemented.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
			17	("T"or"F") Option 9 "T" applies the lateness distribution to the scheduled arrivals each replication.
			19	("T"or"F") Option 10 "T" causes a new schedule to be read each replication.
			21	("T"or"F") Option 11 Not implemented.
			23	("T"or"F") Option 12 "T" suppresses the Average Delay Summary Report.
			25	("T"or"F") Option 13 "T" suppresses the Total Delay Summary Report.
			27	("T"or"F") Option 14 "T" suppresses the Link Delays Report.
			29	("T"or"F") Option 15 "T" suppresses the Separation Delay Report.
			31	("T"or"F") Option 16 "T" suppresses the Runway Queue Statistics
			33	("T"or"F") Option 17 "T" suppresses the Taxiway Queue Statistics
			35	("T"or"F") Option 18 "T" suppresses the printing of the schedule.
			37	("T"or"F") Option 19 "T" suppresses the Verification Report.
6	Number of Runways	1	1-11	"RWYS NO. OF"
		2	8	Number of runways (integer)
7	Runway Names	1	1-9	"RWY NAMES" Runway names (3 characters) Right Justify one every 8 cc.
		2	6-8	1st runway name
			.	.
			.	.
			.	.
			46-48	6th runway name

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
8	Fix Travel Times	1	1-16	"FIX TRAVEL TIMES" A negative fix stops reading of cards; one card per fix.
		2	6-8	Fix (integer)
			14-16	Runway name (3 characters)
			24	Aircraft class (integer)
			25-32	Distance from fix to threshold or from roll to fix (decimal nautical miles)
			33-40	Average speed from fix to threshold or from roll to fix (decimal knots)
			41-48	Time (decimal minutes) from fix to threshold or from roll to fix. If a time is entered, the distance and average speed are ignored.
9	Taxiway Speeds	1	1-36	"TAXIWAY SPEEDS (SEVEN STANDARD SPEEDS)" Standard taxi speeds Miles per hour (decimal)
		2	1-8	1st taxiway speed
			9-16	2nd taxiway speed
			17-24	3rd taxiway speed
			25-32	4th taxiway speed
			33-40	5th taxiway speed
			41-48	6th taxiway speed
			49-56	Towing speed
10	Aircraft Service Times	1	1-17	"A/C SERVICE TIMES" A negative class stops reading of cards; sets of cards 2 and 3 per class.
		2	7-8	Aircraft class (integer)
			9-16	Number of pairs (integer) (cumulative probability, time)
		3	1-80	Pairs (decimal) (cume probability, minutes) One number every 8 cc; one pair every 16 cc. Card 3 is repeated for each 5 pairs of values.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
11	Aircraft Approach Speeds	1	1-19	"A/C APPROACH SPEEDS" Negative class stops reading of cards; one card per class.
		2	6-8	Aircraft class (integer)
			17-24	Mean speed in knots (decimal)
			33-40	Standard deviation of speed (decimal)
12	Aircraft Lateness Distribution	1	1-25	"A/C LATENESS DISTRIBUTION"
		2	7-8	Number of pairs (integer) (cume probability, lateness)
		3	1-80	Pairs (decimal) (cume probability, minutes) One number every 8 cc; one pair every 16 cc. Card 3 is repeated every 5 pairs.
13	Interarrival Gap	1	1-20	"RWY INTERARRIVAL GAP"
		2	14-16	Departure queue length, i.e., number of aircraft (integer)
			25-32	Mean interarrival gap (Decimal minutes)
			41-48	Standard deviation of gap (decimal)
14	Departure Runway Occupancy Times	1	1-24	"RWY DEP. OCCUPANCY TIMES" Negative class stops reading of cards; one card per class.
		2	6-7	Aircraft class (integer)
			17-24	Mean in seconds (decimal)
			33-40	Standard deviation (decimal)
15	Arrival Runway Occupancy Times	1	1-27	"RWY ARRIVAL OCCUPANCY TIMES" Negative class stops reading of cards; sets of cards 2 and 3 per class.
		2	7-8	Aircraft class (integer)
			14-16	Number of pairs (integer) (distance, time)
		3	1-80	Pairs (decimal) (feet,seconds) Distances must be in increasing order. One number each 8 cc, one pair each 16 cc. Card 3 is repeated every 5 pairs.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
16	Runway Touch-and-Go Occupancy Times	1	1-24	"RWY T/GO OCCUPANCY TIMES" Negative class stops reading of cards; one card per class.
		2	6-7	Aircraft class (integer)
			17-24	Mean time in seconds (decimal)
			33-40	Standard deviation (decimal)
17	Probabilistic Link Transit Time	1	1-15	"PROB TRANS TIME"
		2	7-8	Number of pairs (integer) (cumulative probability, time)
		3	1-80	Pairs (decimal) (cume probability, minutes) One number each 8 cc; one pair each 16 cc -- 5 pairs per card.
18	Departure Airspace Delays	1	1-15	"AIRSPACE DELAYS" Negative fix stops reading of cards; two cards per fix.
		2	6-8	Fix number (integer)
		3	1-8	Percent (decimal) of delayed departures over fix
			9-16	Mean hold time (decimal minutes)
			17-24	Standard deviation of hold time (decimal)
19	Lengths of Common Approach Paths	1	1-36	"RWY LENGTHS OF COMMON APPROACH" A minus in cc 5 stops reading of cards.
		2	6-8	Runway name
			15-16	Aircraft class (integer)
			17-24	Path length (nautical miles) (decimal)
20	Taxiway Links	1	1-13	"TAXIWAY LINKS"
		2	1-80	Any heading data Minus speed code stops reading of cards; one card 3 per link.
		3	1-8	Link number (integer)
			16	If not a gate, leave blank. If this link is a gate, enter aircraft class of the largest aircraft that can use the gate.
			17-24	If using a standard taxi speed, enter the length of the link in

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
				feet; otherwise, enter travel time in minutes. (decimal)
			40	Index (integer) of standard speed. If using a nonstandard speed for towing, enter "7". Use "8" for probabilistic link transit time.
			48	A blank flag indicates infinite gate capacity.
21	Holding Areas	1	1-13	"HOLDING AREAS"
		2	7-8	Number of holding areas (integer)
		3	1-80	Holding area numbers (integer) One number every 8 cc.
22	Runway Exit Distances (on arrival)	1	1-18	"RWY EXIT DISTANCES"
		2	7-8	Number of exit pairs (integer)
		3	1-80	Pair (exit, distance in feet) (integer, decimal). One number each 8 cc; one pair each 16 cc. Card 3 is repeated for each 5 pairs of values.
23	Runway Exit Selection	1	1-18	"RWY EXIT SELECTION" A minus class stops reading of cards; sets of cards 2 and 3 per class.
		2	7-8	Aircraft class (integer)
			14-16	Runway name (3 characters)
			23-24	Number of pairs (integer) (exit, probability)
		3	1-80	Pairs (exit link, probability) (integer, decimal). One number each 8 cc; one pair each 16 cc. The pairs must be in descending order of probability.
24	Departure Runway End Links	1	1-13	"RWY END LINKS" (integer) Enter one every 8 cc.
		2	5-8	End link for the 1st runway.
			.	.
			.	.
			.	.
			45-48	End link for the 6th runway.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
25	Takeoff Probability	1	1-19	"TAKEOFF PROBABILITY"
		2	1-4	Number of distributions (integer) Enter probability distributions only for those combinations of runway, gate and aircraft class with a possible intersection takeoff.
		3	2-4	Runway Name (3 characters)
			5-8	Gate number (integer)
			12	Aircraft class (integer)
		4	1-4	Probability/count
			5-8	Takeoff link or end link
			9-12	Probability/count
			13-16	Takeoff link or end link
			.	.
			.	.
			.	.
			73-76	Probability/count
			77-80	Takeoff link or end link
				Maximum of 10 pairs allowed. Enter probabilities or counts. Probabilities are decimal. Counts and links are integers.
26	Runway Crossing Links	1	1-14	"RWY XING LINKS" Minus in cc 1 stops reading of cards; one card per link.
		2	1-80	Any heading data
		3	2-4	Runway name
			13-15	Runway crossing link number
			21-25	Clearance time for class 1 arrival on runway (seconds).
			26-30	Clearance time for class 2 arrival on runway (seconds).
			31-35	Clearance time for class 3 arrival on runway (seconds).
			36-40	Clearance time for class 4 arrival on runway (seconds).
			41-45	Clearance time for class 1 departure on runway (seconds).
			46-50	Clearance time for class 2 departure on runway (seconds).
			51-55	Clearance time for class 3 departure on runway (seconds).

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
			56-60	Clearance time for class 4 departure on runway (seconds).
			61-65	Clearance time for class 1 arrival on final approach (sec).
			66-70	Clearance time for class 2 arrival on final approach (sec).
			71-75	Clearance time for class 3 arrival on final approach (sec).
			76-80	Clearance time for class 4 arrival on final approach (sec).
27	Runway Crossing Delay Limits	1	1-20	"RWY XING DELAY LIMITS"
		2	1-8	Crossing delay (decimal minutes)
			9-16	Mean (decimal minutes)
			17-24	Standard deviation (decimal)
28	Runway Crossing Occupancy Times	1	1-18	"RWY XING OCCUPANCY"
		2	1-32	Occupancy times for each class in seconds. One number every 8 cc.
29	Two-way Paths	1	1-15	"TAXIWAY TWO-WAY" Sets of cards 2 and 3 are repeated for each two-way taxiway. A negative number of links stops reading of cards.
		2	7-8 or 3-4	Number of links (integer)
		3	1-80	Link numbers (integer). One every 4 or 8 cc depending on format of card 2. If number of links in card 2 is in columns 7-8, then use one link number every 8 cc; if the number of links is in columns 3-4, then enter one link number every 4 cc.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
30	Taxiway Queue Links	1	1-19	"TAXIWAY QUEUE LINKS"
		2	1-80	One link every 8 cc (Up to 10 links). If no queue links are specified, no report will be generated.
31	Airline Code Names	1	1-13	"AIRLINE NAMES"
		2	1-8	Airline count (integer). Maximum of 20 allowed.
		3	1-80	Airline code names (3 alphanumeric characters) (right justified) One name every 8 cc. Card 3 is repeated until all names are specified. Enter "GA" if there are general aviation or military operations.
32	Airline Gate Assignments	1	1-13	"AIRLINE GATES" A minus gate count stops reading of cards; sets of cards 2 and 3 per airline.
		2	1-4	Airline code name (3 characters--right justified)
			9-16	Gate count (integer)
		3	1-80	Gate numbers (integer). One gate every 8 cc (integer). There is a maximum of 30 gates per airline.
33	Gate Hold Limits	1	1-16	"GATE HOLD LIMITS" One data card for each runway.
		2	14-16	Length of departure queue at which departures are held at gate (integer)
			29-32	Holding time in minutes (decimal)
34	General Aviation Basing Areas (includes military)	1	1-16	"G/A BASING AREAS"
		2	7-8	Number of G/A basing areas (integer)
		3	1-80	G/A basing area link numbers (integer). One every 8 cc.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
35	Time Switch (time at which inputs change)	1	1-11	"TIME SWITCH"
		2	4-5	Time, hours (integer)
			7-8	Time, minutes (integer)
			12-13	Switch control. A positive value activates the changeover.
36	Departure Runway Reassignments	1	1-15	"TAKE-OFF SWITCH" One data card for each runway.
		2	1-8	Length of departure queue at which departures are reassigned to another runway (integer)
			9-48	Alternate runway names. Enter one runway every 8cc. All runways must be defined in RWY NAMES.
37	Preferred Runway Changes	1	1-20	"DEDICATED RUNWAY USE" A minus in cc 1 stops reading of cards. All runways must be defined in RWY NAMES.
		*2	2-4	Old runway on schedule
			6-8	New arrival runway
			10-12	New departure runway
38	Pre-planning Runway Switch	1	1-26	"PRE PLANNING RUNWAY SWITCH" All runways must be defined in RWY NAMES.
		2	1-8	"ARRIVALS" if arrivals are to be switched. Card 3 is repeated for each each arrival reassignment. A minus in cc 1 stops reading of arrival reassignments.
		3	2-4	Old arrival runway
			6-8	Old arrival runway
			9-12	Arrival demand at which arrivals are reassigned.
			14-16	New runway for class 1
			18-20	New runway for class 2
			22-24	New runway for class 3
			26-28	New runway for class 4 If class not reassigned, enter 0.

* "cc" signifies card column.

TABLE 3 (Continued)

DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
		29-32	1st reassignable fix
		33-36	2nd reassignable fix
		.	.
		.	.
		.	.
		65-68	10th reassignable fix
	2	1-10	"DEPARTURES" if departures are reassigned. Card 3 is repeated for each departure reassignment. A minus in cc 1 stops reading of departure reassignments.
	3	2-4	Old departure runway
		6-8	Old departure runway
		9-12	Departure demand at which departures are reassigned.
		14-16	New runway for class 1
		18-20	New runway for class 2
		22-24	New runway for class 3
		26-28	New runway for class 4 If class not reassigned, enter 0.
		29-32	1st reassignable fix
		33-36	2nd reassignable fix
		.	.
		.	.
		.	.
		65-68	10th reassignable fix
	2	1-19	"ARRIVALS+DEPARTURES" arrivals are reassigned based on arrival and departure demands. Card 3 is repeated for each reassignment. A minus in cc 1 stops reading of these reassignments.
	3	2-4	Demand runway
		6-8	Demand runway (repeated)
		9-12	Combined arrival and departure demand (integer) at which arrivals are reassigned
		14-16	New arrival runway for class 1
		18-20	New arrival runway for class 2
		22-24	New arrival runway for class 3
		26-28	New arrival runway for class 4 If class not reassigned, enter 0.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
			29-32	1st reassignable fix
			33-36	2nd reassignable fix
			.	.
			.	.
			.	.
			65-68	10th reassignable fix
39	Dynamic Runway Reassignment	1	1-23	"DYNAMIC RWY REASSIGNMENT"
		2	7-8	Number of departure reassignments (integer) Card 3 is repeated for each departure reassignment. A minus in cc 1 stops reading of departure reassignments.
		3	2-4	Old runway name
			6-8	New runway name
			10-12	Dependent runway (may be blank)
			13-20	Link number to check for departure reassignment
			21-36	Aircraft class if eligible for reassignment--one class each 4 cc
			37-77	Eligible fix pairs (fix of reassigned A/C, compatible fix for waiting A/C). Maximum of 5 pairs. One number every 4 cc, one pair every 8 cc.
		4	7-8	Number of arrival reassignments (integer) Card 5 is repeated for each arrival reassignment. A minus in cc 1 stops reading of arrival reassignments.
		5	2-4	Arrival runway for reassignment
			6-8	New arrival runway for class 1
			10-12	New arrival runway for class 2
			14-16	New arrival runway for class 3
			18-20	New arrival runway for class 4 If class not reassigned,enter 0.
			22-24	Dependent runway (may be blank)
40	Runway Balancing	1	1-22	"SIDE TO SIDE BALANCING" One card per reassignment. Minus in cc 1 stops reading of cards. Define runways in RWY NAMES.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
		2	2-4	Initial runway
			6-8	New runway
			9-16	Arrival delay at which arrival is switched from first runway to second runway.
41	Aircraft Separations	1	1-15	"A/C SEPARATIONS"
		2	1-80	Any heading data
		3	1-80	Any heading data Card 4 is repeated for each separation. A minus aircraft stops reading of cards.
		4	8	Operation ("A" or "D", i.e., arrival or departure)
			14-16	Aircraft class (integer)
			22-24	Runway name
			30-40	Operation ("A" or "D")
			47-48	Aircraft class (integer)
			54-56	Runway name
			62-64	Fix number (integer)
			65-72	Mean separation in nautical miles for arrival-arrival and departure-departure. Mean separation in minutes for departure-departure and arrival-departure. (decimal)
			73-80	Standard deviation of separation (decimal)
42	Taxiway Routes	1	1-14	"TAXIWAY ROUTES" A minus link stops reading of routes.
		2	6-8 or 3-4	Number of links in the route (integer)
		3	1-80	Link numbers. One number each 4 or 8 cc depending on card 2 format. If the number of links in card 2 is in columns 6-8, then enter one link each 8 cc; if the number of links is in columns 3-4, then enter one link each 4 cc. Repeat card 3 as needed.

* "cc" signifies card column.

TABLE 3 (Continued)

	DATA TYPE	CARD NUMBER	COLUMN	DESCRIPTION
43	Aircraft Schedule	1	1-12	"A/C SCHEDULE" A minus gate stops reading of cards. Card 1 is in file "05" while all card 2's are in file "09".
		2	1-4	Airline name (alphanumeric)
			9-12	Preferred holding area (integer)
			14-16	Preferred gate (integer)
			24	Flight type (value ignored)
			31-32	Aircraft class
			36-37	Arrival time at threshold hours (integer)
			39-40	Arrival time, minutes (integer)
			44-45	Departure time from the gate, hours (integer)
			47-48	Departure time, minutes (integer)
			54-56	Arrival runway name
			63-64	Approach fix number (integer)
			70-72	Departure runway name or "TOW"
			79-80	Departure fix number (integer) or destination gate for tow.
44	Print Input	1	1-16	"PRINT INPUT ONLY" It prints all the input data stored in the memory at that time. This provides the option of checking the data before running the model.
45	Compute	1	1-7	"COMPUTE" It triggers a simulation using the most recent inputs.
46	Stop	2	1-4	"STOP" It terminates the execution.

