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A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME IX - USER'S MANUAL

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Rockwell International Corporation

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Deputy for Development Planning

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
Three computer programs were written with the objective of predicting the structural weight of aircraft through analytical methods. The first program, the structural weight estimation program (SWEEP), is a completely integrated program including routines for airloads, loads spectra, skin temperatures, material properties, flutter stiffness requirements, fatigue life, structural sizing, and for weight estimation of each of the major aircraft structural components. The program produces first-order weight estimates

and indicates trends when parameters are varied. Fighters, bombers, and cargo aircraft can be analyzed by the program. The program operates within 100,000 octal units on the Control Data Corporation 6600 computer. Two stand-alone programs operating within 100,000 octal units were also developed to provide optional data sources for SWEEP. These include (1) the flexible airloads program to assess the effects of flexibility on lifting surface airloads, and (2) the flutter optimization program to optimize the stiffness distribution required for lifting surface flutter prevention.

The final report is composed of 11 volumes. This volume (Volume IX) contains the instructions and input descriptions for use of the integrated SWEEP program.

PREFACE

This report was prepared by Rockwell International Corporation, Los Angeles Aircraft Division, Los Angeles, California, under Contract F33615-71-C-1922, No. FX2826-71-01876/C093. The work was performed for the Deputy for Development Planning, Air Force System Command, Wright-Patterson Air Force Base, Ohio, and extended from September 1971 to June 1974.

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D. Konishi - Advanced Composites
C. Hodson - Structural Dynamics

The final report was published in 11 volumes; the complete list is as follows:

Volume

I "Executive Summary"
II "Program Integration and Data Management Module"
III "Airloads Estimation Module"
IV "Material Properties, Structure Temperature, Flutter, and Fatigue"
V "Air Induction System and Landing Gear Modules"
VI "Wing and Empennage Module"
VII "Fuselage Module"
VIII "Programmer's Manual"
IX "User's Manual"
X "Flutter Optimization Stand-Alone Program"
XI "Flexible Airloads Stand-Alone Program"

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INTRODUCTION TO VOLUME IX

This volume contains instructions for the operation of the Structural Weight Estimation Program (SWEEP) developed under contract F33615-71-C-1922. Included are descriptions for deck setup, required input data, and program controls. Options for input of design data and operations of special features of the program are also described.

Options are provided for the generation and punching of design and mass distribution data for use with the Flutter Optimization Program and the Flexible Loads Analysis Program also developed under this contract. User instructions for these two programs are described in Volume X and XI, respectively.

Section I

PROGRAM OPERATION

INTRODUCTION

The analytical structural weight prediction procedure in SWEEP is an integration of methods formulated to describe design criteria and constraints of aircraft components, synthesize structure to these requirements, and develop mass properties data. The various procedures, engineering methods, and computer programming techniques used in SWEEP provide comprehensive structural weight data in a single computer run.

The program is structured in a modular form which provides the user with multiple modes of operation. It is designed to operate as a fully integrated system such that compatible design constraints are satisfied during analysis of each structural component. SWEEP can also be used in stand-alone modes to evaluate individual components or develop design criteria. A stacked case capability is also provided which permits variation of any single design parameter without repeating other data.

The programmed approach provides flexibility in the type of problem that may be addressed and the magnitude of data that may be input. It is possible to execute any combination of modules appropriate to the problem by inputing only the pertinent data decks. The modules are groups of routines that perform related computations in the structural design and synthesis process. The 10 SWEEP modules which perform control and/or computational functions are:

1. The executive module, level (0,0) overlay, calls the data processing module and other modules as specified in the control data.

2. The data processing module, level (1,0) overlay, reads all input data, initializes mass storage, and transfers variable data to the fuselage and air-induction system data blocks.

3. The data management module, level (2,0) overlay organizes vehicle geometric data and design criteria for the loads module. It develops initial estimates of weight and inertia characteristics for a three-dimensional model of the flight vehicle. In addition, it calculates data required for the weight synthesis modules.

4. The flutter and temperature module, level (3,0) overlay, determines the compressible dynamic pressures which are critical for flutter prevention design of the wing, horizontal, and vertical tails. It

also calculates equilibrium skin temperature for each flight design condition. This module is called after execution of the data management module.

5. The loads module, level (4,0) overlay, calculates gross airloads on each structural component and distributed airloads on wing and tail surfaces. This module can be requested to evaluate up to 23 different flight design conditions. When directed, it also calculates wing bending moment fatigue spectrum data for fatigue analysis.

6. The fatigue module, level (5,0) overlay, evaluates spectrum data for wing and fuselage components. The allowable design tensile stress of the lower cover is the result of the wing fatigue analysis. The tensile stress allowable under pressure cycling and the endurance limit for sonic fatigue analysis are calculated for fuselage panel design.

7. The landing gear module, level (6,0) overlay, estimates the weight of the running gear. Analytical, empirical, and statistical methods are employed to calculate component weights.

8. The air-induction system module, level (7,0) overlay, estimates the weight of the engine section, nacelles, and air-induction systems. The air-induction system estimating procedure includes methods for fixed ducts, variable-geometry ramps, and three-dimensional inlet spikes.

9. The wing and empennage module - level (8,0) (9,0), (10,0), (14,0), (15,0), (16,0), (17,0), and (18,0) overlays - estimates the weight of the wing, horizontal tail, and vertical tail. In the integrated form, execution of this module is repeated for the analysis of each surface. Structural concepts, optimization, options, and materials are some of the program variables.

10. The fuselage module, level (11,0) and (12,0) overlays, provides fuselage weight estimates. The weight estimates are a product of the evaluation of geometry, construction, material properties, temperature, loads, pressure, acoustic fatigue, flutter and stiffness requirements, and design features.

11. The output module, level (13,0) overlay, presents the group weight statement and balance results of the synthesized vehicle as well as a summary of the initial design assumptions.

Geometry definitions are based on mathematical approximations of vehicle physical features and structural arrangements. These definitions provide for weight sensitivity to configuration geometry and to geometric variations. The structural synthesis/weight analysis modules are designed to analytically evaluate design requirements and criteria and to synthesize structures for specified materials and structural concepts. Structural elements are analyzed to satisfy strength, stiffness, life, local stability, and general stability requirements. The synthesis can be controlled to produce material sizing reflecting unconstrained "optimum" structural arrangements or to evaluate material requirements for design constraints resulting from compromises due to cost, producibility, maintainability, or unique local considerations. Some of these design constraints are:

1. Specified frame, stringer, rib, or spar spacings
2. Longeron locations
3. Frame or stringer geometry limits
4. Material minimum gages or fabrication minimums
5. Cutout sizes and locations
6. Bulkhead locations

Program logic is provided so that options are available to (1) control the scope of the analysis and the types of design information to be printed, and (2) provide for bypassing certain design data computations by inputing the pertinent information. The latter approach would be employed to substitute advanced engineering data which become available during the design cycle. Examples of this type of data are local description of geometry, gross design or net loads, and flutter stiffness requirements.

PROGRAM DESCRIPTION

SWEEP is an integrated program written in FORTRAN IV for the CDC 6600 computer system at WPAFB. It is programmed in modular form using one level of overlay. The main overlay consists of the SWEEP control program, OLAY00, which is identified as overlay (0,0). Specific control, data manipulation, and computation functions are performed in subprograms identified as overlays (n,0), where n is the unique integer assigned to each primary overlay.

The basic program is structured to operate within a total of 50,000 octal (20,480 decimal) core locations. An appended version of SWEEP, programmed for analysis of advanced composite wing and empennage torque-box structures, is designed to operate within a total of 100,000 octal core locations.

In order to operate within the foregoing CDC computer core size restriction, certain analysis functions are performed by groupings of (n,0) overlays. The designation "module" is assigned to unique function overlays and to groupings of functional overlays. Table 1 shows the 18 primary overlays which constitute the 10 program modules. Overlay (18,0) is the advanced composite structure link, the only link structured to the 100,000 octal core size restriction.

Figure 1 shows the flow of input and calculated data through the 10 operating modules and the relative order of execution of these modules. The SWEEP control program controls the execution of each problem case. It occupies the main level of the overlay system and monitors execution for initialization of problem data, design data development, structural weights analysis, and output of final results.

OPERATING CONSIDERATIONS

As an integrated engineering program, SWEEP requires three types of external data: (1) an input set of program analysis control data, (2) input data sets that are used to describe the design problem, and (3) a data bank compilation of engineering data from which necessary design information can be drawn, as required. Problem analysis and output control information are input to SWEEP primarily through two case control cards. Module execution and development of required design data are governed by case control card 2. Problem design information is described through 11 discrete input data blocks, Table 2, each containing pertinent variable data required for execution of related SWEEP operating modules.

Problem definition and program controls require compatibility between case control card 2 instructions and variable data blocks. Program execution requirements for design data development, weight analysis, and output are shown in Table 3. This table presents minimum and optional execution requirements which can be employed for the range of problem types.

The modules of SWEEP logically interpret the problem design information, convert them into engineering data, and order the results properly for all the evaluation routines. Mass storage files are used to transmit design information from the data processing and design data modules to the weight analysis modules. These modules perform the necessary structural synthesis/weight analysis; the primary result is a set of weight estimates for the major structural components.

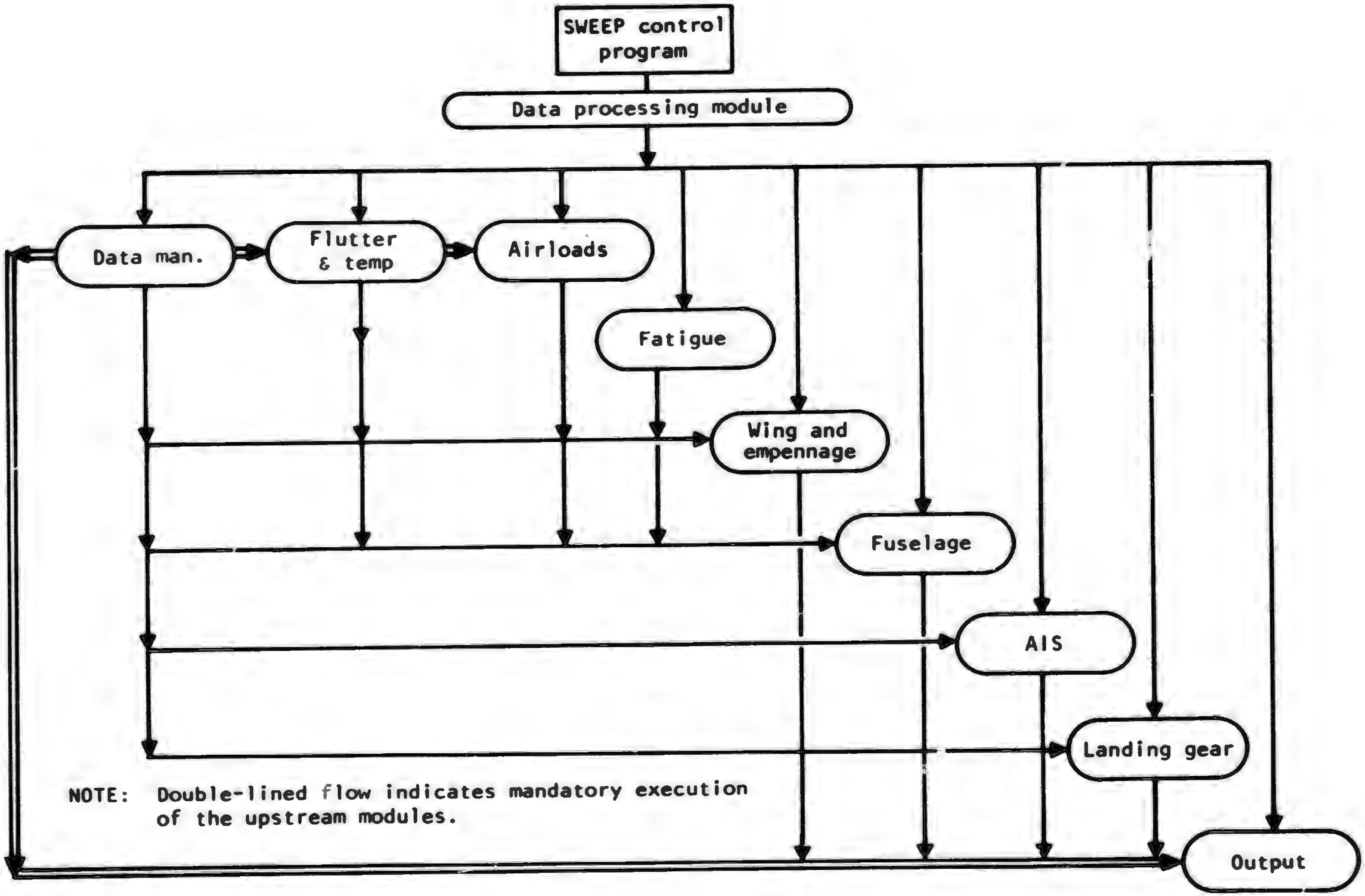

Figure 1. Input and execution flow.

TABLE 1. MODULE DESIGNATION AND GROUPING

Module Name	Module Type	Overlay	Control Routine Name
Input data processing	Data processing	(01,0)	READ
Data management	Data development	(02,0)	DATAIN
Flutter and temperature	Data development	(03,0)	OLAY3
Airloads	Data development	(04,0)	BLCNTL
Fatigue	Data development	(05,0)	FATGUE
Landing Gear	Weight analysis	(06,0)	LANDGR
Air induction system	Weight analysis	(07,0)	AISMN
Wing and empennage	Weight analysis	(08,0) (09,0) (10,0) (14,0) (15,0) (16,0) (17,0) (18,0)	OLAY8 OLAY9 OLAY10 OLAY14 OLAY15 OLAY16 OLAY17 OLAY18
Fuselage	Weight analysis	(11,0) (12,0)	FUS01 FUS02
Final output	Output	(13,0)	OUTPUT

INPUT DATA PROCESSING

The input data processing module organizes data bank data and input variable design data in mass storage file records at the start of each problem case. Computational flow instructions from case control cards 1 and 2 and certain key variables from the input design data are stored in labeled common locations for access by each module.

TABLE 2. USAGE MATRIX OF INPUT DATA DECKS

Data Deck Title	Mass Storage File Record	Module	Component	Description
GENERAL	11	Data management	Vehicle	Vehicle geometry and design data
	24[a]	Fuselage	Fuselage	Fuselage geometry
	28[a]	Air induction system	Nacelles, ducts, and engine section	Nacelle, ducts, and engine section design data
	5	Airloads	Vehicle	Blocked mission segments
WING	23[b]	Wing and empennage	Wing	Wing design data
HORIZONTAL	26[b]	Wing and empennage	Horizontal tail	Horizontal tail design data
VERTICAL	27[b]	Wing and empennage	Vertical tail	Vertical tail design data
FUSELAGE	24[a]	Fuselage	Fuselage	Fuselage design data
LG	25[b]	Landing gear	Landing Gear	Landing gear design data
AIS	28[a]	Air induction system	Nacelles, ducts, and engine section	Nacelle, ducts, and engine section design data
FATIGUE	29	Fatigue	Wing and fuselage	Fatigue design data
	35	Fatigue	Wing	Wing bending moment spectra
WHV LOADS	32	Wing and empennage	Wing, horizontal tail, and vertical tail	Surface loads data

TABLE 2. USAGE MATRIX OF INPUT DATA DECKS (CONCL)

Data Deck Title	Mass Storage File Record	Module	Component	Description
FUS LOADS	33	Fuselage	Fuselage	Vehicle airload, center-of-pressure, and inertia factor data
INERTIA	34	Fuselage	Fuselage	Vehicle and component weight distributions and speed-altitude profile data

[a]Some of the data in the "GENERAL" data deck duplicate data required in the "FUSELAGE" and "AIS" data decks. The values in the "GENERAL" data deck are transfered to the fuselage and AIS data file records whenever the "GENERAL" data deck is read.

[b]Some of the vehicle and design criteria data input through the "GENERAL" data deck are processed by the data management and flutter and temperature modules into design data required in the "WING," "HORIZONTAL," "VERTICAL," AND "LG" data decks. The transfer of these variables are discussed in Sections IV and VI of this volume.

TABLE 3. LOGIC AND DATA REQUIREMENTS FOR EXECUTION OF SWEEP MODULES

Module	Indicator and Reqd Data Deck		Discussion
	Control Card 2 Column	Data Deck	
Data management	None	GENERAL	Data management and flutter and temperature modules are executed in each case in which "GENERAL" is read
Flutter and temperature	None	GENERAL	This module uses speed-altitude profile and geometry data from the data management module
Airloads	71	GENERAL	This module requires data from the data management module from the same case or a previous case. Detail execution controls are in control card 2 columns 1 through 38.
Fatigue	78	FATIGUE	This module may be executed as a stand-alone program or with spectrum data created by the airloads module.
Landing gear	74	LG	This module may be executed as a stand-alone program or with design data from the data management module.
Air induction system	77	AIS	This module may be executed as a stand-alone program. If "GENERAL" data are part of the input case data, certain variables are transferred to the "AIS" data record.

TABLE 3. LOGIC AND DATA REQUIREMENTS FOR EXECUTION OF SWEEP MODULES (CONCL)

Module	Indicator and Reqd Data Deck		Discussion
	Control Card 2 Column	Data Deck	
Wing and empennage (wing)	39-40, 72	WING	This module may be executed as a stand-alone program. Loads may be defined either in the "WING" deck, the "WHV LOADS" deck, or by the airloads module. Flutter data may be defined in the "WING" deck or obtained from the flutter and temperature module.
Wing and empennage (horizontal tail)	41-42, 75	HORIZONTAL	Refer to wing discussion.
Wing and empennage (vertical tail)	43-44, 76	VERTICAL	Refer to wing discussion
Fuselage	73	FUSELAGE	This module may be executed as a stand-alone program. If "GENERAL" data are part of the input case data, certain variables are transferred to the "FUSELAGE" data record. Inertia and loads data may be obtained through execution of the data management, flutter and temperature, and airloads module or by input of the "INERTIA" and "FUS LOADS" decks.
Final output	79	GENERAL	This module requires data from the data management module from the same case or a previous case

DESIGN DATA DEVELOPMENT

The design data development modules interpret input vehicle design specifications and geometry data and compute detail design data for use in evaluating the structural components. Modules programmed for design data development are:

1. Data management module, overlay (2,0)

2. Flutter and temperature module, overlay (3,0)

3. Airloads module, overlay (4,0)

4. Fatigue module, overlay (5,0)

STRUCTURAL WEIGHT ESTIMATION

Air vehicle structural component weight analysis modules calculate structural weights for:

1. Wing (refer to Volume VI)

2. Horizontal tail (refer to Volume VI)

3. Vertical tail (refer to Volume VI)

4. Fuselage (refer to Volume VII)

5. Landing gear (refer to Volume V)

6. Nacelles, engine section, and air-induction system (refer to Volume V)

Computed weights are derived so that detail weight data are available at the end of the evaluation phase. Modules which evaluate these components may be operated in stand-alone modes or in the integrated mode, using data from the design data development modules.

OUTPUT

Several levels of printed output are provided from the modules that are executed in the computation process. Summary weight results and error and warning messages are standard program output. Other types of program output are controlled through user selection of print indicators on case control card 1. These include:

1. Details of weight analysis results

2. Details of structural synthesis results

3. Details of design data and requirements

4. Details of intermediate program calculations

The basic output, Figure 2, is the integrated summary of results from each of the weight analysis modules. This summary is organized in the final output module, overlay (13,0). Initial assumptions (Figure 3) and dimensional and structural data (Figure 4) are other summary information printed by the final output module. The estimated weight summary for problem case vehicle design is printed only if the final output module is executed. Execution of this module is requested by a code value of (0) in column 79 of case control card 2. This module should be executed only for problem cases in which estimated and/or calculated data are available for module input. Module data, stored in mass storage file records and in labelled common arrays, are initially set up by the data management module and subsequently changed with calculated vehicle component data by the weight estimation modules.

The final output summary should be requested for all problem cases in which the complete vehicle is evaluated. This summary may also be requested for all single- or multiple-component-only cases in which the data management module is executed. In cases where the data management module is not executed, program error will occur when single- or multiple-component-only cases are set up (1) as the initial case in a job, or (2) any case in which input data arrays and mass storage file records are initialized through the code value of (1) in column 80 of case control card 2.

All vehicle component weight summary data are printed automatically at the conclusion of the analysis by executed weight estimation modules. Printed module weight summary outputs are presented in Figures 5 through 10.

Error and warning messages are printed when data compatibility problems are encountered or when problem definitions are beyond the program limitations. These messages describe the problem and the path taken to circumvent the situation. This allows for completion of downstream computations which may produce unrelated errors.

GROUP WEIGHT STATEMENT
WEIGHT EMPTY

WING GROUP					32045.6
CENTER SECTION - BASIC STRUCTURE				2434.2	
OUTER PANEL - BASIC STRUCTURE (INCL. TIPS 39.9 LBS.)				25726.3	
PIVOT				0.0	
AILERONS				743.3	
FLAPS - TRAILING EDGE				2414.7	
FLAPS - LEADING EDGE				0.0	
SLATS				0.0	
SPOILERS				725.3	
MISCELLANEOUS				722.2	
HORIZONTAL TAIL GROUP					2330.1
CENTER SECTION/SPINDLE				0.0	
STABILIZER - BASIC STRUCTURE				1611.6	
ELEVATOR				618.6	
MISCELLANEOUS				45.7	
VERTICAL TAIL GROUP					2104.1
CENTER SECTION/SPINDLE				0.0	
FINS - BASIC STRUCTURE				1632.7	
RUDDER				271.5	
MISCELLANEOUS				61.3	
BODY GROUP					26567.5
FUSELAGE BASIC STRUCTURE				18880.8	
SECONDARY STRUCTURE - FUSELAGE				1069.0	
- DOORS, PANELS, AND MISC.				6597.6	
ALIGHTING GEAR GROUP					9040.0
LOCATION	WHEELS, BRAKES TIRES, TUBES	STRUCTURE	CONTROLS		
FUSELAGE - MAIN GEAR	3303.2	2239.0	2823.1	8365.3	
FUSELAGE - NOSE GEAR	317.1	150.5	207.2	674.8	
SURFACE CONTROLS GROUP					3714.0
ENGINE SECTION					3825.8
INBOARD				1898.5	
CENTER					
OUTBOARD				1898.5	
DOORS, PANELS, AND MISC.				28.8	
STRUCTURE - OTHER AND MISC.					0.0
TOTAL (TO BE BROUGHT FORWARD)					79627.3

Figure 2. Calculated weights, group weight statement.

