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Report No. FAA-RD-78-154 III

NONDESTRUCTIVE EVALUATION OF AIRPORT PAVEMENTS

VOLUME III

OPERATION MANUAL FOR MLGPAV PROGRAM AT TCC

BY

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16. Abstract

Sensitivity analysis of aircraft parameters on functional pavement design is the primary goal of the MLGPAV program at the Transportation Computer Center (TCC) in Washington, D.C. The program is an integrated system which is data independent based on defined mathematical models and operational logic. The input data is divided into job and universal default inputs.

The job inputs consists of only the aircraft data such as: (1) forecast of aircraft movements; (2) maximum takeoff weight; (3) natural frequency of aircraft at tire pavement interface; (4) tire pressure of main landing gear wheel; (5) wheel configuration of main landing gear and (6) gear spacing.

The default system contains all of the data independent of the aircraft, such as: (1) regional cost values; (2) types of facility, runway, taxiway, apron: (3) navigation system; (4) operation speed; (5) roughness and maintenance standards; (6) subgrade conditions and (7) airport traffic distribution.

A unified mechanistic method is used to design five types of functional pavements for identical service requirements on riding quality and maintenance needs. They are: (1) asphalt pavements in southern or northern region; (2) concrete pavements on stabilized or aggregate base and (3) full depth stabilized base pavement.

The MLGPAV program operation involves extensive use of data storage and filing techniques. The current operational program and this manual are prepared for execution on the computer hardware system at TCC.

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METRIC CONVERSION FACTORS

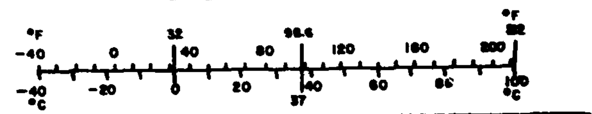
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



OPERATION MANUAL FOR MLGPAV PROGRAM AT TCC

CONTENTS

OPERATION LOGICS, PROGRAM LANGUAGE, AND COMPUTER SYSTEM

Sensitivity analysis of aircraft parameters on functional pavement design is the primary goal of the MLGPAV program at the Transportation Computer Center (TCC) in Washington, D.C. The program is an integrated system for the functional design of airport pavements. The integrated programs are data independent, based on defined mathematical models and operational logic.

The model parameters, operational details and values to be processed, form a set of input data which is defined through the use of natural language heading statements and requires no programming experience on the part of the user. For the operational program at TCC, the input data is divided into job and universal default inputs. The job inputs consists of only the aircraft data. The default system contains all of the data, independent of the aircraft data.

The primary subsystem is the PAVDES subsystem from the PAVBEN operational program at TCC. The primary output from the PAVDES subsystem is the thickness design of pavements of various compositions. In the PAVBEN operation the aircraft data is in the universal default file and all the associated design charts are in the computed data inputs. For MLGPAV operation, the aircraft data is in the job input file, requiring the necessary design charts to be computed for every execution.

The MLGPAV program is operational on the IBM 360/65 at TCC. The program is written in the high level language FORTRAN IV. The program accepts input in the form of cards and needs several temporary files on auxiliary storage.

FORMAT OF USER'S INPUT

The program accepts input in the form of 80 character cards. The input cards are divided into two types: program control cards and cards in data groups. The control cards specify the program sections to be executed. The data groups provide the actual data values for program processing. Unless otherwise specified, each card is logically divided into eight fields of ten characters each. Each control card has a single keyword in field on which identifies itself both to the program and the user as a control card. Additional fields on a control card are used to provide related information.

Logically related input cards are placed together in data groups. The first card or cards are descriptive heading cards. The number of heading cards is fixed and the user should not add or delete any heading card. One of the heading cards is usually a field identifier card. On this card, each field has an acronym which identifies the data values on subsequent cards in that field. For more detail description, the particular field identifier can be found in the dictionary. Following the heading cards are the cards containing the actual data values corresponding to the field identifier. The order of cards in the group is important. The last card of data group is a delimitor card containing, * * in columns 1 and 2.

Values in a field have three definitions: integer, floating point or alphanumeric. They are expressed respectively by blanks and numbers, 0 to 9; blanks, the minus or plus sign, decimal point and the numbers 0 to 9; and all characters. Certain fields have only specific values allowable. Unless otherwise specified all values should be left justified in a field. This is especially important for alphanumeric fields. Blanks in floating point fields are interpreted as zeros. If a decimal point is omitted in a floating point field, the decimal is assumed to be after the rightmost column in that field. Certain field has subfields. The subfields are separated by slashes, /. The slash must appear in the exact column, as specified. To ensure proper recognization of the control cards and the data groups, the spelling and the spacing of the control keywords and heading descriptions must be correct.

JOB INPUTS

JOB CARD

JOB Starting from column 11 is a 70-character space for job name. Usually SENSITIVITY ANALYSIS OF AIRCRAFT and 9-letter aircraft code.

AIRCRAFT DATA GROUP

FIELD	IDENTIFIER	DESCRIPTION
1	AIRCRAFT	defines index, 1 to 20
2	CODE	defines 9 char. AIRCRAFT code
3	MTOW	max. take-off weight, lbs.
4	MLRW	max. landing roll weight, lbs.
5	OEW	operational empty weight, lbs.
6	RANGE	range of aircraft, XLONG, LONG, MEDIUM, or SHORT

1	BLANK	
2	BLANK	
3	MLG	main landing gear weight as fraction of MTOW
4	WGT	single wheel weight as fraction of MTOW
5	PSI	tire pressure, psi
6	FREQ	natural frequency of rubber tire, Hz
7	NWHEEL	number of wheels of MLGS
8	XMAX	distance between outer wheels, inches

1	BLANK	
2	BLANK	
3	WHEEL	NWHEEL transverse coordinates
4	X-COORD	number of cards is the integer of (NWHEEL-1)/6 plus 1.
5		
6		
7		
8		

1	BLANK	
2	BLANK	
3	WHEEL	NWHEEL longitudinal coordinates
4	Y-COORD	number of cards is the integer of (NWHEEL-1)/6 plus 1.
5		
6		
7		
8		

JØB	SENSITIVITY ANALYSIS ØF AIRCRAFT L-1011-1						
AIRCRAFT	CØDE	MTØW	MLRW	ØEW	RANGE		
		MLG	WGT	PSI	FREQ	NWHEEL	XMAX
		WHEEL	X-CØØRD				
		WHEEL	Y-CØØRD				
1	L-1011-1	388800.	322200.	240000.	LØNG		
		.4724	.1181	180.	1.1	8	484.
		0.	-52.	0.	-52.	380.	432.
		380.	432.				
		0.	0.	70.	70.	0.	0.
		70.	70.				
**							

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LISTING OF DEFAULT INPUTS

PROGRAM CONTROL CARDS

The user controls the data processing by means of card inputs. All MLGPAV control cards have two portions (1) control keyword field in columns 1 to 10 and (2) specification field or fields in columns 11 to 80 containing values or additional keywords required by the particular control card being used. There are six control keywords which have been programmed in the listing:

1. SITE — Starting from column 11 is 4-character site code. For TCC operation, this card is in the default system.
2. LINE — In column 11 is a single digit number indicates the lines skipped by the operating system on a printed page. For TCC operation, this card is in the default system.
3. USER — Starting from column 11 is a 12-character user name.
4. JOBCODE — Starting from column 11 are 7 characters to be printed in block letter on title page.
5. RUN — Field 2 identifies the program to be executed.
6. PRINT — There are 2 allowable keywords in field 2:
   DICTIONARY - prints all dictionary items in sorted groups.
   INPUT - prints control cards and job inputs.

REGIONAL COST VALUES

FIELD	IDENTIFIER	DESCRIPTION
1	COST	defines cost index 1 to 25
2	CODE	defines 6 character cost code
3	DATE	date of cost values, month/date/year
4	REGION CODE	cost value for the region coded
5	REGION CODE	
6	REGION CODE	
7	REGION CODE	
8	REGION CODE	

There may be more than one data group. Each data group may have one or more regions. The region code is 4 characters long. The cost values of the last region on the last data group will be used in the computations.

FACILITY TYPES

FIELD	IDENTIFIER	DESCRIPTION
1	TYPE	defines index 1 to 5
2	FACILITY	defines 2 character code
3	FACILITY	defines additional 2 character code
4	FACILITY	for example, the first two characters
5	FACILITY	of RUNWAY is the facility type code
6	FACILITY	

BANDWIDTH FOR TRAFFIC DISTRIBUTION

FIELD	IDENTIFIER	DESCRIPTION
1	BANDWIDTH	defines bandwidth index 1 to 5
2+3	CODE	defines 12 character BANDWIDTH code
4	RW	bandwidth in feet
5	TW	bandwidth in feet
6	SH	bandwidth in feet

DYNAMIC INCREMENT OF AIRCRAFT VIBRATION

FIELD	IDENTIFIER	DESCRIPTION
1	DI	facility type location, keel or side
2	RW	dynamic increment, in g
3	TW	dynamic increment, in g
4	SH	dynamic increment, in g

VELOCITY OF AIRCRAFT

FIELD	IDENTIFIER	DESCRIPTION
1	VEL	facility type location, keel or side
2	RW	aircraft velocity in knots
3	TW	aircraft velocity in knots
4	SH	aircraft velocity in knots

FINANCIAL COST DATA

FIELD	IDENTIFIER	DESCRIPTION
1	FINANCE	blank
2	AIRB	annual interest rate of bond
3	ARCD	annual rate of cash discount
4	ASCCC	annual escalation rate of construction cost
5	ASCMC	annual escalation rate of maintenance need
6	NBL	maturity of revenue band in years
7	NSLP	mortgage payments of bond, in years

DEMAND FORECAST

FIELD	IDENTIFIER	DESCRIPTION
1	FORECAST	defines 6 char. FORECAST Code
2	ADM	defines 6 char. ADM code
3	ATD	defines 6 char. ATD code

PFLDI, smoothness of pavement surface

FIELD	IDENTIFIER	DESCRIPTION
1	col. 1-10	defines DI for deflection analysis
2	Col. 11-50	defines 40 char. smoothness description

CLASS, identification for design coefficients

FIELD	IDENTIFIER	DESCRIPTION
1	CLASS	defines CLASS index 1 to 20
2	CODE	defines 6 char. CLASS code
3	OVSFKL	overstress factor for keel
4	OVSFSD	overstress factor for side
5	STRESS	conversion factor from E-value to tensile stress
6	FATIST	coef. of fatigue stress
7	COVAR	coef. of variance
8	A1	coef. of transfer function (trans. to long def.)
1	BLANK	
2	BLANK	
3	A2	coef. of transfer function (trans. to long def.)
4	D1	coef. of transfer function (elastic to cumulative)
5	D2	coef. of transfer function (elastic to cumulative)
6	DC	coef. of contact rigidity

LAYER, identification for default E-value and Poisson's Ratio

FIELD	IDENTIFIER	DESCRIPTION
1	LAYER	defines LAYER index 1 to 25
2	CODE	defines 6 char. LAYER code
3	EVALUE	default E-value of layer
4	POISSON	default Poisson ratio of layer
5	MOD(S)	mob. and demobilization cost for small job
6	MOD(N)	mob. and demobilization cost for normal work

LAYER COST DATA GROUP

FIELD	IDENTIFIER	DESCRIPTION
1	LAYER	defines LAYER index
2	PCBT	coef. for computing unit price of the layer
3	FIAGT	
4	COAGT	
5	ASCLT	
6	HLBT	
7	POZBT	
8	SFST	
Continuation Card		
1	BLANK	
2	IWFAT	coef. for computing unit price of the layer
3	RSWLB	
4	LBBR	
5	CLHR	
6	SLEHR	

PAVEMENT DATA GROUP

FIELD	IDENTIFIER	DESCRIPTION
1	PAVEMENT	defines PAVEMENT index 1 to 20
2	CODE	defines 6 char. PAVEMENT code
3	LAYER	defines code of layer composition
4	THICKNESS	default thickness of layer, inches
5	EVALUE	if blank, use default E-value
6	POISSON	if blank, use default poisson

Last card in each defined pavement must have a layer code of SUB, PAV or PFLPAV. SUB defines new pavement on subgrade; PAV defines overlay pavement on existing pavement which is treated as one layer; PFLPAV defines overlay pavement on actual existing pavement.