* "cc" signifies card column.

TABLE 4

ORDERING OF INPUT DATA

DATA ITEM		DATA ITEMS
RWYS NO. OF	must precede	RWY NAMES
RWY NAMES	must precede	FIX TRAVEL TIMES RWY LENGTHS OF COMMON APPROACH RWY XING LINKS RWY EXIT SELECTION GATE HOLD LIMITS TAKE-OFF SWITCH PRE PLANNING RUNWAY SWITCH DYNAMIC RWY REASSIGNMENT DEDICATED RUNWAY USE SIDE TO SIDE BALANCING A/C SEPARATIONS A/C SCHEDULE
TAXIWAY LINKS	must precede	TAXIWAY ROUTES RWY END LINKS RWY XING LINKS TAXIWAY TWO-WAY TAXIWAY QUEUE LINKS AIRLINE GATES G/A BASING AREAS A/C SCHEDULE
TIMES(START,FINISH)		TIME SWITCH
AIRLINE NAMES	must precede	AIRLINE GATES A/C SCHEDULE
AIRLINE GATES	must precede	A/C SCHEDULE
HOLDING AREAS	must precede	A/C SCHEDULE

START OF '05' FILE

```
TAXIWAY LINKS
  TAXIWAY LINKS FOR JFK CON-1
       1        1     0.01                7
       2        1     0.01                7
       3        1     0.01                7
       4        1     0.01                7
       5        1     0.01                7
       6        1     0.01                7
       7        1     0.01                7
       8        1     0.01                7
       9        1     0.01                7
      10        1     0.01                7
                        .
                        .
                        .
     300             0.01                7
     301             0.01                7
     302             0.01                7
     303             0.01                7
     304             0.01                7
     305             0.01                7
     306             0.01                7
     307             0.01                7
     308             0.01                7
     309             0.01                7
                        .
                        .
                        .
     690            314.5                3
     691            360.3                3
     692            384.9                3
     693            308.0                3
     694            307.5                3
     695            307.5                3
     696            307.5                3
     697            319.8                3
     698            319.8                3
     699            505.4               -3
TAXIWAY ROUTES
  35          ROUTE =    1     SFIX= R5    EFIX= G1       SLINK= 517  ELINK=   1
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
 348 191 346 188 187 184 183 182 181 178 177 345 159 165   1
  36          ROUTE =    2     SFIX= R5    EFIX= T2       SLINK= 517  ELINK=   2
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
 348 191 346 188 187 184 183 182 181 178 177 345 174 331 175   2
  33          ROUTE =    3     SFIX= R5    EFIX= T3       SLINK= 517  ELINK=   3
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
 348 191 346 188 187 184 183 182 181 179 332 180   3
```

FIGURE 2 -- SAMPLE INPUT DATA WITH EXPLANATORY NOTES

```
 29          ROUTE =    4     SFIX= R5    EFIX= T4       SLINK= 517  ELINK=   4
517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
348 191 346 188 187 185 333 186   4
 25          ROUTE =    5     SFIX= R5    EFIX= T5       SLINK= 517  ELINK=   5
517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
348 199 334 190   5
                      .
                      .
                      .
 49          ROUTE =  159     SFIX= 041   EFIX= A2       SLINK=  41  ELINK= 432
 41 382 381 302 523 524 317 254 339 257 258 267 268 340 269 270 272 341 283 284
546 342 547 548 549 550 551 343 297 322 504 650 649 648 651 652 653 654 655 306
666 665 664 663 662 305 639 640 432
-43          ROUTE =  160     SFIX= 044   EFIX= A2       SLINK=  44  ELINK= 432
 44 374 303 525 526 318 265 340 269 270 272 341 283 284 546 342 547 548 549 550
551 343 297 322 504 650 649 648 651 652 653 654 655 306 666 665 664 663 662 305
639 640 432
TITLE
JFK EXP X DEMAND=XX SEP=XXXXX FLOW=A RWYS=PRESENT SCHED=XX RTE=XXX
RANDOM NUMBER SEEDS
      10
   82651   91921   69011   92157   14577   10493   27001   40961   15011   63661
PRINT OPTIONS
F F F F F F F F T F
RWY XING OCCUPANCY TIMES
      20      20      20      20
RWY DEP. OCCUPANCY TIMES
       1            39.0            4.0
       2            39.0            4.0
       3            34.0            4.0
      -4            34.0            4.0
HOLDING AREAS
       1
      99
TAXIWAY SPEEDS (SEVEN STANDARD SPEEDS)
    5.00   10.00   15.00   20.00   25.00   30.00    5.00
AIRLINE NAMES
      20
AA      AC      D1      D2      D3      D4      F1      F2      F3      F4
F5      F6      I1      I2      I3      I4      I5      OW      TW      GA
AIRLINE GATES
AA              1
       6
AC              1
       4
D1              1
      14
D2              1
       3
D3              1
      22
D4              1
```

FIGURE 2 (Continued)

```
        5
F1              1
       32
F2              1
       34
F3              1
       44
F4              1
       37
F5              1
       35
F6              2
       40      41
I1              3
       17      18       20
I2              1
       16
I3              1
        9
I4              1
        7
I5              1
       11
OW              1
        2
TW              1
       12
GA             -1
        1
A/C SERVICE TIMES                        SOURCE PMM
        1       5
     0.07    25.0    0.11    30.0    0.51    35.0    0.60    38.0    1.00    55.0
        2       3
     0.47    25.0    0.60    30.0    1.00    50.0
        3       5
     0.40    15.0    0.47    20.0    0.56    25.0    0.60    30.0    1.00    35.0
       -4       4
     0.40    10.0    0.80    15.0    0.90    20.0    1.00    25.0
A/C LATENESS DISTRIBUTION                        SOURCE PMM
        9
     0.00   -30.0    .001   -15.0    0.12   -1.00    0.40    1.00    0.55    5.00
     0.70    10.00   0.78    15.00   0.89    30.00   1.00   40.00
A/C APPROACH SPEEDS                          SOURCE PMM
        1            140.0            10.0
        2            130.0            10.0
        3            120.0            10.0
       -4            120.0            10.0
G/A BASING AREAS
        1
        1
TRUNCATION LIMITS
     3.0     3.0
```

FIGURE 2 (Continued)

```
TIMES(START,FINISH)
   00 00   26 00
RWYS NO. OF
      2
RWY NAMES
     31R     31L
RWY END LINKS
     421     432
RWY XING LINKS
RUNWAY CROSSING LINKS FOR JFK CONFIGURATION 1
 31R        523        33   37   40   40   40   40   43   47   20   20   20   20
 31R        524        33   37   40   40   40   40   43   47   20   20   20   20
 31R        518        37   41   44   44   42   42   46   48   20   20   20   20
 31R        519        37   41   44   44   42   42   46   48   20   20   20   20
 31R        288        16   18   19   19   25   25   26   31   20   20   20   20
 31R        529        16   18   19   19   25   25   26   31   20   20   20   20
 31R        527        19   21   22   22   27   27   29   34   20   20   20   20
 31R        528        19   21   22   22   27   27   29   34   20   20   20   20
 31R        525        26   28   31   31   34   34   36   42   20   20   20   20
 31R        526        26   28   31   31   34   34   36   42   20   20   20   20
 31L        536        15   16   17   17   24   24   25   29   20   20   20   20
 31L        537        15   16   17   17   24   24   25   29   20   20   20   20
-31L        608        15   16   17   17   24   24   25   29   20   20   20   20
RWY LENGTHS OF COMMON APPROACH
     31R       1      6.0
     31R       2      6.0
     31R       3      3.0
     31R       4      2.0
     31L       1      6.0
     31L       2      6.0
     31L       3      3.0
    -31L       4      2.0
RWY INTERARRIVAL GAP
               1            3.00            0.30
RWY EXIT SELECTION              SOURCE PMM
       1     31R       4
     522    0.53     524    0.37     517    0.06     526    0.04
       2     31R       3
     524    0.59     522    0.36     526    0.05
       3     31R       2
     528    0.61     526    0.39
       4     31R       1
     528    1.00
       1     31L       3
     533    0.47     532    0.37     534    0.16
       2     31L       3
     533    0.57     534    0.33     532    0.10
       3     31L       2
     533    0.50     534    0.50
      -4     31L       1
     534    1.00
RWY EXIT DISTANCES                 SOURCE PMM
```

FIGURE 2 (Continued)

```
        9
      535    1817     528    2440     526    3768     534    4059     524    5181
      533    5504     522    6631     532    7435     517    8824
RWY ARRIVAL OCCUPANCY TIMES            SOURCE PMM
        1       7
     5380    47.0    5470    51.0    6480    60.0    6800    65.0    7240    65.0
     8740    70.0    9630    70.0
        2       6
     4170    40.0    5380    50.0    5470    51.0    6480    60.0    6800    65.0
     7240    65.0
        3       3
     4170    50.0    5380    51.0    5470    51.0
       -4       3
     4170    50.0    5380    51.0    5470    51.0
TAXIWAY TWO-WAY
   4
 302 523 524 317
   4
 317 524 523 302
   4
 303 525 526 318
   4
 318 526 525 303
   7
 316 244 243 242 519 518 300
   7
 300 518 519 242 243 244 316
   3
 345 159 165
  -3
 165 159 345
FIX TRAVEL TIMES                    CREATED 1-24-83  BY RJH
        1     31R       1    31.5   180.0
        1     31R       2    31.5   180.0
        1     31R       3    31.5   180.0
        1     31R       4    31.5   180.0
        1     31L       1    31.5   180.0
        1     31L       2    31.5   180.0
        1     31L       3    31.5   180.0
        1     31L       4    31.5   180.0
        2     31R       1    34.5   180.0
        2     31R       2    34.5   180.0
        2     31R       3    34.5   180.0
        2     31R       4    34.5   180.0
        2     31L       1    34.5   180.0
        2     31L       2    34.5   180.0
        2     31L       3    34.5   180.0
        2     31L       4    34.5   180.0
        3     31R       1    36.0   196.4
        3     31R       2    36.0   196.4
        3     31R       3    36.0   180.0
        3     31R       4    36.0   180.0
```

FIGURE 2 (Continued)

3	31L	1	36.0	196.4
3	31L	2	36.0	196.4
3	31L	3	36.0	180.0
3	31L	4	36.0	180.0
4	31R	1	24.0	180.0
4	31R	2	24.0	180.0
4	31R	3	24.0	180.0
4	31R	4	24.0	180.0
4	31L	1	24.0	180.0
4	31L	2	24.0	180.0
4	31L	3	24.0	180.0
4	31L	4	24.0	180.0

A/C SEPARATIONS SOURCE FMM PANYNJ

JFK SEPARATIONS PRESENT DAY RWYS 31R+31L

LOP	LCL	LRW	LFX	TOP	TCL	TRW	TFX	MEAN	SIGM
A	1	0	0	A	1	0	0	3.90	0.70
A	1	0	0	A	2	0	0	4.70	0.65
A	1	0	0	A	3	0	0	4.60	0.60
A	1	0	0	A	4	0	0	5.50	0.60
A	2	0	0	A	1	0	0	3.10	0.70
A	2	0	0	A	2	0	0	3.00	0.65
A	2	0	0	A	3	0	0	2.90	0.60
A	2	0	0	A	4	0	0	3.70	0.60
A	3	0	0	A	1	0	0	3.10	0.70
A	3	0	0	A	2	0	0	3.00	0.65
A	3	0	0	A	3	0	0	2.90	0.60
A	3	0	0	A	4	0	0	3.70	0.60
A	4	0	0	A	1	0	0	3.10	0.70
A	4	0	0	A	2	0	0	3.00	0.65
A	4	0	0	A	3	0	0	2.90	0.60
A	4	0	0	A	4	0	0	2.90	0.60
D	1	0	0	A	1	0	0	1.80	0.05
D	1	0	0	A	2	0	0	1.60	0.05
D	1	0	0	A	3	0	0	1.50	0.05
D	1	0	0	A	4	0	0	1.50	0.05
D	2	0	0	A	1	0	0	1.80	0.05
D	2	0	0	A	2	0	0	1.60	0.05
D	2	0	0	A	3	0	0	1.50	0.05
D	2	0	0	A	4	0	0	1.50	0.05
D	3	0	0	A	1	0	0	1.60	0.05
D	3	0	0	A	2	0	0	1.50	0.05
D	3	0	0	A	3	0	0	1.40	0.05
D	3	0	0	A	4	0	0	1.40	0.05
D	4	0	0	A	1	0	0	1.60	0.05
D	4	0	0	A	2	0	0	1.50	0.05
D	4	0	0	A	3	0	0	1.40	0.05
D	4	0	0	A	4	0	0	1.40	0.05
D	1	0	0	D	1	0	0	1.50	0.20
D	1	0	0	D	2	0	0	2.00	0.20
D	1	0	0	D	3	0	0	2.00	0.20
D	1	0	0	D	4	0	0	2.00	0.20
D	2	0	0	D	1	0	0	1.00	0.20

FIGURE 2 (Continued)

```
      D       2       0       0       D       2       0       0    1.00    0.20
      D       2       0       0       D       3       0       0    1.00    0.20
      D       2       0       0       D       4       0       0    0.83    0.20
      D       3       0       0       D       1       0       0    1.00    0.20
      D       3       0       0       D       2       0       0    1.00    0.20
      D       3       0       0       D       3       0       0    1.00    0.20
      D       3       0       0       D       4       0       0    0.83    0.20
      D       4       0       0       D       1       0       0    0.83    0.20
      D       4       0       0       D       2       0       0    0.75    0.20
      D       4       0       0       D       3       0       0    0.75    0.20
      D      -4       0       0       D       4       0       0    0.58    0.20
TITLE
 JFK   EXP-1  18:00-26:00    31R+31L   82 DEMAND     VFR
TIMES(START,FINISH)
   18 00   26 00
TAXIWAY QUEUE LINKS
     182     203     217     228
SIDE TO SIDE BALANCING
-31L 31R    10.0
GATE HOLD LIMITS
              10            2.00
              10            2.00
A/C SCHEDULE
COMPUTE
STOP
```

END OF '05' FILE

START OF '09' FILE (SCHEDULE)

A/C SCHEDULE CARD IN '05' FILE TRIGGERS READING OF '09' FILE

```
GA        99   1       1       4    0  0   18  6       0       0     31L       7
GA        99   1       1       4    0  0   18 17       0       0     31L       7
D1        99  14       1       3    0  0   18 45       0       0     31L       8
I1        99  17       1       1    0  0   18 45       0       0     31L       5
D2        99   3       1       2    0  0   18 50       0       0     31L       7
I1        99  18       1       1    0  0   19  0       0       0     31L       4
GA        99   1       1       4    0  0   19 20       0       0     31L       8
GA        99   1       1       3    0  0   19 31       0       0     31L       5
D1        99  14       1       2    0  0   19 55       0       0     31L       8
GA        99   1       1       4    0  0   20  3       0       0     31L       5
D1        99  14       1       2    0  0   20 15       0       0     31L       7
GA        99   1       1       4    0  0   20 30       0       0     31L       4
I4        99   7       1       3    0  0   20 45       0       0     31L       4
GA        99   1       1       4    0  0   21 10       0       0     31L       8
GA        99   1       1       4    0  0   21 18       0       0     31L       7
```

FIGURE 2 (Continued)

GA	99	1	1	4	0	0	21	25	0	0	31L	4
GA	99	1	1	4	0	0	21	38	0	0	31L	8
GA	99	1	1	4	0	0	21	44	0	0	31L	8
GA	99	1	1	3	0	0	22	1	0	0	31L	7
GA	99	1	1	4	0	0	23	0	0	0	31L	4
GA	99	1	1	4	0	0	23	10	0	0	31L	6
GA	99	1	1	4	0	0	23	16	0	0	31L	6
GA	99	1	1	4	0	0	23	19	0	0	31L	5
GA	99	1	1	4	0	0	23	45	0	0	31L	5
GA	99	1	1	4	0	0	23	53	0	0	31L	7
D2	99	3	2	3	18	0	0	0	31L	3	0	0
D2	99	3	2	2	18	0	0	0	31L	2	0	0
I1	99	17	2	2	18	0	0	0	31L	2	0	0
TW	99	12	2	1	18	0	0	0	31R	1	0	0
I4	99	7	3	3	18	0	19	30	31R	1	31L	4
TW	99	12	3	1	18	0	19	45	31L	3	31L	7
I1	99	18	3	2	18	0	20	30	31L	3	31L	7
D2	99	3	3	1	18	0	21	0	31L	2	31L	6
D1	99	14	2	3	18	1	0	0	31L	3	0	0
AA	99	6	3	1	18	1	19	30	31L	3	31L	7
D2	99	3	2	2	18	2	0	0	31L	2	0	0
			.									
			.									
			.									
GA	99	1	2	4	23	7	0	0	31R	1	0	0
F1	99	32	2	1	23	10	0	0	31L	3	0	0
I2	99	16	2	2	23	10	0	0	31L	2	0	0
D2	99	3	2	1	23	14	0	0	31L	2	0	0
GA	99	1	2	4	23	22	0	0	31R	1	0	0
D3	99	22	3	2	23	23	23	50	31L	2	31L	4
GA	99	1	2	4	23	27	0	0	31L	3	0	0
I2	99	16	2	2	23	30	0	0	31L	2	0	0
TW	99	12	2	1	23	30	0	0	31L	3	0	0
GA	99	1	2	4	23	47	0	0	31R	1	0	0
F1	99	-32	2	1	23	52	0	0	31L	2	0	0

END OF '09' FILE

FIGURE 2 (Continued)

6.0 ADSIM OUTPUTS

The ADSIM output contains an echo of the input data, a verification of the input data, an error summary report, and several reports containing the results of the model execution. This section discusses these reports, presents examples, and describes the run time messages which may appear.