GROUP WEIGHT STATEMENT
WEIGHT EMPTY

PROPULSION GROUP			25239.5
ENGINE INSTALLATION		18759.0	
ACCESSORY GEAR BOXES AND DRIVES		0.0	
AIR INDUCTION SYSTEM		611.5	
STRUCTURE	611.5		
ACTUATION AND CONTROLS	0.0		
EXHAUST SYSTEM		3577.0	
COOLING SYSTEM AND DRAIN PROVISIONS		144.0	
LUBRICATING SYSTEM		212.0	
FUEL SYSTEM		1380.0	
ENGINE CONTROLS		236.0	
STARTING SYSTEM		320.0	
AUXILIARY POWER PLANT GROUP			554.0
INSTRUMENTS GROUP			1122.0
HYDRAULICS AND PNEUMATICS GROUP			1489.0
ELECTRICAL GROUP			2650.0
ELECTRONICS GROUP			2347.0
ARMAMENT GROUP			0.0
FURNISHINGS AND EQUIPMENT GROUP			3320.0
AIR CONDITIONING AND ANTI-ICING EQUIPMENT GROUP			2646.0
PHOTOGRAPHIC GROUP			0.0
AUXILIARY GEAR GROUP			95.0
OTHER EQUIPMENT AND MISC.			113.0
TOTAL FROM PREVIOUS PAGE			79627.3
WEIGHT EMPTY			119204.7

Figure 2. Calculated weights, group weight statement (cont).

GROUP WEIGHT STATEMENT

USEFUL LOAD AND GROSS WEIGHT

LOAD CONDITION	MAXIMUM DESIGN WEIGHT		FLIGHT DESIGN GROSS WEIGHT		LANDING DESIGN GROSS WEIGHT	
	WEIGHT	ARM	WEIGHT	ARM	WEIGHT	ARM
CREW (NO. 4.0)	860.0	351.30	860.0	351.30	860.0	351.30
FUEL						
UNUSABLE	2164.0	1001.90	2164.0	1001.90	2164.0	1001.90
INTERNAL	67640.0	858.00	65739.9	858.00	28090.0	858.00
	49040.0	1047.34	49040.0	1047.34	28090.0	1047.34
	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	0.0	0.0	0.0	0.0	0.0
OIL	416.0	753.61	416.0	753.61	416.0	753.61
FUSELAGE PAYLOAD	70000.0	887.00	70000.0	887.00	70000.0	887.00
WING PAYLOAD	0.0	0.0	0.0	0.0	0.0	0.0
ARMAMENT						
GUNS (QTY. 0.0)	0.0	0.0	0.0	0.0	0.0	0.0
AMMUNITION	0.0	0.0	0.0	0.0	0.0	0.0
INSTALLATIONS (PYLONS RACKS ETC.)						
WING	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0
FUSELAGE	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT						
OXYGEN, LN.	0.0	0.0	0.0	0.0	0.0	0.0
MISCELLANEOUS	236.0	852.97	236.0	852.97	236.0	852.97
USEFUL LOAD	190356.0	916.55	188455.9	917.15	129855.9	913.29
WEIGHT EMPTY	119204.7	922.14	119204.7	922.14	119204.7	922.14
GROSS WEIGHT	309560.7	916.71	307660.7	919.08	249060.6	917.53

Figure 2. Calculated weights, group weight statement (cont).

GROUP WEIGHT STATEMENT

WEIGHT EMPTY BALANCE DATA

	WEIGHT	HORIZ. ARM
WEIGHT EMPTY	119204.75	922.14
WING	32045.82	951.67
HORIZONTAL	2330.15	1842.55
VERTICAL	2104.13	1739.51
BODY	26567.52	975.22
MAIN GEAR	8365.26	991.77
NOSE GEAR	674.77	354.75
SURFACE CONTROLS	3714.00	1121.80
ENGINE SECTION	3825.76	806.47
OTHER STRUCTURE	0.0	0.0
ENGINE	18759.00	774.10
ACCESSORY GEAR BOXES	0.0	0.0
AIR INDUCTION SYSTEM	611.50	679.91
AIS ACTUATION AND CONTROLS	0.0	0.0
EXHAUST SYSTEM	3577.00	845.67
COOLING AND DRAINS	144.00	803.90
LUBRICATING SYSTEM	212.00	840.80
FUEL SYSTEM	1380.00	953.40
ENGINE CONTROLS	236.00	666.20
STARTING SYSTEM	320.00	768.30
AUXILIARY POWER UNIT	554.00	844.70
INSTRUMENTS	1122.00	545.00
HYDRAULIC	1489.00	861.90
ELECTRICAL	2650.00	657.50
ELECTRONICS	2347.00	592.40
ARMAMENT	0.0	0.0
FURNISHINGS	3320.00	596.80
AIR CONDITIONING	2648.00	809.90
PHOTOGRAPHIC	0.0	0.0
AUXILIARY GEAR	95.00	1228.00
OTHER EQUIPMENT	113.00	300.00

Figure 2. Calculated weights, group weight statement (concl).

INITIAL WEIGHT AND BALANCE DATA

	WEIGHT	HORIZ. ARM
WEIGHT EMPTY	127643.87	953.07
WING	31496.64	981.63
HORIZONTAL	3666.65	1846.85
VERTICAL	2171.05	1749.93
BODY	31127.77	1054.76
MAIN GEAR	8175.46	922.42
NOSE GEAR	851.99	356.38
SURFACE CONTROLS	2714.00	1121.80
ENGINE SECTION	6141.39	795.64
OTHER STRUCTURE	0.0	0.0
ENGINE	18759.00	774.10
ACCESSORY GEAR BOXES	0.0	0.0
AIR INDUCTION SYSTEM	832.92	698.99
AIS ACTUATION AND CONTROLS	0.0	0.0
EXHAUST SYSTEM	2577.00	845.67
COOLING AND DRAINS	144.00	803.90
LUBRICATING SYSTEM	212.00	840.80
FUEL SYSTEM	1380.00	953.40
ENGINE CONTROLS	236.00	666.20
STARTING SYSTEM	320.00	768.30
AUXILIARY POWER UNIT	554.00	644.70
INSTRUMENTS	1122.00	545.00
HYDRAULIC	1489.00	881.90
ELECTRICAL	2650.00	657.50
ELECTRONICS	2347.00	592.40
ARMAMENT	0.0	0.0
FURNISHINGS	3320.00	596.80
AIR CONDITIONING	2648.00	809.90
PHOTOGRAPHIC	0.0	0.0
AUXILIARY GEAR	95.00	1228.00
OTHER EQUIPMENT	113.00	300.00

Figure 3. Initial weight and balance data.

INITIAL WEIGHT AND BALANCE DATA

USEFUL LOAD AND GROSS WEIGHT

LOAD CONDITION	MAXIMUM DESIGN WEIGHT		FLIGHT DESIGN GROSS WEIGHT		LANDING DESIGN GROSS WEIGHT	
	WEIGHT	ARM	WEIGHT	ARM	WEIGHT	ARM
CREW (NO. 4.0)	860.0	351.30	860.0	351.30	860.0	351.30
FUEL						
UNUSABLE	2164.0	1001.90	2164.0	1001.90	2164.0	1001.90
INTERNAL	67640.0	858.00	65739.9	858.00	28090.0	858.00
	49040.0	1047.34	49040.0	1047.34	28090.0	1047.34
	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	0.0	0.0	0.0	0.0	0.0
OIL	416.0	753.61	416.0	753.61	416.0	753.61
FUSELAGE PAYLOAD	70000.0	887.00	70000.0	887.00	70000.0	887.00
WING PAYLOAD	0.0	0.0	0.0	0.0	0.0	0.0
ARMAMENT						
GUNS (QTY. 0.0)	0.0	0.0	0.0	0.0	0.0	0.0
AMMUNITION	0.0	0.0	0.0	0.0	0.0	0.0
INSTALLATIONS (PYLONS RACKS ETC.)						
WING	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0
FUSELAGE	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0
EQUIPMENT						
OXYGEN, LN2	0.0	0.0	0.0	0.0	0.0	0.0
MISCELLANEOUS	236.0	852.97	236.0	852.97	236.0	852.97
USEFUL LOAD	190356.0	916.55	188455.9	917.15	129855.9	913.29
WEIGHT EMPTY	127643.9	953.07	127643.9	953.07	127643.9	953.07
GROSS WEIGHT	317999.9	931.21	316099.8	931.65	257499.7	933.01

Figure 3. Initial weight and balance data (concl).

GROUP WEIGHT STATEMENT

DIMENSIONAL AND STRUCTURAL DATA

LENGTH - OVERALL (FT.) 141.53 HEIGHT - OVERALL - STATIC (FT.) 38.55

	FUSELAGE	NACELLES INBOARD	NACELLES CENTER	NACELLES OUTBOARD
LENGTH - MAX. (FT.)	132.29	16.60		16.60
DEPTH - MAX. (FT.)	14.17	5.50		5.50
WIDTH - MAX. (FT.)	14.17	5.50		5.50
WETTED AREA (SQ. FT.)	4572.75	277.19		277.19
FUSELAGE VOLUME (CU. FT.)	16020.56			

	WING	H. TAIL	V. TAIL
GROSS AREA (SQ. FT.)	3002.63	483.00	416.00
WEIGHT/GROSS AREA (LBS./SQ. FT.)	10.67	4.67	5.06
SPAN (FT.)	159.95	50.35	22.72
SWEEPBACK - AT .25C (DEGREES)	25.92	25.00	35.00
THEORETICAL ROOT CHORD - LENGTH (INCHES)	317.67	168.06	273.11
- MAX. THICKNESS (INCHES)	51.90	17.65	35.50
THEORETICAL TIP CHORD - LENGTH (INCHES)	132.70	62.17	166.30
- MAX. THICKNESS (INCHES)	13.27	6.53	21.62
TAIL LENGTH - .25 MAC WING TO .25 MAC H. TAIL (FT.)		74.20	

ALIGHTING GEAR	NOSE	MAIN
LENGTH - OLEO EXTENDED - AXLE TO TRUNNION (INCHES)	41.50	61.70
OLEO TRAVEL - FULL EXTENDED TO FULL COLLAPSED (INCHES)	12.00	28.00

STRUCTURAL DATA - CONDITION

	STRESS GROSS WEIGHT	LIMIT LOAD FACTOR
FLIGHT	316049.81	2.50
LANDING	257469.75	
TAKE-OFF	317499.67	
LIMIT AIRPLANE LANDING SINK SPEED (FT./SEC.)		10.00
WING LIFT ASSUMED FOR LANDING DESIGN CONDITION (PERCENT WT.)		100.00
STALL SPEED - LANDING CONFIGURATION - POWER OFF (KNOTS)		103.00
PRESSURIZED CABIN - ULT. DESIGN PRESSURE DIFFERENTIAL - FLIGHT (P.S.I)		18.47

Figure 4. Dimensional and structural design data.

MAIN LANDING GEAR WEIGHTS (POUNDS) ** LGWT **

OUTER CYLINDER	365.5
PISTON	155.9
AXLE	501.6
OIL	241.7
DRAG STRUT	369.1
SIDE STRUT	0.0
WHEELS	1148.1
TIRES	1403.2
MISC (CALC.)	2823.1
BRAKES	751.9
BOGIE	605.2
MISC (INPUT)	0.0
TOTAL	8365.3

MAIN LANDING GEAR DESIGN DATA

		DESIGN LOAD CONDITION **	AREA (SQ IN)	DIAMETER TO THICKNESS RATIO	BENDING MODULUS OF RUPTURE	TORSIONAL MODULUS OF RUPTURE
OUTER CYLINDER	TOP	16	18.06	26.65	279836.	116399.
	MIDDLE	16	12.85	36.29	258496.	107000.
	BOTTOM	2	9.11	50.00	237500.	98514.
PISTON (20 PCT OF LENGTH FROM AXLE)		2	7.52	50.00	237500.	98514.

PISTON DIAMETER (INCHES)	11.05	CG - BELOW TRUNION POINT	54.3
AFT DEFLECTION (INCHES)	[illegible]	CG - OUTBOARD (INBOARD) FROM TRUNION POINT	0.0
SIDE DEFLECTION (INCHES)	0.0	CG - AFT (FORWARD) FROM TRUNION POINT	0.0
ANGLE OF TWIST (RADIANS)	0.0		

Figure 5. Weight summary, landing gear group.

NOSE LANDING GEAR WEIGHTS (POUNDS) ** LGWT **

OUTER CYLINDER	43.2
PISTON	18.9
AXLE	23.2
OIL	18.6
DRAG STRUT	46.5
SIDE STRUT	0.0
WHEELS	142.7
TIRES	174.4
MISC (CALC.)	207.2
TOTAL	674.8

NOSE LANDING GEAR DESIGN DATA

		DESIGN LOAD CONDITION **	AREA (SQ IN)	DIAMETER TO THICKNESS RATIO	BENDING MODULUS OF RUPTURE	TORSIONAL MODULUS OF RUPTURE
OUTER CYLINDER	TOP	14	6.38	28.87	274445.	113965.
	MIDDLE	14	4.25	41.03	250005.	103422.
	BOTTOM	2	3.53	50.00	237500.	98514.
PISTON (20 PCT OF LENGTH FROM AXLE)		2	2.71	50.00	237500.	98514.

PISTON DIAMETER (INCHES)	6.63	CG - BELOW TRUNION POINT	34.9
AFT DEFLECTION (INCHES)	1.76	CG - OUTBOARD (INBOARD) FROM TRUNION POINT	0.0
SIDE DEFLECTION (INCHES)	0.0	CG - AFT (FORWARD) FROM TRUNION POINT	0.9
ANGLE OF TWIST (RADIANS)	0.0		

** DESIGN LOAD CONDITION INDICATORS

	TAKE-OFF WEIGHT	LANDING WEIGHT
TWO POINT	2	18
SPIN UP	4	20
SPRING BACK	6	22
BRAKED ROLL	8	24
DRIFT LANDING	10	26
UNSYMMETRICAL BRAKING	12	28
TOWING	14	
TURNING	16	

(IF THE DESIGN LOAD CONDITION INDICATORS ARE ALL 0, THE DESIGN LOADS WERE GIVEN IN THE INPUT DATA)

Figure 5. Weight summary, landing gear group (concl).

C 141 TEST CASE FOR NEW WING PROGRAM CHECKOUT AUGUST 1972 ** SUMARY **
C 141 TEST CASE ---NO. 1 ---

A. I. S. & ENGINE SECTION OR NACELLE GROUP WEIGHT & C.G. SUMMARY

	WT.	C.G.		WT.	C.G.
AIR INDUCTION SYSTEM				611.50	679.91
INLET WEDGE	0.0	2.00			
AIR DUCTING	37.90	660.00			
INTAKE DOORS & OP. MECHANISM	0.0	0.0			
BYPASS DOORS & OP. MECHANISM	0.0	0.0			
VARIABLE GEOMETRY STRUCTURE	0.0	0.0			
HALF ROUND FIXED SPIKE	573.60	679.90			
FULL ROUND TRANSLATING SPIKE	0.0	0.0			
FULL TRANS. & EXPND. SPIKE	0.0	0.0			

	INBOARD		OUTBOARD		TOTAL	
	WT.	C.G.	WT.	C.G.	WT.	C.G.
ENGINE MOUNTS	140.70	728.60	140.70	819.60		
BULKHEADS & FRAMES	341.04	728.21	341.04	819.21		
COVERING & STIFFENERS	258.01	737.03	258.01	818.03		
LONGERONS	0.0	0.0	0.0	0.0		
FITTINGS	7.48	[illegible]	7.48	829.50		
PYLONS	1140.00	713.55	1140.00	874.55		
FIREWALL	11.23	640.40	11.23	731.40		
SHROUD	0.0	0.0	0.0	0.0		
TOTAL ENG.SEC./NAC.	1898.46	761.22	1898.46	852.22	3796.93	806.72

	WT.	C.G.	WT.	C.G.
ACCESS DOORS	0.0	0.0		
ENGINE DOORS	0.0	0.0		
EXTERIOR FINISH	28.83	773.51		
TOTAL MISC.			28.83	773.51
TOTAL ENG.SEC./NAC.GROUP & MISC.			3825.76	806.47

Figure 6. Weight summary, air induction system, engine section, and nacelle groups.

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C 141 TEST CASE FOR NEW WING PROGRAM CHECKOUT     AUGUST 1973                                   ** SUMARY **
C 141 TEST CASE                ---NO. 1 ---

                          * * *   P R O P U L S I O N   G R O U P   * * *

         AIR INDUCTION SYSTEM                                                 611.50
             INLET WEDGE                                         0.0
             AIR DUCTING                                        37.90
             INTAKE DOORS & OPERATING MECHANISM                  0.0
             BYPASS DOORS & OPERATING MECHANISM                  0.0
             VARIABLE GEOMETRY STRUCTURE                         0.0

             HALF-ROUND FIXED SPIKE                            573.60
```

Figure 6. Weight summary, air induction system, engine section, and nacelle groups (cont).

C 141 TEST CASE FOR NEW WING PROGRAM CHECKOUT   AUGUST 1973   ** SUMMARY **
C 141 TEST CASE   ---NO. 1 ---

E N G I N E   S E C T I O N   O F   N A C E L L E   G R O U P

	INBOARD	OUTBOARD	TOTAL
ENGINE MOUNTS	140.70	140.70	
NACELLE STRUCTURE			
BULKHEADS & FRAMES	341.04	341.04	
COVERING & STIFFENERS	256.01	256.01	
LONGERONS	0.0	0.0	
FITTINGS	7.46	7.46	
PYLON	1140.00	1140.00	
FIREWALL	11.23	11.23	
SHROUD	0.0	0.0	
TOTAL	1898.46	1898.46	3796.93
DOORS & MISCELLANEOUS			
DOORS			
ACCESS	0.0		
ENGINE	0.0		
EXTERIOR FINISH	28.83		
TOTAL DOORS & MISCELLANEOUS			28.83
TOTAL ENGINE SECTION OR NACELLE GROUP ----------------------			3825.76

Figure 6. Weight summary, air induction system, engine section, and nacelle groups (concl).

```
CASE    1                    WEIGHT SUMMARY.                                                    ** PRTD **
        -***-TOTAL HOPI TAIL                 STIFFENED SKIN/MULTI-RIB-***-
C 141 TEST CASE FOR NEW WING PROGRAM CHECKOUT      AUGUST 1973
C 141 TEST CASE                  ---NO. 1 ---

                                         -****-TOTAL WEIGHT SUMMARY-****-
                 *WEIGHT--LB//V*          *UNIT WEIGHT--LB/SF*      *C.G.--BP*                    *C.G.--FS*             *AREA*
               GW(1)    GW(2)    GW(3)    GW(1)  GW(2) GW(3)     GW(1)   GW(2)   GW(3)     GW(1)   GW(2)  GW(3)     SF/AV
***TOTAL***     0.0    2330.1     0.0      0.0   4.82  0.0        0.0    109.7    0.0       0.0  1842.5   0.0      483.0
 *O-PNL*        0.0    2330.1     0.0      0.0   4.82  0.0        0.0    109.7    0.0       0.0  1842.5   0.0      483.0
 *C-SFC*        0.0       0.0     0.0      0.0   0.0   0.0        0.0      0.0    0.0       0.0     0.0   0.0        1.0
 *PIVOT*        0.0       0.0     0.0                             0.0      0.0    0.0       0.0     0.0   0.0

                                         -**-OUTER PANEL COMPONENTS-**-
 /T-BOX/        0.0    1614.2     0.0      0.0   6.80  0.0        0.0    102.6    0.0       0.0  1828.9   0.0      238.2
 /L.E. /        0.0     117.1     0.0      0.0   1.64  0.0        0.0    125.5    0.0       0.0  1799.4   0.0       71.4
 /T.E. /        0.0     541.6     0.0      0.0   3.25  0.0        0.0    125.9    0.0       0.0  1883.0   0.0      166.7
 /TIP  /        0.0       6.2     0.0      0.0   0.93  0.0        0.0    297.9    0.0       0.0  1915.0   0.0        6.7
 /MISC./        0.0      45.7     0.0      0.0   0.09  0.0        0.0    102.6    0.0       0.0  1828.9   0.0      483.0
 (+V.F.)        0.0       0.0     0.0
 (+FTG )        0.0       0.0     0.0

 TOGW(1)=       0.0 TOGW(2)= 314100.0 TOGW(3)=       0.0  +NZ= 2.500 +NZG= 0.0     FL(TOT)=     0.0  MATL|NO=  4
 DGW(1)=        0.0  DGW(2)= 314100.0  DGW(3)=       0.0  -NZ= 1.000 -NZG= 0.0     FL(DES)=     0.0  YCP=      0.0
```

Figure 7. Weight summary, horizontal tail group.

CASE 1 —***—NOMINAL TORQUE-BOX DETAIL WEIGHTS—***— ** PRTF - 1P(37) **

	—**—TOTAL SURFACE—**—			—**—OUTER PANEL—**—			—**—CENTER-SECTION—**—		
	GW(1)	GW(2)	GW(3)	GW(1)	GW(2)	GW(3)	GW(1)	GW(2)	GW(3)
TORQUE-BOX	0.0	1619.2	0.0	0.0	1619.2	0.0	0.0	0.0	0.0
UPPER COVER	0.0	617.6	0.0	0.0	617.6	0.0	0.0	0.0	0.0
SKINS	0.0	417.3	0.0	0.0	417.3	0.0	0.0	0.0	0.0
STRG.	0.0	174.5	0.0	0.0	174.5	0.0	0.0	0.0	0.0
MISC. SK.	0.0	25.8	0.0	0.0	25.8	0.0	0.0	0.0	0.0
LOWER COVER	0.0	466.0	0.0	0.0	466.0	0.0	0.0	0.0	0.0
SKINS	0.0	308.3	0.0	0.0	308.3	0.0	0.0	0.0	0.0
STRG.	0.0	130.1	0.0	0.0	130.1	0.0	0.0	0.0	0.0
MISC. SK.	0.0	27.5	0.0	0.0	27.5	0.0	0.0	0.0	0.0
RIBS	0.0	297.7	0.0	0.0	297.7	0.0	0.0	0.0	0.0
INTERM.	0.0	212.8	0.0	0.0	212.8	0.0	0.0	0.0	0.0
BULKHEADS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RT/C-L	0.0	85.0	0.0	0.0	85.0	0.0	0.0	0.0	0.0
FRONT SPAR	0.0	103.3	0.0	0.0	103.3	0.0	0.0	0.0	0.0
CAPS	0.0	28.7	0.0	0.0	28.7	0.0	0.0	0.0	0.0
WEB	0.0	74.6	0.0	0.0	74.6	0.0	0.0	0.0	0.0
REAR SPAR	0.0	115.9	0.0	0.0	115.9	0.0	0.0	0.0	0.0
CAPS	0.0	33.2	0.0	0.0	33.2	0.0	0.0	0.0	0.0
WEB	0.0	82.8	0.0	0.0	82.8	0.0	0.0	0.0	0.0
MISC. ATT.	0.0	18.7	0.0	0.0	18.7	0.0	0.0	0.0	0.0
STORE FTG.	0.0	0.0	0.0	0.0	0.0	0.0			

	—**—LEADING EDGE—**—				—**—TRAILING EDGE—**—		
FIXED STR	0.0	117.1	0.0	*FIXED STR*	0.0	23.3	0.0
				ELEVATORS	0.0	518.6	0.0

Figure 7. Weight summary, horizontal tail group (concl).