DESIGN CHARTS - LAYER THICKNESSES

FIELD	IDENTIFIER	DESCRIPTION
1	ITERATE	blank
2	PAVEMENT	PAVEMENT index
3	LAYER	LAYER code
4	HMIN	min. thickness of design chart, inches
5	HMAX	max. thickness of design chart, inches
6	HSTEP	thickness increment of design chart, inches

NEW PAVEMENT ESUB GRID VALUES

FIELD	DESCRIPTION
1 to 8	subgrade E-values of design charts for new pavement and overlay pavements on actual existing pavement.

Continuation card also has same format.
number of cards = the integer of (number of E-values -1)/8 plus 1.
max. number of E-values = 20.

CODES OF KEEL AND SIDE

FIELD	IDENTIFIER	DESCRIPTION
1	PAVEMENT	blank
2	NUMBER	blank
3	KEEL	defines pavement index for keel
4	SIDE	defines pavement index for side

EXISTING PAVEMENT DATA GROUP

FIELD	IDENTIFIER	DESCRIPTION
1	PFLPAV	defines PFLPAV index, 1 to 20
2	CODE	defines 6 char. PFLPAV code
3	LAYER	LAYER code
4	THICKNESS	thickness of layer, inches
5	EVALUE	if blank, default value is used
6	POISSON	if blank, default value is used

Each PFLPAV must end with a LAYER code SUB.

PFLPAV ESUB GRID VALUES

FIELD	DESCRIPTION
1 to 8	subgrade E-value for PFLPAV deflection and stress chart.

Continuation card also has same format.
number of cards = the integer of (number of E-values -1)/8 plus 1.
max. number of E-values = 20.

PFLPAV DESIGN CHARTS CONTROL GROUP DATA

FIELD	IDENTIFIER	DESCRIPTION
1	PFLPAV	PFLPAV index
2	CLASS	CLASS code for design coefficients
3	LAYER FOR STR/MT	LAYER code for governing stress condition

PFLPAV IN AIRCRAFT EQUIVALENCY FOR PFL

FIELD	IDENTIFIER	DESCRIPTION
1	CLASS	CLASS index
2	PFLPAV FOR AND/ANS	PFLPAV index

PAVEMENT IN AIRCRAFT EQUIVALENCY FOR THICKNESS DESIGN

FIELD	IDENTIFIER	DESCRIPTION
1	CLASS	CLASS index
2	PAVEMENT	PAVEMENT index
3	PFLPAV FOR AND/ANS	PFLPAV index, (0 indicates subgrade)

Both PAVEMENT and PFLPAV indexes are used to define the representative pavement to be used in aircraft equivalency for thickness design.

DESIGN CHARTS FOR LIMITING DEFLECTION AND STRESS

FIELD	IDENTIFIER	DESCRIPTION
1	PAVEMENT	PAVEMENT index
2	PFLPAV	PFLPAV index
3	CLASS	CLASS code
4	LAYER FOR STR/MT	LAYER code for governing stress condition.

FACILITY AND STATION IDENTIFICATIONS

FIELD	IDENTIFIERS	DESCRIPTIONS
1	FACILITY	defines FACILITY index, 1 to 50
2	CODE	defines 9 char. FACILITY code, first 2 char. identify facility type code
3	STA-FROM	min. 5 char. station code in hundreds of feet
4	STA-TO	max. 5 char. station code in hundreds of feet

STATISTICALLY PROCESSED NDT GROUP DATA

FIELD	IDENTIFIERS	DESCRIPTIONS
1	FACILITY	FACILITY index
2	STA-FROM	min. 5 char. station code
3	STA-TO	max. 5 char. station code
4	SUMZ	blank
5	EVALUE	NDT E-value from NDT2 AREA-E, psi
6	DRAINAGE	DRAINAGE code, NORM or WET
7	TEMP.	temperature
8	PFLPAV	2 subfields, PFLPAV index, PFLPAV code

Max. number of STA-FROM and STA-TO is 7.

AVERAGE DAILY MOVEMENTS

Heading Card 1, Columns 11 to 20 contain the 6 char. ADM code.
Heading Card 2, defines aircraft movements.

FIELD	IDENTIFIER	DESCRIPTION
1	AIRCRAFT	AIRCRAFT index
2	year	previous year's traffic
3	year + 1	current year's traffic
4	year + 6	5 year ADM
5	year + 11	10 year ADM
6	year + 16	15 year ADM
7	year + 21	20 year ADM

All aircraft indexes must appear. If aircraft does not have any traffic than leave columns under the years blank.

AIRPORT TRAFFIC DISTRIBUTION

Heading card 1, columns 11 to 20 contain the 6 char. ATD code.

FIELD	IDENTIFIER	DESCRIPTION
1	FACILITY	FACILITY index
2	STA-FROM	min. 5 char. station code
3	STA-TO	max. 5 char. station code
4	YEAR	year + 1 as defined in ADM
5	TOW%	percentage of take-off
6	LRW%	percentage of landing roll
7	TDW%	percentage of touchdown

YEAR should match the one defined in ADM.

GELS/NDT3 for each PFLPAV in design charts control group data.

FIELD	DESCRIPTION
1	number of thickness
2	number of PFLPAV E-values

Continuation card or cards

1 to 8 surface deflection of PFLPAV under a single wheel having tire pressure = 200 psi and radius 9 inches
number of cards = the integer of (number of E-values -1)/8 plus 1.

Continuation card or cards

1 to 8 tensile stress in the governing layer under the same single wheel for deflection.
number of cards = the integer of (number of E-values -1)/8 plus 1.

PAVDES PAVEMENT DESIGN

FIELD	IDENTIFIER	DESCRIPTION
1	FACILITY	FACILITY index
2	SERVYR	service year in 5, 10, 15 or 20 years
3	BANDWIDTH	BANDWIDTH index
4	FORECAST	FORECAST code

Controls the number of facilities which will be printed when the PAVDES program is run. Facility number may be repeated to get several different designs for the same facility.

DATE: 17:41:11   DEC 13, 1978

```
SITE        TCC
LINE        1
USER        D. YANG
JOBCODE     MLG-PAV
RUN         GFLS        FAMD
RUN         GFLS        FAM
RUN         GFLS        HDES
RUN         PAVDES
PRINT       INPUT
REGIONAL COST VALUES
COST        CODE        DATE        ACE
1           PCBT        11/09/78    43.90
2           FIAGT       11/09/78     4.91
3           COAGT       11/09/78     5.35
4           ASCLT       11/09/78    80.00
5           HLBT        11/10/78    75.00
6           PO7BT       11/10/78     3.50
7           SEST        11/10/78     3.00
8           IWFAT       11/10/78     2.00
9           RSWLB       11/10/78      .36
10          LBBM        11/05/78      .368
11          CLHR        11/02/78     7.03
12          SLEHR       11/02/78    10.07
**
TYPE        FACILITY    FACILITY    FACILITY    FACILITY    FACILITY
1           RW          RUNWAY
2           TW          TAXIWAY     XTW
3           SH
**
BANDWIDTH   CODE1       CODE2       RW          TW          SH
1           NORM/VISUAL             40.         16.         16.
2           LIGHTS/ILS              20.         10.         16.
**
DI          RW          TW          SH
KEEL        .12         .12         .30
SIDE        .18         .18         .30
**
VEL         RW          TW          SH
KEEL        145.        50.         50.
SIDE        145.        50.         50.
**
FINANCE     AIRB        ARCD        ASCCC       ASCMC       NBL         NSLP
            .08         .10         .09         .02         30.         20.
**
FORECAST    ADM         ATD
FAMSUG      ADMSUG      ATDSUG
**
PELDI
.12         SMOOTH PAVEMENT SURFACE
.18         OPERATIONAL SURFACE
.25         UPPER LIMIT OF ROUGHNESS TOLERANCE
.30         MAJOR REHABILITATION REQUIRED
**
CLASS       CODE        OVSFKL      OVSFSD      STRESS      FATIST      COVAR       A1
                        A2          D1          D2          DC
1           AC/NOR      .9          1.2         .65         .086        .12         2.30
                        .0170       .46         2.00        1.00
2           AC/SOU      .9          1.2         .65         .086        .12         2.30
                        .0170       .46         2.00        1.00
3           CC/CTB      1.0         1.3333      .40         .082        .10         2.95
                        .0104       .61         2.00        .52
4           CC/AGB      1.0         1.3333      .40         .082        .10         2.95
                        .0104       .61         2.00        .52
5           LCF         1.0         1.3333      .38         .092        .15         2.80
                        .0125       .54         2.00        .90
**
```

LAYER	CODE	EVALUE	POISSON	MOD(S)	MOD(N)
1	ASTOP	200000.		.0029	.0016
2	LCFA	1100000.		.0064	.0019
3	LCFB	600000.		.0051	.0015
4	LCFC	400000.		.0051	.0015
5	SUB	8000.		.0009	.0005
6	PAV	60000.		.0009	.0005
7	PCCP	5000000.		.0065	.0032
8	PCC	4000000.		.0054	.0027
9	RLC	1500000.		.0043	.0022
10	CTB	200000.		.0038	.0019
11	ASBS	150000.		.0026	.0014
12	ASTB	60000.		.0020	.0011
13	AGBS	40000.		.0017	.0010
14	SSBS	20000.		.0015	.0008
15	LTSUB	15000.		.0028	.0015
16	EXPCOV	4500000.		.0	.0
17	EXACOV	180000.		.0	.0
18	EXPC	3000000.		.0	.0
19	EXAC	140000.		.0	.0
20	EXBSC	30000.		.0	.0
21	EXBSA	50000.		.0	.0
22	PELPAV	60000.		.0009	.0005

**

LAYER	PCBT	FIAGT	CCAGT	ASCLT	HLBT	POZBT	SFST
	IWFAT	RSWLB	LBBM	CLHR	SLEHR		
1	.0102						
2	.0102						
3	.0102						
4	.0102						
5	.0102						
6	.0102						
7	.0102						
8	.0102						
9	.0102						
10	.0102						
11	.0102						
12	.0102						
13	.0102						
14	.0102						
15	.0102						
16	.0102						
17	.0102						
18	.0102						
19	.0102						
20	.0102						
21	.0102						
22	.0102						