6.1 ECHO OF INPUT DATA REPORT

Figure 3 is a sample Echo of Input Data Report, the first output report. Each card is printed as it is read, all values are checked for validity. If a value is outside the prescribed range, a "$" sign is placed underneath the value and a warning or an error message is printed. Appendix A describes the Warning Messages and their causes while Appendix B lists the Error Messages and their causes.

6.2 VERIFICATION REPORT

Figure 4 is an example of the Verification Report, the second ADSIM output report. It displays the input data as they were stored in the computer memory after input processing. (Note that the runway is stored as an index to the list of runway names. For example, Runway 1 is the first runway in the list of runway names -- Runway 31R.) This report is seldom used since the Echo of Input Data was added. To suppress the printing of this report, set print option 19 to "T".

6.3 ERROR SUMMARY

Figure 5 is a sample Error Summary. It indicates the number of fatal errors and warning messages which are printed on the Echo of the Input Data Report. Fatal errors or the "PRINT ONLY OPTION" stops the model execution after this report is printed.

6.4 RUN TIME MESSAGES

The ADSIM run time messages, developed by various organizations at different times in the life cycle of the software, do not follow any standard. Many of the messages were used for debugging and are not user oriented. Appendix C explains these messages which may be useful to an airport analyst. Appendix D discusses the STOP CODES which may appear during the simulation.

6.5 OUTPUT REPORTS

This section describes the output reports in the order in which they appear in the model execution. They represent the hourly summaries of a six-hour simulation (6PM to midnight) of New York's John F. Kennedy (JFK) Airport with a 1982 demand; there are two runways, 44 gates, current aircraft separations, and 10 random numbers seeds. Each random number seed generates a complete ADSIM simulation (replication). Most of the outputs give the total values over all replications as well as the average values and standard deviations per replication. The average value per replication is distinct from the average value per aircraft.

6.5.1 Airfield Simulation Model Summary

The sample Airfield Simulation Model Summary in Figure 6 provides hourly summaries of the arrival and departure flow rates, and delays by runway. This is the first of six reports printed by the user-specified time period (hour or quarter-hour). This one page report is in two logical parts; the top half pertains to arrivals and the bottom half to departures. Totals are given over all replications or cycles, whose number is the number of random number seeds. The average per cycle equals the total over all cycles divided by the number of cycles. The standard deviation is the deviation of the cycles from the average per cycle. Delays are in minutes.

6.5.2 Runway Crossing Report

The sample Runway Crossing Report in Figure 7 summarizes the runway crossing results for one hour. For each runway crossing link, it depicts the number of arrival and departure runway crossings and their resulting delays (in minutes). The TOTAL columns are totals over all replications. The AVERAGE is the average per replication (not per aircraft) and is equal to the total divided by the number of replications.

6.5.3 Taxiway Queue Links Report

The sample Taxiway Queue Links Report in Figure 8 provides a one hour link delay summary for selected taxiway links over 10 replications. If links are not specified in the TAXIWAY QUEUE LINKS input data, this report is not printed. For each selected taxiway link, the numbers of arrivals and departures and their delays (in minutes) are given. The TOTAL columns are totals over all replications. The AVERAGE is the average per replication, not per aircraft, and equals the total divided by the number of replications.

6.5.4 Travel Times Report

The sample Travel Times Report in Figure 9 depicts one of the hourly arrival and departure travel time summaries over 10 replications. The travel times (in minutes) are printed by fix, runway, and aircraft class. Fix-to-threshold and threshold-to-gate times comprise the arrival travel times; gate-to-roll and roll-to-fix times make up the departure travel times. The TOTAL columns are totals over all replications. The AVERAGE is the average per replication (not per aircraft) and equals the total divided by the number of replications.

6.5.5 Summary Report

The first page of the sample Summary Report in Figure 10 presents the average demands, the average flow rates, and the average delays -- by hour and by runway. The values are the average values per replication. Delays and travel times are in minutes.

The top half of the report provides the following data by hour.

* Time of the day.
* Arrival flow rates by runway.
* Arrival flow rate for all runways.
* Arrival demand.
* Difference between arrival flow rate and arrival demand.
* Departure flow rates by runway.
* Departure flow rate for all runways.
* Departure demand.
* Difference between departure flow rate and departure demand.
* Average travel times in minutes -- fix-to-threshold, threshold-to-gate, and gate-to-roll.

The bottom half of the report contains the following data by hour.

* Time of the day.
* Arrival delays by runway.
* Arrival delay for all runways.
* Arrival runway crossing delay.

* Arrival taxi-in delay.

* Departure delays by runway.

* Departure delays for all runways.

* Departure runway crossing delay.

* Departure taxi-out delay.

* Runway congestion delay.

* Average arrival delay per aircraft.

* Average departure delay per aircraft.

The second page of the sample Summary Report in Figure 11 shows the total flow rates, the total delays, and the total travel times -- by hour. The flow rates are the average per replication. The delays and the travel times (in minutes) represent the averages of the totals over all replications. The output consists of the following items.

* Time of the day.

* Arrival flow rate.

* Total arrival air delay.

* Total arrival taxi-in delay.

* Total arrival runway crossing delay.

* Departure flow rate.

* Total departure runway delay.

* Total departure taxi-out delay.

* Total departure runway crossing delay.

* Total enroute gate-hold delay.

* Total runway congestion gate-hold delay.

* Total arrival and departure ground delay.

* Total arrival air travel time.

* Total arrival ground travel time.

* Total departure ground travel time.

* Total arrival and departure travel time.

6.5.6 Link Delays Report

The sample Link Delays Report in Figure 12 provides one of the hourly link delay summaries. For each taxiway link, these values for arrivals and departures are totaled over 10 replications -- the number of aircraft experiencing link delays and the total delay (in minutes).

6.5.7 Separation Delays Report

The sample Separation Delays Report in Figure 13 provides one of the hourly summaries of separation delay by runway and fix. For each separation, the report gives the total number of aircraft having separation delays and the total delay in minutes -- over all replications.

The four types of separations appear in this order -- arrival-arrival (an arrival followed by an arrival), departure-arrival, departure-departure, and arrival-departure. Since each separation consists of a lead aircraft and a trail aircraft for each aircraft class combination, there are 16 separations by class -- (1,1), (1,2), (1,3), (1,4), (2,1) ... (4,4). Four separations appear on each line and there are four lines for each type of separation.

6.5.8 Runway Queue Statistics Report

The sample Runway Queue Statistics Report in Figure 14 can be used to analyze the number of planes waiting to takeoff. For each hour and each runway, it lists the average number of aircraft in the runway queue, the average number of aircraft in the runway queue while the queue existed, and the maximum number of aircraft in the runway queue. These hourly values are the averages over all replications.

6.5.9 Taxiway Queue Statistics Report

The sample Taxiway Queue Statistics Report in Figure 15 can be used to analyze bottlenecks on the airport. For each hour and each link, it gives the average number of aircraft in the queue, the average number of aircraft in the queue while the queue existed, and the maximum number of aircraft in the queue. These hourly values are the averages over all replications.

```
*** ECHO OF INPUT DATA ***
  ------------------
     1      TAXIWAY LINKS
     2        TAXIWAY LINKS FOR JFK CON-1
     3            1       1   0.010                7       0       0       0
     4            2       1   0.010                7       0       0       0
     5            3       1   0.010                7       0       0       0
     6            4       1   0.010                7       0       0       0
     7            5       1   0.010                7       0       0       0
     8            6       1   0.010                7       0       0       0
     9            7       1   0.010                7       0       0       0
    10            8       1   0.010                7       0       0       0
    11            9       1   0.010                7       0       0       0
    12           10       1   0.010                7       0       0       0
                  .
                  .
                  .
   248          300       0   0.010                7       0       0       0
   249          301       0   0.010                7       0       0       0
   250          302       0   0.010                7       0       0       0
   251          303       0   0.010                7       0       0       0
   252          304       0   0.010                7       0       0       0
   253          305       0   0.010                7       0       0       0
   254          306       0   0.010                7       0       0       0
   255          307       0   0.010                7       0       0       0
   256          308       0   0.010                7       0       0       0
   257          309       0   0.010                7       0       0       0
                  .
                  .
                  .
   582          690       0   314.5                3       0       0       0
   583          691       0   360.3                3       0       0       0
   584          692       0   384.9                3       0       0       0
   585          693       0   308.0                3       0       0       0
   586          694       0   307.5                3       0       0       0
   587          695       0   307.5                3       0       0       0
   588          696       0   307.5                3       0       0       0
   589          697       0   319.8                3       0       0       0
   590          698       0   319.8                3       0       0       0
   591          699       0   505.4                3       0       0       0
   592      TAXIWAY ROUTES
   593        35
   594       517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
   595       348 191 346 188 187 184 183 182 181 178 177 345 159 165   1
   596        36
   597       517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
   598       348 191 346 188 187 184 183 182 181 178 177 345 174 331 175   2
   599        33
   600       517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
   601       348 191 346 188 187 184 183 182 181 179 332 180   3
```

FIGURE 3 -- SAMPLE ECHO OF INPUT DATA REPORT

```
 602      29
 603     517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
 604     348 191 346 188 187 185 333 186   4
 605      25
 606     517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209
 607     348 199 334 190   5
                .
                .
                .
1950      49
1951      41 382 381 302 523 524 317 254 339 257 258 267 268 340 269 270 272 341 283 284
1952     546 342 547 548 549 550 551 343 297 322 504 650 649 648 651 652 653 654 655 306
1953     666 665 664 663 662 305 639 640 432
1954     -43
1955      44 374 303 525 526 318 265 340 269 270 272 341 283 284 546 342 547 548 549 550
1956     551 343 297 322 504 650 649 648 651 652 653 654 655 306 666 665 664 663 662 305
1957     639 640 432
1958    TITLE
1959    JFK EXP X DEMAND=XX SEP=XXXXX FLOW=A RWYS=PRESENT SCHED=XX RTE=XXX
1960    RANDOM NUMBER SEEDS
1961          10
1962       82651   91921   69011   92157   14577   10493   27001   40961   15011   63661
1963    PRINT OPTIONS
1964     F F F F F F F F T F F F F F F F F F F F
1965    RWY XING OCCUPANCY TIMES
1966         20.   20.00     20.   20.00
1967    RWY DEP. OCCUPANCY TIMES
1968           1            39.0             4.0
1969           2            39.0             4.0
1970           3            34.0             4.0
1971          -4            34.0             4.0
1972    HOLDING AREAS
1973           1
1974          99
1975    TAXIWAY SPEEDS (SEVEN STANDARD SPEEDS)
1976        5.00   10.00   15.00   20.00   25.00   30.00    5.00    0.
1977    AIRLINE NAMES
1978          20
1979    AA      AC      D1      D2      D3      D4      F1      F2      F3      F4
1980    F5      F6      I1      I2      I3      I4      I5      OW      TW      GA
1981    AIRLINE GATES
1982    AA             1
1983           6
1984    AC             1
1985           4
1986    D1             1
1987          14
1988    D2             1
1989           3
1990    D3             1
1991          22
1992    D4             1
```

FIGURE 3 (Continued)

```
1993          5
1994    F1            1
1995         32
1996    F2            1
1997         34
1998    F3            1
1999         44
2000    F4            1
2001         37
2002    F5            1
2003         35
2004    F6            2
2005         40      41
2006    I1            3
2007         17      18      20
2008    I2            1
2009         16
2010    I3            1
2011          9
2012    I4            1
2013          7
2014    I5            1
2015         11
2016    OW            1
2017          2
2018    TW            1
2019         12
2020    GA           -1
2021          1
2022    A/C SERVICE TIMES                    SOURCE PMM
2023          1       5
2024          0.   25.00      0.   30.00      1.   35.00      1.   38.00      1.   55.00
2025          2       3
2026          0.   25.00      1.   30.00      1.   50.00
2027          3       5
2028          0.   15.00      0.   20.00      1.   25.00      1.   30.00      1.   35.00
2029         -4       4
2030          0.   10.00      1.   15.00      1.   20.00      1.   25.00
2031    A/C LATENESS DISTRIBUTION                     SOURCE PMM
2032          9
2033          0.  -30.00      0.  -15.00      0.   -1.00      0.    1.00      1.    5.00
2034          1.   10.00      1.   15.00      1.   30.00      1.   40.00
2035    A/C APPROACH SPEEDS                       SOURCE PMM
2036          1           140.0            10.0
2037          2           130.0            10.0
2038          3           120.0            10.0
2039         -4           120.0            10.0
2040    G/A BASING AREAS
2041          1
2042          1
2043    TRUNCATION LIMITS
2044          3.    3.00
```

FIGURE 3 (Continued)

```
TIMES(START,FINISH)
    0  0   26  0
RWYS NO. OF
        2
RWY NAMES
     31R     31L
RWY END LINKS
     421     432
RWY XING LINKS
RUNWAY CROSSING LINKS FOR JFK CONFIGURATION 1
  31R       523       33.  37.  40.  40.  40.  40.  43.  47.  20.  20.  20.  20.
  31R       524       33.  37.  40.  40.  40.  40.  43.  47.  20.  20.  20.  20.
  31R       518       37.  41.  44.  44.  42.  42.  46.  48.  20.  20.  20.  20.
  31R       519       37.  41.  44.  44.  42.  42.  46.  48.  20.  20.  20.  20.
  31R       288       16.  18.  19.  19.  25.  25.  26.  31.  20.  20.  20.  20.
  31R       529       16.  18.  19.  19.  25.  25.  26.  31.  20.  20.  20.  20.
  31R       527       19.  21.  22.  22.  27.  27.  29.  34.  20.  20.  20.  20.
  31R       528       19.  21.  22.  22.  27.  27.  29.  34.  20.  20.  20.  20.
  31R       525       26.  28.  31.  31.  34.  34.  36.  42.  20.  20.  20.  20.
  31R       526       26.  28.  31.  31.  34.  34.  36.  42.  20.  20.  20.  20.
  31L       536       15.  16.  17.  17.  24.  24.  25.  29.  20.  20.  20.  20.
  31L       537       15.  16.  17.  17.  24.  24.  25.  29.  20.  20.  20.  20.
 -31L       608       15.  16.  17.  17.  24.  24.  25.  29.  20.  20.  20.  20.
RWY LENGTHS OF COMMON APPROACH
     31R       1     6.0
     31R       2     6.0
     31R       3     3.0
     31R       4     2.0
     31L       1     6.0
     31L       2     6.0
     31L       3     3.0
    -31L       4     2.0
RWY INTERARRIVAL GAP
                1            3.00
RWY EXIT SELECTION              SOURCE PMM
        1     31R       4
    522.    0.53    524.    0.37    517.    0.06    526.    0.04
        2     31R       3
    524.    0.59    522.    0.36    526.    0.05
        3     31R       2
    528.    0.61    526.    0.39
        4     31R       1
    528.    1.00
        1     31L       3
    533.    0.47    532.    0.37    534.    0.16
        2     31L       3
    533.    0.57    534.    0.33    532.    0.10
        3     31L       2
    533.    0.50    534.    0.50
       -4     31L       1
    534.    1.00
RWY EXIT DISTANCES                  SOURCE PMM
```

FIGURE 3 (Continued)

```
2097          9
2098        535   1817.     528   2440.     526   3768.     534   4059.     524   5181.
2099        533   5504.     522   6631.     532   7435.     517   8824.
2100    RWY ARRIVAL OCCUPANCY TIMES            SOURCE FMM
2101          1       7
2102     5380.0    47.0  5470.0    51.0  6480.0    60.0  6800.0    65.0  7240.0    65.0
2103     8740.0    70.0  9630.0    70.0
2104          2       6
2105     4170.0    40.0  5380.0    50.0  5470.0    51.0  6480.0    60.0  6800.0    65.0
2106     7240.0    65.0
2107          3       3
2108     4170.0    50.0  5380.0    51.0  5470.0    51.0
2109         -4       3
2110     4170.0    50.0  5380.0    51.0  5470.0    51.0
2111    TAXIWAY TWO-WAY
2112       4
2113     302 523 524 317
2114       4
2115     317 524 523 302
2116       4
2117     303 525 526 318
2118       4
2119     318 526 525 303
2120       7
2121     316 244 243 242 519 518 300
2122       7
2123     300 518 519 242 243 244 316
2124       3
2125     345 159 165
2126      -3
2127     165 159 345
2128    FIX TRAVEL TIMES                    CREATED 1-24-83  BY RJH
2129          1     31R       1   31.50  180.00    0.
2130          1     31R       2   31.50  180.00    0.
2131          1     31R       3   31.50  180.00    0.
2132          1     31R       4   31.50  180.00    0.
2133          1     31L       1   31.50  180.00    0.
2134          1     31L       2   31.50  180.00    0.
2135          1     31L       3   31.50  180.00    0.
2136          1     31L       4   31.50  180.00    0.
2137          2     31R       1   34.50  180.00    0.
2138          2     31R       2   34.50  180.00    0.
2139          2     31R       3   34.50  180.00    0.
2140          2     31R       4   34.50  180.00    0.
2141          2     31L       1   34.50  180.00    0.
2142          2     31L       2   34.50  180.00    0.
2143          2     31L       3   34.50  180.00    0.
2144          2     31L       4   34.50  180.00    0.
2145          3     31R       1   36.00  196.40    0.
2146          3     31R       2   36.00  196.40    0.
2147          3     31R       3   36.00  180.00    0.
2148          3     31R       4   36.00  180.00    0.
```

FIGURE 3 (Continued)

2149	3	31L	1	36.00	196.40	0.
2150	3	31L	2	36.00	196.40	0.
2151	3	31L	3	36.00	180.00	0.
2152	3	31L	4	36.00	180.00	0.
2153	4	31R	1	24.00	180.00	0.
2154	4	31R	2	24.00	180.00	0.
2155	4	31R	3	24.00	180.00	0.
2156	4	31R	4	24.00	180.00	0.
2157	4	31L	1	24.00	180.00	0.
2158	4	31L	2	24.00	180.00	0.
2159	4	31L	3	24.00	180.00	0.
2160	4	31L	4	24.00	180.00	0.