```
CASE    1                              WEIGHT SUMMARY.                                                  ** PRTD **
         -***-TOTAL VERT TAIL                          STIFFENED SKIN/MULTI-RIB-***-
C 141 TEST CASE FOR NEW WING PROGRAM CHECKOUT    AUGUST 1973
C 141 TEST CASE               ---NO. 1 ---

                                        -****-TOTAL WEIGHT SUMMARY-****-
                  *WEIGHT--LB/AV*        *UNIT WEIGHT--LB/SF*         *C.G.--FP*                  *C.G.--FS*               *AREA*
                GW(1)   GW(2)    GW(3)   GW(1)  GW(2)  GW(3)     GW(1)   GW(2)    GW(3)     GW(1)   GW(2)    GW(3)      SF/AV
***TOTAL***      0.0   2104.1     0.0     0.0   5.06    0.0       0.0   10[illegible].3    0.0       0.0  1739.5     0.0       416.0
  *O-PNL*        0.0   2104.1     0.0     0.0   5.06    0.0       0.0   10[illegible]     0.0       0.0  1739.5     0.0       416.0
  *C-SEC*        0.0      0.0     0.0     0.0   0.0     0.0       0.0      0.0    0.0       0.0     0.0     0.0         1.0
  *PIVOT*        0.0      0.0     0.0                             0.0      0.0    0.0       0.0     0.0     0.0

                                        -**-OUTER PANEL COMPONENTS-**-
  /T-BOX/        0.0   1613.6     0.0     0.0   7.91    0.0       0.0   10[illegible]     0.0       0.0  1722.4     0.0       204.0
  /L.E. /        0.0     83.2     0.0     0.0   1.3[illegible]    0.0       0.0   12[illegible]     0.0       0.0  1663.[illegible]     0.0        61.2
  /T.E. /        0.0    336.7     0.0     0.0   2.37    0.0       0.0   117.4    0.0       0.0  1640.[illegible]     0.0       142.6
  /TIP  /        0.0      7.3     0.0     0.0   0.[illegible]    0.0       0.0   26[illegible]     0.0       0.0  1643.[illegible]     0.0         7.9
  /MISC./        0.0     61.3     0.0     0.0   0.1[illegible]    0.0       0.0   10[illegible]     0.0       0.0  1722.4     0.0       416.0
  (*V.F.)        0.0      0.0     0.0
  (*FTG )        0.0      0.0     0.0