**

```
PAVEMENT  CODE      LAYER     THICKNESS EVALUE    POISSON
1         AC/NOR    ASTOP     2.
                    ASBS      16.
                    AGBS      8.
                    SUB
2         AC/SOU    ASTOP     2.        100000.
                    ASBS      20.       85000.
                    AGBS      8.
                    SUB
3         CC/CTB    PCC       12.
                    CTB       6.
                    SUB
4         CC/AGB    PCC       14.
                    AGBS      8.
                    SSBS      8.
                    SUB
5         LCF       ASTOP     4.
                    LCFA      6.
                    LCFB      8.
                    LCFC      8.
                    SUB
**
ITERATE   PAVEMENT  LAYER     HMIN      HMAX      HSTEP
          1         ASBS      4.        37.       3.
          2         ASBS      4.        37.       3.
          3         PCC       8.        19.       1.
          4         PCC       8.        19.       1.
          5         LCFA      2.        18.5      1.5
**
NEW PAVEMENT ESUB GRID EVALUES
3000.     5000.     9000.     15000.    21000.    35000.
**
PAVEMENT NUMBER     KEEL      SIDE
                    1         1
                    2         2
                    3         3
                    4         4
                    5         5
**
PFLPAV    CODE      LAYER     THICKNESS EVALUE
1         AC1       EXAC      3.
                    EXBSA     6.
                    SUB
**
PFLPAV ESUB GRID EVALUES
2000.     3000.     4000.     6000.     8000.     12000.    16000.    25000.
35000.    45000.    70000.    100000.
**
PFLPAV    CLASS     LAYER FOR STR/MT
1         AC/NOR    EXBSA
**
CLASS     PFLPAV FOR AND/ANS
1         1
**
CLASS     PAVEMENT  PFLPAV FOR AND/ANS
1         1         0
2         2         0
3         3         0
4         4         0
5         5         0
**
PAVEMENT  PFLPAV    CLASS     LAYER FOR STR/MT
1         0         AC/NOR    ASBS
2         0         AC/SOU    ASBS
3         0         CC/CTB    PCC
4         0         CC/AGB    PCC
5         0         LCF       LCFC
**
```

```
FACILITY AND STATION IDENTIFICATIONS
FACILITY  CODE     STA-FROM  STA-TO
1         RW 5     000.0     090.0
2         RW 15    000.0     090.0
3         RW 35    000.0     090.0
4         TW 5     000.0     090.0
5         TW 15    000.0     090.0
6         TW 35    000.0     090.0
7         SH 5     000.0     090.0
8         SH 15    000.0     090.0
9         SH 35    000.0     090.0
**
STATISTICALLY PROCESSED NOT GROUP DATA
FACILITY  STA-FROM  STA-TO   SUMZ     EVALUE    DRAINAGE  TEMP.     PFLPAV
1         000.0     030.0             5000.     NORM                0/SUB
          030.0     060.0             5000.     NORM                0/SUB
          060.0     090.0             5000.     NORM                0/SUB
2         000.0     030.0             15000.    NORM                0/SUB
          030.0     060.0             15000.    NORM                0/SUB
          060.0     090.0             15000.    NORM                0/SUB
3         000.0     030.0             35000.    NORM                0/SUB
          030.0     060.0             35000.    NORM                0/SUB
          060.0     090.0             35000.    NORM                0/SUB
4         000.0     030.0             5000.     NORM                0/SUB
          030.0     060.0             5000.     NORM                0/SUB
          060.0     090.0             5000.     NORM                0/SUB
5         000.0     030.0             15000.    NORM                0/SUB
          030.0     060.0             15000.    NORM                0/SUB
          060.0     090.0             15000.    NORM                0/SUB
6         000.0     030.0             35000.    NORM                0/SUB
          030.0     060.0             35000.    NORM                0/SUB
          060.0     090.0             35000.    NORM                0/SUB
7         000.0     030.0             5000.     NORM                0/SUB
          030.0     060.0             5000.     NORM                0/SUB
          060.0     090.0             5000.     NORM                0/SUB
8         000.0     030.0             15000.    NORM                0/SUB
          030.0     060.0             15000.    NORM                0/SUB
          060.0     090.0             15000.    NORM                0/SUB
9         000.0     030.0             35000.    NORM                0/SUB
          030.0     060.0             35000.    NORM                0/SUB
          060.0     090.0             35000.    NORM                0/SUB
**
ADM       ADMSUG    AVERAGE DAILY MOVEMENTS, SUGGESTED
                    NUMBER OF AIRCRAFT MOVEMENTS
AIRCRAFT  1977      1978     1983     1988      1993      1998
1         15.       15.      20.      25.       30.       35.
**
ATD       ATDSUG    AIRPORT TRAFFIC DISTRIBUTION, SUGGESTED
FACILITY  STA-FROM  STA-TO   YEAR     TOW%      LRW%      TOW%
1         000.0     030.0    1978     1000.     1000.     1000.
          030.0     060.0    1978     100.      100.      100.
          060.0     090.0    1978     10.       10.       10.
2         000.0     030.0    1978     1000.     1000.     1000.
          030.0     060.0    1978     100.      100.      100.
          060.0     090.0    1978     10.       10.       10.
3         000.0     030.0    1978     1000.     1000.     1000.
          030.0     060.0    1978     100.      100.      100.
          060.0     090.0    1978     10.       10.       10.
4         000.0     030.0    1978     1000.     1000.
          030.0     060.0    1978     100.      100.
          060.0     090.0    1978     10.       10.
5         000.0     030.0    1978     1000.     1000.
          030.0     060.0    1978     100.      100.
          060.0     090.0    1978     10.       10.
6         000.0     030.0    1978     1000.     1000.
          030.0     060.0    1978     100.      100.
          060.0     090.0    1978     10.       10.
```

```
         7          000.0      030.0      1978                  1.
                    030.0      060.0      1978                  .1
                    060.0      090.0      1978                  .01
         8          000.0      030.0      1978                  1.
                    030.0      060.0      1978                  .1
                    060.0      090.0      1978                  .01
         9          000.0      030.0      1978                  1.
                    030.0      060.0      1978                  .1
                    060.0      090.0      1978                  .01
         **
         GFLS       NDT3
          1         12
          0.484288  0.367159  0.301377  0.228033  0.187158  0.142052  0.117210  0.087903
          0.071678  0.062120  0.049477  0.042216
            329.908   279.614   243.886   194.094   159.736   113.800    83.746    42.653
             16.847     0.648   -21.661   -34.545
         **
         PAVDES     PAVEMENT DESIGN
         FACILITY   SERVYR     BANDWIDTH FORECAST
         1          20         2          FAMSUG
         2          20         2          FAMSUG
         3          20         2          FAMSUG
         1          20         1          FAMSUG
         2          20         1          FAMSUG
         3          20         1          FAMSUG
         4          20         1          FAMSUG
         5          20         1          FAMSUG
         6          20         1          FAMSUG
         7          20         1          FAMSUG
         8          20         1          FAMSUG
         9          20         1          FAMSUG
         **
```

DESCRIPTION OF SYSTEM OUTPUTS

TITLE PAGE   Print the name of user, MLG-PAV, job name and TCC site. The top and bottom margin of title page is 2 and 1 inch respectively.

PRINT/INPUT   Head card of input data groups

1. Listing of Default Inputs
2. Aircraft Data Group

GELS/FAMD   For aircraft 1; with weight, MTOW; pavements AC/NOR, AC/SOU, CC/CTB, CC/AGB, LCF; all wheels and 1 wheel; prints the maximum horizontal stress at the bottom of each pavement layer, and the surface deflection at wheel 0., 0.

GELS/FAM   Same as GELS/FAMD except all weights, MTOW, MLRW, MTDW. Under the MWFPRT page counter, a table of stresses at the critical layer and the surface deflection for all pavements is printed. GELS/FAMD and GELS/FAM are used to get a single equivalent operation of aircraft 1, weight MTOW.

GELS/HDES   For aircraft 1; weight MTOW; pavements AC/NOR, AC/SOU, CC/CTB, CC/AGB, LCF; different thicknesses of design layer; different E-VALUE of subgrade support; all wheels and one wheel; prints the maximum horizontal stress at the bottom of each pavement layer and the surface deflection at wheel 0., 0. Under the MWPRT page counter, a table of stresses at the critical layer and the surface deflection for all pavements is printed.

RUN/PAVDES

1. Under ATM page counter, listing of aircraft movements which is equal to the product of average daily movements and airport distribution for each facility segment during the 20 year design service life. ATM for RW and TW stations 0. - 30., 30. - 60., and 60. - 90. is 1825000., 182500. and 18250. respectively. ATM for SH stations 0. - 30., 30. - 60., and 60. - 90. are 1825., 182.5 and 18.25 respectively.
2. Under the OPWPT page counter, lists the MTOW, MLRW and MTDW for aircraft 1.
3. Under the AND/ANS page counter, equivalent single type aircraft operation will be listed for each pavement and facility. For each pavement only the first two facility segments are printed.
4. Under the CED page counter for each pavement, the computed engineering data relating to aircraft load repetition, E-value of subgrade, deflection and stress limits, and thickness analysis for two drainage and three traffic conditions are tabulated. There are five new pavements AC/NOR, AC/SOU, CC/CTB, CC/AGB and LCF. For each new pavement there are three RW, three TW and three SH facilities having respective E-value of subgrade. Under the NORM drainage condition, the associated ESUB NORM values are 5000., 15000., and 35000. psi. The corresponding ESUB WET values are 3000., 9000., and 21000. psi respectively.

5. Under the PAV page counter, the pavement data relating to functional requirements and governing condition of design are tabulated, similar to the CED listing.

ERROR MESSAGES AND DIAGNOSTICS

The input goes through two stages of processing:

1. Identification stage in which the input data group or control card must be recognized. If it is not, then, an error message is printed. All cards are printed and the error is temporarily ignored until the next delimitor ** is encountered. If a control card is mispelled, the next data group will be flagged in error yet the program will assume as if the last card of a data group is in error.

2. Data verification in which the program prints a limited number of self-explantory error messages. FORTRAN will print messages if the characters do not match the field, such as type of integer or floating point. FORTRAN will also print execution error messages, such as mispunched, incorrect or missing data.

Error messages printed in the system log at the beginning of each job listing can be refered to the OS 360 Manual. These messages help identify whether the program, JCL or hardware caused the error.

REFERENCES

1. Yang, Nai C., DESIGN OF FUNCTIONAL PAVEMENTS, McGraw Hill Book Co., New York, 1972.

2. Yang, Nai C., Nondestructive Evaluation of Civil Airport Pavements, FAA-RD-76-83, September 1976.

3. Yang, Nai C., Nondestructive Evaluation of Airport Pavements, Volume I, Program References, FAA-RD-78-154 I, September 1979.

MLG = PAV

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

NONDESTRUCTIVE PAVEMENT EVALUATION

A PARTIAL FULFILLMENT OF THE FAA VALIDATION PROGRAM BY NAI C. YANG AND ASSOCIATES, ENGINEERS, P. C.

THIS IS A PROPRIETARY PROGRAM DEVELOPED BY NAI C. YANG
AND ASSOCIATES, ENGINEERS, PC PRIOR TO FAA VALIDATION.
THE USE OF THIS COMPUTER PROGRAM SHALL BE CONFINED TO
THOSE APPROVED BY NAI C. YANG, AND ALSO, THE FAA UNTIL
THE PROGRAM OF NONDESTRUCTIVE EVALUATION OF CIVIL AIR-
PORT PAVEMENTS IS OFFICIALLY ADOPTED AND IMPLEMENTED.

USER: D. YANG   SITE: TCC   CREATED AT: 23:48:55   DEC 13, 1978

THE FAA UNDER THE PRESENT CONDITION ASSUMES NO
RESPONSIBILITIES NOR OBLIGATIONS FROM THE USE OF
THE PROGRAM AND THE INTERPRETATION OF ITS OUTPUTS