2161 A/C SEPARATIONS SOURCE FMM PANYNJ

2162 JFK SEPARATIONS PRESENT DAY RWYS 31R+31L

	LOP	LCL	LRW	LFX	TOP	TCL	TRW	TFX	MEAN	SIGM
2163										
2164	A	1	0	0	A	1	0	0	3.90	0.70
2165	A	1	0	0	A	2	0	0	4.70	0.65
2166	A	1	0	0	A	3	0	0	4.60	0.60
2167	A	1	0	0	A	4	0	0	5.50	0.60
2168	A	2	0	0	A	1	0	0	3.10	0.70
2169	A	2	0	0	A	2	0	0	3.00	0.65
2170	A	2	0	0	A	3	0	0	2.90	0.60
2171	A	2	0	0	A	4	0	0	3.70	0.60
2172	A	3	0	0	A	1	0	0	3.10	0.70
2173	A	3	0	0	A	2	0	0	3.00	0.65
2174	A	3	0	0	A	3	0	0	2.90	0.60
2175	A	3	0	0	A	4	0	0	3.70	0.60
2176	A	4	0	0	A	1	0	0	3.10	0.70
2177	A	4	0	0	A	2	0	0	3.00	0.65
2178	A	4	0	0	A	3	0	0	2.90	0.60
2179	A	4	0	0	A	4	0	0	2.90	0.60
2180	D	1	0	0	A	1	0	0	1.80	0.05
2181	D	1	0	0	A	2	0	0	1.60	0.05
2182	D	1	0	0	A	3	0	0	1.50	0.05
2183	D	1	0	0	A	4	0	0	1.50	0.05
2184	D	2	0	0	A	1	0	0	1.80	0.05
2185	D	2	0	0	A	2	0	0	1.60	0.05
2186	D	2	0	0	A	3	0	0	1.50	0.05
2187	D	2	0	0	A	4	0	0	1.50	0.05
2188	D	3	0	0	A	1	0	0	1.60	0.05
2189	D	3	0	0	A	2	0	0	1.50	0.05
2190	D	3	0	0	A	3	0	0	1.40	0.05
2191	D	3	0	0	A	4	0	0	1.40	0.05
2192	D	4	0	0	A	1	0	0	1.60	0.05
2193	D	4	0	0	A	2	0	0	1.50	0.05
2194	D	4	0	0	A	3	0	0	1.40	0.05
2195	D	4	0	0	A	4	0	0	1.40	0.05
2196	D	1	0	0	D	1	0	0	1.50	0.20
2197	D	1	0	0	D	2	0	0	2.00	0.20
2198	D	1	0	0	D	3	0	0	2.00	0.20
2199	D	1	0	0	D	4	0	0	2.00	0.20
2200	D	2	0	0	D	1	0	0	1.00	0.20

FIGURE 3 (Continued)

```
2201          D      2      0      0      D      2      0      0   1.00   0.20
2202          D      2      0      0      D      3      0      0   1.00   0.20
2203          D      2      0      0      D      4      0      0   0.83   0.20
2204          D      3      0      0      D      1      0      0   1.00   0.20
2205          D      3      0      0      D      2      0      0   1.00   0.20
2206          D      3      0      0      D      3      0      0   1.00   0.20
2207          D      3      0      0      D      4      0      0   0.83   0.20
2208          D      4      0      0      D      1      0      0   0.83   0.20
2209          D      4      0      0      D      2      0      0   0.75   0.20
2210          D      4      0      0      D      3      0      0   0.75   0.20
2211          D     -4      0      0      D      4      0      0   0.58   0.20
2212     TITLE
2213      JFK   EXP-1  18:00-26:00    31R+31L    82 DEMAND     VFR
2214     TIMES(START,FINISH)
2215        18  0   26  0
2216     TAXIWAY QUEUE LINKS
2217          182     203     217     228      0      0      0      0      0      0
2218     SIDE TO SIDE BALANCING
2218     -31L 31R   10.00
2220     GATE HOLD LIMITS
2221              10              2.0
2222              10              2.0
2223     A/C SCHEDULE
2224     GA       99   1      1      4    0  0  18  6      0      0    31L      7
2225     GA       99   1      1      4    0  0  18 17      0      0    31L      7
2226     D1       99  14      1      3    0  0  18 45      0      0    31L      8
2227     I1       99  17      1      1    0  0  18 45      0      0    31L      5
2228     D2       99   3      1      2    0  0  18 50      0      0    31L      7
2229     I1       99  18      1      1    0  0  19  0      0      0    31L      4
2230     GA       99   1      1      4    0  0  19 20      0      0    31L      8
2231     GA       99   1      1      3    0  0  19 31      0      0    31L      5
2232     D1       99  14      1      2    0  0  19 55      0      0    31L      8
2233     GA       99   1      1      4    0  0  20  3      0      0    31L      5
2234     D1       99  14      1      2    0  0  20 15      0      0    31L      7
2235     GA       99   1      1      4    0  0  20 30      0      0    31L      4
2236     I4       99   7      1      3    0  0  20 45      0      0    31L      4
2237     GA       99   1      1      4    0  0  21 10      0      0    31L      8
2238     GA       99   1      1      4    0  0  21 18      0      0    31L      7
2239     GA       99   1      1      4    0  0  21 25      0      0    31L      4
2240     GA       99   1      1      4    0  0  21 38      0      0    31L      8
2241     GA       99   1      1      4    0  0  21 44      0      0    31L      8
2242     GA       99   1      1      3    0  0  22  1      0      0    31L      7
2243     GA       99   1      1      4    0  0  23  0      0      0    31L      4
2244     GA       99   1      1      4    0  0  23 10      0      0    31L      6
2245     GA       99   1      1      4    0  0  23 16      0      0    31L      6
2246     GA       99   1      1      4    0  0  23 19      0      0    31L      5
2247     GA       99   1      1      4    0  0  23 45      0      0    31L      5
2248     GA       99   1      1      4    0  0  23 53      0      0    31L      7
2249     D2       99   3      2      3   18  0   0  0    31L      3      0      0
2250     D2       99   3      2      2   18  0   0  0    31L      2      0      0
2251     I1       99  17      2      2   18  0   0  0    31L      2      0      0
2252     TW       99  12      2      1   18  0   0  0    31R      1      0      0
```

FIGURE 3 (Continued)

2253	I4	99	7	3	3	18	0	19	30	31R	1	31L	4
2254	TW	99	12	3	1	18	0	19	45	31L	3	31L	7
2255	I1	99	18	3	2	18	0	20	30	31L	3	31L	7
2256	D2	99	3	3	1	18	0	21	0	31L	2	31L	6
2257	D1	99	14	2	3	18	1	0	0	31L	3	0	0
2258	AA	99	6	3	1	18	1	19	30	31L	3	31L	7
2259	D2	99	3	2	2	18	2	0	0	31L	2	0	0
2370	GA	99	1	2	4	23	7	0	0	31R	1	0	0
2371	F1	99	32	2	1	23	10	0	0	31L	3	0	0
2372	I2	99	16	2	2	23	10	0	0	31L	2	0	0
2373	D2	99	3	2	1	23	14	0	0	31L	2	0	0
2374	GA	99	1	2	4	23	22	0	0	31R	1	0	0
2375	D3	99	22	3	2	23	23	23	50	31L	2	31L	4
2376	GA	99	1	2	4	23	27	0	0	31L	3	0	0
2377	I2	99	16	2	2	23	30	0	0	31L	2	0	0
2378	TW	99	12	2	1	23	30	0	0	31L	3	0	0
2379	GA	99	1	2	4	23	47	0	0	31R	1	0	0
2380	F1	99	32	2	1	23	52	0	0	31L	2	0	0
2381	COMPUTE												

FIGURE 3 (Continued)

```
                                        I N P U T   D A T A
JFK   EXP-1  18:00-26:00    31R+31L   82 DEMAND     VFR
NUMBER OF RANDOM NUMBER SEEDS
      10
RANDOM NUMBER SEEDS
   82651   91921   69011   92157   14577   10493   27001   40961   15011   63661
START TIME AND FINISH TIME
   18  0   26  0
PRINT OPTIONS
 F F F F F F F F T F F F F F F F F F F F
NUMBER OF AIRLINES
      20
AIRLINE CODES
  AA      AC      D1      D2      D3      D4      F1      F2      F3      F4
  F5      F6      I1      I2      I3      I4      I5      OW      TW      GA
NUMBER OF RUNWAYS
       2
RUNWAY NAMES
  31R     31L
RUNWAY END LINK NUMBERS
     421     432
RUNWAY CROSSING LINKS--CLEARANCE TIMES FOR A/C CROSSING ACTIVE RUNWAY
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   523      1   33. 37. 40. 40. 40. 40. 43. 47. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   524      1   33. 37. 40. 40. 40. 40. 43. 47. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   518      1   37. 41. 44. 44. 42. 42. 46. 48. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   519      1   37. 41. 44. 44. 42. 42. 46. 48. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   288      1   16. 18. 19. 19. 25. 25. 26. 31. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   529      1   16. 18. 19. 19. 25. 25. 26. 31. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   527      1   19. 21. 22. 22. 27. 27. 29. 34. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   528      1   19. 21. 22. 22. 27. 27. 29. 34. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   525      1   26. 28. 31. 31. 34. 34. 36. 42. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   526      1   26. 28. 31. 31. 34. 34. 36. 42. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   536      2   15. 16. 17. 17. 24. 24. 25. 29. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   537      2   15. 16. 17. 17. 24. 24. 25. 29. 20. 20. 20. 20.
XNG LINK RUNWAY  ARRIVAL ON R/W DEPARTURE ON R/W  ARRIVAL ON FINAL
   608      2   15. 16. 17. 17. 24. 24. 25. 29. 20. 20. 20. 20.
```

FIGURE 4 -- SAMPLE VERIFICATION REPORT

RUNWAY CROSSING LINKS--OCCUPANCY TIMES (SECS)

CLASS	TIME
1	20.00
2	20.00
3	20.00
4	20.00

NUMBER OF EXITS
9

DISTANCE IN FEET FROM THRESHOLD TO THE EXIT TAXIWAY (EXIT LINK NO. VERSUS DISTANCE)

535	1817.0	528	2440.0	526	3768.0	534	4059.0	524	5181.0
533	5504.0	522	6631.0	532	7435.0	517	8824.0		

NUMBER OF HOLDING AREAS
1

HOLDING AREA NUMBERS
99

NUMBER OF G/A BASING AREAS
1

G/A BASING AREA NUMBERS
1

TAXIWAY LINK DATA

LINK NO.	LINK SIZE	LENGTH	SPEED CODE	ONE-WAY	ROUTE NO.
1	1	0.01	7	0	0
2	1	0.01	7	0	0
3	1	0.01	7	0	0
4	1	0.01	7	0	0
5	1	0.01	7	0	0
6	1	0.01	7	0	0
7	1	0.01	7	0	0
8	1	0.01	7	0	0
9	1	0.01	7	0	0
10	1	0.01	7	0	0
		.			
		.			
		.			
300	0	0.01	7	0	0
301	0	0.01	7	0	0
302	0	0.01	7	0	0
303	0	0.01	7	0	0
304	0	0.01	7	0	0
305	0	0.01	7	0	0
306	0	0.01	7	0	0
307	0	0.01	7	0	0
308	0	0.01	7	0	0
309	0	0.01	7	0	0
		.			
		.			
		.			
690	0	314.50	3	0	0
691	0	360.30	3	0	0
692	0	384.90	3	0	0
693	0	308.00	3	0	0
694	0	307.50	3	0	0

FIGURE 4 (Continued)

```
  695          0        307.50        3     0        0
  696          0        307.50        3     0        0
  697          0        319.80        3     0        0
  698          0        319.80        3     0        0
  699          0        505.40        3     0        0
AIRLINE GATES
  AA
       6
  AC
       4
  D1
      14
  D2
       3
  D3
      22
  D4
       5
  F1
      32
  F2
      34
  F3
      44
  F4
      37
  F5
      35
  F6
      40      41
  I1
      17      18      20
  I2
      16
  I3
       9
  I4
       7
  I5
      11
  OW
       2
  TW
      12
  GA
       1
TRUNCATION LIMITS
     UPPER LIMIT = 3.00
     LOWER LIMIT = 3.00
DEPARTURE QUEUE LENGTH AND INTERARRIVAL GAP
QUEUE =   1      MEAN =    3.00      STD DEV =    0.30
LENGTHS OF COMMON APPROACH PATHS FROM OUTER MARKER TO THRESHOLD IN NAUTICAL MILES (RUNWAY NO., A/C CLASS, LENGTH)
```

FIGURE 4 (Continued)

```
        1        1     6.00
        1        2     6.00
        1        3     3.00
        1        4     2.00
        2        1     6.00
        2        2     6.00
        2        3     3.00
        2        4     2.00
TAXIWAY PATH DATA
PATH      1                              LENGTH     35                              LOCATION      1                                          6.179
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209 348 191 346 188 187 184 183 182 181 178
 177 345 159 165   1
PATH      2                              LENGTH     36                              LOCATION     36                                          6.533
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209 348 191 346 188 187 184 183 182 181 178
 177 345 174 331 175   2
PATH      3                              LENGTH     33                              LOCATION     72                                          5.920
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209 348 191 346 188 187 184 183 182 181 179
 332 180   3
PATH      4                              LENGTH     29                              LOCATION    105                                          5.265
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209 348 191 346 188 187 185 333 186   4
PATH      5                              LENGTH     25                              LOCATION    134                                          4.736
 517 239 240 241 242 243 244 316 218 217 216 215 350 214 213 212 349 211 210 209 348 199 334 190   5
                          .
                          .
                          .
PATH    439                              LENGTH     49                              LOCATION 14189                                        10.727
  41 382 381 302 523 524 317 254 339 257 258 267 268 340 269 270 272 341 283 284 546 342 547 548 549 550 551 343 297 322
 504 650 649 648 651 652 653 654 655 306 666 665 664 663 662 305 639 640 432
PATH    440                              LENGTH     43                              LOCATION 14238                                         9.599
  44 374 303 525 526 318 265 340 269 270 272 341 283 284 546 342 547 548 549 550 551 343 297 322 504 650 649 648 651 652
 653 654 655 306 666 665 664 663 662 305 639 640 432
THIS AIRPORT USES THE FOLLOWING--
LINKS-      589          PATHS-      440          PATH SEGMENTS-    14280
AVERAGE PATH LENGTH IS 32.45  SEGMENTS
TAXIWAY TWO-WAY PATHS
LINKS  4
     302      523      524      317
LINKS  4
     317      524      523      302
LINKS  4
     303      525      526      318
LINKS  4
     318      526      525      303
LINKS  7
     316      244      243      242      519      518      300
LINKS  7
     300      518      519      242      243      244      316
LINKS  3
     345      159      165
LINKS  3
     165      159      345
```