TOGW(1)=      0.0 TOGW(2)= 316100.0 TOGW(3)=      0.0  +NZ= 0.001 +NZG= 0.0    FL(TOT)=     0.0  MATL NC=  6
 DGW(1)=      0.0  DGW(2)= 316100.0  DGW(3)=      0.0  -NZ= 1.000 -NZG= 0.0    FL(DES)=     0.0  YCP=     0.0
```

Figure 8. Weight summary, vertical tail group.

CASE 1

---**-[illegible] DETAIL WEIGHTS-***-

** PRTD - IP(37) *

	-**-TOTAL SURFACE-**- GW(1)	GW(2)	GW(3)	-**-OUTER PANEL-**- GW(1)	GW(2)	GW(3)	-**-CENTER-SECTION-**- GW(1)	GW(2)	GW(3)
[illegible]	0.0	[illegible]	0.0	0.0	1613.6	0.0	0.0	0.0	0.0
UPPER COVER	0.0	[illegible]	0.0	0.0	410.0	0.0	0.0	0.0	0.0
SKINS	0.0	[illegible]	0.0	0.0	264.2	0.0	0.0	0.0	0.0
STRG.	0.0	[illegible]	0.0	0.0	125.4	0.0	0.0	0.0	0.0
MISC. SR.	0.0	[illegible]	0.0	0.0	19.6	0.0	0.0	0.0	0.0
LOWER COVER	0.0	[illegible]	0.0	0.0	407.6	0.0	0.0	0.0	0.0
SKINS	0.0	[illegible]	0.0	0.0	263.6	0.0	0.0	0.0	0.0
STRG.	0.0	[illegible]	0.0	0.0	124.4	0.0	0.0	0.0	0.0
MISC. SR.	0.0	[illegible]	0.0	0.0	19.5	0.0	0.0	0.0	0.0
RIBS	0.0	[illegible]	0.0	0.0	536.7	0.0	0.0	0.0	0.0
INTERP.	0.0	[illegible]	0.0	0.0	379.5	0.0	0.0	0.0	0.0
BULKHEADS	0.0	[illegible]	0.0	0.0	33.5	0.0	0.0	0.0	0.0
RT/C-L	0.0	[illegible]	0.0	0.0	123.6	0.0	0.0	0.0	0.0
FRONT SPAR	0.0	[illegible]	0.0	0.0	108.1	0.0	0.0	0.0	0.0
CAPS	0.0	14.4	0.0	0.0	14.4	0.0	0.0	0.0	0.0
WEB	0.0	[illegible]	0.0	0.0	93.6	0.0	0.0	0.0	0.0
REAR SPAR	0.0	[illegible]	0.0	0.0	123.2	0.0	0.0	0.0	0.0
CAPS	0.0	16.7	0.0	0.0	16.7	0.0	0.0	0.0	0.0
WEB	0.0	[illegible]	0.0	0.0	106.6	0.0	0.0	0.0	0.0
MISC. ATT.	0.0	[illegible]	0.0	0.0	26.1	0.0	0.0	0.0	0.0
STORE FIG.	0.0	0.0	0.0	0.0	0.0	0.0			

	-**-LEADING EDGE-**-				-**-TRAILING EDGE-**-		
FIXED STR	0.0	[illegible]	0.0	*FIXED STR*	0.0	67.2	0.0
				RUDDERS	0.0	271.5	0.0

Figure 8. Weight summary, vertical tail group (concl).

CASE 1 WEIGHT SUMMARY. ** PRTD **

-***-TOTAL WING STIFFENEL SKIN/MULTI-RIB-***-

C 141 TEST CASE FOR NEW WING PROGRAM CHECKOUT AUGUST 1972

C 141 TEST CASE ---NO. 1 ---

-****-TOTAL WEIGHT SUMMARY-****-

	WEIGHT--LB/AV			*UNIT WEIGHT--LB/SF*			*C.G.--BP*			*C.G.--FS*			*AREA*
	GW(1)	GW(2)	GW(3)	GW(1)	GW(2)	GW(3)	GW(1)	GW(2)	GW(3)	GW(1)	GW(2)	GW(3)	SF/AV
TOTAL	0.0	32045.8	0.0	0.0	10.67	0.0	0.0	371.6	0.0	0.0	951.7	0.0	3002.5
O-PNL	0.0	29611.6	0.0	0.0	11.10	0.0	0.0	399.0	0.0	0.0	963.4	0.0	2667.6
C-SEC	0.0	2434.2	0.0	0.0	10.07	0.0	0.0	38.8	0.0	0.0	803.1	0.0	241.7
PIVOT	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0	
				-**-OUTER PANEL COMPONENTS-**-									
/T-BOX/	0.0	21614.0	0.0	0.0	15.98	0.0	0.0	391.2	0.0	0.0	942.7	0.0	1352.6
/L.E. /	0.0	1399.8	0.0	0.0	4.44	0.0	0.0	453.6	0.0	0.0	899.6	0.0	315.2
/T.E. /	0.0	5835.8	0.0	0.0	5.28	0.0	0.0	411.6	0.0	0.0	1056.7	0.0	1105.9
/TIP /	0.0	39.9	0.0	0.0	0.97	0.0	0.0	947.4	0.0	0.0	1203.8	0.0	41.2
/MISC./	0.0	722.2	0.0	0.0	0.27	0.0	0.0	391.3	0.0	0.0	942.7	0.0	2667.6
(AV.E.)	0.0	3834.3	0.0										
(+FTG)	0.0	28.0	0.0										

TOGW(1)= 0.0 TOGW(2)= 316100.0 TOGW(3)= 0.0 +NZ= 2.500 +NZG= 0.0 FL(TOT)=116940.0 MATL NO= 6

DGW(1)= 0.0 DGW(2)= 316100.0 DGW(3)= 0.0 -NZ= 1.000 -NZG= 0.0 FL(DFS)=116939.9 YCP= 418.6

Figure 9. Weight summary, wing group.

CASE 1

-***-NOMINAL TORQUE-BOX DETAIL WEIGHTS-***-

** PRTD - IP(37) **

	-**-TOTAL SURFACE-**- GW(1)	GW(2)	GW(3)	-**-OUTER PANEL-**- GW(1)	GW(2)	GW(3)	-**-CENTER-SECTION-**- GW(1)	GW(2)	GW(3)
TORQUE-BOX	0.0	24046.1	0.0	0.0	21614.0	0.0	0.0	2434.2	0.0
UPPER COVER	0.0	8653.1	0.0	0.0	7942.2	0.0	0.0	911.0	0.0
SKINS	0.0	5694.6	0.0	0.0	5156.2	0.0	0.0	538.3	0.0
STRG.	0.0	2642.5	0.0	0.0	2285.5	0.0	0.0	357.0	0.0
MISC. SK.	0.0	516.0	0.0	0.0	500.4	0.0	0.0	15.6	0.0
LOWER COVER	0.0	7813.1	0.0	0.0	7124.2	0.0	0.0	686.9	0.0
SKINS	0.0	5306.8	0.0	0.0	4903.4	0.0	0.0	403.4	0.0
STRG.	0.0	1960.9	0.0	0.0	1693.4	0.0	0.0	267.5	0.0
MISC. SK.	0.0	545.4	0.0	0.0	527.3	0.0	0.0	16.1	0.0
RIBS	0.0	4492.0	0.0	0.0	3944.6	0.0	0.0	547.4	0.0
INTERM.	0.0	2615.7	0.0	0.0	2406.1	0.0	0.0	209.5	0.0
BULKHEADS	0.0	933.4	0.0	0.0	933.4	0.0	0.0	0.0	0.0
RT/C-L	0.0	942.9	0.0	0.0	605.0	0.0	0.0	337.9	0.0
FRONT SPAR	0.0	1068.5	0.0	0.0	967.3	0.0	0.0	101.2	0.0
CAPS	0.0	132.7	0.0	0.0	123.2	0.0	0.0	9.5	0.0
WEB	0.0	935.8	0.0	0.0	844.1	0.0	0.0	91.8	0.0
REAR SPAR	0.0	1324.1	0.0	0.0	1245.3	0.0	0.0	78.8	0.0
CAPS	0.0	150.9	0.0	0.0	140.2	0.0	0.0	10.6	0.0
WEB	0.0	1173.3	0.0	0.0	1105.1	0.0	0.0	68.2	0.0
MISC. ATT.	0.0	404.9	0.0	0.0	362.5	0.0	0.0	47.4	0.0
STORE FTG.	0.0	28.0	0.0	0.0	28.0	0.0			

	-**-LEADING EDGE-**-		
FIXED STR	0.0	1299.8	0.0
DEV. NO. 1	0.0	0.0	0.0
DEV. NO. 2	0.0	0.0	0.0
DEV. NO. 3	0.0	0.0	0.0

	-**-TRAILING EDGE-**-		
FIXED STR	0.0	1952.5	0.0
T.E. FLAPS	0.0	2414.7	0.0
SPOILERS	0.0	725.3	0.0
AILERONS	0.0	743.3	0.0

-**-FLUTTER STIFFNESS SUMMARY--OUTER-PANEL-**-

	UPPER COVER			LOWER COVER			RIBS, SPARS, ATT.		
COM-U./-L.//I.R.	0.0	1283.4	0.0	0.0	2066.9	0.0	0.0	0.0	0.0
SK.-U./-L.//F.S.	0.0	1135.8	0.0	0.0	1933.3	0.0	0.0	234.3	0.0
STG-U./-L.//R.S.	0.0	147.0	0.0	0.0	75.2	0.0	0.0	301.5	0.0
SK.-U/-L//M.A.	0.0	0.6	0.0	0.0	0.4	0.0	0.0	6.3	0.0

Figure 9. Weight summary, wing group (concl).

*** BODY GROUP ***			** SPRINT **
BULKHEADS AND FRAMES			
	351.00	168.4	
	998.00	1530.9	
	1056.00	100.4	
	734.00	331.4	
	958.00	727.2	
	1641.00	165.7	
	1728.00	138.0	
	1314.47	402.1	
	272.00	34.8	
	452.00	427.4	
	1398.00	114.9	
MINOR FRAMES		1904.1	
JOINTS, SPLICES AND FASTENERS		617.9	
COVERING - UPPER BETWEEN LONGERONS		903.5	
- SIDE BETWEEN LONGERONS		2257.0	
- LOWER BETWEEN LONGERONS		797.9	
COVERING LONGITUDINAL STIFFENERS - UPPER BETW. LONG.		547.6	
- SIDE BETW. LONG.		1194.1	
- LOWER BETW. LONG.		738.3	
LONGERONS - UPPER		535.5	
- LOWER		470.5	
ENGINE DRAG		0.0	
LONGITUDINAL PARTITIONS - (STRUCTURAL)		1172.5	
FLOORING AND SUPPORTS - (BASIC STRUCTURE)		3421.1	
FITTINGS		179.6	
TOTAL - BASIC STRUCTURE			18880.8

Figure 10. Weight summary, fuselage group.

*** BODY GROUP *** SECONDARY STRUCTURE			** SPRINT **
ENCLOSURES (EXCLUDING TURRET ENCLOSURES) CANOPY - PILOT	0.0		
WINDSHIELD (EXCLUDING BULLET PROTECTION)	250.0		
WINDOWS AND PORTS INCL. FRAMES	300.6		
WINDOWS AND PORTS - CABIN	6.3		
FLOORING AND SUPPORTS (SECONDARY STRUCTURE)	404.4		
STAIRWAYS AND LADDERS (FIXED)	32.4		
NOSE RADOME	95.3		
SPEED BRAKES - STRUCTURE AND SUPPORTS	0.0		
TOTAL SECONDARY STRUCTURE		1089.0	

Figure 10. Weight summary, fuselage group (cont).

** SPRINT **

*** BODY GROUP ***
SECONDARY STRUCTURE
(DOORS, PANELS AND MISCELLANEOUS)

	AREA-SQ.FT.		
DOORS AND FRAMES			
- MAIN GEAR	163.0	863.4	
- NOSE GEAR	32.9	164.5	
- AFT CARGO	365.3	1117.4	
- AFT RAMP	108.8	1071.4	
- PRESSURE	68.7	344.9	
- BOMB	0.0	0.0	
- GUN		0.0	
- AMMO		0.0	
- ESCAPE	24.2	471.9	
- ESCAPE	18.8	185.0	
- PARATROOP	42.4	466.4	
- ENTRANCE	12.2	122.0	
- ACCESS		113.3	
PANELS (NON STRUCTURAL)			
- SPOILER DEFLECTOR		20.0	
- MAIN GEAR POD	700.0	1181.4	
WALKWAYS, STEPS, GRIPS		168.2	
ANTI-SKID PROTECTION		58.9	
FAIRING AND FILLETS		0.0	
EXTERIOR FINISH		0.0	
INTERIOR FINISH		248.7	
TOTAL SECONDARY STRUCTURE (DOORS, PANELS, MISC.)			6597.8
TOTAL - BASIC STRUCTURE			18880.8
TOTAL SECONDARY STRUCTURE			1089.0
TOTAL - BODY GROUP			26567.5

Figure 10. Weight summary, fuselage group (cont).

*** BODY GROUP *** ** SPRINT **

BALANCE DATA

	WEIGHT	HORIZ. ARM
BULKHEADS AND FRAMES	4141.18	974.42
JOINTS, SPLICES AND FASTENERS	617.89	978.43
MINOR FRAMES	1904.11	573.19
COVERING - UPPER	903.53	592.62
SIDE	2257.02	969.34
LOWER	797.92	824.66
LONGERONS AND LONGITUDINAL STIFFENERS	547.61	1000.50
	1194.09	971.59
	738.26	925.39
	535.51	901.75
	470.45	1409.84
ENGINE DRAG	0.0	0.0
LONGITUDINAL PARTITIONS	1172.51	955.59
FLOORING AND SUPPORTS	3421.06	872.00
FITTINGS	179.61	1259.41
TOTAL BASIC STRUCTURE	18660.77	958.61
SECONDARY STRUCTURE		
	0.0	0.0
	0.0	0.0
	250.00	309.40
	300.50	309.40
	6.30	1020.00
	404.43	365.30
	32.45	442.80
	95.30	319.00
	0.0	0.0
	0.0	0.0
	0.0	0.0
	0.0	0.0
TOTAL SECONDARY STRUCTURE	1088.98	346.51

Figure 10. Weight summary, fuselage group (cont).

*** BODY GROUP ***
BALANCE DATA

** SPRINT **

	WEIGHT	HORIZ. ARM
DOORS, PANELS AND MISCELLANEOUS		
	863.90	968.60
	164.50	353.80
	1117.37	1540.80
	0.0	0.0
	0.0	0.0
	0.0	0.0
	1071.36	1356.80
	0.0	0.0
	344.94	1611.00
	0.0	0.0
	0.0	0.0
	0.0	0.0
	471.90	810.90
	185.01	842.50
	466.40	1218.00
	20.00	1200.00
	122.00	468.00
	113.28	850.00
	0.0	0.0
	0.0	0.0
	0.0	0.0
	0.0	0.0
	0.0	0.0
	1181.40	971.80
	0.0	0.0
	0.0	0.0
	168.20	872.00
	56.67	872.00
	0.0	0.0
	248.65	882.40
TOTAL SECONDARY STRUCTURE (DOORS, PANELS, MISC.)	6597.77	1125.95
TOTAL - BODY GROUP	26567.52	975.22

END FUSELAGE

Figure 10. Weight summary, fuselage group (concl).

INPUT DATA DECK SETUP

A deck setup for SWEEP is shown in Figure 11. In this arrangement, the first file of program tape PA2 must contain object decks of all SWEEP programs, subroutines, and function subprograms, previously arranged in the required overlay structure by use of the COPYLIB operation. The last record on the tape must contain the complete SWEEP data bank stored in card image format. The first nine cards in the deck are CDC system control cards for the job setup, mounting of the program tape, and system processing of the program for the execution of the first case. The CDC PPLOADER is required for program execution within 50,000 octal core locations for the basic SWEEP program (metallic design, with dummy overlay (18,0)). For the SWEEP advanced composite version (with overlay (18,0)), use of the PPLOADER will allow program execution within the indicated 71,000 octal locations. These restrictions assume that all object decks were compiled under the OPT=2 option.

Each case shown in Figure 11 represents a new problem to be analyzed by SWEEP. As shown, each case must start with two title cards, followed by two case control cards and the necessary variable data decks, and terminate with a case termination card titled "EXECUTE." Independent problems and/or related problems may be set up and executed with discrete cases. In tandem case setups, the required elements for each case must be properly arranged and the variable data decks must contain the necessary information or changes in information required for that case. The two title cards, the two control cards, and the case termination card must be included in each case. Data decks are included only as required. For example, if only the print indicators are to be changed from the preceding case, no input data decks would be included. Proper execution of SWEEP requires compatibility between the instructions on the control cards and the input data decks.

CASE TITLE CARDS

Two title cards for each case must be included for each case data set. These cards may contain up to 80 alphanumeric characters for case descriptions. These case titles are printed for identification purposes on printed outputs for the case.

CASE CONTROL CARDS

Two case control cards are required in each case, following the case title cards. The first, control card 1, contains optional output print control indicators. The second card, control card 2, contains module execution and analysis control information.

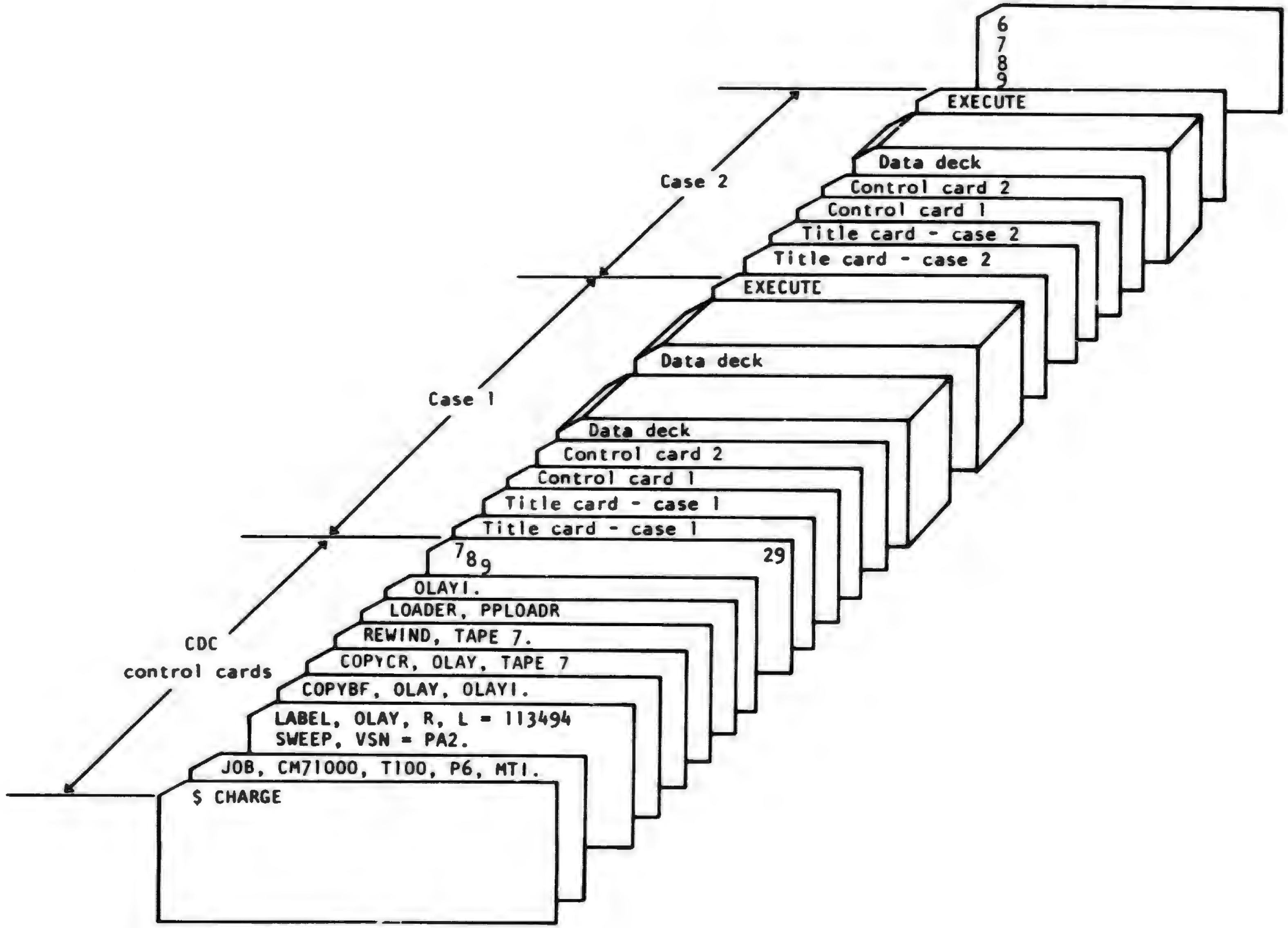


Figure 11. SWEEP input data deck arrangement.

Control Card 1

Optional print and punch card outputs from SWEEP is controlled by data contained in control card 1. Additional data from the wing and empennage module can be printed under control of input data locations 271, 280, and 574 through 578 of the wing, horizontal tail, and vertical tail input data decks. Descriptions of these data locations can be found in Section VI of this volume.

Information in each column of control card 1 instructs the affected SWEEP routine if output is required. A zero or blank indicates "print"; a 1 indicates "do not print." The subroutines in which these indicators are used to control printed output are presented in Table 4. If a second subroutine appears in parenthesis, such as PRTG (GEOMW) for column 6, this means that the subroutine PRTG does nothing except print, and this indicator is used in subroutine GEOMW to call subroutine PRTG. Samples of output printed under control of each column can be found in Appendix A of this volume.

Since only one print control cards is used per case, printed output for wing and empennage analysis will include similar data under control of columns 3 through 38.

Control Card 2

Control card 2 contains input commands for airloads module analysis in columns 1 through 38, metallic or advanced composite analysis indicators for wing and empennage analysis in columns 39 through 44, program flow indicators in columns 71 through 79, and in column 80, an indicator to reinitialize mass storage files from permanent data during execution of the second and subsequent cases. The definitions for the control data required in control card 2 are presented in Table 5.

Airloads module indicators are input as two-digit integers in the columns shown. If this module is not executed (column 71 on control card 2 equals one), these indicators, except for the second and third, are not used and may be left blank. The second and third indicators (columns 3-6) are also used by the data management module, so required information must be input in each case in which the "GENERAL" variable data deck is input.

Wing and empennage construction indicators, columns 39 through 44, must be used to indicate the type of analysis for each surface. The status of these indicators is used by the SWEEP control program to determine which of the wing and empennage synthesis overlays to execute. In metallic designs, overlays (9,0) and (10,0) are executed, while overlay (18,0) is executed for advanced composite designs. Compatible data in the input data blocks for each surface must be included.

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
1	READ	413-463	(1,0)	Permanent data, first case only
2	READ	464-476	(1,0)	Case data
3	CCNTL	573-576	(8,0)	WD array, some of D-array before data transfer, total D-array, SPAL array (record 38)
4	GEOMC	577	(8,0)	YC, YTC, and TAF arrays
5	DMAX ABOXC TBWDC	578	(8,0) (8,0) (8,0)	Values from YTC, YC, and TAF arrays Values from YTC and TT arrays Title for DMAX print
6	PRTG (GEOMW)	579-581	(8,0)	Detail geometry
7	GEOMW PRTG VSGEOM	582	(8,0) (8,0) (8,0)	TGJ array TXY array - only when IP(6) also = 0 TVS array
8	CTOT1 GCNTL LEWT TEDEV TEWT TEWTI	583, 585, 588	(14,0) (14,0) (14,0) (14,0) (14,0) (14,0)	TT(1), TT(2), and YC array Title for CTOT1 print Title for CTOT1 print Title for CTOT1 print Title for CTOT1 print Title for CTOT1 print
9	GCNTL	584	(14,0)	TG and TGA arrays
10	LETEI	591-594	(14,0)	TCS, TWG, CLEI, and CTEI arrays
11	LEWT TEWT TEWTI	586, 587 589, 590	(14,0) (14,0) (14,0)	TGR, TST, CCI, CCL, and CCW arrays CCW, CCT, and TE arrays TGR, TST and CCI arrays
12	WLETE	595	(14,0)	Leading and trailing edge weight and loads summary
13	MISCNT PRTM (MISCIT)	597-601	(15,0) (15,0)	Detail - CCI, TST, and TGR arrays Detail - CCI, TST, TGR, and TCS arrays

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS (CONT)

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
14	MISCNT	602, 604	(15,0)	Summary - CMII and TMVT arrays
	PRTM (MISCIT)		(15,0)	Summary - TCS and CCI arrays
15	CTOT2	596, 605	(15,0)	TT(1), TT(2), and YC arrays
	MISCNT		(15,0)	Title for CTOT2 print
	MISCIT		(15,0)	Title for CTOT2 print
	CDL		(15,0)	Title for CTOT2 print
	FDIS		(15,0)	Title for CTOT2 print
16	CDL	603, 606	(15,0)	TGR and TCS arrays
	TBFWI1		(15,0)	CCI and TCS arrays
17	FDIS	607-609	(15,0)	CCI, TST, TCS, TWG, and TVMT arrays
18	FDIS	610	(15,0)	Fuel distribution summary
19	MTLPW (MTLCW)	611, 617	(16,0)	Torque box and pivot material properties
	TEMPC		(18,0)	Material properties for advanced composites
20	ALOAD	612, 616	(16,0)	Limit airloads and scaling ratios
	ACLOAD		(18,0)	ACL array
21	ABDW	614	(16,0)	Initial deadweight distribution
22	GJCAL	613	(16,0)	Flutter analysis values, GJ and J comparison, design GJ values