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REGIONAL COST VALUES
TYPE        FACILITY  FACILITY  FACILITY  FACILITY  FACILITY
BANDWIDTH   CODE1     CODE2     RW        TW        SH
DA          RW        TW        SH
VEL         RW        TW        SH
FINANCE     AIRB      ARCD      ASCCC     ASCMC     NBL       NSLP
FORECAST    ACM       ATC
PFLDT
CLASS       CODE      OVSFKL    OVSFSD    STRESS    FATIST    COVAR     A1
LAYER       CODE      EVALUE    POISSON   MOD(S)    MOD(N)
LAYER       PCBT      FIAGT     COAGT     ASCLT     HLBT      POZBT     SFST
PAVEMENT    CODE      LAYER     THICKNESS EVALUE    POISSON
ITERATE     PAVEMENT  LAYER     HMIN      HMAX      HSTEP
NEW PAVEMENT ESUB GRID EVALUES
PAVEMENT NUMBER       KEEL      SIDE
PFLPAV      CODE      LAYER     THICKNESS EVALUE
PFLPAV ESUB GRID EVALUES
PFLPAV      CLASS     LAYER FOR STR/MT
CLASS       PFLPAV FOR AND/ANS
CLASS       PAVEMENT  PFLPAV FOR AND/ANS
PAVEMENT    PFLPAV    CLASS     LAYER FOR STR/MT
FACILITY AND STATION IDENTIFICATIONS
STATISTICALLY PROCESSED NOT GROUP DATA
ADM         ACMSUG    AVERAGE DAILY MOVEMENTS, SUGGESTED
ATD         ATDSUG    AIRPORT TRAFFIC DISTRIBUTION, SUGGESTED
AIRCRAFT    CODE      MTOW      MLRW      OEW       RANGE
```

HAI C. YANG, ENGINEERING CONSULTANT MWFPRT 1

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

MODEL PAVEMENT: AC/NOR

ASTOP	2.0	200000.	0.23
ASBS	16.0	150000.	0.24
AGBS	8.0	40000.	0.28
SUB	INFI	8000.	0.34

AIRCRAFT	SURFACE DEFLECTION, WZ TCW	LRW	TDW	STRESS AT LAYER: ASBS TCW	LRW	TDW
L-1011-1	0.16022	0.13417	0.19673	64.4	55.4	76.1
	0.06957	0.05905	0.08405	66.8	57.3	79.1

MODEL PAVEMENT: AC/SOU

ASTOP	2.0	100000.	0.25
ASBS	20.0	85000.	0.26
AGBS	8.0	40000.	0.28
SUB	INFI	8000.	0.34

AIRCRAFT	SURFACE DEFLECTION, WZ TCW	LRW	TDW	STRESS AT LAYER: ASBS TCW	LRW	TDW
L-1011-1	0.16923	0.14345	0.20628	30.6	26.0	36.5
	0.07906	0.06872	0.09418	32.4	27.5	38.8

MODEL PAVEMENT: CC/CTB

PCC	12.0	4000000.	0.12
CTB	6.0	200000.	0.23
SUB	INFI	8000.	0.34

AIRCRAFT	SURFACE DEFLECTION, WZ TCW	LRW	TDW	STRESS AT LAYER: PCC TCW	LRW	TDW
L-1011-1	0.11715	0.09778	0.14462	388.8	330.8	467.6
	0.03510	0.02978	0.04264	326.3	279.2	389.8

NAI C. YANG, ENGINEERING CONSULTANT MWPRT 1

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

DESIGN CHART - DEFLECTION CRITERIA

AIRCRAFT: L-1011-1 WEIGHT: 388800.

PAVEMENT: AC/NGR				
	ASTGP	2.0	200000.	0.23
	ASBS	****	150000.	0.24
	AGBS	8.0	40000.	0.28
	SUB	INFI	****	

THICK./EVALUE

	3000.	5000.	9000.	15000.	21000.	35000.
4.0	0.47305	0.31089	0.19514	0.13310	0.10499	0.07537
7.0	0.43175	0.28289	0.17635	0.11950	0.09393	0.06716
10.0	0.39987	0.26228	0.16327	0.11029	0.08648	0.06169
13.0	0.37436	0.24644	0.15395	0.10425	0.08183	0.05847
16.0	0.35265	0.23295	0.14613	0.09916	0.07795	0.05573
19.0	0.33383	0.22123	0.13932	0.09491	0.07478	0.05367
22.0	0.31772	0.21136	0.13374	0.09168	0.07250	0.05235
25.0	0.30368	0.20287	0.12907	0.08901	0.07069	0.05140
28.0	0.29109	0.19529	0.12491	0.08645	0.06890	0.05040
31.0	0.27943	0.18819	0.12093	0.08396	0.06710	0.04930
34.0	0.26848	0.18144	0.11701	0.08160	0.06538	0.04820
37.0	0.25837	0.17521	0.11341	0.07933	0.06369	0.04713

NAI C. YANG, ENGINEERING CONSULTANT MWPRT 2

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

DESIGN CHART - STRESS CRITERIA, LAYER ASBS

AIRCRAFT: L-1011-1 WEIGHT: 388800.

PAVEMENT: AC/NGR				
	ASTGP	2.0	200000.	0.23
	ASBS	****	150000.	0.24
	AGBS	8.0	40000.	0.28
	SUB	INFI	****	

THICK./EVALUE

	3000.	5000.	9000.	15000.	21000.	35000.
4.0	149.1	134.8	119.4	107.3	100.4	91.8
7.0	145.3	129.6	113.7	101.7	94.8	86.2
10.0	124.2	108.9	93.9	83.1	77.0	69.5
13.0	104.2	89.9	75.9	66.1	60.6	54.0
16.0	88.1	74.9	62.1	52.9	48.0	42.0
19.0	75.6	63.5	51.7	43.2	38.7	33.1
22.0	66.0	54.8	43.9	36.1	31.8	26.7
25.0	58.4	48.0	38.0	30.7	26.7	21.9
28.0	52.4	42.7	33.3	26.6	22.9	18.3
31.0	47.5	38.5	29.7	23.4	19.9	15.6
34.0	43.6	35.0	26.8	20.9	17.6	13.5
37.0	40.2	32.2	24.4	18.8	15.7	11.9

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

ATM, AIRCRAFT TRAFFIC MOVEMENTS

FACILITY	SERVYR	FORECAST	STATION FROM-TO	L-1011-1
RW 15	20	FAMSUG	0.- 30.	TOW:1.825E 06
				LRW:1.825E 06
				TDW:1.825E 06
RW 15	20	FAMSUG	30.- 60.	TOW:1.825E 05
				LRW:1.825E 05
				TDW:1.825E 05
RW 15	20	FAMSUG	60.- 90.	TOW:1.825E 04
				LRW:1.825E 04
				TDW:1.825E 04
RW 35	20	FAMSUG	0.- 30.	TOW:1.825E 06
				LRW:1.825E 06
				TDW:1.825E 06
RW 35	20	FAMSUG	30.- 60.	TOW:1.825E 05
				LRW:1.825E 05
				TDW:1.825E 05
RW 35	20	FAMSUG	60.- 90.	TOW:1.825E 04
				LRW:1.825E 04
				TDW:1.825E 04
TW 5	20	FAMSUG	0.- 30.	TOW:1.825E 06
				LRW:1.825E 06
				TDW:0.0
TW 5	20	FAMSUG	30.- 60.	TOW:1.825E 05
				LRW:1.825E 05
				TDW:0.0
TW 5	20	FAMSUG	60.- 90.	TOW:1.825E 04
				LRW:1.825E 04
				TDW:0.0
TW 15	20	FAMSUG	0.- 30.	TOW:1.825E 06
				LRW:1.825E 06
				TDW:0.0
TW 15	20	FAMSUG	30.- 60.	TOW:1.825E 05
				LRW:1.825E 05
				TDW:0.0
TW 15	20	FAMSUG	60.- 90.	TOW:1.825E 04
				LRW:1.825E 04
				TDW:0.0

HAI C. YANG, ENGINEERING CONSULTANT OPWGT 1

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

OPERATIONAL AIRCRAFT WEIGHTS

AIRCRAFT	CODE	RANGE	LOAD FACTOR	TOW	LRW	TDW
1	L-1011-1	LONG		388800.	322200.	483300.

NAI C. YANG, ENGINEERING CONSULTANT

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

EQUIVALENT SINGLE TYPE AIRCRAFT OPERATION

EQ. AIRCRAFT: L-1011-1 WEIGHT: 388800. LBS CLASS: 1/AC/NGR FACILITY: RW 5
BANDWIDTH: LIGHTS/ILS FORECAST: FAMSUG YEAR: 20

STATIONS 0. TO 30. LOCATION: KEEL

	DEFLECTION CRITERIA			AND			AAND	STRESS CRITERIA			ANS			AANS
	TDW	LRW	TDW	TDW	LRW	TDW		TDW	LRW	TDW	TDW	LRW	TDW	
L-1011-1	1.0E 00	5.2E-01	1.8E 00	7.2E 05	9.5E 04	1.2E 04		1.0E 00	2.6E-01	5.8E 00	7.2E 05	1.7E 05	1.2E 04	
				7.2E 05	9.5E 04	1.2E 04	8.3E 05				7.2E 05	1.7E 05	1.2E 04	9.0E 05

STATIONS 30. TO 60. LOCATION: KEEL

	DEFLECTION CRITERIA			AND			AAND	STRESS CRITERIA			ANS			AANS
	TDW	LRW	TDW	TDW	LRW	TDW		TDW	LRW	TDW	TDW	LRW	TDW	
L-1011-1	1.0E 00	5.2E-01	1.8E 00	7.2E 04	9.5E 03	8.0E 02		1.0E 00	2.6E-01	5.8E 00	7.2E 04	1.7E 04	1.2E 03	
				7.2E 04	9.5E 03	8.0E 02	8.2E 04				7.2E 04	1.7E 04	1.2E 03	9.0E 04

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

SUMMARY OF AIRCRAFT FORECAST, FUNCTIONAL LIMITS AND THICKNESS ANALYSIS

EQUIVALENT AIRCRAFT OPERATION: L-1011-1 WEIGHT: 388800. LBS

PAVEMENT MODEL: CCCE

	LAYER	THICKNESS	EVALUE	POISSON	UNIT-PRICE
AC/NOR	ASTOP	2.0	200000.	0.23	
	ASBS	****	150000.	0.24	
	AGBS	8.0	40000.	0.28	
	SUB	INFI	****	0.34	

FOR ESUB NORM AND FAM DEFINED

FACILITY	STATION FROM-TO	LOC	ESUB NORM	AANS	AAND	LIMIT DEF/W2	LIMIT STRESS ASBS	DESIGN SERVICE YEARS	THICKNESS OF ASBS LAYER FAM NORM	FAM/2 NORM	FAM*2 NORM	FAM WET	FAM/2 WET	FAM*2 WET
KW 5	0.- 30.	KEEL	5000.	902088.	828211.	0.2243	86.8	20	18.2	16.7	19.8	28.4	26.6	30.2
KW 5	30.- 60.	KEEL	5000.	90209.	82444.	0.2461	102.2	20	13.1	11.6	14.7	22.0	20.1	24.0
KW 5	60.- 90.	KEEL	5000.	9021.	8210.	0.2757	117.5	20	8.8	8.1	9.5	15.5	13.5	17.5
KW 5	0.- 30.	SIDE	5000.	9539.	8282.	0.4115	148.2	20	4.0	4.0	4.0	4.7	4.0	7.4
KW 5	30.- 60.	SIDE	5000.	954.	824.	0.4770	167.6	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 5	60.- 90.	SIDE	5000.	95.	82.	0.5887	186.9	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 15	0.- 30.	KEEL	15000.	902088.	828211.	0.1295	86.8	20	9.4	8.7	10.2	11.2	10.4	12.0
KW 15	30.- 60.	KEEL	15000.	90209.	82444.	0.1421	102.2	20	6.7	4.3	7.7	8.7	8.0	9.5
KW 15	60.- 90.	KEEL	15000.	9021.	8210.	0.1592	117.5	20	4.0	4.0	4.0	5.0	4.0	7.1
KW 15	0.- 30.	SIDE	15000.	9539.	8282.	0.2376	148.2	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 15	30.- 60.	SIDE	15000.	954.	824.	0.2754	167.6	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 15	60.- 90.	SIDE	15000.	95.	82.	0.3399	186.9	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 35	0.- 30.	KEEL	35000.	902088.	828211.	0.0848	86.8	20	6.7	4.2	7.7	8.3	7.6	9.1
KW 35	30.- 60.	KEEL	35000.	90209.	82444.	0.0930	102.2	20	4.0	4.0	4.0	4.0	4.0	5.5
KW 35	60.- 90.	KEEL	35000.	9021.	8210.	0.1042	117.5	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 35	0.- 30.	SIDE	35000.	9539.	8282.	0.1555	148.2	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 35	30.- 60.	SIDE	35000.	954.	824.	0.1803	167.6	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 35	60.- 90.	SIDE	35000.	95.	82.	0.2225	186.9	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 5	0.- 30.	KEEL	5000.	529956.	486555.	0.2288	90.4	20	17.1	15.5	18.6	27.0	25.0	28.8
KW 5	30.- 60.	KEEL	5000.	52996.	48376.	0.2521	105.7	20	11.9	10.3	13.5	20.6	18.6	22.5
KW 5	60.- 90.	KEEL	5000.	5300.	4820.	0.2843	121.0	20	8.2	7.6	8.9	14.0	12.0	16.0
KW 5	0.- 30.	SIDE	5000.	5604.	4866.	0.4242	152.7	20	4.0	4.0	4.0	4.0	4.0	5.8
KW 5	30.- 60.	SIDE	5000.	560.	484.	0.4972	172.0	20	4.0	4.0	4.0	4.0	4.0	4.0
KW 5	60.- 90.	SIDE	5000.	56.	48.	0.6279	191.4	20	4.0	4.0	4.0	4.0	4.0	4.0

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

SUMMARY OF AIRCRAFT FORECAST, FUNCTIONAL LIMITS AND THICKNESS ANALYSIS

EQUIVALENT AIRCRAFT OPERATION: L-1011-1 WEIGHT: 388800. LBS

PAVEMENT MODEL: CODE

	LAYER	THICKNESS	EVALUE	POISSON	UNIT-PRICE
AC/SOU	ASTOP	2.0	100000.	0.25	
	ASBS	****	85000.	0.26	
	AGBS	8.0	40000.	0.28	
	SUB	INFI	****	0.34	

FOR ESUB NORM AND FAM DEFINED

FACILITY	STATION FROM-TO	LOC	ESUB NORM	AANS	AANO	LIMIT DEF/WZ	LIMIT STRESS ASBS	DESIGN SERVICE YEARS	THICKNESS OF ASBS LAYER FAM NORM	FAM/2 NORM	FAM*2 NORM	FAM WET	FAM/2 WET	FAM*2 WET
RW 5	0.- 30.	KEEL	5000.	993644.	861637.	0.2129	64.9	20	31.2	28.7	33.5	38.5	38.5	38.5
RW 5	30.- 60.	KEEL	5000.	99364.	85845.	0.2335	76.4	20	22.6	20.1	25.2	34.1	31.4	36.8
RW 5	60.- 90.	KEEL	5000.	9936.	8554.	0.2615	87.9	20	14.6	12.2	17.0	24.6	21.5	27.6
RW 5	0.- 30.	SIDE	5000.	10477.	8616.	0.3903	111.0	20	4.0	4.0	4.0	4.0	4.0	4.8
RW 5	30.- 60.	SIDE	5000.	1048.	858.	0.4521	125.5	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 5	60.- 90.	SIDE	5000.	105.	86.	0.5571	140.1	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 15	0.- 30.	KEEL	15000.	993644.	861637.	0.1229	64.9	20	10.7	9.3	12.4	18.3	16.4	20.4
RW 15	30.- 60.	KEEL	15000.	99364.	85845.	0.1348	76.4	20	6.5	5.3	7.6	12.0	10.0	13.9
RW 15	60.- 90.	KEEL	15000.	9936.	8554.	0.1510	87.9	20	4.0	4.0	4.0	6.5	5.1	8.0
RW 15	0.- 30.	SIDE	15000.	10477.	8616.	0.2254	111.0	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 15	30.- 60.	SIDE	15000.	1048.	858.	0.2610	125.5	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 15	60.- 90.	SIDE	15000.	105.	86.	0.3216	140.1	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 35	0.- 30.	KEEL	35000.	993644.	861637.	0.0805	64.9	20	5.7	4.7	6.7	7.9	6.8	9.1
RW 35	30.- 60.	KEEL	35000.	99364.	85845.	0.0882	76.4	20	4.0	4.0	4.0	4.3	4.0	5.5
RW 35	60.- 90.	KEEL	35000.	9936.	8554.	0.0988	87.9	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 35	0.- 30.	SIDE	35000.	10477.	8616.	0.1475	111.0	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 35	30.- 60.	SIDE	35000.	1048.	858.	0.1709	125.5	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 35	60.- 90.	SIDE	35000.	105.	86.	0.2106	140.1	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 5	0.- 30.	KEEL	5000.	583743.	506192.	0.2171	67.6	20	29.3	26.7	31.8	38.5	38.5	38.5