FIGURE 4 (Continued)

```
A/C SEPARATIONS
128 SEPARATION VALUES IN 4 SETS OF 32, ARRIVAL / ARRIVAL, DEPARTURE / ARRIVAL, DEPARTURE / DEPARTURE AND ARRIVAL / DEPARTURE
EACH SET OF 32 IS COMPOSED OF 16 PAIRS OF MEAN AND STANDARD DEVIATION
THE 16 SETS ARE POSSIBLE WAYS OF A/C CLASS X FOLLOWED BY A/C CLASS Y
THERE ARE 4 A/C CLASSES -- 1 = D CLASS
                            2 = C CLASS
                            3 = B CLASS
                            4 = A CLASS
THE ORDER OF SETS OF (X,Y) IS
(1,1), (1,2), (1,3), (1,4), (2,1), (2,2), (2,3), (2,4)
(3,1), (3,2), (3,3), (3,4), (4,1), (4,2), (4,3), (4,4)
LEAD A/C RUNWAY  0     LEAD A/C FIX  0     TRAIL A/C RUNWAY  0     TRAIL A/C FIX  0
128 SEPARATION VALUES IN 4 SETS OF 32, A/A (N.MILES), D/A (N.MILES), D/D (MINUTES) AND A/D (MINUTES)
    3.90    0.70    4.70    0.65    4.60    0.60    5.50    0.60
    3.10    0.70    3.00    0.65    2.90    0.60    3.70    0.60
    3.10    0.70    3.00    0.65    2.90    0.60    3.70    0.60
    3.10    0.70    3.00    0.65    2.90    0.60    2.90    0.60
    1.80    0.05    1.60    0.05    1.50    0.05    1.50    0.05
    1.80    0.05    1.60    0.05    1.50    0.05    1.50    0.05
    1.60    0.05    1.50    0.05    1.40    0.05    1.40    0.05
    1.60    0.05    1.50    0.05    1.40    0.05    1.40    0.05
    1.50    0.20    2.00    0.20    2.00    0.20    2.00    0.20
    1.00    0.20    1.00    0.20    1.00    0.20    0.83    0.20
    1.00    0.20    1.00    0.20    1.00    0.20    0.83    0.20
    0.83    0.20    0.75    0.20    0.75    0.20    0.58    0.20
    0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.
VECTORING DELAY INPUTS
FIX    DELAY EVALUATION LEVEL     HOLDING PCT.   MAXIMUM VECTORING DELAY   MINIMUM HOLDING DELAY
GATE HOLD LIMIT = 10 HOLD TIME =   2.00
GATE HOLD LIMIT = 10 HOLD TIME =   2.00
AIRSPACE DELAYS
FIX   OCCURENCE PERCENTAGE   HOLD MEAN   HOLD SIGMA
A/C DEPARTURE RUNWAY OCCUPANCY TIME IN SECONDS (A/C CLASS, MEAN, AND STD. DEV.)
       1   39.00    4.00
       2   39.00    4.00
       3   34.00    4.00
       4   34.00    4.00
TOUCH-AND-GO RUNWAY OCCUPANCY TIME IN SECONDS (A/C CLASS, MEAN, AND STD. DEV.)
       1    0.      0.
       2    0.      0.
       3    0.      0.
       4    0.      0.
GATE SERVICE TIME DISTRIBUTION (PROBABILITY VS TIME)
CLASS 1
   0.070   25.00   0.110   30.00   0.510   35.00   0.600   38.00   1.000   55.00
CLASS 2
   0.470   25.00   0.600   30.00   1.000   50.00
CLASS 3
   0.400   15.00   0.470   20.00   0.560   25.00   0.600   30.00   1.000   35.00
```

FIGURE 4 (Continued)

```
CLASS 4
   0.400   10.00   0.800   15.00   0.900   20.00   1.000   25.00
A/C APPROACH SPEED IN KNOTS (A/C CLASS, MEAN, STD. DEV.)
       1  140.00   10.00
       2  130.00   10.00
       3  120.00   10.00
       4  120.00   10.00
RUNWAY EXIT SELECTION--USAGE PERCENTAGE BY EACH A/C CLASS AND BY EACH RUNWAY (EXIT LINK NO. VERSUS PROBABILITY)
CLASS  1 RWY   1
    522.    0.53    524.    0.90    517.    0.96    526.    1.00
CLASS  2 RWY   1
    524.    0.59    522.    0.95    526.    1.00
CLASS  3 RWY   1
    528.    0.61    526.    1.00
CLASS  4 RWY   1
    528.    1.00
CLASS  1 RWY   2
    533.    0.47    532.    0.84    534.    1.00
CLASS  2 RWY   2
    533.    0.57    534.    0.90    532.    1.00
CLASS  3 RWY   2
    533.    0.50    534.    1.00
CLASS  4 RWY   2
    534.    1.00
THE ARRIVAL RUNWAY OCCUPANCY TIME IN SECONDS BY A/C CLASS (DISTANCE IN FEET FROM THRESHOLD TO EXIT TAXIWAY VERSUS TIME)
CLASS  1
  5380.0   47.00  5470.0   51.00  6480.0   60.00  6800.0   65.00  7240.0   65.00
  8740.0   70.00  9630.0   70.00
CLASS  2
  4170.0   40.00  5380.0   50.00  5470.0   51.00  6480.0   60.00  6800.0   65.00
  7240.0   65.00
CLASS  3
  4170.0'  50.00  5380.0   51.00  5470.0   51.00
CLASS  4
  4170.0   50.00  5380.0   51.00  5470.0   51.00
TAXIING SPEEDS IN MPH
    5.00   10.00   15.00   20.00   25.00   30.00    5.00    0.
A/C LATENESS DISTRIBUTION IN MINUTES (RANDOM NUMBER VERSUS TIME)
    0.    -30.00    0.00  -15.00    0.12   -1.00    0.40    1.00    0.55    5.00
    0.70   10.00    0.78   15.00    0.89   30.00    1.00   40.00
A/C SCHEDULE DATA
A/C NO.   AIRLINE   HOLD   GATE   FLT.TYPE   CLASS   ARRIVE   DEPART   SERV.TIME   ARR RWY   ARR FIX   DEP RWY   DEP FIX
AIRCRAFT READ IN-  157
FIX TRAVEL TIMES
FIX     RUNWAY     CLASS     FIX TO R/W DIST.       AVERAGE SPEED     TRAVEL TIME
 1        1         1          31.50                   180.00            10.50
 1        1         2          31.50                   180.00            10.50
 1        1         3          31.50                   180.00            10.50
 1        1         4          31.50                   180.00            10.50
 1        2         1          31.50                   180.00            10.50
 1        2         2          31.50                   180.00            10.50
 1        2         3          31.50                   180.00            10.50
```

FIGURE 4 (Continued)

1	2	4	31.50	180.00	10.50
2	1	1	34.50	180.00	11.50
2	1	2	34.50	180.00	11.50
2	1	3	34.50	180.00	11.50
2	1	4	34.50	180.00	11.50
2	2	1	34.50	180.00	11.50
2	2	2	34.50	180.00	11.50
2	2	3	34.50	180.00	11.50
2	2	4	34.50	180.00	11.50
3	1	1	36.00	196.40	11.00
3	1	2	36.00	196.40	11.00
3	1	3	36.00	180.00	12.00
3	1	4	36.00	180.00	12.00
3	2	1	36.00	196.40	11.00
3	2	2	36.00	196.40	11.00
3	2	3	36.00	180.00	12.00
3	2	4	36.00	180.00	12.00
4	1	1	24.00	180.00	8.00
4	1	2	24.00	180.00	8.00
4	1	3	24.00	180.00	8.00
4	1	4	24.00	180.00	8.00
4	2	1	24.00	180.00	8.00
4	2	2	24.00	180.00	8.00
4	2	3	24.00	180.00	8.00
4	2	4	24.00	180.00	8.00

DYNAMIC RWY REASSIGNMENT
THERE ARE 0 DEPARTURE REASSIGNMENTS
THERE ARE 0 ARRIVAL REASSIGNMENTS.
SIDE TO SIDE BALANCING
ORIGINAL RWY REASSIGNMENT RWY DELAY
PROBABILISTIC LINK TRANSIT TIME PROB .VS. TIME
0.

FIGURE 4 (Continued)

```
*** ERROR SUMMARY ***
    NUMBER FATAL ERRORS -      0
    NUMBER WARNINGS           39
```

FIGURE 5 -- SAMPLE ERROR SUMMARY

JFK EXP-1 18:00-26:00 31R+31L 82 DEMAND VFR ADSIM 1F 7/1/81 VERSION PAGE 1

AIRFIELD SIMULATION MODEL SUMMARY
TIME PERIOD FROM 18:00 TO 19:00

RUN-WAY	TOTAL ARRIVAL	AVERAGE ARRIVAL	STANDARD DEVIATION ARRIVAL	CLASS 1 TOTAL	CLASS 2 TOTAL	CLASS 3 TOTAL	CLASS 4 TOTAL	TOTAL ARRIVAL DELAY	AVERAGE ARRIVAL DELAY	S.D. ARRIVAL DELAY	TOTAL A/C ARRIVAL DELAY	AVG A/C ARRIVAL DELAY	S.D. A/C ARRIVAL DELAY
31R	88.000	8.800	0.919	4.500	2.900	1.400	0.	25.314	2.531	1.379	2.915	0.291	0.157
31L	224.000	22.400	1.174	7.900	10.900	2.000	1.600	456.086	45.609	17.645	20.244	2.024	0.746
ALL	312.000	31.200	1.932					481.400	48.140	17.333	15.310	1.531	0.512

					CLASS 1	CLASS 2	CLASS 3	CLASS 4
NUMBER ON GATE TOTAL = 292.	AVG PER CYCLE = 29.20	STANDARD DEVIATION = 1.48	AVG		11.40	13.10	3.10	1.60

DELAY PARAMETERS	TOTAL OVER ALL CYCLES	AVERAGE PER CYCLE	STANDARD DEVIATION	AVG/AC ALL CYCLES	AVG/AC PER CYCLE	STANDARD DEVIATION
TAXI IN	5.024	0.502	0.314	0.160	0.016	0.010
TAXI IN QUEUED	0.080	0.008	0.025	0.002	0.000	0.001
HOLDING AREA	0.	0.	0.	0.	0.	0.
RUNWAY CROSSING	0.	0.	0.	0.	0.	0.

RUN-WAY	TOTAL DEPARTURE	AVERAGE DEPARTURE	STANDARD DEVIATION DEPARTURE	CLASS 1 TOTAL	CLASS 2 TOTAL	CLASS 3 TOTAL	CLASS 4 TOTAL	TOTAL DEPARTURE DELAY	AVERAGE DEPARTURE DELAY	S.D. DEPARTURE DELAY	TOTAL A/C DEPARTURE DELAY	AVG A/C DEPARTURE DELAY	S.D. A/C DEPARTURE DELAY
31R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31L	55.000	5.500	0.527	1.000	1.500	1.000	2.000	40.237	4.024	2.885	7.038	0.704	0.467
ALL	55.000	5.500	0.527					40.237	4.024	2.885	7.038	0.704	0.467

					CLASS 1	CLASS 2	CLASS 3	CLASS 4
NUMBER OFF GATE TOTAL = 70.	AVG PER CYCLE = 7.00	STANDARD DEVIATION = 0.47	AVG		2.20	1.80	1.00	2.00

DELAY PARAMETERS	TOTAL OVER ALL CYCLES	AVERAGE PER CYCLE	STANDARD DEVIATION	AVG/AC ALL CYCLES	AVG/AC PER CYCLE	STANDARD DEVIATION
TAXI OUT	1.525	0.152	0.203	0.283	0.028	0.038
TAXI OUT QUEUED	0.	0.	0.	0.	0.	0.
ENROUTE GATE HOLD	0.	0.	0.	0.	0.	0.
GATE HOLD (RWY)	0.	0.	0.	0.	0.	0.
RUNWAY CROSSING	0.	0.	0.	0.	0.	0.
NUMBER OF TOWS	0.	0.	0.			
TOWING TIME	0.	0.	0.	0.	0.	0.

FIGURE 6 -- AIRFIELD SIMULATION MODEL SUMMARY

AIRFIELD SIMULATION MODEL SUMMARY
TIME PERIOD FROM 18:00 TO 19:00

RUNWAY CROSSING

LINK	TOTAL ARRIVAL	AVERAGE ARRIVAL	S.D. ARRIVAL	TOTAL ARRIVAL DELAY	AVERAGE ARRIVAL DELAY	S.D. ARRIVAL DELAY	TOTAL DEPARTURE	AVERAGE DEPARTURE	S.D. DEPARTURE	TOTAL DEPARTURE DELAY	AVERAGE DEPARTURE DELAY	S.D. DEPARTURE DELAY
523	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
524	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
518	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
519	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
288	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
529	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
527	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
528	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
525	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
526	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
536	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
537	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
608	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

FIGURE 7 -- RUNWAY CROSSING REPORT

AIRFIELD SIMULATION MODEL SUMMARY
TIME PERIOD FROM 18:00 TO 19:00

TAXIWAY QUEUE LINKS

LINK	TOTAL ARRIVAL	AVERAGE ARRIVAL	S.D. ARRIVAL	TOTAL ARRIVAL DELAY	AVERAGE ARRIVAL DELAY	S.D. ARRIVAL DELAY	TOTAL DEPARTURE	AVERAGE DEPARTURE	S.D. DEPARTURE	TOTAL DEPARTURE DELAY	AVERAGE DEPARTURE DELAY	S.D. DEPARTURE DELAY
182	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
203	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
217	1.00	0.10	0.32	0.08	0.01	0.03	0.	0.	0.	0.	0.	0.
228	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ALL	1.00	0.10	0.32	0.08	0.01	0.03	0.	0.	0.	0.	0.	0.

FIGURE 8 -- TAXIWAY QUEUE LINKS REPORT

AIRFIELD SIMULATION MODEL SUMMARY
TIME PERIOD FROM 18:00 TO 19:00

TRAVEL TIMES

			ARRIVAL						DEPARTURE					
			FIX TO THRESHOLD			THRESHOLD TO GATE			GATE TO ROLL			ROLL TO FIX		
FIX	RWY	CLS	TOTAL	MEAN	S.D.	TOTAL	MEAN	S.D.	TOTAL	MEAN	S.D.	TOTAL	MEAN	S.D.
1	31R	1	107.056	10.706	0.192	68.371	6.837	0.264	0.	0.	0.	0.	0.	0.
1	31R	2	107.043	10.704	0.333	65.720	6.572	0.408	0.	0.	0.	0.	0.	0.
1	31R	3	113.610	11.361	1.074	54.737	5.474	0.339	0.	0.	0.	0.	0.	0.
2	31L	1	130.081	13.008	0.785	36.930	3.693	0.564	0.	0.	0.	0.	0.	0.
2	31L	2	136.131	13.613	0.845	59.703	5.970	0.342	0.	0.	0.	0.	0.	0.
3	31L	1	130.215	13.022	1.165	61.432	6.143	0.427	0.	0.	0.	0.	0.	0.
3	31L	2	134.140	13.414	1.345	69.990	6.999	0.311	0.	0.	0.	0.	0.	0.
3	31L	3	146.364	14.636	1.529	67.709	6.771	0.836	0.	0.	0.	0.	0.	0.
3	31L	4	131.744	13.174	1.663	31.843	3.184	0.001	0.	0.	0.	0.	0.	0.
5	31L	1	0.	0.	0.	0.	0.	0.	58.801	5.880	0.784	0.	0.	0.
7	31L	2	0.	0.	0.	0.	0.	0.	85.396	8.540	0.805	0.	0.	0.
7	31L	4	0.	0.	0.	0.	0.	0.	90.682	9.068	0.542	0.	0.	0.
8	31L	3	0.	0.	0.	0.	0.	0.	92.327	9.233	1.161	0.	0.	0.
	ALL		126.656	12.666	0.509	59.889	5.989	0.142	83.453	8.345	0.463	0.	0.	0.

FIGURE 9 -- TRAVEL TIMES REPORT

AVERAGE FLOW RATES

TIME	ARRIVALS RWY 31R	RWY 31L	RWY	RWY	RWY	RWY	TOT	DE-MAND	DIF	DEPARTURES RWY 31R	RWY 31L	RWY	RWY	RWY	RWY	TOT	DE-MAND	DIF	AVERAGE TRAVEL TIMES FIX TO THRESH	THRESH TO GATE	GATE TO ROLL
1800-1900	8.8	22.4	0.	0.	0.	0.	31.2	32.0	-0.8	0.	5.5	0.	0.	0.	0.	5.5	6.0	-0.5	12.67	5.99	8.35
1900-2000	5.0	18.2	0.	0.	0.	0.	23.2	24.0	-1.6	0.	10.8	0.	0.	0.	0.	10.8	12.0	-1.7	11.85	6.16	9.12
2000-2100	7.7	17.9	0.	0.	0.	0.	25.6	25.8	-1.8	0.	15.2	0.	0.	0.	0.	15.2	14.0	-0.5	12.08	5.55	8.97
2100-2200	3.6	20.8	0.	0.	0.	0.	24.4	23.4	-0.8	0.	20.4	0.	0.	0.	0.	20.4	22.0	-2.1	13.83	5.33	9.72
2200-2300	3.5	9.5	0.	0.	0.	0.	13.0	12.6	-0.4	0.	11.9	0.	0.	0.	0.	11.9	10.0	-0.2	11.84	4.90	8.43
2300-2400	4.1	9.6	0.	0.	0.	0.	13.7	13.4	-0.1	0.	9.3	0.	0.	0.	0.	9.3	10.0	-0.9	11.51	6.16	9.34
2400-2500	0.3	0.6	0.	0.	0.	0.	0.9	0.8	0.0	0.	2.9	0.	0.	0.	0.	2.9	2.0	0.0	6.63	4.56	9.12
2500-2600	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.	0.	0.	0.	0.	0.	0.	0.0	0.	0.	0.