	GJTT		(16,0)	T-tail GJ values
23	WDDATA	615	(16,0)	T and CD arrays
24	VLOAD1	618, 619	(16,0)	Initial design loads, required GJ
	DEADW		(9,0)	Deadweight summary and adjustment results, for NODW > 1
	DWYBA		(9,0)	Deadweight and Y-bar adjustment values, for NODW > 1
	VLOAD		(9,0)	Design loads and required GJ, for NODW > 1

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS (CONT)

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
24 (cont)	DEADW		(18,0)	Deadweight summary and adjustment results, for NODW > 1
	DWYBA		(18,0)	Deadweight and Y-bar adjustment values, for NODW > 1
	AVLOAD		(18,0)	Design loads, required GJ, loads at each condition
25	DEADW	627	(9,0)	Deadweight summary and adjustment results, for NODW=1
	DWYBA		(9,0)	Deadweight and Y-bar adjustment values, for NODW=1
	VLOAD		(9,0)	Design loads and required GJ, for NODW=1
	DEADW		(18,0)	Deadweight summary and adjustment results, for NODW=1
	DWYBA		(18,0)	Deadweight and Y-bar adjustment values, for NODW=1
	AVLOAD		(18,0)	Design loads, required GJ, loads at each condition, for NODW=1
26	DLPVT	--	(9,0)	TW array
	PIVOT		(9,0)	Pivot values
	DLPVT		(18,0)	TW array
	PIVOT		(18,0)	Pivot values
27	PRTA (TBOPT)	624-626	(9,0)	Design synthesis and weight distribution summary, for NODW > 1 and DGW=2
	ACPRTA (ATBOPT)		(18,0)	Design synthesis and weight distribution summary, for NODW > 1 and DGW=2
28	PRTA (TBOPT)	--	(9,0)	Design synthesis and weight distribution summary, for NODW > 1 and DGW=1,3
	ACPRTA (ATBOPT)		(18,0)	Design synthesis and weight distribution summary, for NODW > 1 and DGW=1,3

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS (CONT)

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
29	PRTA (TBOPT)	630-632	(9,0)	Design synthesis and weight distribution summary, for NODW=1 and DGW=2
	PRTH (TBOPT)		(9,0)	Pivot and center section analysis values, for NODW=1 and DGW=2
	ACPRTA (ATBOPT)		(18,0)	Design synthesis and weight distribution summary, for NODW=1 and DGW=1,2,3
	PRTH (ATBOPT)		(18,0)	Pivot and center section analysis values, for NODW=1 and DGW=1,2,3
30	PRTA (TBOPT)	--	(9,0)	Design synthesis and weight distribution summary, for NODW=1 and DGW=1,3
	PRTH (TBOPT)		(9,0)	Pivot and center section analysis values, for NODW=1 and DGW=1,3
31	PRTB (CNSTR)	620-623 628, 629	(10,0)	Synthesis details, for DGW=2
	PRTC (CNSTR)		(10,0)	Weight analysis details, for DGW=2
	PRTB (ACNSTR)		(18,0)	Synthesis details, for DGW=2
	PRTC (ACNSTR)		(18,0)	Weight analysis details, for DGW=2
	ACNSTR		(18,0)	DDUC, DDLC, DDIS, DDFS, DDRS, and DDSTR arrays, for DGW=2
	ASTIFF		(18,0)	CD array, for DGW=2
32	PRTB (CNSTR)	620-623	(18,0)	Synthesis details, for DGW=1,3
	PRTC (CNSTR)		(18,0)	Weight analysis details, for DGW=1,3
	PRTB (ACNSTR)		(18,0)	Synthesis details, for DGW=1,3
	PRTC (ACNSTR)		(18,0)	Weight analysis details, for DGW=1,3
	ACNSTR		(18,0)	DDUC, DDLC, DDIS, DDFS, DDRS, and DDSTR arrays, for DGW=1,3
	ASTIFF		(18,0)	CD array, for DGW=1,3

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS (CONT)

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
33	PRTBK (STRG)	--	(10,0)	Checkout print, requires data indicators
	PRTBK (TSCH)		(10,0)	Checkout print, requires data indicators
34	WVFDD	633, 643	(17,0)	TCS and CCDLI arrays
	TBFWI		(17,0)	TCS and CCI arrays
35	CTOT	640, 642	(17,0)	TT(1), TT(2), and YC array
	WVFDD		(17,0)	Title for CTOT print
	WFLDD		(17,0)	Title for CTOT print
36	WODATA	638	(17,0)	Surface inertia summary
37	PRTD	635	(17,0)	Detail weight and coefficient summaries
38	WODATA	634 636-639	(17,0)	WCG, CTBW, CTBI, CLEI, CTEI, CMII, CFL1I, CFL2I, CCDLI, CIOY, and CCI arrays
39	not used			
40	OLAY00	400, 479, 499, 508, 528, 539, 546, 572, 647	(0,0)	Case title and module identification
41	WHVMAT	500-505	(3,0)	Stress vs temperature tables
	WHVQQ		(3,0)	Compressible dynamics pressure values
	SVFTAB		(3,0)	Flutter parameter vs mach number
42	SPDALT	480	(2,0)	Speed-altitude profile tables
43	DSGNPR	481	(2,0)	Speed profile design factors
44	QUIKIE	482	(2,0)	S-array
45	AVDINR	485, 486	(2,0)	RT, RW, RH, RV, RA, and RO arrays
46	PRTOWE (DATAIN)	483, 484	(2,0)	Weight empty breakdown, expendable useful load

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS (CONT)

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
47	DATAIN	488-492	(2,0)	BC array
	DMAXLD	497	(2,0)	Estimated shear, bending moment, and torque
	DCCNTL		(2,0)	WD array
48	AVDATA	487	(2,0)	S-array
49	DATAIN	493-496	(2,0)	Common at end of Data Management
50	BNLDS	520	(4,0)	Body loads
51	SPABM	521	(4,0)	Shear, bending moment, and torsion moment
52	USPAN	509-519	(4,0)	Airload distribution factors
53	WHVNET	522-524	(4,0)	Design loads and ratios
54	BLCNTL	525	(4,0)	Temperature and stress for 23 load conditions, design temperature and load conditions, maximum net bending moments for fatigue
55	FATMG	526	(4,0)	Fatigue spectra
56	FATGUE	529, 530	(5,0)	Bending moment spectra input
57	FATIGU	531-536	(5,0)	Damage table, calc life, etc
	FTGCTL		(5,0)	"FATIGUE" input values
58	FATIGU	537	(5,0)	Intermediate values, iteration trace
59	LANDGR	540	(6,0)	Landing gear input data
60	LGEAR	541	(6,0)	Landing gear loads
61	AISMN	547	(7,0)	AIS system input data
62	SPAL	548	(7,0)	Speed-altitude profile tables
63	MATLP2 (MCNTL1)	549-551	(7,0)	Duct, ramp and nacelle material properties
64	MCNTL1	552	(7,0)	TMS array
65	DSGNP	553	(7,0)	Speed profile design factors

TABLE 4. CASE CONTROL CARD 1 - PRINT INDICATORS (CONCL)

Control Card 1 Column (IP loc)	Routine[a]	Sample Page Reference	Overlay	Description
66	PRECRT	554	(7,0)	Ramp design conditions
67	RAMPS	554, 555	(7,0)	Built-in parameters, reaction forces and weights
68	FRMELD	556	(7,0)	Duct frame data
69	DUCTS	557-558	(7,0)	Duct frame data and duct geometry - section data
70	NACELE	559	(7,0)	Nacelle geometry - section data
71	FUSLD	648-651	(11,0)	Fuselage loads and inertia data
72	MATLP1 (MFCNTL)	652-653	(11,0)	Cover, longeron, major and minor frames material properties
73	MFCNTL	653	(11,0)	TMS array
74	FUSLD DUMMY1	652-654	(11,0) (11,0)	Loads array Input and corrected data
75	FFRME FRMND1	655	(11,0) (11,0)	External frame loads details Fuselage shape details
76	SFOAWE FRMLD	656	(11,0) (11,0)	Frame synthesis details Segment loads details
77	FFRME	656	(11,0)	Major frames detail weights
78	MINFR	657	(12,0)	T-array
79	FUSSHL	657	(12,0)	T-array
80	SPRINT	658-663	(12,0)	Details - Construction indicators, basic vehicle data, secondary structure, shell and section values

[a]Routine in which the corresponding IP element is tested and printing is done. If a second routine name appears in parenthesis as PRTG(GEOMW), this indicates that PRTG is strictly a print routine and the indicator is used in GEOMW to call or not call PRTG.

Descriptions follow for each module execution control indicators in columns 71 through 80.

Column 71 is used to designate execution of the airloads module. This module requires data from the data management module and cannot be executed unless general data is input or available from a previous case.

Column 72 is used to designate execution of the wing and empennage module for wing structure. Execution of this module requires wing data either input or available from a previous case. Loads data is also necessary and must be available as input, or calculated by the airloads module, or either of these left from a previous case.

Column 73 is used to designate execution of the fuselage module. Fuselage data is required. Fuselage loads data and inertial data must be avail- either by input, calculations from the data management module and the airloads module, or left from a previous case.

Column 74 is used to designate execution of the landing gear module. Landing gear datais all that is necessary for the execution of this module.

Columns 75 and 76 are used to designate execution of the wing and empennage module for the horizontal and vertical tails, respectively. Horizontal data, vertical data, and loads data are required.

Column 77 designates execution of the air induction system module. Air induction system data is required for the execution of this module.

Column 78 designates execution of the fatigue module. Fatigue data is required.

Column 79 is used to designate execution of the output module. This module requires data developed in the data management module; therefore, execution of the output module should be indicated only if general data is input or available from a previous case.

Column 80 on control card No. 2 is used to indicate that the permanent data arrays which were initialized at the start of case 1 are to be reinitialized at the start of this case. These data arrays are stored in records 1-9, 11, 12, 17, 21, 23-29, 32-34, 36-38, and 41-60. A 1 in column 80 indicates that these records are to be reinitialized; a 0 (or blank) indicates that the data for this case will be read into the data arrays as they were left from the previous case.

VARIABLE DATA DECKS

Eleven data blocks are used to input design information for execution by SWEEP modules. Each block is set up to be processed by program READ as discrete data decks consisting of a leading deck identification card, variable data cards, and a deck termination variable data card (Figure 12).

Processing of numeric data is dictated by the control title in the deck identification card. The title identifies the data array that is to be initialized before numeric data cards are read. During the first execution case, each data array is initialized with data from the SWEEP data bank. For subsequent cases, initialization is governed by the status of column 80 of case control card 2 (Table 5).

Data blocks are identified by the deck titles as shown in Figure 13. These titles must appear as shown, starting in column 1 of the card. Only columns 1 through 10 are processed so user comments may be punched in columns 11 through 80 for problem identification purposes.

If errors in title format are encountered, program READ will skip processing of all numeric data in that deck and print the following error message:

***BAD TITLE CARD - - - AAAAAAAAAA ***

where A....A is the alphanumeric image contained in columns 1 through 10 of the title card.

Title card errors will not result in termination of program analysis. All case data decks are processed, and required modules are executed through completion or until a fatal error is encountered. Case execution is continued so that results can be obtained from SWEEP modules not affected by the missing data deck information. However, the user is cautioned to scan program output for error messages and assess the validity of all module outputs.

The procedure used to process numeric information on variable data cards permits random access to all array locations (Figure 14). All variable data cards contain a relative location address field plus five data fields. The processing of real data on each card into the reference data array is governed by the index value in the address field. This technique allows the user to input values for only those variables that need to be changed. Thus, the size of each data deck for all problem cases can be kept to a minimum, containing only the necessary location and numeric information pertinent to the problem. Information existing in array locations not addressed through variable data cards are not changed. Processing of variable data cards for each deck is terminated when the read routine senses a minus (-) character in column 1 of any variable data card.

TABLE 5. CASE CONTROL CARD 2 INDICATORS

Control Card 2 Column	Labeled Common Location	Description
1-2	XMISC(51)	Air vehicle class indicator 01 = fighter (F) 02 = attack (A) 03 = tactical bomber (BI) 04 = strategic bomber (BII) 05 = cargo assault (CA) 06 = cargo transport (CT)
3-4	XMISC(52)	Wing-type indicator -1 = fixed wing 01 = variable-sweep wing
5-6	XMISC(53)	Vertical-tail-type indicator -1 = single tail 00 = dual tail 01 = T-type tail
7-8	XMISC(54)	Load calculation option indicator -1 = calculate basic loads only 00 = calculate fatigue spectra only 01 = calculate both basic loads and fatigue spectra
9-10	XMISC(55)	Total vehicle load calculation control 01 = compute all loads (fuselage, wing, horizontal tail, vertical tail) 00 = compute loads as indicated by controls in columns 11 through 18
11-12	XMISC(56)	Fuselage load calculation indicator 01 = compute 00 = do not compute
13-14	XMISC(57)	Wing load calculation indicator 01 = compute 00 = do not compute
15-16	XMISC(58)	Horizontal tail load calculation indicator 01 = compute 00 = do not compute

TABLE 5. CASE CONTROL CARD 2 INDICATORS (CONT)

Control Card 2 Column	Labeled Common Location	Description
17-18	XMISC(59)	Vertical tail load calculation indicator 01 = compute 00 = do not compute
19-20	XMISC(60)	Load conditions 1 through 5 calculation indicator (positive maneuver conditions) 01 = Compute 00 = do not compute
21-22	XMISC(61)	Load conditions 6 and 7 calculation indicator (negative maneuver conditions) 01 = compute 00 = do not compute
23-24	XMISC(62)	Load condition 8 calculation indicator (maneuvering flap) 01 = compute 00 = do not compute
25-26	XMISC(63)	Load condition 9 calculation indicator (1 g trim flap) 01 = compute 00 = do not compute
27-28	XMISC(64)	Load conditions 10 through 13 calculation indicator (positive vertical gust conditions) 01 = compute 00 = do not compute
29-30	XMISC(65)	Load conditions 14 through 17 calculation indicator (negative vertical gust conditions) 01 = compute 00 = do not compute
31-32	XMISC(66)	Load conditions 18 and 19 calculation indicator (lateral gust conditions) 01 = compute 00 = do not compute

TABLE 5. CASE CONTROL CARD 2 INDICATORS (CONT)

Control Card 2 Column	Labeled Common Location	Description
33-34	XMISC(67)	Load conditions 20 and 21 calculation indicator (pitching acceleration conditions) 01 = compute 00 = do not compute
35-36	XMISC(68)	Load conditions 21 and 23 calculation indicator (yawing acceleration conditions) 01 = compute 00 = do not compute
37-38	XMISC(69)	Wing fatigue spectra calculation indicator -1 = compute gust and maneuver spectra 01 = compute gust spectra only
39-40	IFL(11)	Wing construction indicator 00 = metal structure 01 = advanced composite structure
41-42	IFL(12)	Horizontal tail construction indicator 00 = metal structure 01 = advanced composite structure
43-44	IFL(13)	Vertical tail construction indicator 00 = metal structure 01 = advanced composite structure
45-70		Not used
71	IFL(1)	Airloads module execution control 0 = execute 1 = do not execute
72	IFL(2)	Wing execution control for wing and empennage module 0 = execute 1 = do not execute
73	IFL(3)	Fuselage module execution control 0 = execute 1 = do not execute

TABLE 5. CASE CONTROL CARD 2 INDICATORS (CONCL)

Control Card 2 Column	Labeled Common Location	Description
74	IFL(4)	Landing gear module execution control 0 = execute 1 = do not execute
75	IFL(5)	Horizontal tail execution control for wing and empennage module 0 = execute 1 = do not execute
76	IFL(6)	Vertical tail execution control for wing and empennage module 0 = execute 1 = do not execute
77	IFL(7)	Air induction system module execution control 0 = execute 1 = do not execute
78	IFL(8)	Fatigue module execution control 0 = execute 1 = do not execute
79	IFL(9)	Final output module execution control 0 = execute 1 = do not execute
80	IFL(10)	File initialization control for subsequent cases (not applicable for first case) 0 = leave files as they exist and update with input data 1 = reinitialize data files (mass storage file records 1-9, 11, 12, 17, 21, 23-29, 32-34, 36-38, and 41-60) from TAPE7

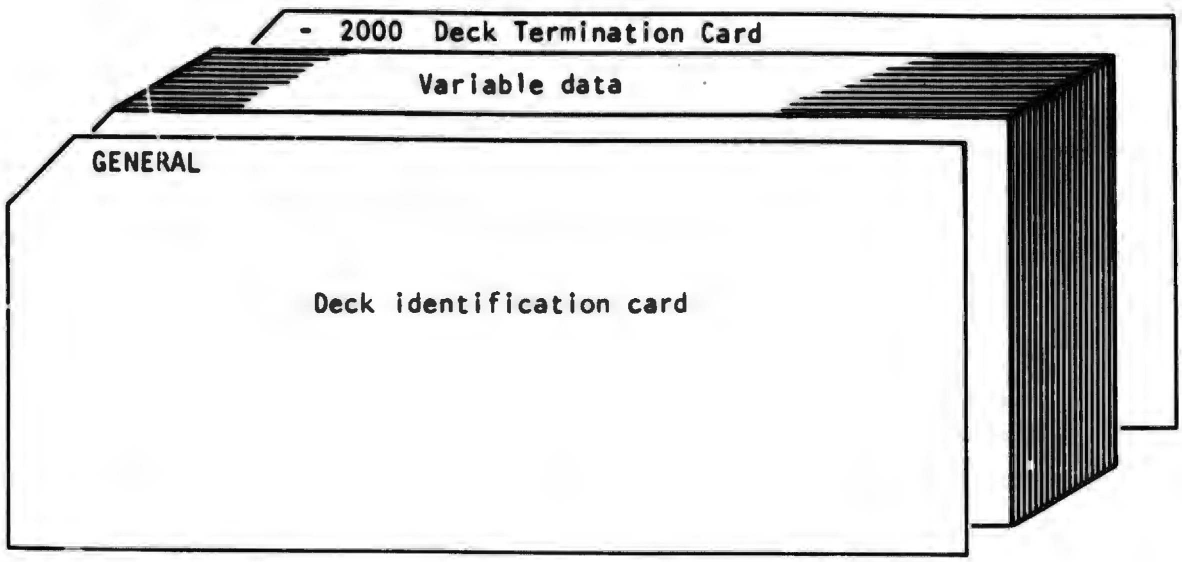