RW 5	30.- 60.	KEEL	5000.	58374.	50382.	0.2391	79.1	20	20.7	18.2	23.2	32.0	29.3	34.7
RW 5	60.- 90.	KEEL	5000.	5837.	5022.	0.2696	90.6	20	12.8	10.4	15.2	22.2	19.3	25.3
RW 5	0.- 30.	SIDE	5000.	6155.	5062.	0.4023	114.3	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 5	30.- 60.	SIDE	5000.	616.	504.	0.4711	128.9	20	4.0	4.0	4.0	4.0	4.0	4.0
RW 5	60.- 90.	SIDE	5000.	62.	50.	0.5937	143.5	20	4.0	4.0	4.0	4.0	4.0	4.0

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

SUMMARY OF AIRCRAFT FORECAST, FUNCTIONAL LIMITS AND THICKNESS ANALYSIS

EQUIVALENT AIRCRAFT OPERATION: L-1011-1 WEIGHT: 388800. LBS

PAVEMENT MODEL: CODE LAYER THICKNESS EVALUE POISSON UNIT-PRICE

CODE	LAYER	THICKNESS	EVALUE	POISSON
CC/CTB	PCC	****	4000000.	0.12
	CTB	6.0	200000.	0.23
	SUB	INFI	****	0.34

FOR ESUB NORM AND FAM DEFINED

FACILITY	STATION FROM-TO	LOC	ESUB NORM	AANS	AAND	LIMIT DEF/WZ	LIMIT STRESS PCC	DESIGN SERVICE YEARS	FAM NORM	FAM/2 NORM	FAM*2 NORM	FAM WET	FAM/2 WET	FAM*2 WET
									THICKNESS OF PCC LAYER					
KW 5	0.- 30.	KEEL	5000.	840312.	825781.	0.3564	330.6	20	15.9	15.2	16.6	18.5	17.7	19.5
KW 5	30.- 60.	KEEL	5000.	84031.	82169.	0.3911	383.3	20	13.8	13.3	14.4	16.0	15.4	16.7
KW 5	60.- 90.	KEEL	5000.	8403.	8180.	0.4383	436.0	20	12.2	11.8	12.7	14.1	13.7	14.7
KW 5	0.- 30.	SIDE	5000.	8429.	8258.	0.7314	551.7	20	9.7	9.3	10.0	11.2	10.8	11.6
KW 5	30.- 60.	SIDE	5000.	843.	822.	0.8478	618.4	20	8.6	8.3	8.9	9.9	9.6	10.3
KW 5	60.- 90.	SIDE	5000.	84.	82.	1.0466	685.1	20	8.0	8.0	8.0	8.9	8.6	9.2
KW 15	0.- 30.	KEEL	15000.	840312.	825781.	0.2058	330.6	20	11.9	11.4	12.4	13.5	12.9	14.1
KW 15	30.- 60.	KEEL	15000.	84031.	82169.	0.2258	383.3	20	10.4	10.0	10.8	11.8	11.4	12.3
KW 15	60.- 90.	KEEL	15000.	8403.	8180.	0.2531	436.0	20	9.1	8.8	9.5	10.5	10.1	10.8
KW 15	0.- 30.	SIDE	15000.	8429.	8258.	0.4223	551.7	20	8.0	8.0	8.0	8.2	8.0	8.6
KW 15	30.- 60.	SIDE	15000.	843.	822.	0.4895	618.4	20	8.0	8.0	8.0	8.0	8.0	8.0
KW 15	60.- 90.	SIDE	15000.	84.	82.	0.6043	685.1	20	8.0	8.0	8.0	8.0	8.0	8.0
KW 35	0.- 30.	KEEL	35000.	840312.	825781.	0.1347	330.6	20	9.7	9.3	10.1	10.9	10.5	11.4
KW 35	30.- 60.	KEEL	35000.	84031.	82169.	0.1478	383.3	20	8.4	8.0	8.7	9.5	9.2	9.9
KW 35	60.- 90.	KEEL	35000.	8403.	8180.	0.1657	436.0	20	8.0	8.0	8.0	8.4	8.1	8.7
KW 35	0.- 30.	SIDE	35000.	8429.	8258.	0.2764	551.7	20	8.0	8.0	8.0	8.0	8.0	8.0
KW 35	30.- 60.	SIDE	35000.	843.	822.	0.3205	618.4	20	8.0	8.0	8.0	8.0	8.0	8.0
KW 35	60.- 90.	SIDE	35000.	84.	82.	0.3956	685.1	20	8.0	8.0	8.0	8.0	8.0	8.0
KW 5	0.- 30.	KEEL	5000.	493664.	485127.	0.3636	342.7	20	15.3	14.7	16.0	17.8	17.1	18.6
KW 5	30.- 60.	KEEL	5000.	49366.	48210.	0.4006	395.4	20	13.4	12.9	13.9	15.6	15.0	16.2
KW 5	60.- 90.	KEEL	5000.	4937.	4802.	0.4519	448.2	20	11.9	11.5	12.3	13.8	13.3	14.3
KW 5	0.- 30.	SIDE	5000.	4952.	4851.	0.7535	567.1	20	9.4	9.1	9.8	10.9	10.5	11.3
KW 5	30.- 60.	SIDE	5000.	495.	482.	0.8837	633.8	20	8.3	8.1	8.6	9.7	9.3	10.0
KW 5	60.- 90.	SIDE	5000.	50.	48.	1.1163	700.5	20	8.0	8.0	8.0	8.7	8.4	8.9

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

SUMMARY OF AIRCRAFT FORECAST, FUNCTIONAL LIMITS AND THICKNESS ANALYSIS

EQUIVALENT AIRCRAFT OPERATION: L-1011-1 WEIGHT: 388800. LBS

PAVEMENT MODEL: CODE	LAYER	THICKNESS	EVALUE	POISSON	UNIT-PRICE
CC/AGB	PCC	****	4000000.	0.12	
	AGBS	8.0	40000.	0.28	
	SSBS	8.0	20000.	0.31	
	SUB	INFI	++++	0.34	

FOR ESUB NORM AND FAM DEFINED

FACILITY	STATION FROM-TO	LOC	ESUB NORM	AANS	AAND	LIMIT DEF/WZ	LIMIT STRESS PCC	DESIGN SERVICE YEARS	THICKNESS OF PCC LAYER FAM NORM	FAM/2 NORM	FAM*2 NORM	FAM WET	FAM/2 WET	FAM*2 WET
RW 5	0.- 30.	KEEL	5000.	838646.	826953.	0.3648	330.6	20	16.5	15.8	17.2	18.9	18.2	19.5
RW 5	30.- 60.	KEEL	5000.	83865.	82300.	0.4003	383.3	20	14.4	13.9	15.0	16.6	15.9	17.2
RW 5	60.- 90.	KEEL	5000.	8386.	8194.	0.4486	436.0	20	12.9	12.5	13.3	14.7	14.2	15.2
RW 5	0.- 30.	SIDE	5000.	8551.	8270.	0.7486	551.2	20	10.4	10.1	10.8	11.8	11.4	12.2
RW 5	30.- 60.	SIDE	5000.	855.	823.	0.8678	617.9	20	9.4	9.1	9.7	10.6	10.3	10.9
RW 5	60.- 90.	SIDE	5000.	86.	82.	1.0711	684.7	20	8.5	8.3	8.8	9.6	9.3	9.9
RW 15	0.- 30.	KEEL	15000.	838646.	826953.	0.2106	330.6	20	12.9	12.4	13.4	14.3	13.7	14.9
RW 15	30.- 60.	KEEL	15000.	83865.	82300.	0.2311	383.3	20	11.5	11.1	11.8	12.6	12.2	13.1
RW 15	60.- 90.	KEEL	15000.	8386.	8194.	0.2590	436.0	20	10.3	10.0	10.6	11.3	11.0	11.7
RW 15	0.- 30.	SIDE	15000.	8551.	8270.	0.4322	551.2	20	8.5	8.2	8.7	9.2	8.9	9.5
RW 15	30.- 60.	SIDE	15000.	855.	823.	0.5010	617.9	20	8.0	8.0	8.0	8.4	8.1	8.6
RW 15	60.- 90.	SIDE	15000.	86.	82.	0.6184	684.7	20	8.0	8.0	8.0	8.0	8.0	8.0
RW 35	0.- 30.	KEEL	35000.	838646.	826953.	0.1379	330.6	20	11.4	11.0	11.8	12.2	11.8	12.7
RW 35	30.- 60.	KEEL	35000.	83865.	82300.	0.1513	383.3	20	10.2	9.8	10.5	10.8	10.5	11.2
RW 35	60.- 90.	KEEL	35000.	8386.	8194.	0.1696	436.0	20	9.2	8.9	9.5	9.8	9.5	10.1
RW 35	0.- 30.	SIDE	35000.	8551.	8270.	0.2829	551.2	20	8.0	8.0	8.0	8.1	8.0	8.3
RW 35	30.- 60.	SIDE	35000.	855.	823.	0.3280	617.9	20	8.0	8.0	8.0	8.0	8.0	8.0
RW 35	60.- 90.	SIDE	35000.	86.	82.	0.4048	684.7	20	8.0	8.0	8.0	8.0	8.0	8.0
RW 5	0.- 30.	KEEL	5000.	492686.	485816.	0.3722	342.8	20	15.9	15.3	16.6	18.3	17.6	19.5
RW 5	30.- 60.	KEEL	5000.	49269.	48289.	0.4101	395.5	20	14.0	13.6	14.6	16.1	15.9	16.7
RW 5	60.- 90.	KEEL	5000.	4927.	4810.	0.4625	448.2	20	12.6	12.2	13.0	14.3	13.9	14.8
RW 5	0.- 30.	SIDE	5000.	5023.	4858.	0.7717	566.6	20	10.2	9.8	10.5	11.5	11.1	11.9
RW 5	30.- 60.	SIDE	5000.	502.	483.	0.9044	633.4	20	9.2	8.9	9.5	10.3	10.0	10.7
RW 5	60.- 90.	SIDE	5000.	50.	48.	1.1424	700.1	20	8.4	8.1	8.6	9.4	9.1	9.7

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

SUMMARY OF AIRCRAFT FORECAST, FUNCTIONAL LIMITS AND THICKNESS ANALYSIS

EQUIVALENT AIRCRAFT OPERATION: L-1011-1 WEIGHT: 388800. LBS

PAVEMENT MODEL: CODE	LAYER	THICKNESS	EVALUE	POISSON	UNIT-PRICE
LCF	ASTOP	4.0	230000.	0.23	
	LCFA	****	1100000.	0.17	
	LCFB	8.0	600000.	0.19	
	LCFC	8.0	400000.	0.20	
	SUB	INFI	****	0.34	

FOR ESUB NORM AND FAM DEFINED

FACILITY	STATION FROM-TO	LOC	ESUB NORM	AANS	AAND	LIMIT DEF/WZ	LIMIT STRESS LCFC	DESIGN SERVICE YEARS	FAM NORM	THICKNESS OF LCFA LAYER FAM/2 NORM	FAM*2 NORM	FAM WET	FAM/2 WET	FAM*2 WET
KM 5	0.- 30.	KEEL	5000.	848840.	835636.	0.3015	82.9	20	9.2	8.1	10.5	13.2	11.5	14.6
KM 5	30.- 60.	KEEL	5000.	84884.	83209.	0.3308	99.7	20	6.0	5.1	6.8	9.3	8.3	10.3
KM 5	60.- 90.	KEEL	5000.	8488.	8288.	0.3707	116.5	20	3.5	3.0	4.2	6.4	5.6	7.2
KM 5	0.- 30.	SIDE	5000.	8839.	8356.	0.6032	147.0	20	2.0	2.0	2.0	2.7	2.0	3.3
KM 5	30.- 60.	SIDE	5000.	884.	832.	0.6591	168.3	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 5	60.- 90.	SIDE	5000.	88.	83.	0.8625	189.5	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 15	0.- 30.	KEEL	15000.	848840.	835636.	0.1741	82.9	20	2.7	2.0	3.5	5.5	4.6	6.5
KM 15	30.- 60.	KEEL	15000.	84884.	83209.	0.1910	99.7	20	2.0	2.0	2.0	2.8	2.2	3.5
KM 15	60.- 90.	KEEL	15000.	8488.	8288.	0.2140	116.5	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 15	0.- 30.	SIDE	15000.	8839.	8356.	0.3483	147.0	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 15	30.- 60.	SIDE	15000.	884.	832.	0.4036	168.3	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 15	60.- 90.	SIDE	15000.	88.	83.	0.4980	189.5	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 35	0.- 30.	KEEL	35000.	848840.	835636.	0.1140	82.9	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 35	30.- 60.	KEEL	35000.	84884.	83209.	0.1250	99.7	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 35	60.- 90.	KEEL	35000.	8488.	8288.	0.1401	116.5	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 35	0.- 30.	SIDE	35000.	8839.	8356.	0.2280	147.0	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 35	30.- 60.	SIDE	35000.	884.	832.	0.2642	168.3	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 35	60.- 90.	SIDE	35000.	88.	83.	0.3260	189.5	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 5	0.- 30.	KEEL	5000.	498674.	490917.	0.3076	86.8	20	8.4	7.4	9.5	12.2	10.9	13.5
KM 5	30.- 60.	KEEL	5000.	49867.	48828.	0.3388	103.6	20	5.3	4.6	6.2	8.5	7.6	9.5
KM 5	60.- 90.	KEEL	5000.	4987.	4866.	0.3821	120.3	20	3.1	2.5	3.7	5.8	5.1	6.5
KM 5	0.- 30.	SIDE	5000.	5153.	4909.	0.6218	151.9	20	2.0	2.0	2.0	2.2	2.0	2.8
KM 5	30.- 60.	SIDE	5000.	519.	488.	0.7286	173.2	20	2.0	2.0	2.0	2.0	2.0	2.0
KM 5	60.- 90.	SIDE	5000.	52.	49.	0.9197	194.4	20	2.0	2.0	2.0	2.0	2.0	2.0

SENSITIVITY ANALYSIS OF AIRCRAFT L-1011-1

LISTING OF PAVEMENT DESIGN AND COST ANALYSIS

EQUIVALENT AIRCRAFT OPERATION: L-1011-1 WEIGHT: 388800. LBS

PAVEMENT MODEL: CGCE

LAYER		THICKNESS	EVALUE	POISSON	UNIT-PRICE
AC/NOR	ASTOP	2.0	200000.	0.23	
	ASBS	****	150000.	0.24	
	AGBS	8.0	40000.	0.28	
	SUB	INFI	****	0.34	

FACILITY	STATION FROM-TO	LOC	DI	VEL	ESUB NORM ****	AIRPORT NAVIGATION SYSTEM	FORECAST AIRCRAFT MOVEMENT	DESIGN SERVICE YEARS	FUNCTION GOVERNED	AMC	ICC	PCV	THICKNESS ****
RW 5	0.- 30.	KEEL	0.12	145.	5000.	LIGHTS/ILS	FAMSUG	20	DEF/DI				16.2
RW 5	30.- 60.	KEEL	0.12	145.	5000.	LIGHTS/ILS	FAMSUG	20	DEF/DI				13.1
RW 5	60.- 90.	KEEL	0.12	145.	5000.	LIGHTS/ILS	FAMSUG	20	STR/MT				8.8
RW 5	0.- 30.	SIDE	0.18	145.	5000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 5	30.- 60.	SIDE	0.18	145.	5000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 5	60.- 90.	SIDE	0.18	145.	5000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 15	0.- 30.	KEEL	0.12	145.	15000.	LIGHTS/ILS	FAMSUG	20	STR/MT				9.4
RW 15	30.- 60.	KEEL	0.12	145.	15000.	LIGHTS/ILS	FAMSUG	20	STR/MT				6.7
RW 15	60.- 90.	KEEL	0.12	145.	15000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 15	0.- 30.	SIDE	0.18	145.	15000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 15	30.- 60.	SIDE	0.18	145.	15000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 15	60.- 90.	SIDE	0.18	145.	15000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 35	0.- 30.	KEEL	0.12	145.	35000.	LIGHTS/ILS	FAMSUG	20	STR/MT				6.7
RW 35	30.- 60.	KEEL	0.12	145.	35000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 35	60.- 90.	KEEL	0.12	145.	35000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 35	0.- 30.	SIDE	0.18	145.	35000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 35	30.- 60.	SIDE	0.18	145.	35000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 35	60.- 90.	SIDE	0.18	145.	35000.	LIGHTS/ILS	FAMSUG	20	STR/MT				4.0
RW 5	0.- 30.	KEEL	0.12	145.	5000.	NORM/VISUAL	FAMSUG	20	DEF/DI				17.1
RW 5	30.- 60.	KEEL	0.12	145.	5000.	NORM/VISUAL	FAMSUG	20	DEF/DI				11.9
RW 5	60.- 90.	KEEL	0.12	145.	5000.	NORM/VISUAL	FAMSUG	20	STR/MT				8.2
RW 5	0.- 30.	SIDE	0.18	145.	5000.	NORM/VISUAL	FAMSUG	20	STR/MT				4.0
RW 5	30.- 60.	SIDE	0.18	145.	5000.	NORM/VISUAL	FAMSUG	20	STR/MT				4.0
RW 5	60.- 90.	SIDE	0.18	145.	5000.	NORM/VISUAL	FAMSUG	20	STR/MT				4.0

APPENDIX 1 OS 360 JOB CONTROL CARDS FOR OPERATION AT TCC

The program set-ups consist of a single procedure, MLGPAV. The procedure may be stored on a permanent data set and referenced through use of the PROCLIB DD card. If not stored, then an instream procedure on cards is necessary. The following is the deck necessary for executing the MLGPAV program at TCC:

```
//JOBNAME JOB
Instream procedure or //PROCLIB DD
// EXEC MLGPAV, TIME.MLGPAV=150
//MLGPAV.INPUT DD *
Job card
Aircraft data group
/*
```

The procedures assume the load module data set, DYLM and the default input data set, DYDT are on a single removable 3330 disk pack D0012. Several temporary data sets, as required, are allocated on any 2 available scratch packs. The temporary data sets may be placed on the pack, D00012, but the wall clock execution time will increase due to arm contention.

JOB CONTROL CARDS

```
//MLGPAV PROC
//MLGPAV EXEC PGM=GOL,REGION=290K
//STEPLIB DD DSNAME=DYLM,DISP=SHR,UNIT=3330,
// VOL=(PRIVATE,RETAIN,,,SER=D00012)
//FT03F001 DD DSNAME=DYDT,DISP=SHR,UNIT=3330,VOL=SER=D00012
//FT04F001 DD DDNAME=INPUT
//FT05F001 DD UNIT=(SYSDA,SEP=STEPLIB),VOL=(PRIVATE,RETAIN),
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT06F001 DD SYSOUT=A
//FT07F001 DD UNIT=SYSDA,VOL=REF=*.FT05F001,
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT08F001 DD UNIT=SYSDA,VOL=REF=*.FT05F001,
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT09F001 DD UNIT=(SYSDA,SEP=(STEPLIB,FT05F001)),VOL=(PRIVATE,RETAIN),
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT10F001 DD UNIT=SYSDA,VOL=REF=*.FT05F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT11F001 DD UNIT=3330,VOL=SER=D00012,
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT12F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT13F001 DD UNIT=3330,VOL=SER=D00012,
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT14F001 DD UNIT=SYSDA,VOL=REF=*.FT05F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT15F001 DD DUMMY
```

```
//FT16F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT17F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT18F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT19F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(2,2)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT20F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(2,2)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
//FT21F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT22F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT23F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT24F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT25F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT26F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(2,2)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT27F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT28F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT29F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT30F001 DD UNIT=SYSDA,VOL=REF=*.FT09F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT31F001 DD UNIT=SYSDA,VOL=REF=*.FT05F001,
// SPACE=(CYL,(1,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT32F001 DD UNIT=SYSDA,VOL=REF=*.FT05F001,
// SPACE=(CYL,(4,4)),DCB=(RECFM=VSB,LRECL=1284,BLKSIZE=2572)
// PEND
```

APPENDIX 2 BASIC FORTRAN LISTING

A2.05 SUBROUTINE NDT3
Compute NDT inventory file

A2.06 SUBROUTINE CALC(1)
Compute Poisson's Ratio, and aircraft operational weights

A2.07 SUBROUTINE CALC(2)
Longitudinal and transverse wheel probability distribution

A2.08 SUBROUTINE PAVDES
Equivalent single type aircraft operation and unit price of pavement components

A2.09 SUBROUTINE FAM
Forecast of aircraft movement for equivalency computation

A2.10 SUBROUTINE HDES
Limiting stress and deflection in pavement thickness design

A2.11 SUBROUTINE PCVCAL
Compute present cash value

A2.05 Subroutine NDT3

```
      DO 600 J=1,ISEPAV
      IF(K.NE.IPFL(J))GO TO 600
      WZ=2.*200.*9.*VALC(KP,10)/SEVAL(J)
      IF(WZ.LT.WZH(1,1))GO TO 520
      EV=PFLESG(1)*.75
      GO TO 540
  520 DO 530 I=2,NFLESG
      IF(WZ.LT.WZH(1,I))GO TO 530
      EV=(PFLESG(I)-PFLESG(I-1))*(WZ-WZH(1,I-1))
     +/(WZH(1,I)-WZH(1,I-1))+PFLESG(I-1)
      GO TO 540
  530 CONTINUE
      EV=PFLESG(NFLESG)*1.25
  540 IF(MDRAIN(J).EQ.MNORM)GO TO 550
      IS=J
      I1=ISEPAV+J
      EPAV(I1)=SEVAL(J)
      ESUB(I1)=EV
      ESUB(J)=EV/.6
      GO TO 560
  550 IS=ISEPAV+J
      EPAV(J)=SEVAL(J)
      ESUB(J)=EV
      I1=ISEPAV+J
      ESUB(I1)=.6*EV
  560 IF(ESUB(IS).GT.PFLESG(1))GO TO 570
      WZA=WZH(1,1)+.25*(WZH(1,1)-WZH(1,2))
      GO TO 590
  570 DO 580 I=2,NFLESG
      IF(ESUB(IS).GT.PFLESG(I))GO TO 580
      WZA=(WZH(1,I)-WZH(1,I-1))*(ESUB(IS)-PFLESG(I-1))
     +/(PFLESG(I)-PFLESG(I-1))+WZH(1,I-1)
      GO TO 590
  580 CONTINUE
      WZA=WZH(1,NFLESG)-.25*(WZH(1,NFLESG-1)-WZH(1,NFLESG))
  590 EPAV(IS)=SEVAL(J)*WZ/WZA
  600 CONTINUE
```

A2.06 Subroutine CALC(1)