AVERAGE DELAYS

TIME	ARRIVALS RWY 31R	RWY 31L	RWY	RWY	RWY	RWY	TOT	RWY CRS	TAXI IN	DEPARTURES RWY 31R	RWY 31L	RWY	RWY	RWY	RWY	TOT	RWY CRS	TAXI OUT	RWY CNG	GRAND TOTAL AVERAGE DELAYS ARR DELAY	DEP DELAY
1800-1900	0.3	2.0	0.	0.	0.	0.	1.5	0.	0.0	0.	0.7	0.	0.	0.	0.	0.7	0.	0.0	0.	1.5	0.7
1900-2000	0.0	0.9	0.	0.	0.	0.	0.7	0.	0.0	0.	0.8	0.	0.	0.	0.	0.8	0.	0.0	0.	0.7	0.8
2000-2100	0.3	1.4	0.	0.	0.	0.	1.0	0.0	0.0	0.	0.8	0.	0.	0.	0.	0.8	0.	0.0	0.	1.1	0.8
2100-2200	0.2	3.0	0.	0.	0.	0.	2.6	0.	0.0	0.	1.8	0.	0.	0.	0.	1.8	0.	0.1	0.	2.6	1.9
2200-2300	0.1	0.9	0.	0.	0.	0.	0.7	0.	0.0	0.	0.9	0.	0.	0.	0.	0.9	0.	0.1	0.	0.7	1.0
2300-2400	0.1	0.4	0.	0.	0.	0.	0.3	0.	0.0	0.	0.4	0.	0.	0.	0.	0.4	0.	0.1	0.	0.3	0.5
2400-2500	0.	0.1	0.	0.	0.	0.	0.1	0.	0.	0.	0.1	0.	0.	0.	0.	0.1	0.	0.	0.	0.1	0.1
2500-2600	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

FIGURE 10 -- SUMMARY REPORT, FIRST PAGE

	ARRIVALS				DEPARTURES						TOTAL		TRAVEL TIMES		
TIME	FLOW RATE	AIR DELAY	TAXI-IN DELAY	RWY-XNG DELAY	FLOW RATE	RUNWAY DELAY	TAXI-OUT DELAY	RWY-XNG DELAY	ENRTE GTE-HLD	GTE-HLD RWY-CNG	GROUND DELAYS	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURE GROUND	TOTAL
1800-1900	31.2	48.1	0.5	0.	5.5	4.0	0.2	0.	0.	0.	4.7	395.2	186.9	45.9	627.9
1900-2000	23.2	17.4	0.4	0.	10.8	9.0	0.2	0.	0.	0.	9.6	274.9	142.9	98.5	516.3
2000-2100	25.6	26.7	0.5	0.1	15.2	11.8	0.4	0.	0.	0.	12.8	309.4	142.1	136.3	587.8
2100-2200	24.4	63.7	0.8	0.	20.4	36.5	1.8	0.	0.	0.	39.1	337.3	130.0	198.3	665.6
2200-2300	13.0	10.1	0.2	0.	11.9	10.7	1.1	0.	0.	0.	12.0	153.9	63.6	100.3	317.8
2300-2400	13.7	4.1	0.5	0.	9.3	3.9	1.1	0.	0.	0.	5.5	157.7	84.4	86.9	329.0
2400-2500	0.9	0.2	0.	0.	2.9	0.2	0.	0.	0.	0.	0.2	6.0	4.1	26.4	36.5
2500-2600	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL	132.0	170.4	2.9	0.1	76.0	76.2	4.7	0.	0.	0.	83.8	1634.3	754.0	692.5	3080.8

FIGURE 11 -- SUMMARY REPORT, SECOND PAGE

LINK DELAYS FOR HOUR 1 (FROM 18:00 TO 19:00)

LINK NUMBER	DELAYED ARRIVALS	ARRIVAL DELAY	DELAYED DEPARTURES	DEPARTURE DELAY
22	0.	0.	1.000	0.140
158	1.000	0.016	0.	0.
165	0.	0.	1.000	0.097
216	1.000	0.076	0.	0.
258	1.000	0.157	0.	0.
270	1.000	0.508	0.	0.
271	0.	0.	1.000	0.199
283	0.	0.	1.000	0.037
284	0.	0.	1.000	0.047
305	0.	0.	1.000	0.149
316	1.000	0.080	0.	0.
318	1.000	0.215	0.	0.
324	0.	0.	1.000	0.122
326	0.	0.	2.000	0.052
329	4.000	0.868	3.000	0.598
332	3.000	0.476	0.	0.
335	1.000	0.411	0.	0.
338	1.000	0.237	0.	0.
339	2.000	0.412	0.	0.
341	0.	0.	1.000	0.025
345	6.000	1.648	3.000	0.419
432	0.	0.	77.000	39.573
640	0.	0.	9.000	3.485
TOTAL	23.000	5.105	102.000	44.943

FIGURE 12 -- LINK DELAYS REPORT

SEPARATION DELAYS FOR HOUR = 1 (FROM 18:00 TO 19:00)

LEAD RUNWAY = LEAD FIX = 0 TRAIL RWY = TRAIL FIX = 0

COUNT	DELAY	COUNT	DELAY	COUNT	DELAY	COUNT	DELAY
12.00	17.50	40.00	70.72	8.00	17.51	4.00	10.43
28.00	36.44	37.00	48.54	8.00	15.37	3.00	4.43
11.00	11.57	7.00	11.05	1.00	1.86	1.00	0.65
4.00	4.54	3.00	3.73	2.00	2.72	0.	0.
2.00	0.67	2.00	0.21	0.	0.	0.	0.
4.00	0.98	1.00	0.44	0.	0.	1.00	0.76
1.00	0.67	4.00	1.61	0.	0.	0.	0.
6.00	1.42	5.00	1.64	1.00	0.78	0.	0.
0.	0.	1.00	1.18	3.00	2.01	0.	0.
4.00	0.82	2.00	0.25	2.00	0.41	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.

LEAD RUNWAY = LEAD FIX = 0 TRAIL RWY = TRAIL FIX = 0

THERE WERE NO SEPARATION DELAYS

LEAD RUNWAY = LEAD FIX = 0 TRAIL RWY = TRAIL FIX = 0

THERE WERE NO SEPARATION DELAYS

LEAD RUNWAY = LEAD FIX = 0 TRAIL RWY = TRAIL FIX = 0

THERE WERE NO SEPARATION DELAYS

LEAD RUNWAY = LEAD FIX = 0 TRAIL RWY = TRAIL FIX = 0

THERE WERE NO SEPARATION DELAYS

FIGURE 13 -- SEPARATION DELAYS REPORT

EXHIBIT 1

RUNWAY QUEUE STATISTICS

	RWY NUMBER 31R			RWY NUMBER 31L			RWY NUMBER			RWY NUMBER			RWY NUMBER		
HOUR	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE
1800-1900	0.	0.	0.	0.03	1.11	0.60	0.	0.	0.	0.	0.	0.	0.	0.	0.
1900-2000	0.	0.	0.	0.14	1.32	1.90	0.	0.	0.	0.	0.	0.	0.	0.	0.
2000-2100	0.	0.	0.	0.21	1.22	1.80	0.	0.	0.	0.	0.	0.	0.	0.	0.
2100-2200	0.	0.	0.	0.82	1.73	4.30	0.	0.	0.	0.	0.	0.	0.	0.	0.
2200-2300	0.	0.	0.	0.11	1.13	1.70	0.	0.	0.	0.	0.	0.	0.	0.	0.
2300-2400	0.	0.	0.	0.05	1.04	1.20	0.	0.	0.	0.	0.	0.	0.	0.	0.
2400-2500	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2500-2600	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

+ AVERAGE QUEUE WHILE QUEUE EXISTED.

FIGURE 14 -- RUNWAY QUEUE STATISTICS REPORT

EXHIBIT 2

TAXIWAY QUEUE STATISTICS

	LINK NUMBER 182			LINK NUMBER 203			LINK NUMBER 217			LINK NUMBER 228			LINK NUMBER 0		
HOUR	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE	AVG QUEUE	AVG+ Q EXT	MAX QUEUE
1800-1900	0.	0.	0.	0.	0.	0.	0.00	1.00	0.10	0.	0.	0.	0.	0.	0.
1900-2000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2000-2100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2100-2200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2200-2300	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2300-2400	0.	0.	0.	0.	0.	0.	0.00	1.00	0.10	0.	0.	0.	0.	0.	0.
2400-2500	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2500-2600	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

+ AVERAGE QUEUE WHILE QUEUE EXISTED.

FIGURE 15 -- TAXIWAY QUEUE STATISTICS REPORT

7.0 SHORT FORM

ADSIM can simulate the runways and airspace delays without a detailed description of the airfield taxiways and gates. This mode of using the model is called the SHORT FORM; it yields significant savings in computer running costs and analyst data preparation time.

7.1 WHEN TO USE THE SHORT FORM

The SHORT FORM should be used when ground delays and ground travel times are not required for the analysis. The SHORT FORM can be used to analyze the capacity of an airport limited by runway utilization, examine the effect of different separations on the airfield capacity, and investigate the impact of different ATC procedures.

7.2 USING THE SHORT FORM

The time difference between an aircraft's arrival time and its subsequent departure time depends on its ground travel time, its delay, its gate service time, and its scheduled departure time. Because the SHORT FORM does not simulate ground operations (travel and delay times), the model could subsequently produce erroneous departure times for aircraft that both arrive and depart. Therefore, it is necessary to separate all scheduled aircraft into arrivals and departures. An aircraft that both arrives and departs becomes two separate aircraft; two separate flights must be scheduled.

The other input to the SHORT FORM is identical to the input described previously, except for the taxiway links, the airline data, the gates, the holding areas, and the routes. Specify one gate, one airline, and no holding areas. Routes connect each runway exit directly to the gate. For example, if the gate is 1 and the runway exit is 100, the route is 100 1. Define only the runway end links and the exit links required for the routes.

APPENDIX A

INPUT WARNING MESSAGES

APPENDIX A -- INPUT WARNING MESSAGES

Whenever a data value is out of the acceptable range, the model issues a warning to the user that the value flagged may be in error. Although such a warning message does not terminate the simulation, the values should be verified before they are used again.

Table A-1 shows the value ranges for the input data. Then the warning messages and their causes are listed; the warning message numbers are in the 100's.

TABLE A-1

VALUE RANGES FOR INPUT DATA

DATA TYPE	UNITS	MIN	MAX
LENGTH OF COMMON APPROACH PATH	(NM)	1	15
RUNWAY EXIT DISTANCE	(FT)	200	12,000
STANDARD LINK SPEED	(MI/HR)	5	200
LINK LENGTH	(FT)	50	1,000
A/C APPROACH SPEED	(KNOTS)	50	250
DISTANCE FROM FIX TO THRESHOLD	(NM)	1	50
AVERAGE SPEED FROM FIX TO THRESHOLD	(KNOTS)	50	250
DEPARTURE RUNWAY OCCUPANCY TIME	(SEC)	5	100
RUNWAY T/GO OCCUPANCY TIME	(SEC)	5	100
RUNWAY INTERARRIVAL GAP	(MIN)	0.1	5
ARRIVAL RUNWAY OCCUPANCY TIME	(SEC)	5	100
A/C SERVICE TIMES	(MIN)	10	300
A/C SEPARATION	(NM)	0.2	15
MEAN HOLD TIME	(MIN)	0	10
NUMBER OF LINKS IN A ROUTE	(LINKS)	1	60

** WARNING 100 APPROACH LENGTH MAY BE IN ERROR

CAUSE: The runway length of common approach, expressed in nautical miles, was outside the prescribed range.

** WARNING 101 LINK LENGTH MAY BE IN ERROR

CAUSE: The length of a taxiway link was outside the prescribed range.

** WARNING 102 SPEED MAY BE IN ERROR

CAUSE: A speed, such as a standard link speed or aircraft approach speed, was outside the prescribed range for that parameter.

** WARNING 103 DISTANCE MAY BE IN ERROR

CAUSE: A distance, such as a runway exit distance or link length, was outside the prescribed range for that parameter.

** WARNING 104 TIME MAY BE IN ERROR

CAUSE: A time, such as an occupancy time or service time, was outside the prescribed range for that parameter.

** WARNING 105 TOO FEW SEEDS, NO. DECREASED

CAUSE: The number of random number seeds given was less than the count specified. The model used the number of seeds actually supplied.

** WARNING 106 TOO MANY LINKS FOR THIS ROUTE

CAUSE: The number of links specified for this route exceeded the prescribed limit.

** WARNING 108 HOURS EXCEED 23

CAUSE: In a time specification, the number of hours exceeded 23.

APPENDIX B

FATAL INPUT ERROR MESSAGES

APPENDIX B -- FATAL INPUT ERROR MESSAGES

A fatal error message is issued whenever a serious problem is encountered in the data. Although the inputs will still be processed, the simulation will terminate if any fatal errors are found. Therefore, all fatal errors must be corrected. The ADSIM model accepts only a limited number of items for some data types and issues a fatal error message if the limits are exceeded. For each data type, Table B-1 shows the maximum number of items accepted by the model. Then the fatal error messages are listed; their numbers are in the 200's.

TABLE B-1

LIMITS FOR NUMBER OF DATA ITEMS

ITEM	MAXIMUM
NUMBER OF RUNWAYS	6
NUMBER OF LINKS	700
NUMBER OF AIRLINES	20
NUMBER OF RUNWAY EXITS	40
NUMBER OF AIRCRAFT CLASSES	4
NUMBER OF RANDOM SEEDS	10
NUMBER OF RUNWAY CROSSINGS	35
NUMBER OF ROUTES	3,000
NUMBER OF HOLDING AREAS	10
NUMBER OF TWO-WAY ROUTES	100
NUMBER OF FIXES	10
NUMBER OF LINKS IN ALL ROUTES	30,000

****ERROR 200 LINK NOT PREVIOUSLY DEFINED

CAUSE: A link number was not previously defined in TAXIWAY LINKS.

****ERROR 201 RUNWAY NOT PREVIOUSLY DEFINED

CAUSE: A runway name was not previously defined in RWY NAMES.

****ERROR 202 START TIME GREATER THAN FINISH TIME

CAUSE: The TIMES (START, FINISH) data is in error. The ending time for the simulation occured before its start time.

****ERROR 204 MINUTES EXCEED 59

CAUSE: In a time specification, the minutes exceeded 59.

****ERROR 205 PRINT OPTION MUST BE T OR F

CAUSE: A PRINT OPTIONS input must have either a "T" or "F" as its first non-blank character.

****ERROR 206 EXIT PROBABILITIES MUST SUM TO 1.0

CAUSE: The RWY EXIT SELECTION data had an improper set of probabilities. The cumulative probability of exiting from the specified links must be 1.0.

****ERROR 207 CLASS NOT PREVIOUSLY DEFINED

CAUSE: An illegal aircraft class was specified.

****ERROR 208 ONLY 6 STANDARD TAXI SPEEDS DEFINED

CAUSE: Not currently implemented.

****ERROR 209 IMPROPER PROBABILITY IN CUM. DIST.

CAUSE: A cumulative probability distribution must be non-decreasing with all elements less than or equal to 1.0. The sequence specified did not conform to this rule.

****ERROR 210 OPERATION MUST BE A OR D

CAUSE: An illegal operation code was used in the A/C SEPARATIONS. The legal codes are "A" (arrival) and "D" (departure).

****ERROR 211 ARRIVAL TIME EXCEEDS DEPARTURE TIME

CAUSE: In the A/C SCHEDULE data, an aircraft arrived after it should have departed.

****ERROR 212 FIX NUMBER NOT PREVIOUSLY DEFINED

CAUSE: A fix number was not previously defined in FIX TRAVEL TIMES.

****ERROR 213 SWITCH TIME LESS THAN BEGINNING TIME

CAUSE: A TIME SWITCH was earlier than the start of the simulation.

****ERROR 214 MINIMUM GREATER THAN MAXIMUM

CAUSE: The data specified a minimum and maximum, but the minimum exceeded the maximum.

****ERROR 215 PERCENTAGE EXCEEDS 100

CAUSE: A specified percentage exceeded 100.