Figure 12. Data deck setup for SWEEP data blocks.

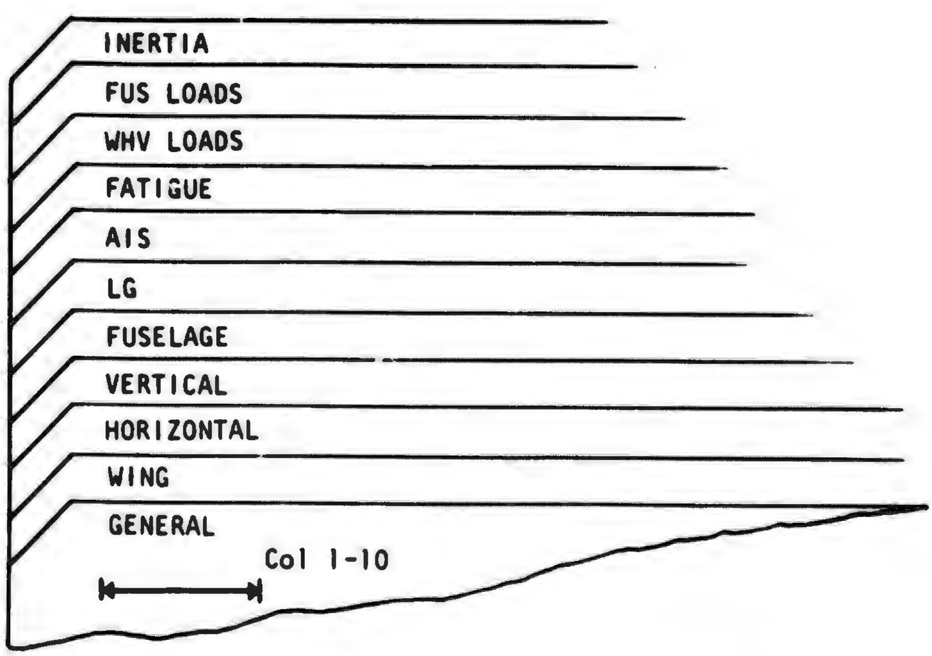


Figure 13. Data deck titles for SWEEP data blocks.

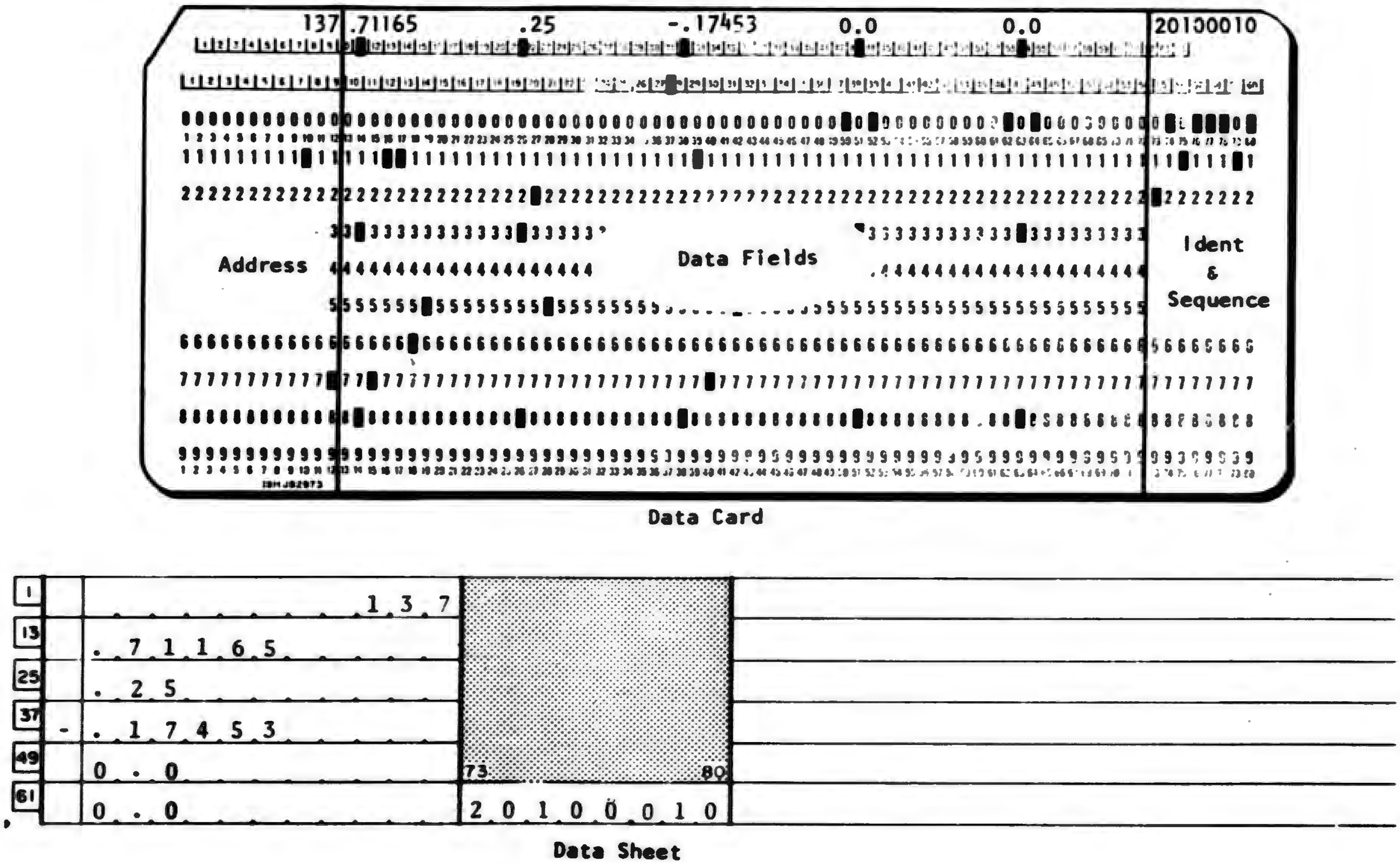


Figure 14. Relative read data card format.

Data cards with illegal punches such as alphabetic characters that cannot be interpreted into numeric form will result in job termination. Missing deck termination cards (minus (-) punch in column 1) will also result in job termination. Without the deck termination card, processing of the variable data deck will continue. The next card read will be an alphanumeric title card which cannot be interpreted, resulting in system stoppage. A deck termination card must always include an integer number in the address field to be read. If the address is not included, the card processing routine will misinterpret the card. Information in the data field need not be included. A deck termination card misplaced within a data deck will result in continued processing and execution of the problem case. However, all data cards following the misplaced deck termination card will not be processed. An error message will be printed by program READ since the card following the misplaced deck termination card will be interpreted as a bad data deck title card.

Data cards without information in the address field will not be processed. The data field information will be printed along with the error message:

NO DECK LOCATION

Normal processing and execution will continue after the error message is printed.

Design information contained in variable data decks titled "WING," "HORIZONTAL," "VERTICAL," "FUSELAGE," "LG," "AIS," and "FATIQUE" are transmitted to the SWEEP modules identified in Table 2. The design data in these decks are used by these modules for components structural synthesis and weight analysis. Further discussion on the use of these decks and descriptions for each data array location can be found in Sections III through VII of this volume. Data decks titled "WHV LOADS, " "FUS LOADS, " and "INERTIA" are special data decks used for input of lifting surface and fuselage design loads data. Use of these decks and descriptions of data array locations are discussed in Sections VIII, IX, and X of this volume.

All data blocks may be arranged in any order during case setup. However, the recommended setup is to start with the "GENERAL" data deck first. The relationship of the "GENERAL" data deck, the design information contained in that deck, and the analysis control information contained in case control card 2 to the other variable data blocks must be considered in the setup. Tables 2 and 3 should be used as setup guides. The "GENERAL" data deck descriptions in Section II of this volume should also be used.

The "GENERAL" data deck contains general design information used in the development of design data for the weight estimation modules. It causes the execution of the data management and flutter and temperature modules and contains the necessary vehicle data used by the airloads module.

Data items from this deck are also processed into the input data set for the weight estimation modules. Variable data locations in data decks "FUSELAGE," "AIS," "LG," "WING," "HORIZONTAL," and "VERTICAL" which can be replaced with either data from the "GENERAL" data block or calculated data resulting from execution of the data management and flutter and temperature modules are identified in the variable data descriptions for each deck.

CASE TERMINATION CARD

The last data block in each problem case must be followed by a case termination control card (Figure 12) titled "EXECUTE" in columns 1 through 10. The information on this card directs program READ to stop case data deck processing and initiate problem execution.

Title errors on this card will result in printing of the error message discussed previously for deck title cards. Further data deck processing will be attempted by program READ, resulting in either a normal job termination or a system job termination due to a fatal error condition. The normal job termination will result if the error occurred during processing of the last problem case for the job. An end-of-file mark will be read on input device TAPE 5, causing job termination without execution of the case. The fatal job termination will occur for multicase jobs when "EXECUTE" card errors occur in cases other than the last. This is due to reading the first case title card of the next case as a variable data card.

NUMERIC DATA CARDS

All numeric data are input to SWEEP with six-field data cards on columns 1 through 72 (Figure 14). The first field, columns 1 through 12, contains relative location address information for the real data on the card in fields 2 through 6. Each data field consists of 12 consecutive columns starting at column 13. The first column of each field, columns 13, 25, 37, 49 and 61, are used to denote the sign of the data in the field.

This data card format, coupled with the internal data processing, permits random access to all locations of the data array into which input data is to be transmitted. Processing and storage of data is governed only by the index value in the address field which is used to identify the array locations to be changed with card data. Thus, data cards in each data deck may be arranged in any order.

Data card read, is initiated by a control routine that identifies the internal data array that is to be changed. Data cards are then read and processed by SWEEP subroutine DECRD. This routine provides the facility for reading a variable number of pieces of real data from input device, TAPE5, and storing them in specified elements (either sequential or nonconsecutive) of the array. The subroutine argument is the name of the array into which real data are to be stored. Only the information specified is actually read into storage; the remaining elements of the array are unchanged.

Each card must contain an index, an integer written in columns 1 through 12. The five data fields of 12 columns each (columns 13 thorugh 72) contain input data of the real type. However, any data field may be left blank to indicate that the corresponding location is not to be changed. Columns 73 through 80 are not read and may contain deck identification.

The index defines the location of the first piece of data on the card within the array specified as the argument. This integer must be written to the extreme right of the field. If the name of the array is not subscripted in the CALL statement, the index can be considered equivalent to the subscript of a one-dimensional array. For example, if the argument is the nonsubscripted array name, ARR, and the index is 10, the first piece of data on the card (columns 13 through 24) will be read into ARR (10); the third piece of data (columns 37 through 48) will be read into ARR (12).

All data items must be the real type; they are written following the rules for input with the F-type format specification. If an exponent is written, it must be at the extreme right of the field.

1. If the number is written without either an exponent or a decimal point, the point is assumed to be at the extreme right of the field (as if read with an F12.0 format).

2. If the decimal point is explicitly written, the number may be positioned anywhere in the field.

3. If no decimal point is written but an exponent is furnished, the point is assumed to be immediately to the left of the exponent.

When a field is left blank, no information is read into the location corresponding to this field; the information already in this location is unaltered. A negative zero is read as zero.

Reading is terminated by putting a negative sign in column 1 of the last card to be read.

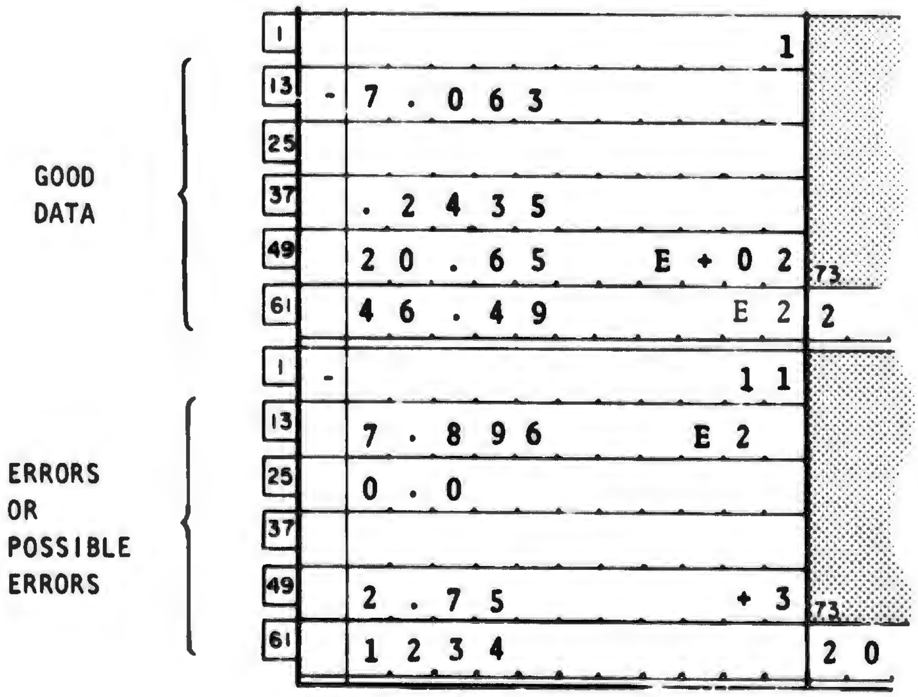
The data fields of each card are converted twice, using two formats, 5F12.0 and 10A6. The A-type conversion is used to check for blank fields. If the field is not blank, the result of the F-type conversion is stored in the proper element of the specified array. After reading each card, a test is made for a negative sign in the first field; reading is terminated if the sign is negative.

The index may not be zero or blank. If it is, an error message, "NO DECK LOCATION" and the contents of columns 13 thorugh 72 of the card are printed and reading continues.

If any card contains data which cannot be interpreted, (alphabetic punches, for example), a system stop will occur and job processing is terminated. This condition will also occur if any variable data deck does not have a minus sign in the index field of the last card.

Example of DECRD input:

Assume a CALL DECRD (ARR) statement and the following data cards:



The first card will result in information being stored as follows:

ARR (1)	-0.7063 E+01
ARR (2)	Unchanged
ARR (3)	0.2435 E-00
ARR (4)	0.2065 E+04
ARR (5)	0.4649 E+04

The - sign in column 1 of the second card signals that this is the last card to be read under control of this CALL DECRD statement. This card has been written to illustrate some types of errors (or possible errors) in writing the data. The information will be stored as:

ARR (11)	0.7896 E+21
(Exponent mislocated or incomplete)	
ARR (12)	0.0
ARR (13)	Unchanged
ARR (14)	0.275 E+04
ARR (15)	0.1234 E+11
(Decimal point assumed at extreme right)	

When no decimal point is written, as in the last item, the decimal point is assumed to be at the extreme right of the field.

PERMANENT DATA BANK

The permanent data bank deck, is used to create TAPE7, the permanent data file. Figure 15 shows the sequential order of data sets in the data bank deck. The data bank is used for module access of the following types of data:

1. Aerodynamic data for loads analysis

2. Spectrum data for fatigue analysis

3. Weight analysis constants and index factors

4. Flutter and temperature constants

5. Weight constants and data for initial weight distributions

6. Airfoil descriptions

7. Material property descriptions

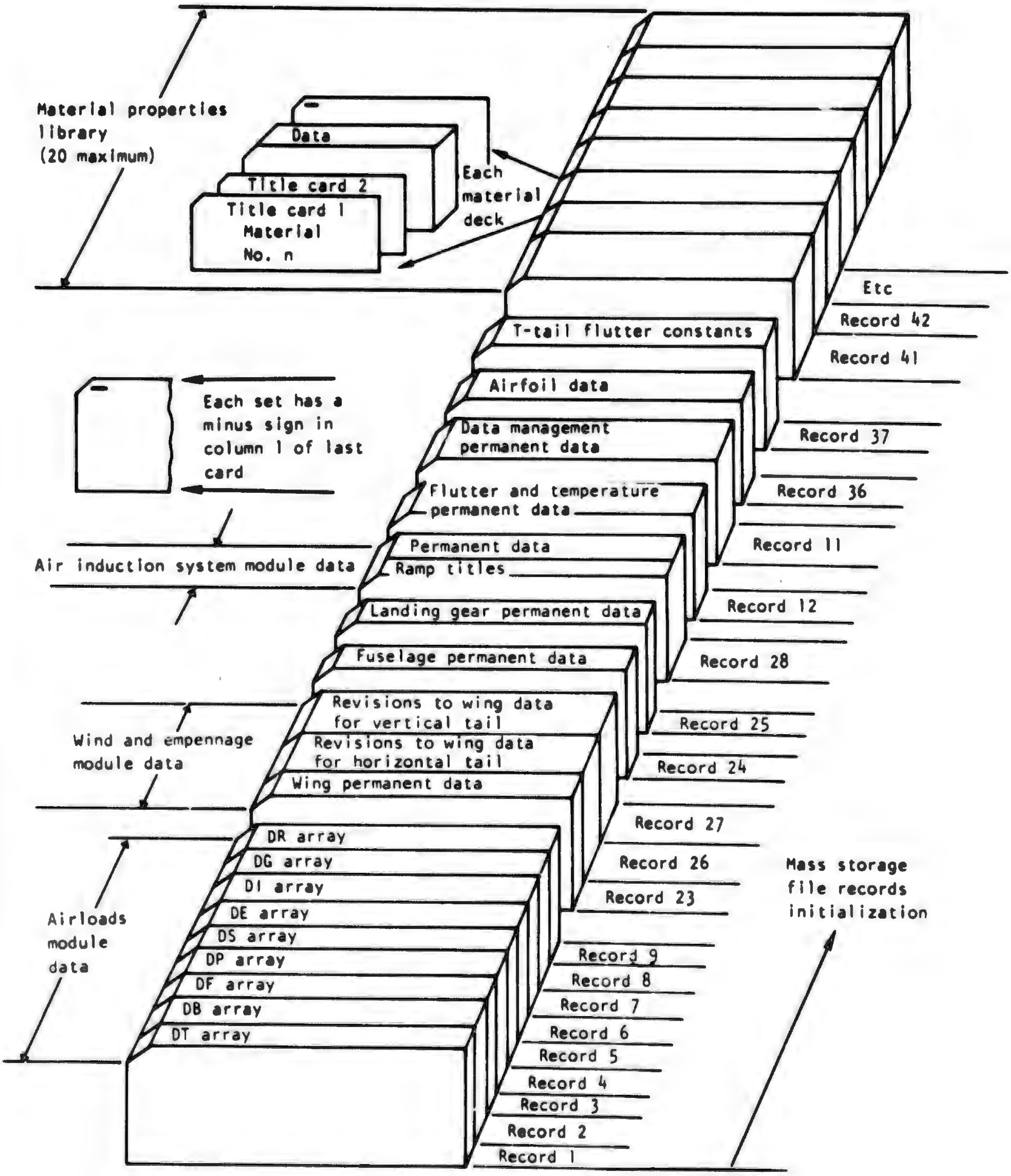


Figure 15. SWEEP permanent data bank data deck setup and mass storage file initialization.

Records in this data bank are used to initialize mass storage file design data records for use by the different program modules. Revisions of data values in any data set requires appropriate job control card and deck setup changes (Figure 16) which will result in update of card image data on peripheral device 7. The data sets must be arranged as shown for processing by program READ, overlay (1,0). All numeric data sets are read and processed with the same method used for variable input data processing. Thus revision of data items can be made with the addition of new cards containing the correct numeric values and relative addresses before the last card of each set.

The material properties library of the SWEEP data bank includes the necessary information required for structural synthesis of metallic structures. Changes and/or additions to this library must be made using the aforementioned procedures and the material description data cards presented in Section XI of this volume. Material properties for advanced composite structure analysis are included in the wing and empennage permanent data sets of the data bank. These data, describing boron/epoxy material, are used to initialize the variable data array for wing or empennage analysis. Material property changes for advanced composite material should be made with appropriate data cards in the variable data blocks for these components. Section VI of this volume contains the descriptions of data items necessary to make these changes.

Note: (1) Update permanent data deck for current job only.
(2) Create tape with new data deck.

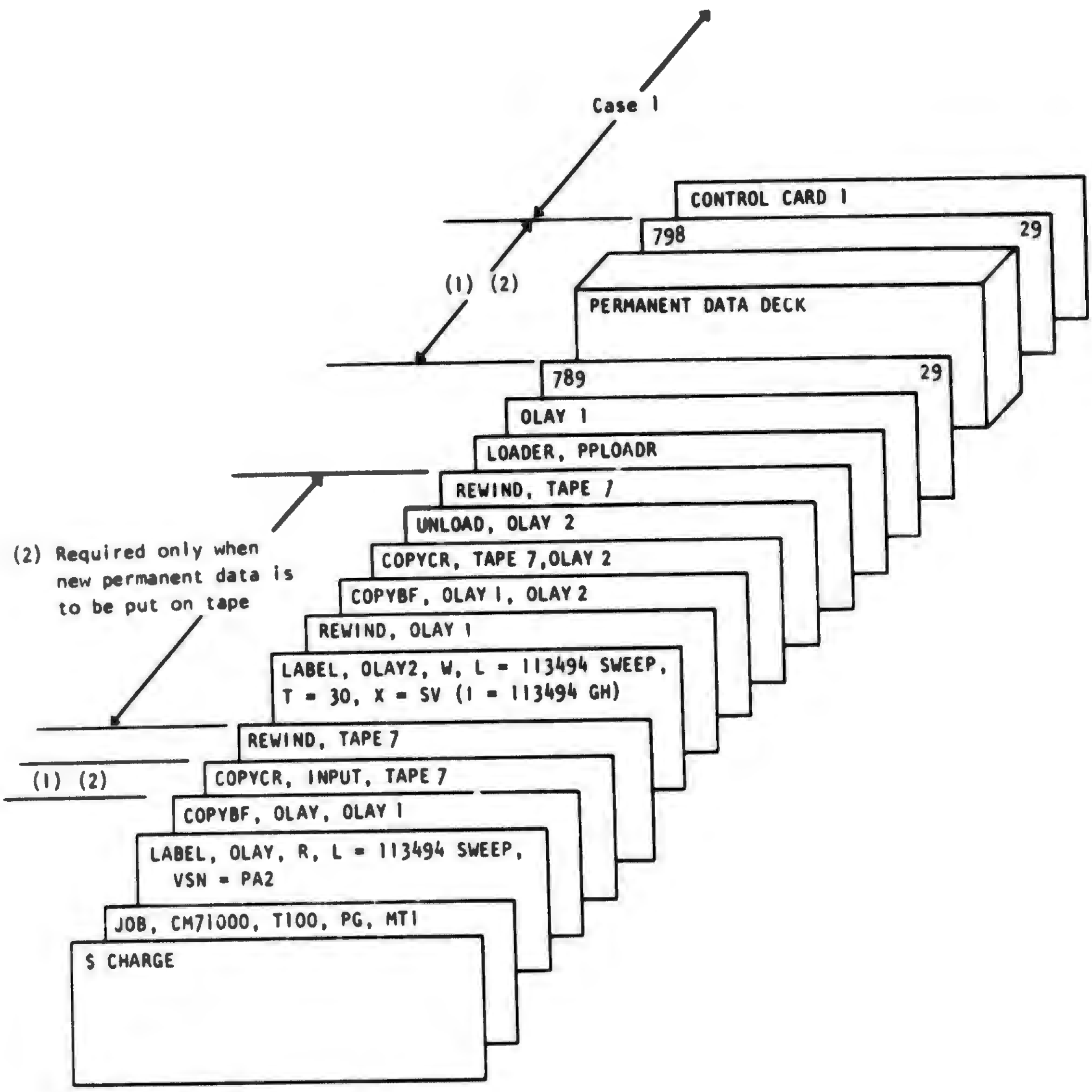


Figure 16. Setup to revise permanent data.

Section II

GENERAL DATA

INTRODUCTION

The data management module is overlay (2,0) of the integrated SWEEP program. The primary function of this module is to organize vehicle geometric data and criteria for the overloads module, overlay (4,0) and the flutter and temperature module, overlay (3,0). Execution of both the data management and the flutter and temperature modules is initiated by input of the GENERAL data block. The following paragraphs describe this input data and some of the programmed methods.

GENERAL DESCRIPTION

The data management module develops the weight and inertia characteristics for a three-dimensional model of the flight vehicle. Structural component geometry is combined to determine their relative locations and to resolve the aerodynamic geometry. In the case of variable sweep wing aircraft, theoretical trapezoidal data are calculated for the forward and aft wing sweep positions. Vertical tail geometry is modified to account for body carryover effects. The relative position of the horizontal and vertical tails is also evaluated to account for end plate effect or for T-tail load introduction. Nose geometry for the purpose of estimating body lift characteristics is based on the location of the lifting surface and on body cross-sectional variation. Synthesis cut locations for the wing, horizontal tail, vertical tail, and fuselage are also defined in this module. This insures consistency between the data generated in the loads module and the weight synthesis module.

The weights and centers of gravity (CG) of equipment, propulsion components, and useful load at the different vehicle design weights are user input data. The weights of structural components are not required. If the weight of any structural item is not input, statistical weight and CG estimates are made using the geometry and design requirement data. The calculated estimates are then adjusted to be in agreement with the input basic flight design weight and CG. Should all of the structural component weight data be input, the basic flight weight and balance is determined by the summation of group weight and useful load data.

Weight and balance at the other design weights are obtained by adding the corresponding useful load data to the empty weight data. Variable sweep wing aircraft balance calculations are made for the forward and aft wing positions.

Balance data are used to distribute the weight of contents among the different components. A rule-of-thumb approach is used to distribute weight empty items; useful load distribution is specified by input data. These mass distributions in conjunction with geometry are used to estimate pitch and yaw inertia.

One of the primary purposes of the data management module is to establish data in the appropriate form for use by the airloads module. A familiarity with the loading conditions analyzed by the airloads module is essential for the user to efficiently generate general data deck input.

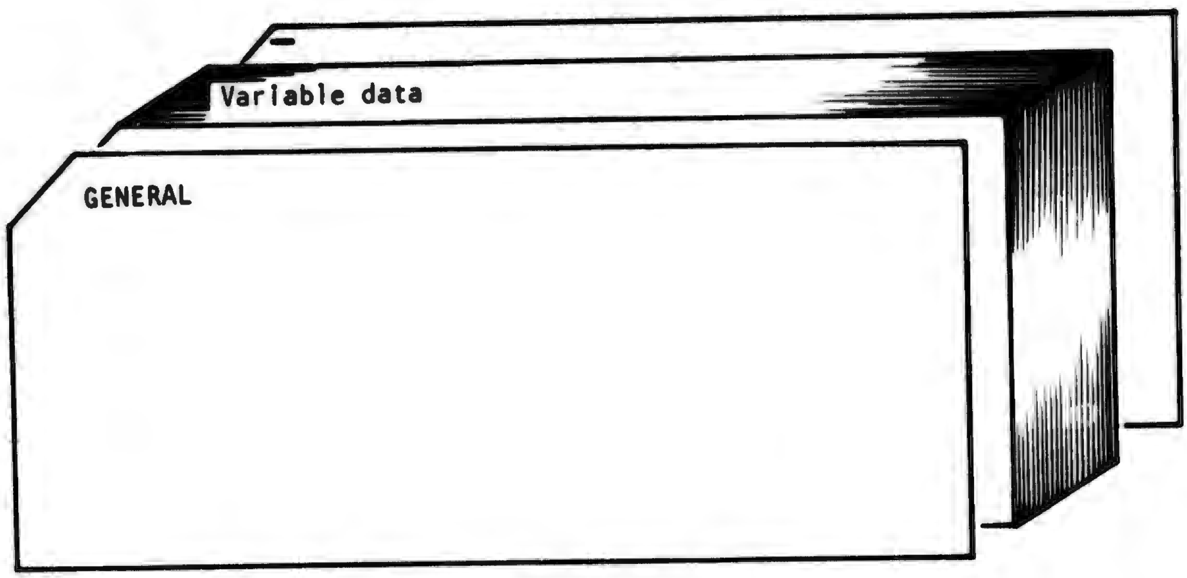
A primary function of the airloads module is to estimate airloads for as many as 24 flight conditions. A summary of the 24 possible airload conditions and their speed-altitude profile (Figure 17) are presented in Table 6. The user selects the appropriate flight conditions for analysis, depending on such factors as the type of aircraft, wing configuration (fixed or variable sweep), wing sweep position (forward or aft), and type of load (maneuver, gust, etc) to be analyzed. These conditions are indicated by the user on control card No. 2. Input data and gross weights (BFDW, MDW, and LDW) are developed in the data management module.

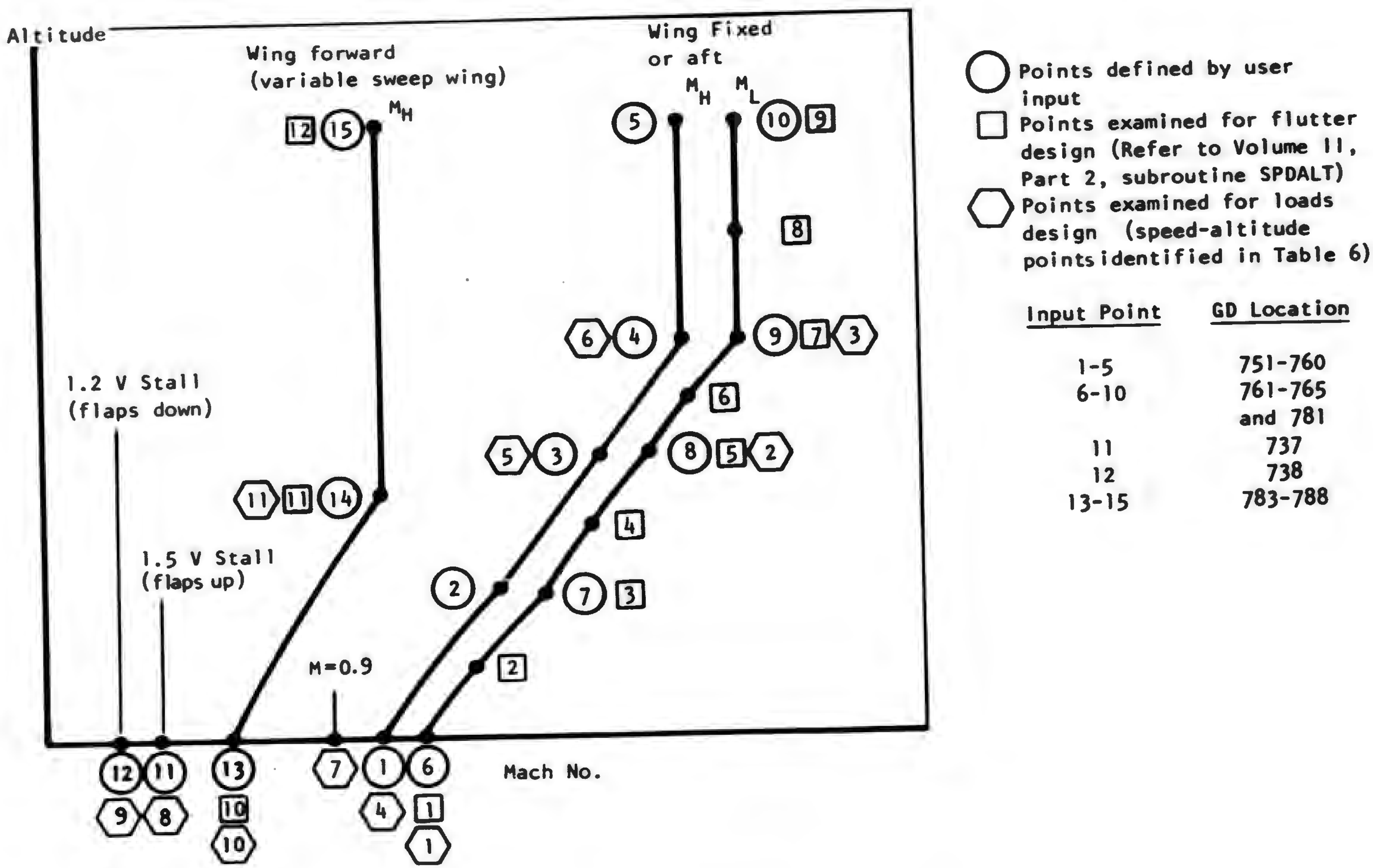