```
      C *** APY
            APY(I)=0.
            N=NWHEEL(I)
            DO 420 J=1,N
            IF(WHEELX(I,J).NE.0.)GO TO 420
            APY(I)=APY(I)+EXP(-(WHEELY(I,J)/(12.*450.))**2/2.)
        420 CONTINUE
            DO 450 J=1,3
      C *** RADIUS FACTOR
            RADIUS(I,J)=SQRT(.31830987E0*DPWGT(L,J)*AIRC(I,5)/AIRC(I,6))
            FACTOR(I,J)=0.
            T1=(3./8.)**2
            T2=(15./48.)**2
            DO 440 K=1,N
            WX=SQRT(ABS(WHEELX(I,K)**2)+ABS(WHEELY(I,K)**2))
            IF(WX.NE.0.)GO TO 430
            FACTOR(I,J)=FACTOR(I,J)+1.
            GO TO 440
        430 YK=(RADIUS(I,J)/WX)**2
            WK=1.5708*(1.+.25*YK+T1*YK**2+T2*YK**3)
            WE=1.5708*(1.-.25*YK-T1*YK**2/3.-T2*YK**3/5.)
            FIRM=2./3.14159*WX/RADIUS(I,J)*(WE-(1-YK)*WK)
            FACTOR(I,J)=FACTOR(I,J)+FIRM
        440 CONTINUE
        450 CONTINUE
            APY(I)=APY(I)*.00157*RADIUS(I,3)/12.
        460 CONTINUE
            ID=IDESI(1)
            RADIUS(20,1)=SQRT(.31830987E0*DJPWGT(1)*AIRC(ID,5)/AIRC(ID,6))
      C *** APX
            DO 560 K=1,NBAND
            IAPX=NTYPE*(K-1)
            DO 550 LA=1,NTYPE
            L=IAPX+LA
            DO 540 M=1,NOPWGT
            I=IAIRC(M)
            IF(I.LE.0)GO TO 540
            NW=NWHEEL(I)
            DO 530 J=1,3
            APX(I,J,L)=0.
            DO 520 N=1,NW
            APX(I,J,L)=APX(I,J,L)+EXP(-10.8167*
           +(WHEELX(I,N)/(12.*BAND(K,LA)))**2)
        520 CONTINUE
            APX(I,J,L)=APX(I,J,L)*3.2886*RADIUS(I,J)/(12.*BAND(K,LA))
        530 CONTINUE
        540 CONTINUE
```

A2.07 Subroutine CALC(2)

```
C *** PAVL CODE LAYE
      DO 260 I=1,NPAVL
  230 N=NLAYER(I)
      DO 250 J=1,N
      DO 240 K=1,NLAY
      IF(LAYER(I,J,1).NE.MLAY(K,1))GO TO 240
      IF(LAYER(I,J,2).NE.MLAY(K,2))GO TO 240
      ILAYER(I,J)=K
      IF(EVAL(I,J).LT.1.)EVAL(I,J)=VALAY(K,1)
      IF(PDIS(I,J).LT.0.001)PDIS(I,J)=.65-.08*ALOG10(EVAL(I,J))
      GO TO 250
  240 CONTINUE
C *** ERROR
  250 CONTINUE
  260 CONTINUE
C *** AIRC CODE TOW
      DO 255 I=1,NAIRC
      IALF(I)=0
      IRANGE(I)=0
  255 CONTINUE
      DO 270 K=1,NOPWGT
      I=IAIRC(K)
      IF(I.LE.0)GO TO 270
      IRANGE(I)=1
      IF(LRANGE(K,1).NE.IBLANK)GO TO 261
      LRANGE(K,1)=MRANG(I,1)
      LRANGE(K,2)=MRANG(I,2)
  261 DO 262 J=1,4
      IF(LRANGE(K,1).NE.MRANGE(J))GO TO 262
      IRANGE(I)=J
      GO TO 263
  262 CONTINUE
  263 IALF(I)=1
      IF(LALF(K,1).EQ.MALF(2))IALF(I)=2
      L=IALF(I)
      J=IRANGE(I)
      IF(LALF(K,1).EQ.IBLANK.AND.TOW(J,I,L).GT.1.
     +.AND.OPWGT(K,1).LT.1.)LALF(K,1)=MALF(1)
      IF(TOW(J,I,L).LT.1..AND.OPWGT(K,1).LT.1.)OPWGT(K,1)=AIRC(I,1)
      IF(OPWGT(K,1).LT.1.)OPWGT(K,1)=TOW(J,I,L)
      IF(OPWGT(K,2).LT.1.)OPWGT(K,2)=(AIRC(I,2)-AIRC(I,3))
     +*(OPWGT(K,1)-AIRC(I,3))/(AIRC(I,1)-AIRC(I,3))+AIRC(I,3)
      IF(OPWGT(K,3).LT.1.)OPWGT(K,3)=1.5*OPWGT(K,2)
  270 CONTINUE
```

A2.08 Subroutine PAVDES

```
 1317 ELAY=EVAL(KM,IHSA)
      EBOT=EVAL(KM,NL)
 1318 CONSTA=VALC(KB,2)*SQRT(ELAY)*VALC(KB,3)*(1.-VALC(KB,4))
      DO 1330 IA=1,NOPWGT
      I=IAIRC(IA)
      IF(I.LE.0)GO TO 1330
      DO 1320 J=1,3
      ANS(I,J)=-(ABS(STRFD(KAA))-ABS(STRFAM(I,J)))/CONSTA
 1320 CONTINUE
 1330 CONTINUE
      ANS(20,1)=0.
      DO 1350 IA=1,NOPWGT
      I=IAIRC(IA)
      IF(I.LE.0)GO TO 1350
      DO 1340 J=1,3
      FACTOR(I,J)=WZFAM(I,J)/WZW(I,J)
      PRESS=AIRC(I,6)*FACTOR(I,J)
      WO=2.*PRESS*RADIUS(I,J)*VALC(KB,10)/EBOT
      D4=1./VALC(KB,8)
      DODEF=WO**(1.-D4)*WZFAM(I,J)**D4*VALC(KB,7)**(-D4)
      AND(I,J)=DODEF
 1340 CONTINUE
 1350 CONTINUE
      FACTOR(20,1)=WZFD(KAA)/WZWFD(KAA)
      PRESS=AIRC(ID,6)*FACTOR(20,1)
      WO=2.*PRESS*RADIUS(20,1)*VALC(KB,10)/EBOT
      AND(20,1)=WO**(1.-D4)*WZFD(KAA)**D4*VALC(KB,7)**(-D4)
      DO 1376 I=1,NPAVHD
      IF(IPAVL(I).EQ.ICL)GO TO 1374
      IF(IPAVL(I).GT.ICL)GO TO 1372
      REWIND 9
      ICL=0
 1372 ICL=ICL+1
      IF(IFAMDS(ICL,1).LE.0)GO TO 1372
      READ(9)((ANS(IA,J),AND(IA,J),FACTOR(IA,J),IA=1,20),J=1,3)
      IF(IPAVL(I).NE.ICL)GO TO 1372
 1374 WRITE(12)((ANS(IA,J),AND(IA,J),FACTOR(IA,J),IA=1,20),J=1,3)
 1376 CONTINUE
      ENDFILE 12
      REWIND 12
      REWIND 9
      REWIND L18
      NSLP=FINA(6)
      ASCM=(FINA(4)+FINA(3)-FINA(2))-FINA(2)*(FINA(3)+FINA(4))
      PCVAMC=FLOAT(NSLP-1)*(1.+FLOAT(NSLP-2)*ASCM/2.*
     +(1.+FLOAT(NSLP-3)*ASCM/3.))
      AIRBV=1.-1./(1.+FINA(1))
      PCVICC=1.-(FINA(5)-2.)*(FINA(2)-AIRBV)/2.*
     +(1.-(FINA(5)-3.)*FINA(2)/3.)
```

A2.09 Subroutine FAM

```
          DO 415 J=1,3
          ANSA(I,J)=10.**(ANS(I,J)/(OVERSF/(1.+DI(LOC,ITYP))))
      415 CONTINUE
          DO 420 J=1,3
C         CONST=2.28
C         C1=.01
C         DD=SQRT(DI(LOC,ITYP)/(1.+DI(LOC,ITYP)))
C         VV=DD*VEL(LOC,ITYP)+60.*(1.-DD)
C         XX=8.6*FACTOR(I,J)+XNZ(I)/RADIUS(I,J)
C         AK=CONST/VV*DI(LOC,ITYP)/SQRT(AIRC(I,7))
C         AAK=10.**(VALC(KP,5)*ALOG10(AK/VALC(KP,6)))
C         DN=12.*AAK*SQRT(XX*RADIUS(I,J)/12.)
C         ANDB(I,J)=(DN-C1)/AND(I,J)
          ANDA(I,J)=10.**((AND(I,J)-AND(20,1))/AND(I,J))
      420 CONTINUE
C         IF(KPAV(KP).LE.1)WRITE(6,40)DI(LOC,ITYP),VEL(LOC,ITYP),
C        +(FACTOR(I,J),J=1,3),XNZ(I),(RADIUS(I,J),J=1,3),AIRC(I,7),
C        +VALC(KP,5),VALC(KP,6)
C      40 FORMAT(1X,12F11.6)
      425 CONTINUE
C         XX=8.6*FACTOR(20,1)+XNZ(ID)/RADIUS(20,1)
C         AK=CONST/VV*DI(LOC,ITYP)/SQRT(AIRC(ID,7))
C         AAK=10.**(VALC(KP,5)*ALOG10(AK/VALC(KP,6)))
C         DN=12.*AAK*SQRT(XX*RADIUS(20,1)/12.)
C         ANDB(20,1)=(DN-C1)/AND(20,1)
          ANDA(20,1)=1.
C         IF(KPAV(KP).LE.1)
C        +WRITE(6,30)((AND(I,J),J=1,3),I=1,12)
C         IF(KPAV(KP).LE.1)
C        +WRITE(6,30)AND(20,1)
C      30 FORMAT(1X,1PE13.5)
          DO 600 K=1,NST1
C         DO 440 IA=1,NCPWGT
C         I=IAIRC(IA)
C         IF(I.LE.0)GO TO 440
C         DO 430 J=1,3
C         ANDA(I,J)=1.
C         IF(ATM(K,IA,J).LE.0.0001)GO TO 430
C         ANDA(I,J)=10.**((ANDB(20,1)-ANDB(I,J))
C        +)
C        +*ALOG10(ATM(K,IA,J)*APX(I,J,IAPX))/ANDB(20,1))
C     430 CONTINUE
C     440 CONTINUE
C *** ANNS
          DO 450 J=1,3
      450 SUMNUV(J)=0.
          DO 470 IA=1,NCPWGT
          I=IAIRC(IA)
          IF(I.LE.0)GO TO 470
          DO 460 J=1,3
          ANS(I,J)=ATM(K,IA,J)*ANSA(I,J)*APX(I,J,IAPX)
```

A2.09 Subroutine FAM (cont'd)