****ERROR 216 TOO MANY TAXIWAY LINKS

CAUSE: The number of TAXIWAY LINKS exceeded its preset limit.

****ERROR 217 TOO MANY TAXIWAY ROUTES

CAUSE: The number of TAXIWAY ROUTES exceeded its preset limit.

****ERROR 218 AIRPLANE NAME NOT DEFINED

CAUSE: An airline name was not previously defined in AIRLINE NAMES.

****ERROR 219 NOT A LEGAL INPUT HEADING

CAUSE: The program expected an input heading and the data was not one of the legal entries. It is usually caused by a spelling error in the heading, or a previous error which caused the processing to lose synchronization with the data.

****ERROR 220 RANDOM NUMBER SEEDS EXCEED 10

CAUSE: The number of random number seeds exceeded 10.

****ERROR 221 TOO MANY RUNWAYS

CAUSE: The RWYS NO. OF data exceeded its preset limit.

****ERROR 222 TOO MANY SEPARATIONS

CAUSE: The number of A/C SEPARATIONS exceeded its preset limit.

****ERROR 223 TOO MANY RUNWAY CROSSINGS

CAUSE: The number of RWY XING LINKS exceeded its preset limit.

****ERROR 224 TOO MANY FIXES

CAUSE: The number of fixes exceeded the preset limit.

****ERROR 225 ONLY 4 AIRCRAFT CLASSES

CAUSE: An aircraft class was greater than 4.

****ERROR 226 TOO MANY GATES FOR THIS AIRLINE

CAUSE: The number of gates exceeded its preset limit.

****ERROR 227 GATE NOT DEFINED

CAUSE: A gate number was not previously defined in TAXIWAY LINKS.

****ERROR 228 TOO MANY FLIGHT TYPES

CAUSE: The flight type in an A/C SCHEDULE was not a valid value. The model currently ignores the flight type so this message does not appear.

****ERROR 229 TOO MANY PAIRS

CAUSE: A distribution exceeded its allowable number of pairs.

****ERROR 230 TOO MANY AIRLINES

CAUSE: The number of AIRLINE NAMES exceeded its preset limit.

****ERROR 231 TOO MANY RUNWAY EXITS

CAUSE: The number of runway exits exceeded its preset limit.

****ERROR 233 TOO MANY LINKS IN ROUTES

CAUSE: The number of links in TAXIWAY ROUTES exceeded its preset limit.

****ERROR 234 TOO MANY 2-WAY ROUTES

CAUSE: The number of paths in TAXIWAY TWO-WAY exceeded its preset limit.

****ERROR 235 NOT YET IMPLEMENTED

CAUSE: The input heading was legal but the input was not implemented. The remaining data for this input was flagged as ERROR 219, NOT A LEGAL INPUT HEADING. This input must be removed.

****ERROR 236 HOLDING AREA NOT DEFINED

CAUSE: A holding area was not previously defined in HOLDING AREAS.

APPENDIX C

RUN TIME MESSAGES

APPENDIX C -- RUN TIME MESSAGES

Appendix C describes the Run Time Messsses and the action which the user should take when encountering them. Some of these messsses indicate error conditions while others merely provide information.

CONDITION indicates what print options, if any, must be set to "TRUE" for the messsse to be printed. In most instances, a runway is identified in a messsse by its index instead of by the runway name. The runway index is the same as the order in which the runway names are specified in the input. An aircraft is also identified by its index which is a pointer to the location in the array used to store the aircraft information. Since the array locations are reused once an aircraft leaves the system, the aircraft index is not unique.

Each aircraft in the model has a status to which some of the messsses refer. The description of the aircraft status codes in Table C-1 preceeds the explanation of the Run Time Messsses.

TABLE C-1

AIRCRAFT STATUS

CODE	DESCRIPTION
0	AIRCRAFT HAS NOT ARRIVED AT AIRFIELD.
1	AIRCRAFT IS BEING VECTORED OR IS IN A HOLDING PATTERN.
2	AIRCRAFT LANDED AND IS TAXIING TO A GATE OR A HOLDING AREA.
3	AIRCRAFT IS PARKED AT THE GATE.
4	AIRCRAFT IS TAXIING TO A DEPARTURE RUNWAY.
5	AIRCRAFT DEPARTED AND LEFT THE SYSTEM.
6	AIRCRAFT IS PUSHING BACK FROM A GATE.
7	AIRCRAFT IS IN A HOLDING AREA.
8	AIRCRAFT IS LEAVING A HOLDING AREA AFTER SECURING A GATE.

IERR=1 N=X1 IEXIT(N)=X2

SUBROUTINE -- ARRIVE
CONDITION -- Print Option 4.
REASON -- No distance was specified from the threshold to runway exit X2 used by aircraft X1.
ACTION -- The last distance in RWY EXIT DISTANCE was used.

TOUCH-AND-GO A/C=X1 TIME GO X2 RUNWAY X3

SUBROUTINE -- ARRIVE
CONDITION -- Print Option 1.
REASON -- Informational. Aircraft X1 made a touch-and-go landing at time X2 on runway X3.
ACTION -- NONE

ID=3 IRUN=X1 JRUN=X2
N=X3 IATC=X4 DELAY=X5 ITEST=X6 ICLASS=X7 ITYPA(ITEST)=X8
JSUB1=X9 JSUB2=X10 ISEP=X11 ASPTST=X12 ASPN=X13 DSRDSP=X14
ACTLSP=X15 EVTM(N)=X16 TMAR(ITEST)=X17

SUBROUTINE -- ATC
CONDITION -- None.
REASON -- Informational. Aircraft X3 (class X7) on runway X1 was delayed X5 minutes because of separation with aircraft X6 (class X8) on runway X2. The type of separation was indicated by X4; i.e., 1 was arrival-arrival, 2 was departure-arrival, 3 was departure-departure, and 4 was arrival-departure. X10 was the time of the event.
ACTION -- None.

SUBTRACE ATC THE NCKSEP ARRAY IS FULL

SUBROUTINE -- ATC
CONDITION -- None.
REASON -- There were more than 40 aircraft waiting to land.
ACTION -- Simulation terminated with Stop Code 10.

SAME PLANE AND SAME TIME MAY BE LOOPING

SUBROUTINE -- DGNSTC
CONDITION -- None.
REASON -- A loop was detected in the execution of the model. An aircraft executed 50 consecutive events without advancing time.
ACTION -- Simulation terminated with Stop Code 11.

ALL GATES FOR THE A/C FULL A/C=X A/C SIZE=X PREFERRED GATE=X
NEXT GATE VACANT AT X DELAY=X

SUBROUTINE -- GATE
CONDITION -- Print Option 4.
REASON -- Informational. An aircraft was delayed because all gates were full.
ACTION -- The aircraft was assigned to a holding area.

SUBTRACE GATE I=X1 J=X2

SUBROUTINE -- GATE
CONDITION -- Print Option 2.
REASON -- Informational. An aircraft was assigned to holding area X2, indexed by X1 in the list of holding areas.
ACTION -- None.

SUBTRACE GATE NHDCM=X1 IHDCM=X2...X11 LKHDCM=X12...X21

SUBROUTINE -- GATE
CONDITION -- Print Option 2.
REASON -- Informational. An aircraft was assigned to a holding area. The number of holding areas was X1, of which there are a maximum of 10. X2 through X11 were the indicies to the aircraft in each holding area -- X12 through X21 were the holding areas.
ACTION -- None.

SUBTRACE GATE DELAY=X DELAY.LE.0

SUBROUTINE -- GATE
CONDITION -- Print Option 4.
REASON -- An aircraft was delayed an amount of time less than or equal to zero. There was a possible input error.
ACTION -- None.

ERROR SUBROUTINE INSI HAS BEEN CALLED WITH A BAD DISTRIBUTION
THE DISTRIBUTION IS X...X.

SUBROUTINE -- INSI
CONDITION -- None.
REASON -- A probability distribution had an error.
ACTION -- An error flag was set by subroutine INSI.

SUBTRACE MOVE CHECK FOR BLOCKING PUSHBK X1 X2...X8

SUBROUTINE -- MOVE
CONDITION -- Print Option 2.
REASON -- Informational. Aircraft X3, with status X4 and event time X5, was delayed because of aircraft X6 occupying link X2, with status X7 and event time X8. X1 was the index of link X2 in the route table.
ACTION -- None.

AUTO-DELAY X1 X2 X3

SUBROUTINE -- MOVE
CONDITION -- Print Option 4.
REASON -- Aircraft X1 delayed itself at link X2. While the model attempted to move an aircraft from one taxiway link to another, it found an aircraft with the same number occupying the link to which it attempted to move the first aircraft. Repeating a link in a taxiway route frequently causes this error.
ACTION -- None.

NEVENT PROBLEM NODE X1 PLANE X2

SUBROUTINE -- MOVE
CONDITION -- Print Option 4.
REASON -- Aircraft X2 was out of range at taxiway link X1.
ACTION -- None.

BLOCK-TWO WAY PATH X1 X2 X3 X4
SUBTRACE MOVE CHECKING BLOCK LOGIC X5 X6...X22
AIRCRAFT SWITCHED DUE TO ROUTE ERROR.

SUBROUTINE -- MOVE
CONDITION -- Print Option 4.
REASON -- An aircraft was blocked by another aircraft. This is usually caused by an error in the taxiway route or by an unspecified two-way path.
ACTION -- If Print Option 5 was true, then the simulation was aborted with Stop Code 25.

GA A/C=X1 ARRIVE AT GATE X2 TIME ON GATE X3

SUBROUTINE -- MOVE
CONDITION -- Print Option 1.
REASON -- Informational. General aviation aircraft X1 arrived on gate X2 at time X3.
ACTION -- None.

SUBTRACE MOVE CHECKING THE LOGIC TO DECREASE TAKEOFF QUEUE X

SUBROUTINE -- MOVE
CONDITION -- Print Option 2.
REASON -- Informational.
ACTION -- None.

GA A/C=X1 TIME TAKEN OFF X2 RUNWAY X3

SUBROUTINE -- MOVE
CONDITION -- Print Option 1.
REASON -- Informational. General aviation aircraft X1 departed at time X2 from runway X3.
ACTION -- None.

A/C=X1 ARRIVED AT HOLDING AREA X2 TIME ON HOLDING AREA X3

SUBROUTINE -- MOVE
CONDITION -- Print Option 1.
REASON -- Informational. Aircraft X1 arrived at holding area X2 at time X3.
ACTION -- None.

SUBTRACE MOVE CHECK THE HOLDING AREA X1 X2...X7

SUBROUTINE -- MOVE
CONDITION -- Print Option 2.
REASON -- Informational. X1 was the holding area index, X2 the aircraft index, X3 the route index, and X4 the index to the aircraft's location on the route. X5 was the aircraft's current link; X6 and X7 were the next two links of the route.
ACTION -- None.

SUBTRACE MOVE NHDCM=X1 IHDCM=X2...X11 LKHDCM=X12...X21

SUBROUTINE -- MOVE
CONDITION -- Print Option 2.
REASON -- Informational. There were X1 holding areas (maximum of 10). X2 through X11 were the indicies of the aircraft in holding areas X12 through X21.
ACTION -- None.

SUBTRACE MOVE DELAY=X1 X2 X3 X4 X5

SUBROUTINE -- MOVE
CONDITION -- Print Option 4.
REASON -- Informational. Aircraft X4 at time X5 was delayed X1 minutes because of aircraft X2 with event time X3.
ACTION -- None.

SUBTRACE MOVE DELAY X DELAY.LE.0

SUBROUTINE -- MOVE
CONDITION -- Print Option 4.
REASON -- Informational. An aircraft was delayed X minutes, an amount of time less than or equal to zero. There was a possible input error.
ACTION -- None.

SUBTRACE OUT X1 X2 X3 X4

SUBROUTINE -- OUT
CONDITION -- Print Option 2.
REASON -- Informational. Aircraft X1 vacated gate X3 and was on link X2 of route X4.
ACTION -- None.

SUBTRACE PAVCHK CALL PDELAY

SUBROUTINE -- PAVCHK
CONDITION -- Print Option 2.
REASON -- Informational. An aircraft was delayed by another aircraft on a two-way path.
ACTION -- None.

SUBTRACE PAVCHK DELAY=X
IFLAG=1 I=X1 ID=X2 N=X3 K=X4 K3=X5 JB=X6 J=X7
LKOCC(J)=X8 X9 X10...

SUBROUTINE -- PAVCHK
CONDITION -- Print Option 2.
REASON -- Informational. An aircraft was delayed X minutes by another aircraft on a two-way path. X1 was the index to the two-way path. X3 was the index of the aircraft. X4 was the number of links on the two-way path plus one. X5 pointed to the location of the aircraft in the route. X6 was the next-plus-one taxiway link that the aircraft would occupy. X7 was the link in the two-way path that was occupied and X8 the aircraft which occupied the link. The two-way path was printed beginning with X9.
ACTION -- None.

SUBTRACE PAVCHK - A/C DOES NOT STAY ON TWO-WAY PATH
IFLAG=1 I=X1 ID=X2 N=X3 K=X4 K3=X5 JB=X6 J=X7
LKOCC(J)=X8 X9 X10.....

SUBROUTINE -- PAVCHK
CONDITION -- Print Option 2.
REASON -- Informational. X1 was the index to the two-way path. X3 was the aircraft index. X4 was the number of links on the two-way path plus one. X5 pointed to the location of the aircraft in the route. X6 was the next-plus-one taxiway link the aircraft would occupy. X7 was the link in the two-way path that was occupied by aircraft X8. The two-way path was printed beginning with X9.
ACTION -- None.

SUBTRACE PAVCHK DELAY X DELAY.LE.0

SUBROUTINE -- PAVCHK
CONDITION -- Print Option 4.
REASON -- An aircraft was delayed X minutes, an amount of time less than or equal to zero. There was a possible input error.
ACTION -- None.

SUBTRACE PDELAY DELAY X DELAY.LE.0

SUBROUTINE -- PDELAY
CONDITION -- Print Option 4.
REASON -- An aircraft was delayed X minutes, an amount of time less than or equal to zero. There was a possible input error.
ACTION -- None.

SUBTRACE PDELAY N=X1 DELAY=X2

SUBROUTINE -- PDELAY
CONDITION -- Print Option 4.
REASON -- Aircraft X1 was delayed X2 minutes. The delay was greater than or equal to 6 minutes. If the delay was greater than or equal to 10 minutes, information on all current aircraft was printed.
ACTION -- None.

GATE HOLD A/C=X1 GATE=X2 TAKEOFF RUNWAY=X3 HOLD TIME=X4 TIME=X5

SUBROUTINE -- PUSHBK
CONDITION -- Print Option 2.
REASON -- Informational. Aircraft X1, at gate X2 with takeoff runway X3, was held X4 minutes at time X5.
ACTION -- None.

SUBTRACE PUSCHBK CALL PDELAY N=X1 EVTM(N)=X2 K=X3 EVTM(K)=X4 DELAY=X5 K2=X6 J=X7 TIME=X8

SUBROUTINE -- PUSHBK
CONDITION -- Print Option 2.
REASON -- Informational. Aircraft X1 with event time X2 was delayed X5 minutes at time X8, by aircraft X3 with event time X4.
ACTION -- None.

SUBTRACE PUSHBK STOP EXECUTION CHECKING ITS LOGIC N=X1 K2=X2 ITRE(K2)=X3 NHDCM=X4 IHDCM=X5 LKHDCM=X6

SUBROUTINE -- PUSHBK
CONDITION -- Print Option 4.
REASON -- An error condition was detected. An aircraft left a holding area but the first link of its route was not a holding area.
ACTION -- Model execution terminated.

SUBTRACE PUSHBK CHECKING PUSHBACK INTO A TWO-WAY SECTION

SUBROUTINE -- PUSHBK
CONDITION -- Print Option 2.
REASON -- Informational.
ACTION -- None.

SUBTRACE PUSHBK STOP EXECUTION CHECKING VACATE HOLDING AREA

SUBROUTINE -- PUSHBK
CONDITION -- Print Option 2.
REASON -- An error was detected when an aircraft left a holding area.
ACTION -- Model execution terminated with a Stop Code 14.

SUBTRACE PUSHBK DELAY=X DELAY.LE.0

SUBROUTINE -- PUSHBK
CONDITION -- Print Option 4.
REASON -- An aircraft was delayed X minutes, an amount of time less than or equal to zero. There was a possible input error.
ACTION -- None.

RUNWAY CHANGE A/C=X1 OLD RWY=X2 NEW RWY=X3 TIME=X4

SUBROUTINE -- ROUTE
CONDITION -- Print Option 2.
REASON -- Informational. The runway assignment for the aircraft X1 was changed from X2 to X3, at time X4.
ACTION -- None.

ROUTE ERROR X1 X2 X3 X4

SUBROUTINE -- ROUTE
CONDITION -- None.
REASON -- A route going from X2 to X3 was not found for aircraft X1. If X2 was a valid origin and X3 a valid destination, a route was missing from the input.
ACTION -- Model execution terminated.