The flutter and temperature module calculates equilibrium skin temperature at each flight design load condition point (Figure 17). It also examines the speed-altitude profile and geometry data established by the data management module to determine compressible dynamic pressures which are critical for lifting surface flutter prevention design of the wing, horizontal, and vertical tails. Surface aspect ratio, taper ratio, and sweep of the quarter chord are geometric parameters used in the flutter investigation. These parameters are based on the theoretical gross trapezoidal geometry of the wing and horizontal tail and on the theoretical exposed geometry of the vertical tail. Vertical tail aspect ratio, for the purpose of flutter evaluation, is based on an equivalent mirror-image set (twice the true aspect ratio). For variable-sweep wing aircraft, the theoretical wing geometry associated with the respective flight profiles (Figure 17) is used in the flutter evaluation.

This program has been written to implement the structural design specifications, MIL-A-8860, -8861, -8862, and -8866. Liberal references to these specifications are made in the discussions that follow. The intention here is not to subjugate the user to these specifications, but to provide insight into the relevance of this data.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 8. All of the variables in the list of inputs are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card, "GENERAL." The last data card must have a minus sign in column 1. The GENERAL deck setup is as follows:





Input Point	GD Location
1-5	751-760
6-10	761-765 and 781
11	737
12	738
13-15	783-788

Figure 17. Speed-altitude profile points.

TABLE 6. DESIGN LOAD CONDITIONS AND CONSTRAINTS

Load Cond No.	Type of Load Cond	A/V Type	Vehicle Weight	Wing Sweep ΛW	Speed-Altitude Profile (Fig. 17)			Additional Design Constraints
					Point[a]	Mach No.	Alt	
1	$+N_Z$	F, A, B, C	BFDW	Fix - aft	1	M_L	SL	
2	$+N_Z$	F, A, B, C	BFDW	Fix - aft	2	M_L	Int	Only if M_L at 2 ≥ M_L at 3
3	$+N_Z$	F, A, B, C	BFDW	Fix - aft	3	M_L	Min at max M_H	Only if M_L at 3 ≥ M_L at 2
4	$+N_Z$	F, A	BFDW	Fix - aft	7	0.9	SL	Only if M_L at 1 ≥ 1.0
5	$+N_Z$	F, A, B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
6	$-N_Z$	F, A, B, C	BFDW	Fix - aft	4	M_H	SL	
7	$-N_Z$	F, A, B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
8	Man. flap	F, A, B, C	MDW	Fix - fwd	8	1.5 V_{SO}	SL	
9	1 g trim	F, A, B, C	LDW	Fix - fwd	9	1.2 V_{SL}	SL	
10	+ Vert gust	B, C	BFDW	Fix - aft	4	M_H	SL	
11	+ Vert gust	B, C	BFDW	Fix - aft	5	M_H	Int	
12	+ Vert gust	B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
13	+ Vert gust	B, C	BFDW	Fwd	11	M_H	Int	Variable sweep wing only
14	- Vert gust	F, A, B, C	BFDW	Fix - aft	4	M_H	SL	
15	- Vert gust	F, A, B, C	BFDW	Fix - aft	5	M_H	Int	
16	- Vert gust	B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
17	- Vert gust	B, C	BFDW	Fwd	11	M_H	SL	Variable sweep wing only
18	Lat gust	F, A, B, C	BFDW	Fix - aft	4	M_H	SL	
19	Lat gust	F, A, B, C	BFDW	Fix - aft	5	M_H	Int	

[a]Identified by hexagonal points in Figure 17.

TABLE 6. DESIGN LOAD CONDITIONS AND CONSTRAINTS (CONCL)

Load Cond No.	Type of Load Cond	A/V Type	Vehicle Weight	Wing Sweep ΛW	Speed-Altitude Profile (Fig. 17)			Additional Design Constraints
					Point[a]	Mach No.	Alt	
20	Pitch acc	F, A, B, C	BFDW	Fix - aft	1	M_L	SL	
21	Pitch acc	F, A, B, C	BFDW	Fix - aft	3	M_L	Min at max M_H	
22	Yaw acc	F, A, B, C	BFDW	Fix - aft	1	M_L	SL	
23	Yaw acc	F, A, B, C	BFDW	Fix - aft	3	M_L	Min at max M_H	
24	2 g taxi	F, A, B, C	MDW	Fix - fwd	-	-	-	

[a]Identified by hexagonal points in Figure 17.

Expanded explanations for those variables which may be subject to misinterpretation are presented below.

- Locations 702 and 951 through 990 specify the wing geometry. Location 702 specifies whether the analysis is to be directed for either a fixed or variable-sweep wing vehicle. Locations 951 through 980 define the reference wing planform geometry, locations 981 through 984 provide information for rotating the reference wing, and locations 987 through 990 provide flap data.

  A zero or blank in location 702 indicates a fixed wing vehicle, in which case locations 981 through 984 are not used. Vehicle speed-altitude profile data for the wing in a forward position, locations 783 through 788, are also not required.

  A positive value in location 702 indicates a variable-sweep wing. Locations 951 through 980 define the reference wing, and locations 981 through 984 provide information for rotating this reference wing to the two load and flutter evaluation positions. The reference wing data may define geometry at either of the two evaluation positions, or at another position. Reference geometry is the aerodynamic reference planform.

- Locations 719, 720, 751-765, 781, 783-788, and a number of other inputs are directly related to points on the mach-altitude design envelopes of Figure 17. A familiarity with the mach-altitude points in Figure 17 and their relationship to the loading conditions of Table 6 is therefore necessary.

  Figure 17 depicts flight envelope points which are input by the user, as well as points which are selected by the program for the various airload conditions of Table 6. Of the 15 points defined by user input, points 1, 2, 3, 4, 5, 13, 14, and 15 are directly input by the user through locations 751-760 and 783-788; points 6, 7, 8, 9, and 10 are set up by the program in accordance with the speed margins on M_H designated by the user in locations 761-765 and 781; and points 11 and 12 are automatically determined by the program from user input of stall speeds in locations 737 and 738.

  Figure 17 contains 11 mach-altitude locations at which airloads conditions are defined. With the exception of point 7, each airloads design condition occurs at some corresponding user input point. The loading design points are normally selected automatically by the program. However, the mach-altitudes for loading design points 2 and 3 may be overridden via general data deck input locations 719 and 720. The user thus has the option of relocating loading point 2 at input point 7, 9, or 10, and loading point 3 at input point 7, 8, or 10.

  Figure 17 contains 12 mach-altitude points that are surveyed to determine critical flutter conditions. For further explanation of flutter points, refer to Volume II, Part 2, subroutine SPDALT, and Volume IV, Part 2.

- Location 721 specifies the desired maximum design weight (MDW). This value is used to determine initial structural weight estimates for the main gear or nose gear components when locations 795 or 796 are left blank.

- Location 723 specifies the basic flight design weight (BFDW). This value is used to determine the initial structural weight estimates for the wing horizontal tail, vertical tail, and fuselage if locations 791 through 794 are left blank. It is also used to compute the operational weight empty (OWE) when one or more of locations 791 through 796, 798, and 802 are left blank. The data in this location would normally be explained in MIL-A-008860A(USAF), paragraph 6.2.1.3.

- Location 724 specifies the vehicle CG at the basic flight design weight. In the case of variable-sweep wing configurations, the CG is for the input wing geometry. It is advisable to input the most forward CG at BFDW, since the most critical loads usually occur at this balance condition.

- Location 725 specifies the landing design weight (LDW). This value is used to determine initial structural weight estimates for the main gear and nose gear when locations 795 or 796 are left blank. The data in this location would normally be explained in MIL-A-008860A(USAF), paragraph 6.2.1.5.

- Locations 791 through 870 specify the required vehicle detailed weight and CG data locations. Locations 871 through 940 specify the weight and CG locations of the useful load items for the MDW, BFDW, and LDW conditions. Locations 791 through 796, 798, and 802 are used for the wing, horizontal tail, vertical tail, fuselage, main gear, nose gear, engine section, and air induction system weights. Any or all of these locations can be left blank, and the program will estimate the weight and CG of each component left blank. The estimated component weights and CG's will then be adjusted so that the summation of the adjusted weights, detailed weights, useful load for the BFDW and their CG's will reflect the BFDW entered in location 723 and vehicle CG in location 724. If weights are input for locations 791 through 796, 798, and 802, then the BFDW and its CG are equal to the summation of the detailed weights and CG's and the useful load and CG's defined by locations 871 through 890 and 921 through 930. The OWE is defined as the summation of the adjusted weights and detailed weight items. MDW and LDW conditions are then defined as the summation of the OWE and their respective useful loads defined in locations 911 through 920 and 931 through 940. The three program-developed gross weights previously explained are used by the airloads module in evaluating the 24 load conditions shown in Table 6. It is the responsibility of the user to insure that the program-developed MDW, BFDW, BFDW CG, and LDW are consistent with input in locations 721, 723, 724, and 725.

- Locations 727 and 728 specify the vehicle service life and number of landings which are used to calculate wing fatigue spectrum data. Suggested service life and number of landings for the different vehicles classes are as follows:

Vehicle Class	Location 27	Location 28
Fighter, Attack	4,000	4,000
BI Bomber	5,000	2,500
BII Bomber	10,000	4,000
Cargo Assault	20,000	30,000
Cargo Transport	30,000	12,000

- Locations 731 through 734 specify the limit maneuver load factors. Suggested values from MIL-A-8861 are as follows (reference loading conditions 1 through 7, Table 6):

Vehicle Class	Location			
	31	32	33	34
Fighter, Attack	8.0	6.5	-3.0	4.0
BI Bomber	4.0	4.0	-2.0	2.5
BII Bomber	3.0	3.0	-1.0	2.0
Cargo Assault	3.0	3.0	-1.0	2.0
Cargo Transport	2.5	2.5	-1.0	2.0

- Locations 735 and 736 specify the vehicle pitch and yaw accelerations. During the preliminary design phase, it is difficult to ascertain acceleration data. Suggested rule-of-thumb values for these data locations are as follows. (reference loading conditions 20 through 23, Table 6).

Vehicle Class	Location 735	Location 736
Fighter, Attack	6.0	-1.5
BI Bomber	3.0	-0.75
BII Bomber	2.0	-0.5
Cargo	2.0	-0.5

- Location 737 specifies the stall speed used in calculating the design speed for the flaps - down maneuver loading condition at MDW (reference condition 8, Table 6).

- Location 738 specifies the flaps-down stall speed used in calculating the design speed for the landing loads condition at LDW (reference condition 9, Table 6).

- Locations 741 through 749 specify the landing gear geometry. The data in these locations are shown in Figure 18.

- Location 789 specifies the equivalent cabin pressure altitude. The ambient pressure at the vehicle altitude is subtracted from the ambient pressure at this altitude to determine the maximum differential cabin pressure. Currently, these data are printed by the output module as part of the dimensional and structural data only.

- Locations 951 through 1069 specify the wing, horizontal and vertical tail geometry and synthesis cut locations. The data in these locations are shown in Figure 19 through 21. These data are also required in the wing data block.

- Locations 1081 through 1155 specify the fuselage geometry. The data in these locations are identical to the data required in the fuselage data block. Expanded explanations are presented in Section VII of this volume. Required fuselage data are shown in Figure 22. The curves in Figures 23 should be used to derive the perimeter correction factors, K_c, required in locations 1126 through 1135. These factors are required if a value of 2.0 is specified for the data set control word in location 1081.

- Locations 1180 through 1360 specify nacelle and air induction system geometry. The data for these locations are identical to the data required in the air induction system data block, and are discussed in Section V of this volume. Required nacelle and air induction system data are shown in Figures 24 and 25.

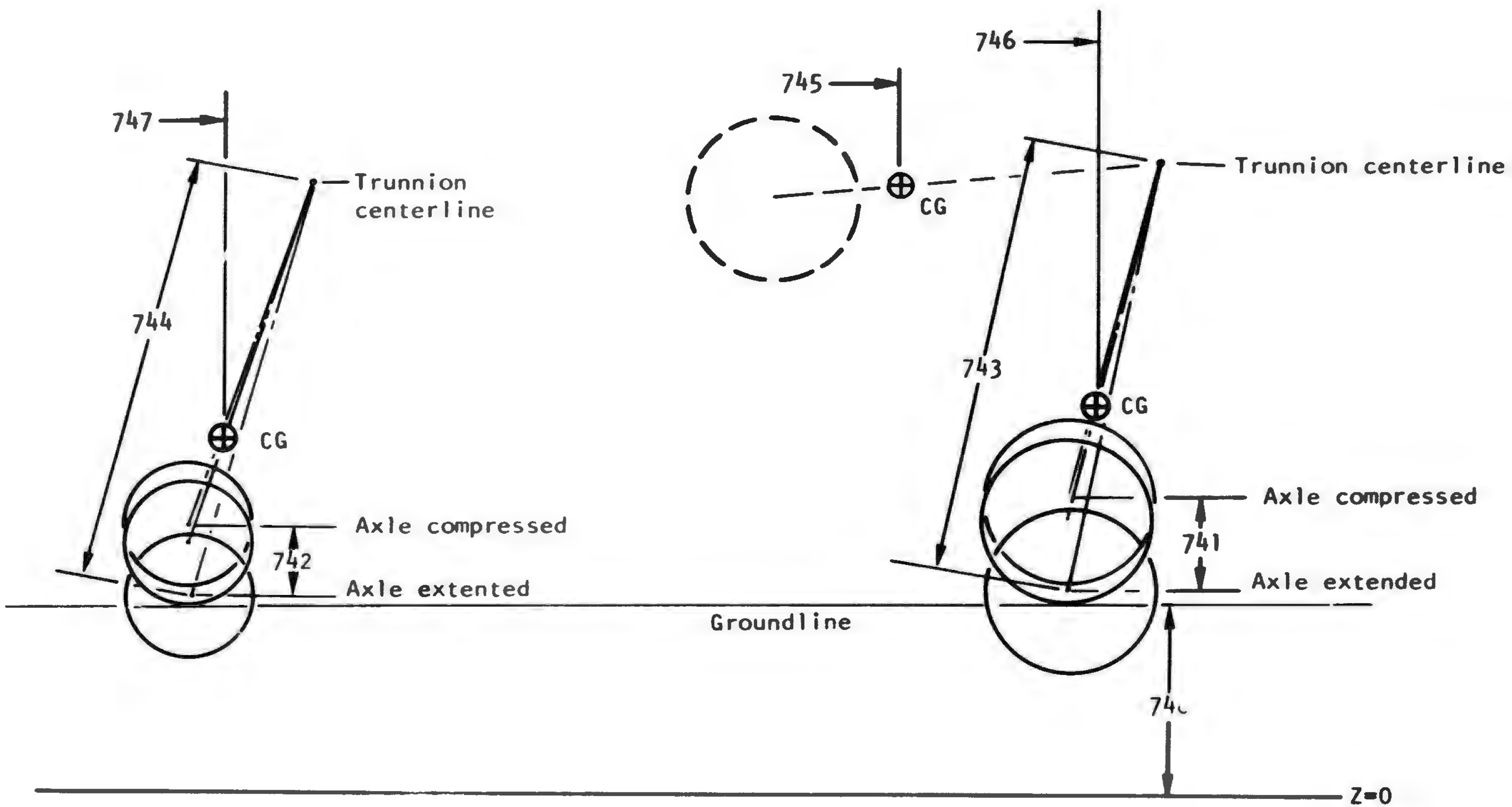


Figure 18. Landing gear geometry.

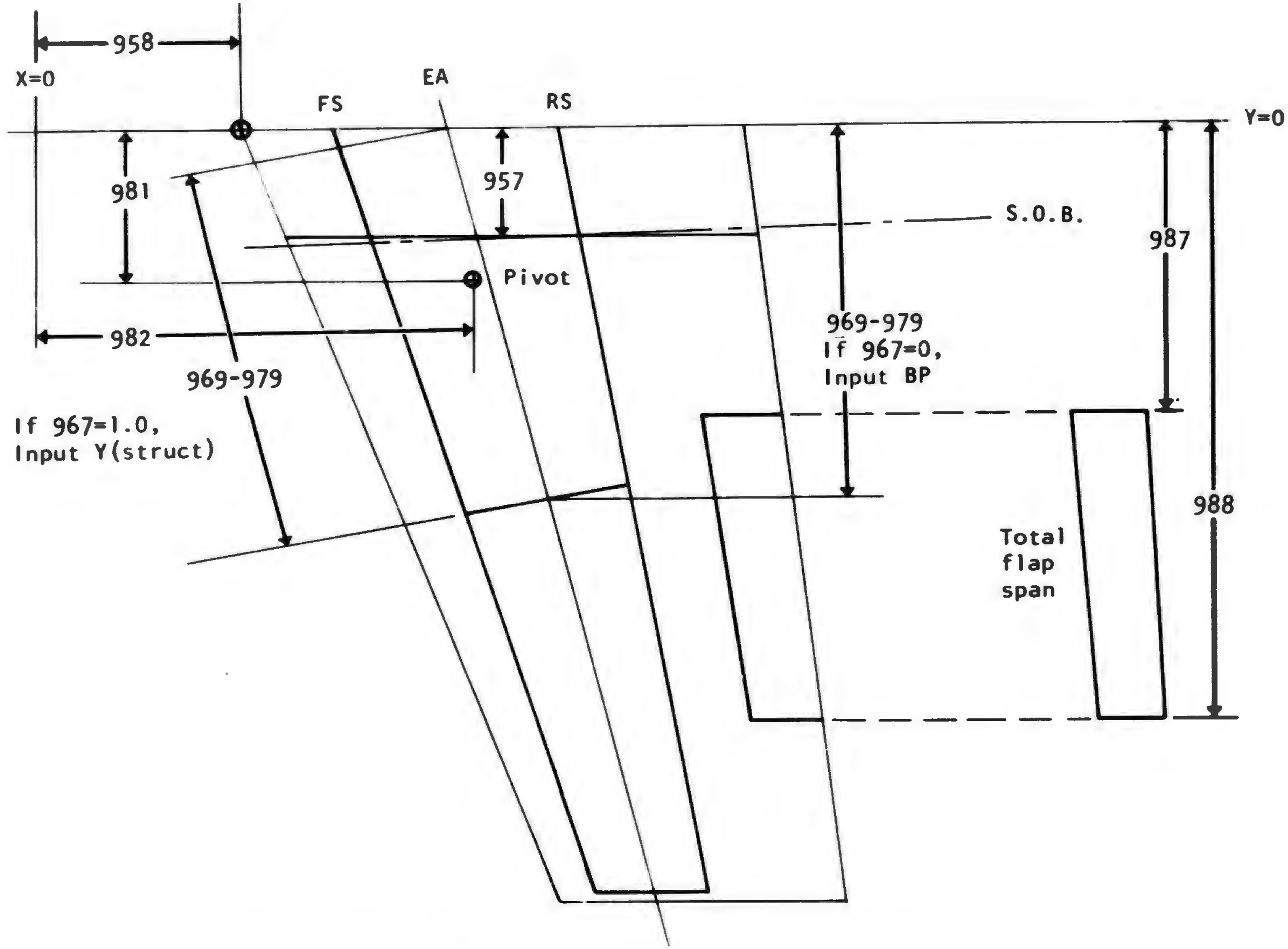
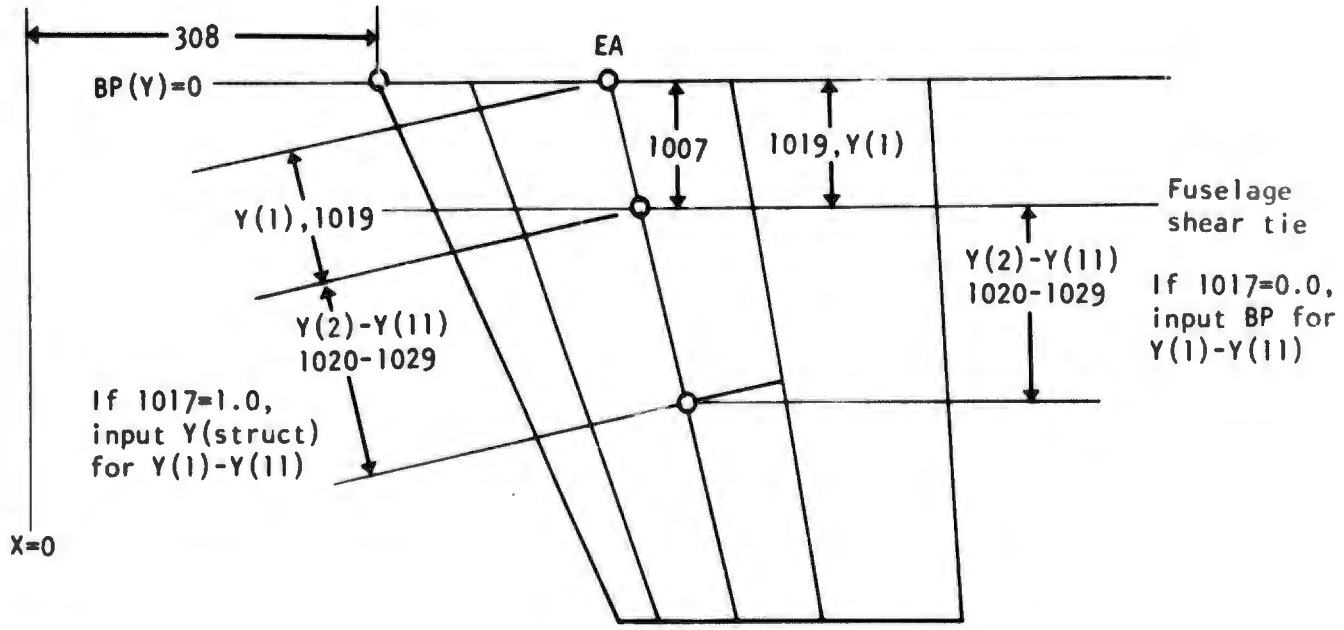
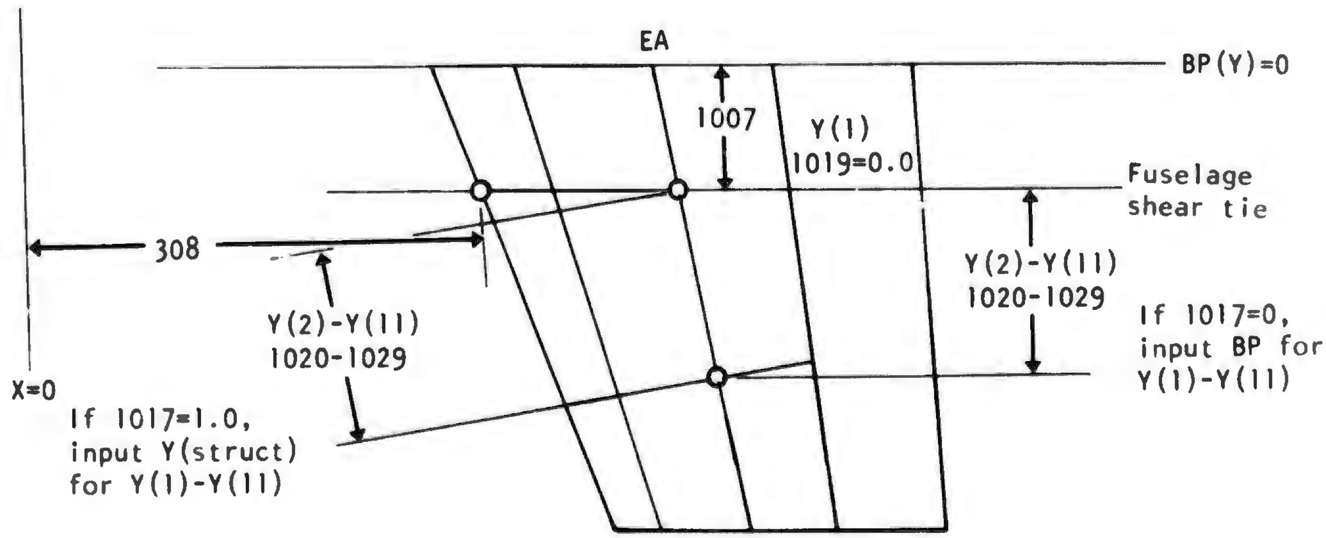


Figure 19. Wing synthesis cuts and pivot location.



Input based on total area, 1030=0.0



Input based on exposed area, 1030=1.0

Figure 20. Horizontal tail location and synthesis cuts.

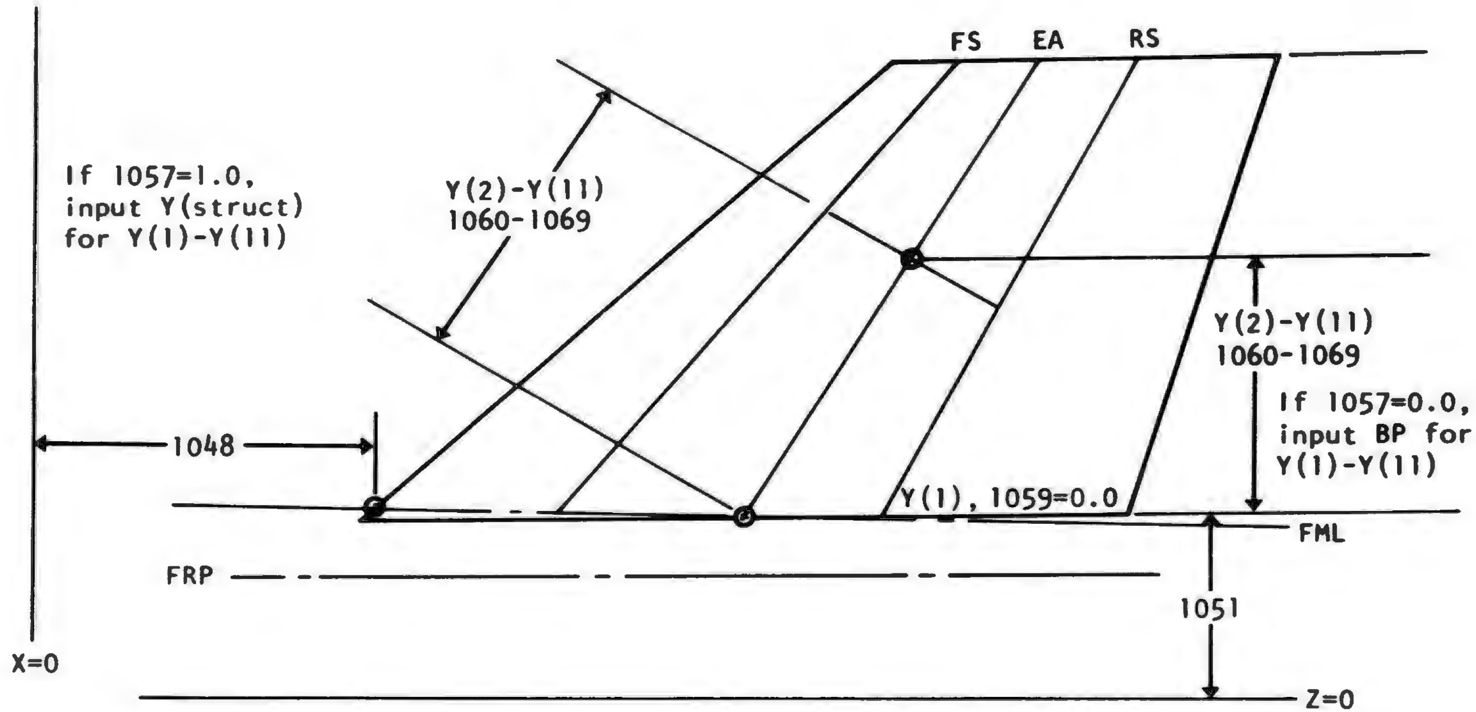


Figure 21. Vertical tail location and synthesis cuts.

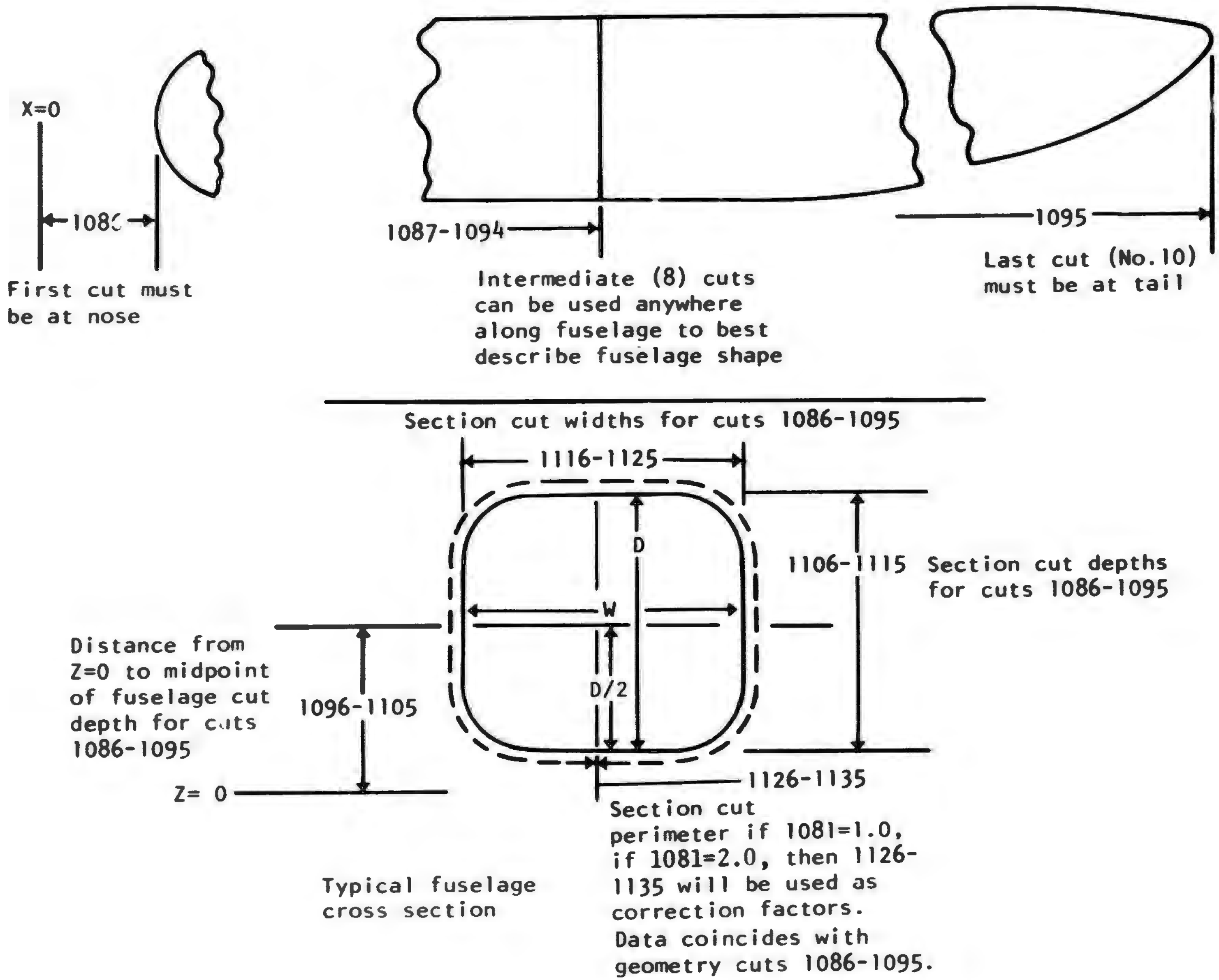


Figure 22. Fuselage geometry.

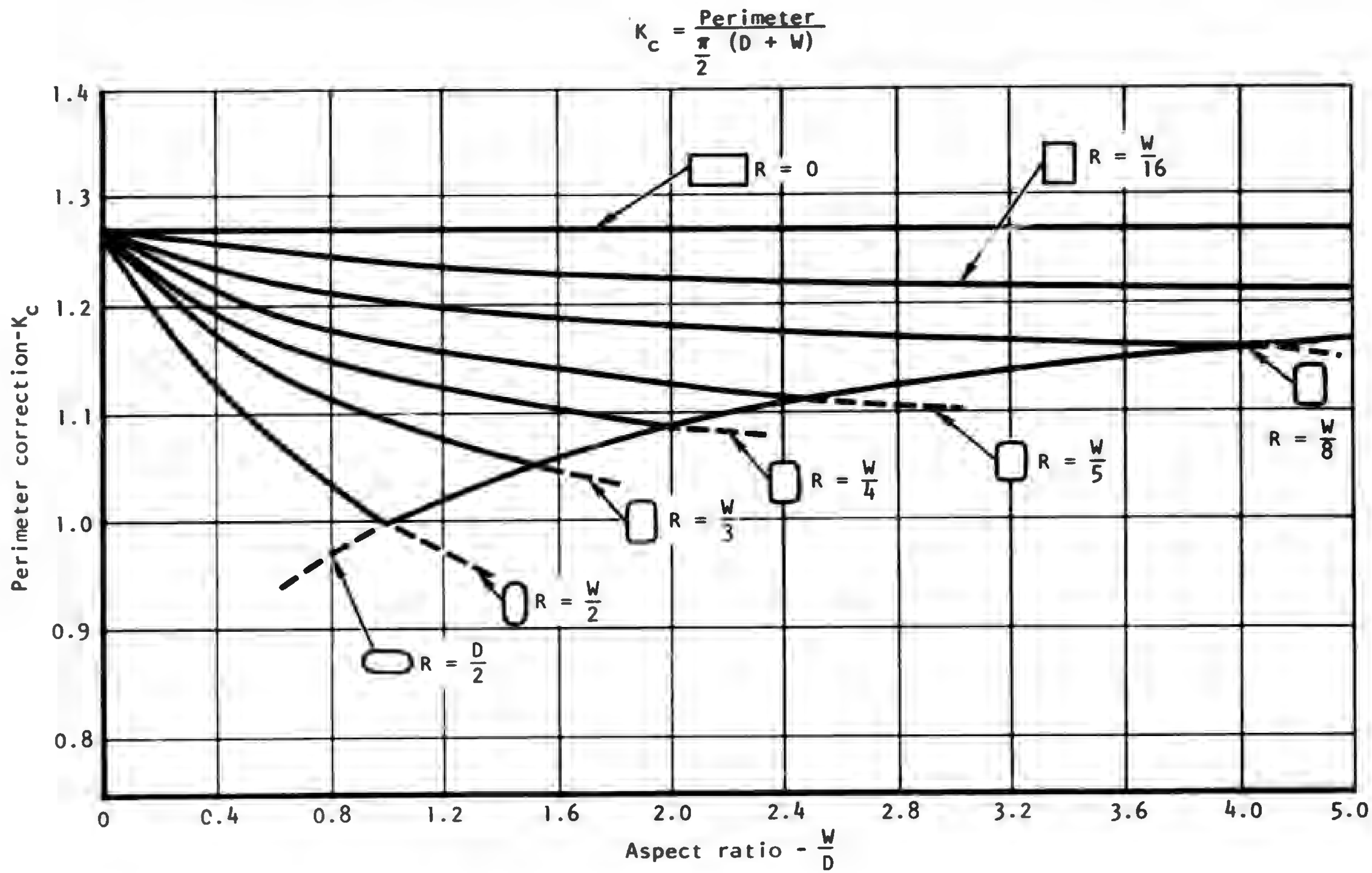


Figure 23. Programmed shapes and correction factors.

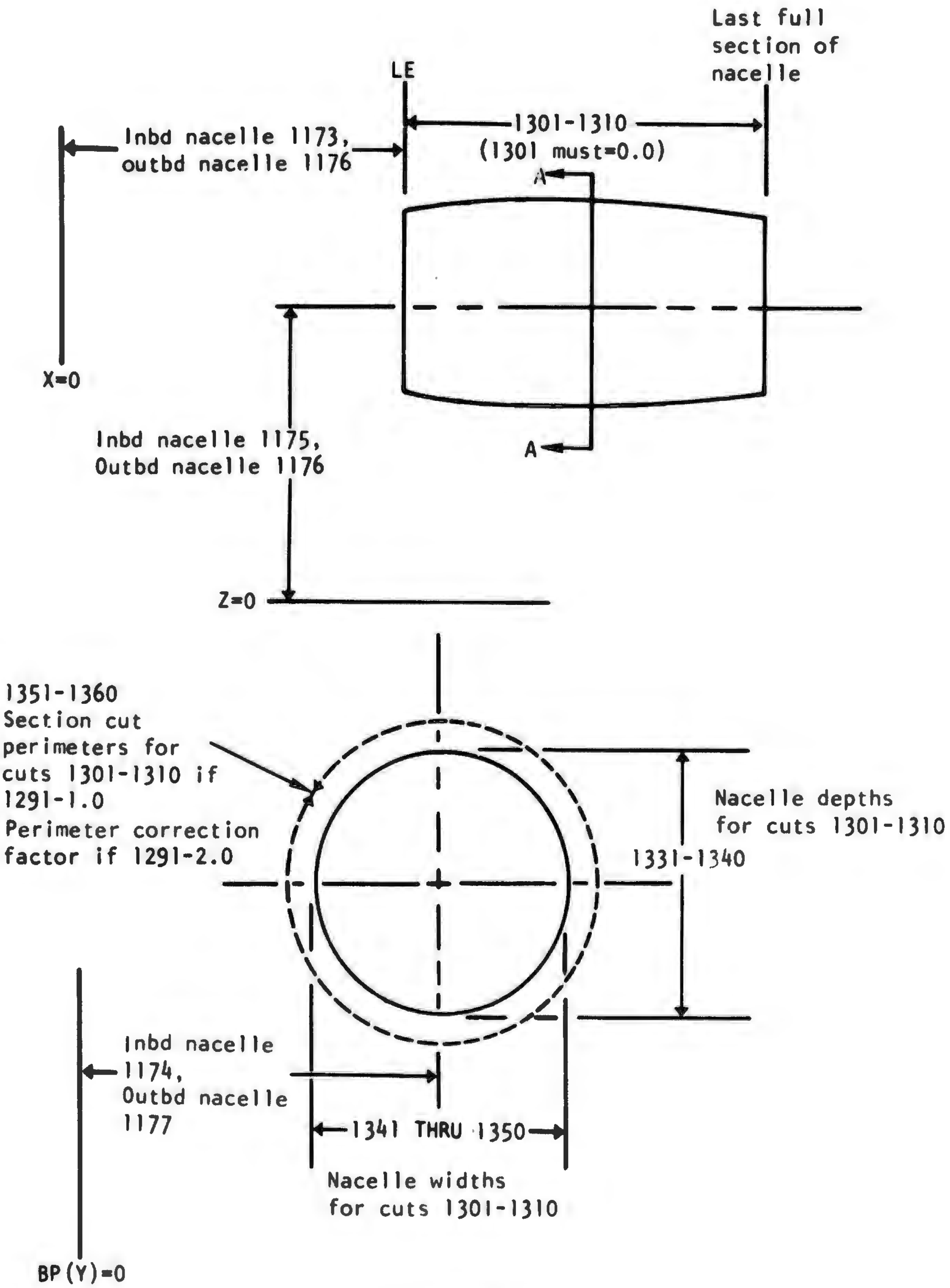


Figure 24. Nacelle geometry.

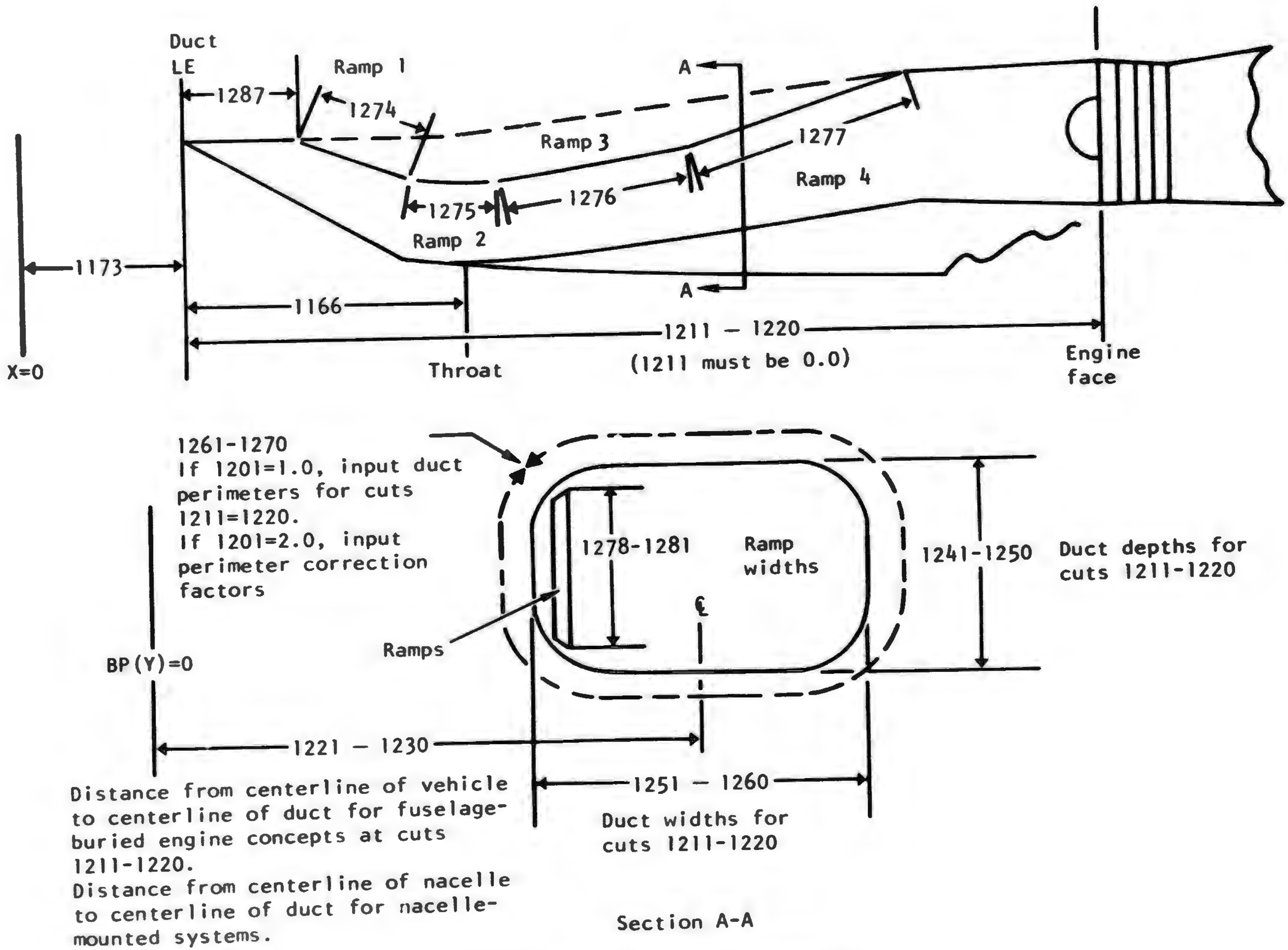


Figure 25. Duct and ramp geometry.

• Locations 1401 through 1448 specify the blocked mission segments used to determine fatigue spectrum data. If this data set is not input, pertinent blocked mission segment constants from the SWEEP permanent data bank are used (DS array). Data contained in the data bank are described in Table 7.

TABLE 7. BLOCKED MISSION SEGMENTS

Blocked Usage Segment	Average Mach No.	Average Altitude (ft)	Wing Sweep Position	Weight Fraction W/W_O	Life Fraction T/T_L
Fighter Class					
Ascent	0.70	15,000	Fixed	1.00	0.07
Cruise	0.70	20,000	↓	0.95	0.15
Cruise	2.00	40,000	↓	0.80	0.10
Cruise	0.90	25,000	↓	0.80	0.20
Cruise	0.85	0	↓	0.80	0.15
Air-ground	0.80	0	↓	0.80	0.10
Air-air	0.80	10,000	↓	0.75	0.05
Loiter/ descent	0.60	10,000	↓	0.70	0.18
Attack Class					
Ascent	0.70	15,000	Fixed	1.00	0.08
Cruise	0.70	10,000	↓	0.95	0.25
Cruise	0.85	40,000	↓	0.80	0.20
Cruise	0.80	0	↓	0.80	0.12

TABLE 7. BLOCKED MISSION SEGMENTS (CONT)

Blocked Usage Segment	Average Mach No.	Average Altitude (ft)	Wing Sweep Position	Weight Fraction W/W_0	Life Fraction T/T_L
Attack Class (Cont)					
Air-air	0.95	10,000	Fixed	0.75	0.05
Air-ground	0.80	0	↓	0.80	0.12
Descent	0.60	15,000	↓	0.70	0.08
Loiter	0.60	10,000	↓	0.70	0.10
BI Class					
Ascent	0.70	15,000	Fixed	1.00	0.08
Cruise	0.70	10,000	↓	0.95	0.20
Cruise	0.85	40,000	↓	0.80	0.25
Cruise	0.70	0	↓	0.80	0.12
Cruise	0.75	5,000	↓	0.75	0.05
Cruise	0.60	0	↓	0.80	0.12
Descent	0.60	15,000	↓	0.70	0.08
Loiter	0.60	10,000	↓	0.70	0.10

TABLE 7. BLOCKED MISSION SEGMENTS (CONT)

Blocked Usage Segment	Average Mach No.	Average Altitude (ft)	Wing Sweep Position	Weight Fraction W/W_0	Life Fraction T/T_L
BII Class					
Ascent	0.355	0	Fixed	1.0	0.104
Cruise	0.70	30,000	↓	0.8611	0.0654
Cruise	0.70	30,000	↓	0.8611	0.6199
Refuel	0.70	25,000	↓	1.0833	0.0407
Cruise	2.20	50,000	↓	0.6944	0.0269
Penetrate	0.85	0	↓	0.8611	0.1081
Penetrate	0.95	0	↓	0.6944	0.0232
Penetrate	0.55	0	↓	0.75	0.0118
C - Assault Class					
Ascent/ descent	0.60	20,000	Fixed	0.94	0.2185
Ascent	0.60	20,000	↓	1.10	0.0044
Ascent/ descent	0.40	5,000	↓	0.94	0.0332
Cruise	0.75	40,000	↓	0.94	0.3341
Cruise	0.75	40,000	↓	1.06	0.0255
Cruise	0.65	20,000	↓	0.94	0.0354

TABLE 7. BLOCKED MISSION SEGMENTS (CONCL)

Blocked Usage Segment	Average Mach No.	Average Altitude (ft)	Wing Sweep Position	Weight Fraction W/W_0	Life Fraction T/T_L
C - Assault Class (Cont)					
Cruise	0.47	10,000	Fixed	0.91	0.0135
Cruise	0.456	1,000	↓	0.91	0.3354
C - Transport Class					
Ascent	0.50	20,000	Fixed	1.00	0.05
Ascent/ descent	0.50	10,000	↓	0.70	0.05
Cruise	0.80	30,000	↓	0.80	0.25
Cruise	0.85	40,000	↓	0.75	0.30
Cruise	0.75	25,000	↓	0.80	0.15
Cruise	0.70	15,000	↓	0.70	0.10
Cruise	0.65	10,000	↓	0.70	0.05
Cruise	0.55	1,000	↓	0.70	0.05

TABLE 8. GENERAL DATA DESCRIPTIONS