```
      SEGMOV(J)=SEGMOV(J)+ATM(K,IA,J)*ANSA(I,J)*APX(I,J,IAPX)
  460 CONTINUE
      J=3
      EQS(I,J)=0.
      IF(NW.GT.2)EQS(I,J)=ATM(K,IA,J)*ANSA(I,J)*APX(I,J,IAPX)
     +*APY(I)
      IF(NW.GT.2)SEGMOV(J)=SEGMOV(J)+ATM(K,IA,J)*ANSA(I,J)*
     +APX(I,J,IAPX)*APY(I)
  470 CONTINUE
      AANS(K,LOC)=0.
      DO 480 J=1,NW
      AANS(K,LOC)=AANS(K,LOC)+SEGMOV(J)
  480 CONTINUE
      AANS(K,LOC)=AANS(K,LOC)*SPERC(LOC)
C *** AAND
      DO 490 J=1,3
  490 DEGMOV(J)=0.
      DO 510 IA=1,NOPWGT
      I=IAIRC(IA)
      IF(I.LE.0)GO TO 510
      DO 500 J=1,2
      EQD(I,J)=0.
      ALND=0.
      IF(ATM(K,IA,J).GT.0.1)
     +ALND=ALOG10(ATM(K,IA,J)*APX(I,J,IAPX))
      IF(ALND.GT.3.)ALND=3.
      IF(ATM(K,IA,J).GT.0.1)
     +EQD(I,J)=(ANDA(I,J)**ALND)
     +*ATM(K,IA,J)*APX(I,J,IAPX)
      DEGMOV(J)=DEGMOV(J)+EQD(I,J)
  500 CONTINUE
      J=3
      EQD(I,J)=0.
      ALND=0.
      IF(NW.GT.2.AND.ATM(K,IA,J).GT.0.1)
     +ALND=ALOG10(ATM(K,IA,J)*APX(I,J,IAPX)*APY(I))
      IF(ALND.GT.3.)ALND=3.
      IF(NW.GT.2.AND.ATM(K,IA,J).GT.0.1)
     +EQD(I,J)=(ANDA(I,J)**ALND)
     +*ATM(K,IA,J)*APX(I,J,IAPX)*APY(I)
      IF(NW.GT.2)DEGMOV(J)=DEGMOV(J)+EQD(I,J)
  510 CONTINUE
      AAND(K,LOC)=0.
      DO 520 J=1,NW
      AAND(K,LOC)=AAND(K,LOC)+DEGMOV(J)
  520 CONTINUE
      AAND(K,LOC)=AAND(K,LOC)*SPERC(LOC)
```

A2.10 Subroutine HDES

```
      C *** STRESS LIMIT
            NL=NLAYER(KM)
            NL1=NL-1
            DO 190 J=1,NL1
            STRL(K,LOC,J)=SQRT(EVAL(KM,J))*(1.-VALC(KP,3)*
           +ALOG10(AANS(K,LOC)))/(1.+DI(LOC,ITYP))
            STRL(K,LOC,J)=STRL(K,LOC,J)*VALC(KP,2)
            OVERSF=VALC(KP,1)
            IF(LOC.GT.1)OVERSF=VALC(KP,9)
            STRL(K,LOC,J)=STRL(K,LOC,J)*OVERSF*(1.-VALC(KP,4))
        190 CONTINUE
            IF(KN.LE.0)GO TO 197
            NLA=NPSLAY(KN)
            NLA1=NLA-1
            DO 195 J1=1,NLA1
            J=J1+NL1
            STRL(K,LOC,J)=SQRT(PSLE(KN,J1))*(1.-VALC(KP,3)*
           +ALOG10(AANS(K,LOC)))/(1.+DI(LOC,ITYP))
            STRL(K,LOC,J)=STRL(K,LOC,J)*VALC(KP,2)
            OVERSF=VALC(KP,1)
            IF(LOC.GT.1)OVERSF=VALC(KP,9)
            STRL(K,LOC,J)=STRL(K,LOC,J)*OVERSF*(1.-VALC(KP,4))
        195 CONTINUE
      C *** WZL
        197 CONST=2.28
            C1=.01
            XX=8.6*FACTOR(20,1)+XNZ(ID)/RADIUS(20,1)
            PRESS=AIRC(ID,6)*FACTOR(20,1)
            DD=SQRT(DI(LOC,ITYP)/(1.+DI(LOC,ITYP)))
            VV=DD*VEL(LOC,ITYP)+60.*(1.-DD)
            AK=CONST/VV*DI(LOC,ITYP)/SQRT(AIRC(ID,7))
      C     WRITE(6,20)KP,AK,VALC(KP,6)
      C  20 FORMAT(1X,I5,2F10.4)
            AAK=10.**(VALC(KP,5)*ALOG10(AK/VALC(KP,6)))
            DN=12.*AAK*SQRT(XX*RADIUS(20,1)/12.)
            EBOT=EVAL(KM,NL)
            IF(KN.GT.0)EBOT=PSLE(KN,NLA)
            WO=2.*PRESS*RADIUS(20,1)*VALC(KP,10)/EBOT
            D3=VALC(KP,7)*WO**(1.-VALC(KP,8))
            IF(AAND(K,LOC).LE.10.)WZL(K,LOC)=(DN-C1)**VALC(KP,8)
            IF(AAND(K,LOC).GT.10.)
           +WZL(K,LOC)=((DN-C1)/ALOG10(AAND(K,LOC)))**VALC(KP,8)
            D4=1./VALC(KP,8)
            DODEF=VALC(KP,7)**(-D4)
            IF(NXSL.LE.1)WZL(K,LOC)=(DN-C1)
      C *** WO AND D3 TO BE CALCULATED LATER
      C *** SHOULD USE ESUP
```

```
      360 IST=IST-1
      370 I1=IEST+IES
          ESUP(K)=ESUB(I1)
          NL=NLAYER(KM)
          NL1=NL-1
          PRESS=AIRC(ID,6)*FACTOR(20,1)
          WO=2.*PRESS*RADIUS(20,1)*VALC(KP,10)/ESUP(K)
          D3=VALC(KP,7)*WO**(1.-VALC(KP,8))
          D4=1./VALC(KP,8)
          LOC2=2
          IF(NXSL.LE.1)GO TO 501
          DO 373 LOC=1,LOC2
          WZLIM(K,LOC)=D3*WZL(IST,LOC)
          TAND(K,LOC)=AAND(IST,LOC)
          TANS(K,LOC)=AANS(IST,LOC)
          DO 371 J=1,NL1
          STRLIM(K,LOC,J)=STRL(IST,LOC,J)
      371 CONTINUE
          IF(KN.LE.0)GO TO 373
          DO 372 J1=1,NLA1
          J=J1+NL1
          STRLIM(K,LOC,J)=STRL(IST,LOC,J)
      372 CONTINUE
      373 CONTINUE
    C *** INTERPOLATE EVALUE
          IF(ESUB(I1).GT.ESUBG(1))GO TO 375
    C *** ERROR
      375 DO 380 I=2,NE
          IF(ESUB(I1).EQ.ESUBG(I))GO TO 390
          IF(ESUB(I1).LT.ESUBG(I))GO TO 410
      380 CONTINUE
    C *** ERROR
          I=NE
          GO TO 410
      390 DO 400 N=1,NHG
          WZ(N)=WZH(N,I)
          STR(N)=STRH(N,I)
      400 CONTINUE
          GO TO 422
      410 DO 420 N=1,NHG
          WZ(N)=(WZH(N,I)-WZH(N,I-1))*(ESUB(I1)-ESUBG(I-1))
         +/(ESUBG(I)-ESUBG(I-1))+WZH(N,I-1)
          STR(N)=(STRH(N,I)-STRH(N,I-1))*(ESUB(I1)-ESUBG(I-1))
         +/(ESUBG(I)-ESUBG(I-1))+STRH(N,I-1)
      420 CONTINUE
      422 DO 500 J=1,2
          IF(WZLIM(K,J).LT.WZ(1))GO TO 425
          HDES(K,J)=HVAL(KM,1)
          GO TO 460
      425 DO 430 N=2,NHG
          IF(WZLIM(K,J).GE.WZ(N))GO TO 450
      430 CONTINUE
```

```
      HDES(K,J)=HVAL(KM,2)+HVAL(KM,3)/2.
      ICRIT(K,J)=-1
      GO TO 500
  450 HDES(K,J)=(HGRID(KM,N)-HGRID(KM,N-1))*(WZLIM(K,J)-WZ(N-1))
     +/(WZ(N)-WZ(N-1))+HGRID(KM,N-1)
  460 IH=IPAVHS(KI)
      IF(KN.GT.0)IH=IH+NL1
      IF(STRLIM(K,J,IH).LT.STR(1))GO TO 465
      H=HVAL(KM,1)
      GO TO 480
  465 DO 470 N=2,NHG
      IF(STRLIM(K,J,IH).GE.STR(N))GO TO 475
  470 CONTINUE
      HDES(K,J)=HVAL(KM,2)+HVAL(KM,3)/2.
      ICRIT(K,J)=1
      GO TO 500
  475 H=(HGRID(KM,N)-HGRID(KM,N-1))*(STRLIM(K,J,IH)-STR(N-1))
     +/(STR(N)-STR(N-1))+HGRID(KM,N-1)
  480 ICRIT(K,J)=-1
      IF(HDES(K,J).GT.H)GO TO 500
      HDES(K,J)=H
      ICRIT(K,J)=1
  500 CONTINUE
      GO TO 510
  501 IP=IPFL(I1)
      IF(ESUP(K).GT.PFLESG(1))GO TO 502
      WZ(IP)=WZH(IP,1)+.25*(WZH(IP,1)-WZH(IP,2))
      STR(IP)=STRH(IP,1)+.25*(STRH(IP,1)-STRH(IP,2))
      GO TO 504
  502 DO 503 I=2,NFLESG
      IF(ESUP(K).GT.PFLESG(I))GO TO 503
      WZ(IP)=(WZH(IP,I)-WZH(IP,I-1))*(ESUP(K)-PFLESG(I-1))
     +/(PFLESG(I)-PFLESG(I-1))+WZH(IP,I-1)
      STR(IP)=(STRH(IP,I)-STRH(IP,I-1))*(ESUP(K)-PFLESG(I-1))
     +/(PFLESG(I)-PFLESG(I-1))+STRH(IP,I-1)
      GO TO 504
  503 CONTINUE
      WZ(IP)=WZH(IP,NFLESG)-.25*(WZH(IP,NFLESG-1)-WZH(IP,NFLESG))
      STR(IP)=STRH(IP,NFLESG)-.25*(STRH(IP,NFLESG-1)-STRH(IP,NFLESG))
C 504 DCDEF=WO**(1.-D4)*WZ(IP)**D4*VALC(KP,7)**(-D4)
  504 DCDEF=ESUB(I1)/(VALC(KP,7)*EPAV(I1))
      DCDEF=WO*10.**(D4*ALOG10(DCDEF))
      TAND(K,1)=AAND(IST,1)
C     TAND(K,2)=10.**(WZL(IST,1)/DCDEF)
      TAND(K,2)=(WZL(IST,1)/DCDEF)
      IF(TAND(K,2).GT.30.)TAND(K,2)=30.
      TAND(K,2)=10.**TAND(K,2)
      TANS(K,1)=AANS(IST,1)
      IH=IHS(IP)
      SIGY=VALC(KP,1)*(1.-VALC(KP,4))*VALC(KP,2)*SQRT(EVAL(IP,IH))
      SIGY=SIGY/(1.+DI(1,ITYP))
C     TANS(K,2)=10.**((SIGY-STR(IP))/(VALC(KP,3)*SIGY))
      TANS(K,2)=((SIGY-STR(IP))/(VALC(KP,3)*SIGY))
      TANS(K,2)=10.**TANS(K,2)
  510 CONTINUE
```

A2.11 Subroutine PCVCAL

```
      DO 300 LOC=1,2
      DO 200 K=1,NASTI
      IHSA=IPATHS(K1)
      IF(KM.LE.0)ELAY=CVAL(KM,IHSA)
      IF(KM.GT.0)ELAY=PSLE(KM,IHSA)
      IF(KM.GT.0)IHSA=IHSA+NLAYER(KM)-1
      IM=IHS(KM)
      IL=ILAYER(KM,IM)
      AICC(K,LOC)=CCST(KM)+HDES(K,LOC)*UL(IL)
      ULSTR=VALC(KP,2)*SQRT(ELAY)*(1.-VALC(KP,4))
      WCSTR=ULSTR*(1.-VALC(KP,3)*ALOG10(TAMS(K,LOC)))
      OVERSF=VALC(KP,1)
      IF(LOC.GT.1)OVERSF=VALC(KP,9)
      ZMC=VALC(KP,4)*OVERSF*(ULSTR-WCSTR)/(ULSTR-STRLIM(K,LOC,IHSA)
     +/OVERSF)
      AMC(K,LOC)=ZMC*UL(IL)
      PCV(K,LOC)=AMC(K,LOC)*PCVAMC+AICC(K,LOC)*PCVICC
  200 CONTINUE
  300 CONTINUE
      IF(ESTA(IXFAC,2).GT.0.00)GO TO 320
      APCV(1)=PCV(1,1)
      APCV(2)=PCV(1,2)
      GO TO 900
  320 DO 400 LOC=1,2
      APCV(LOC)=0.
      DO 350 K=1,NASTI
      APCV(LOC)=APCV(LOC)+PCV(K,LOC)*(ASTA(K+1)-ASTA(K))
  350 CONTINUE
      APCV(LOC)=APCV(LOC)/(ASTA(NAST)-ASTA(1))
  400 CONTINUE
```