SUBTRACE RUNCRS N=X1 ISUB=X2 NRNWX(ISUB)=X3 IRUNX(ISUB)=X4
A/C IS CROSSING ACTIVE RUNWAY

SUBROUTINE -- RUNCRS
CONDITION -- Print Option 2.
REASON -- Informational. Aircraft X1 crossed an active runway.
ACTION -- None.

SUBTRACE RUNCRS DELAY=X1 A/C N=X2 TIME=X3 RUNWAY=X4
CROSSING ISUB=X5

SUBROUTINE -- RUNCRS
CONDITION -- Print Option 2.
REASON -- Informational. Aircraft X2 was delayed X1 minutes at time X3; the aircraft was waiting to cross runway X4.
ACTION -- None.

A/C=X1 ARSTM=X2 IACSTA=X3

SUBROUTINE -- SCHED
CONDITION -- None.
REASON -- The arrival time, X2, of aircraft X1 with status X3 was later than the ending time of the simulation.
ACTION -- Model execution terminated with Stop Code 103.

SCHEDULE AIRLINE NAME IS NOT IN TABLE

SUBROUTINE -- SCHED
CONDITION -- None.
REASON -- A flight was scheduled (input) with an airline code that was not defined in the list of airline names. The airline name was probably typed incorrectly.
ACTION -- Model execution terminated with Stop Code 23.

TOTAL DEPT QUEUE=X1 AT TIME=X2 ON DEPT RUNWAY=X3

SUBROUTINE -- TAKEOFF
CONDITION -- Print Option 4.
REASON -- Informational.
ACTION -- None.

DEPARTURE REASSIGNMENT A/C=X1 OLD RWY=X2 NEW RWY=X3
TIME=X4

SUBROUTINE -- ADDMD
CONDITION -- None.
REASON -- Informational. Departure aircraft X1 was reassigned from runway X2 to X3 at time X4.
ACTION -- None.

REASSIGNED ARRIVAL

SUBROUTINE -- REASGN
CONDITION -- None.
REASON -- Informational. An aircraft was reassigned to a different runway.
ACTION -- None.

ARRIVAL FIX RUNWAY REASSIGNMENT A/C=X1 OLD RWY=X2 OLD FIX=X3 NEW RWY=X4 NEW FIX=X5

SUBROUTINE -- FIXRES
CONDITION -- None.
REASON -- Informational. Arrival aircraft X1 was reassigned from runway X2 and fix X3, to runway X4 and fix X5.
ACTION -- None.

REASSIGNED AC STOS X

SUBROUTINE -- DVRTSS
CONDITION -- Print Option 2.
REASON -- Informational. An aircraft was reassigned to a different runway by the SIDE-TO-SIDE feature.
ACTION -- None.

APPENDIX D

ADSIM STOP CODES

APPENDIX D -- ADSIM STOP CODES

When the simulation stops because of an error condition, the following message is printed:

ADSIM STOP CODE = X

where X is a numerical value.

See the descriptions below for each of the stop codes. Some of the stop codes are preceded by messages indicating the error condition, but this is not always the case.

STOP CODE	DESCRIPTION
10	There was an internal array overflow in subroutine ATC. More than 40 aircraft separations were required.
11	An error was detected in subroutine DGNSTC. An aircraft executed 50 consecutive events without time advancing. Most likely, there was a looping error.
14	An error was detected in subroutine PUSHBK. An aircraft left a holding area and followed a route which did not have the holding area as the first link.
17	An error was detected in subroutine SCHED. An arrival did not have a preferred holding area. No error message was printed.
21	Either a STOP card was read or the end of the input was reached and there was at least one fatal error in the input data.
22	A route for an aircraft between two points was not in the route input (TAXIWAY ROUTES).
23	An error was detected in subroutine SCHED. An airline code was not defined in AIRLINE NAMES.
24	The "PRINT INPUT ONLY" option was used.
25	An error was detected in subroutine MOVE. An aircraft blocked another aircraft on a two-way path and Print Option 5 was true.
26	There was a route array overflow in subroutine READER. TAXIWAY ROUTES exceeded its preset limit.

31	An error was detected in subroutine GATE. An aircraft's preferred holding area was not defined in HOLDING AREAS. No error message was printed.
44	An error was detected in subroutine GATE. There was a possible error in RWY EXIT SELECTION probabilities. No error message was printed.
46	An error was detected by subroutine ATC in RWY EXIT SELECTION probabilities or RWY EXIT DISTANCE input. No error message was printed.
47	An error was detected by subroutine ATC in the RWY EXIT SELECTION probabilities. No error message was printed.
51	There was an arrival sequence table overflow in subroutine ADDMD. There were more than 99 aircraft waiting to land on the preferred runway.
52	There was an arrival sequence table overflow in subroutine ADDMD. There were more than 99 aircraft waiting to land on the alternate runway.
53	There was a departure sequence table overflow in subroutine ADDMD. There were more than 99 aircraft waiting to takeoff on a runway.
101	There was an array overflow in subroutine RUNCRS. An aircraft crossed more than three active runways while taxiing in.
102	There was an array overflow in subroutine RUNCRS. An aircraft crossed more than three active runways while taxiing out.
103	An error was detected in subroutine SCHED. An arrival's threshold time was greater than the start time of the simulation.
104	An error was detected in subroutine SCHED. A departure's roll time was greater than the stop time of the simulation. No error message was printed.
203	An error was detected in subroutine SCHED. An arrival's time at the gate was greater than the simulation stop time. No error message was printed.
204	An error was detected in subroutine SCHED. A departure's push-back time was greater than the simulation stop time. No error message was printed.
1000	More than 1000 errors were detected in the input.

APPENDIX E

ADSIM JCL AND FILE DESCRIPTIONS

FOR THE HONEYWELL SERIES 60 (LEVEL 66) COMPUTER SYSTEM

APPENDIX E -- ADSIM JCL AND FILE DESCRIPTIONS

ADSIM is installed on the Honeywell Computer System at the FAA Technical Center. Appendix E describes how the Technical Center analysts execute the model.

To reduce the amount of core memory required by the model, ADSIM was divided into two FORTRAN programs and several intermediate sorts. The first program (the Simulation Module) reads the input data, performs the simulation, and writes the detailed results to several intermediate output files. Those files are sorted and read by the second program (the Averaging Module), which produces the ADSIM output reports.

The Honeywell version of ADSIM operates on a Honeywell Series 60 (Level 66) central processing unit, with a minimum of 140K (thousand) decimal words of available memory, adequate direct access storage for the input files and the work files, and a nine track tape drive to read the Honeywell release tape.

The following software was used at the Technical Center:

* GCOS-3 Operating System 4JS2
* TSS (Timesharing System)
* FORTRAN 4.0 Compiler
* SORT/MERGE

Listed below is the JCL (Job Control Language) to compile the source code Simulation Module (/MODEL/SRCSMRH5) into the object module (/MODEL/OBJSMRH5).

```
0020$        IDENT    086-400-100,ACT310-RH
0030$        OPTION   FORTRAN
0040$        FORTRAN  DECK,MAP,XREF
0050$        LIMITS   ,,,P40000
0060$$SELECT(086-400-100/MODEL/SRCSMRH5:M)
0065$        PRMFL    C*,W,S,086-400-100/MODEL/OBJSMRH5
0070$        ENDJOB
```

The JCL to compile the source code Averaging Module (/MODEL/SRCAVRH3) into the object module (/MODEL/OBJAVRH3) is shown below.

```
0020$        IDENT    086-400-100,ACT310-RH
0030$        OPTION   FORTRAN
0040$        FORTRAN  DECK,MAP,XREF
0050$        LIMITS   ,,,P40000
0060$$SELECT(086-400-100/MODEL/SRCAVRH3:M)
0065$        PRMFL    C*,W,S,086-400-100/MODEL/OBJAVRH3
0070$        ENDJOB
```

Figure E-1 lists the sample control cards for executing ADSIM on the Honeywell Computer System at the Technical Center; comments are provided within quotation marks. There are two input files -- 05 and 09. UTL2 copies the aircraft schedule (/JFK-DATA/MODEL/TSMPDOCU) into File 09 and the remaining input into the SYSIN File 05. The "05" inputs in the example are stored in several disk files by their logical data types -- links, routes, basic airport data, configuration dependent data, aircraft separations, and individual experimental data. There are six SYSOUT Files -- 06, 07, 26, 27, 28, and 29 -- which are directed to a high speed printer. File 06 contains the bulk of the output and File 07 has the debug data. Files 26 and 27 provide the Taxiway Queue Statistics Report while Files 28 and 29 contain the Runway Queue Statistics. The rest of the files are intermediate work files -- whether sequential or random, formatted or unformatted.

```
20$        IDENT    086-400-100,ACT310-RH
30$        MSG3     061383/1900
0031CC 086-400-100/JFK-DATA,DEVICE/450PK,DP066/
40$        UTL2
60$        PRMFL    LK,R,S,086-400--100/JFK-DATA/MODEL/LINKS-1 "Inputs"
60$        PRMFL    RT,R,S,086-400-100/JFK-DATA/MODEL/RTE-1FLW      "
50$        PRMFL    BS,R,S,086-400-100/JFK-DATA/MODEL/BASE-EXP      "
80$        PRMFL    CF,R,S,086-400-100/JFK-DATA/MODEL/CON-1         "
90$        PRMFL    SP,R,S,086-400-100/JFK-DATA/MODEL/SEPV1         "
110$        PRMFL    SH,R,S,086-400-100/JFK-DATA/MODEL/TSMPDOCU     "
100$        PRMFL    MX,R,S,086-400-100/JFK-DATA/MODEL/MOD-X1M3     "
130$        FILE     05,X1S,30L
140$        FILE     09,X2S,30L
150FDEF LK AND RT AND BS AND CF AND SP AND SH AND MX,GFRC.
170FDEF 05 AND 09,GFRC.
190PROC MCOPY LK TO 05 1F.
190PROC MCOPY RT TO 05 1F.
240PROC MCOPY BS TO 05 1F.
220PROC MCOPY CF TO 05 1F.
230PROC MCOPY SP TO 05 1F.
250PROC MCOPY MX TO 05 1F.
270PROC MCOPY SH TO 09 1F.
280PROC CLOSE 05. REWIND 05.
280PROC CLOSE 09. REWIND 09.
380$       SET      /18
390$       OPTION   FORTRAN
400$       SELECT   086-400-100/MODEL/OBJSMRH5"Simulation Object Code"
410$       EXECUTE
420$       LIMITS   300,140K,0,P90000
422$       FILE     01,U3R,50R
430$       FILE     04,X3S,220L
440$       FILE     05,X1R
450$       SYSOUT   07,ORG
460$       FILE     08,X4R,10L
470$       FILE     09,X2R
480$       FILE     10,X5S,310L
490$       FILE     11,X6S,310L
500$       FILE     15,NULL
510$       FILE     16,X8R,20L
520$       FILE     17,X9R,20L
530$       FILE     19,Y1S,110L
540$       FILE     21,Y2S,20L
550$       FILE     22,Y3S,80L
560$       FILE     24,Y4S,80L
570$       FILE     37,NULL
580$       IF       /18,FIN
590$       GMAP     NDECK                    "Start Arrival Sort"
600        600SM                             "Sort File 10 into File 1"
610        SORT     INOUT,,29
620        FIELD    (W1S)
630        SEQ      (A1)
640        ELECT    1
```

FIGURE E-1 -- SAMPLE CONTROL CARDS FOR EXECUTING ADSIM

```
650        ASSIGN  10,01
660        FILCB   INOUT,**,2
670        END
680$       EXECUTE
690$       FILE    10,X5R
700$       FILE    01,C10S,100L
710$       FILE    S1,A1R,60R
720$       FILE    S2,A2R,60R
730$       FILE    S3,A3R,60R
740$       FILE    S4,A4R,60R
750$       FILE    S5,A5R,60R
760$       FILE    S6,A6R,60R
770$       GMAP    NDECK                    "Start Departure Sort"
780        600SM                            "Sort File 11 into File 02"
790        SORT    INOUT,,29
800        FIELD   (W1S)
810        SEQ     (A1)
820        ELECT   1
830        ASSIGN  11,02
840        FILCB   INOUT,**,2
850        END
860$       EXECUTE
870$       FILE    11,X6R
880$       FILE    02,C11S,100L
890$       FILE    S1,A1R,60R
900$       FILE    S2,A2R,60R
910$       FILE    S3,A3R,60R
920$       FILE    S4,A4R,60R
930$       FILE    S5,A5R,60R
940$       FILE    S6,A6R,60R
950$       GMAP    NDECK                    "Start Link Delay Sort"
960        600SM                            "Sort File 04 into File 12"
970        SORT    INOUT,,5
980        FIELD   (W1S)
990        SEQ     (A1)
1000        ELECT   1
1010        ASSIGN  04,12
1020        FILCB   INOUT,**,2
1030        END
1040$       EXECUTE
1050$       LIMITS  10
1060$       FILE    04,X3R
1070$       FILE    12,B3S,220L
1080$       FILE    S1,A1R,60R
1090$       FILE    S2,A2R,60R
1100$       FILE    S3,A3R,60R
1110$       FILE    S4,A4R,60R
1120$       FILE    S5,A5R,60R
1130$       FILE    S6,A6R,60R
1140$       GMAP    NDECK                    "Start Queue Sort"
1150        600SM                            "Sort File 22 into File 23"
1160        SORT    INOUT,,6
```

FIGURE E-1 -- SAMPLE CONTROL CARDS FOR EXECUTING ADSIM

```
1170        FIELD    (W1S)
1180        SEQ      (A1)
1190        ELECT    1
1200        ASSIGN   22,23
1210        FILCB    INOUT,**,2
1220        END
1230$       EXECUTE
1240$       FILE     22,Y3R
1250$       FILE     23,B4S,80L
1260$       FILE     S1,A1R,60R
1270$       FILE     S2,A2R,60R
1280$       FILE     S3,A3R,60R
1290$       FILE     S4,A4R,60R
1300$       FILE     S5,A5R,60R
1310$       FILE     S6,A6R,60R
1320$       GMAP     NDECK                    "Start Runway Queue Sort"
1330        600SM                             "Sort File 24 into File 25"
1340        SORT     INOUT,,6
1350        FIELD    (W1S)
1360        SEQ      (A1)
1370        ELECT    1
1380        ASSIGN   24,25
1390        FILCB    INOUT,**,2
1400        END
1410$       EXECUTE
1420$       FILE     24,Y4R
1430$       FILE     25,B5S,80L
1440$       FILE     S1,A1R,60R
1450$       FILE     S2,A2R,60R
1460$       FILE     S3,A3R,60R
1470$       FILE     S4,A4R,60R
1480$       FILE     S5,A5R,60R
1490$       FILE     S6,A6R,60R
1500$       GMAP     NDECK                    "Start Separation Delay Sort"
1510        600SM                             "Sort File 19 into File 20"
1520        SORT     INOUT,,133
1530        FIELD    (W1S)
1540        SEQ      (A1)
1550        ELECT    1
1560        ASSIGN   19,20
1570        FILCB    INOUT,**,2
1580        END
1590$       EXECUTE
1600$       FILE     19,Y1R
1610$       FILE     20,B6S,110L
1620$       FILE     S1,A1R,60R
1630$       FILE     S2,A2R,60R
1640$       FILE     S3,A3R,60R
1650$       FILE     S4,A4R,60R
1660$       FILE     S5,A5R,60R
1670$       FILE     S6,A6R,60R
1680$       OPTION   FORTRAN
```

FIGURE E-1 -- SAMPLE CONTROL CARDS FOR EXECUTING ADSIM

```
1690$        SELECT   086-400-100/MODEL/OBJAVRH3 "Averasins Object Code"
1700$        EXECUTE
1710$        LIMITS   100,100K,,20000P
1720$        FILE     01,C10R                    "Sorted Arrivals"
1730$        FILE     02,C11R                    "Sorted Departures'
1740$        FILE     12,B3R
1750$        FILE     20,B6R
1760$        FILE     23,B4R
1770$        FILE     25,B5R
1780$        FILE     21,Y2R
1790$        FILE     14,Z1R,2L
1800$        FILE     18,Z2R,2L
1810$        FILE     30,X3R,50L
1820$        FILE     31,X4R,30L
1830$        SYSOUT   07,ORG                     "Debus Output"
1840$        SYSOUT   26,ORG                     "Output Report"
1850$        SYSOUT   27,ORG                     "Output Report"
1860$        SYSOUT   28,ORG                     "Output Report"
1870$        SYSOUT   29,ORG                     "Output Report"
2460$ FIN.
2470$        ENDJOB
```

FIGURE E-1 -- SAMPLE CONTROL CARDS FOR EXECUTING ADSIM

GLOSSARY

ATC:	Air Traffic Control
CC:	Card column(s)
DEC:	Decimal
FAA:	Federal Aviation Administration
FT:	Feet
JCL:	Job Control Language
K:	1024
MI:	Mile(s)
MIN:	Minute(s)
KNOTS:	Nautical miles per hour
NM:	Nautical mile(s)
NTIS:	National Technical Information Service
SEC:	Second(s)