```
*****************************************************************
*     CONSTANT DATA AREA LOCATIONS 1-700                        *
*     CONSTANTS IN THESE LOCATIONS ARE STORED ON PERMANENT FILE. *
*     INPUT MAY BE USED TO OVERRIDE THESE CONSTANTS.            *
*****************************************************************
```

LOCATIONS	DESCRIPTIONS
1	CONSTANT = 1.0
2	CONSTANT = 2.0
3	CONSTANT = 3.0
4	CONSTANT = 4.0
5	CONSTANT = 5.0
6	CONSTANT = 6.0
7	CONSTANT = 7.0
8	CONSTANT = 8.0
9	CONSTANT = 9.0
10	CONSTANT = 10.0
11	CONSTANT = 11.0
12	CONSTANT = 12.0
13	CONSTANT = 20.0
14	CONSTANT = 1000.0
15	CONSTANT = 3.1415927 (PI)
16	CONSTANT = 0.01745329 (PI/180)
17	CONSTANT = 144.0
18	CONSTANT = 24.0
19	CONSTANT = 0.5
20	CONSTANT = 1.5
21	CONSTANT = 0.33333333 (1/3)
22	CONSTANT = 0.95
23	CONSTANT = 0.25
24	CONSTANT = 0.0
25	CONSTANT = 1.414213562 SQUARE ROOT OF TWO
26	CONSTANT = 32.174049 GRAVITATIONAL ACCELERATION
27	CONSTANT = 180.0
28	CONSTANT = 1.732051 SQUARE ROOT OF THREE
29	2.5 LAND TO COVER RATIO - MAXIMUM
30	1.333333 ADDITIONAL FACTOR OF SAFETY - HUMAN ENVIRONMENT

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

31	1.5	LIMIT TO ULTIMATE FACTOR - HAMMERSHOCK AT VH AND STATIC PRESSURE AT VL	
32	1.2	LIMIT TO ULTIMATE FACTOR - HAMMERSHOCK AT VL	
33	2.0	TAXI LOAD FACTOR	
34		FLUTTER SPEED MARGIN - IF NOT INPUT, FACTOR STORED IN PERMANENT FLUTTER AND TEMPERATURE DATA RECORD IS USED. (SEE VOL IV, PART 2, TABLE 11)	
35-80	NOT USED		
	CONSTANTS - STANDARD DAY ATMOSPHERIC PARAMETERS LOCATIONS 81 THRU 108		
81	36.089239	ALTITUDE	1000-FT
82	2116.22	AMBIENT PRESSURE AT SEA LEVEL	PSF
83	0.00687559	CURVE FIT CONSTANT	
84	5.25591	CURVE FIT CONSTANT	
85	65.61689	ALTITUDE	1000-FT
86	20.80556	CURVE FIT CONSTANT	PSF
87	472.68	AMBIENT PRESSURE AT 36K FT	PSF
88	104.98638	ALTITUDE	1000-FT
89	114.345	AMBIENT PRESSURE AT 66K FT	PSF
90	389.970	CURVE FIT CONSTANT	
91	-34.1634	CURVE FIT CONSTANT	
92	0.548641	CURVE FIT CONSTANT	
93	18.131	AMBIENT PRESSURE AT 105K FT	PSF
94	1.53619	CURVE FIT CONSTANT	
95	411.57	AMBIENT TEMP. AT 105K FT	DEGREES R
96	-12.2012	CURVE FIT CONSTANT	
97	154.19948	ALTITUDE	1000-FT
98	518.670	AMBIENT AT SEA LEVEL	DEGREES R
99	3.56616	CURVE FIT CONSTANT	
100	389.970	AMBIENT TEMP. BETWEEN 36K AND 66K FT	DEGREES R
101	0.00000304	CURVE FIT CONSTANT	
102	53.3	GAS CONSTANT	FT-LB/LB/DEG F
103	1.4	RATIO OF SPECIFIC HEATS	
104	0.075	CONSTANT PRESSURE RECOVERY CALC.	
105	1.35	CONSTANT PRESSURE RECOVERY CALC.	
106	0.3	CONSTANT FLOW AT ENGINE	MN

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

107	0.5	CONSTANT FLOW AT ENGINE MN
108	460.0	CONVERSION DEGREES F TO DEGREES F
		CONSTANTS - SPIKE WEIGHT EQUATIONS - LOC. 109 THRU 111
109	12.53	SPIKE WT. EST. EQUATION FACTORS - FIX
110	15.65	- TRANSLATING
111	51.8	- EXPANDING
		CONSTANTS - DUCT DESIGN PARAMETERS LOCATIONS 112 THRU 144
112	0.8	CONSTANT-STATIC PRESSURE CALC.
113	0.05	CONSTANT-STATIC PRESSURE CALC.
114	400.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
115	1.019056	CONSTANT-HAMMERSHOCK PRESSURE CALC.
116	0.0289156	CONSTANT-HAMMERSHOCK PRESSURE CALC.
117	1.350112	CONSTANT-HAMMERSHOCK PRESSURE CALC.
118	0.664319	CONSTANT-HAMMERSHOCK PRESSURE CALC.
119	1.5	CONSTANT-HAMMERSHOCK PRESSURE CALC.
120	0.00602627	CONSTANT-HAMMERSHOCK PRESSURE CALC.
121	0.080725	CONSTANT-HAMMERSHOCK PRESSURE CALC.
122	3.16503	CONSTANT-HAMMERSHOCK PRESSURE CALC.
123	1.598524	CONSTANT-HAMMERSHOCK PRESSURE CALC.
124	1100.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
125	2.5	CONSTANT-HAMMERSHOCK PRESSURE CALC.
126	0.770476	CONSTANT-HAMMERSHOCK PRESSURE CALC.
127	0.1492515	CONSTANT-HAMMERSHOCK PRESSURE CALC.
128	4.371759	CONSTANT-HAMMERSHOCK PRESSURE CALC.
129	2.114069	CONSTANT-HAMMERSHOCK PRESSURE CALC.
130	900.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
131	1.538116	CONSTANT-HAMMERSHOCK PRESSURE CALC.
132	0.3029637	CONSTANT-HAMMERSHOCK PRESSURE CALC.
133	0.4972335	CONSTANT-HAMMERSHOCK PRESSURE CALC.
134	0.4652126	CONSTANT-HAMMERSHOCK PRESSURE CALC.
135	700.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
136-140	NOT USED.	
141	1.6	CONSTANT-HAMMERSHOCK PRESSURE CALC.
142	0.394	CONSTANT-HAMMERSHOCK PRESSURE CALC.
143	0.0074	CONSTANT-HAMMERSHOCK PRESSURE CALC.
144	0.0263	CONSTANT-HAMMERSHOCK PRESSURE CALC.

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

145	2000.0	RULE OF THUMB NUMBER OF LANDINGS	
146	0.975	RULE OF THUMB WING STRUCTURAL TIP STATION, FRACTION OF EXPOSED SPAN	
147	0.975	-HORIZONTAL	
148	0.975	-VERTICAL	
149-150	NOT USED.		
		CONSTANTS - AIS AND ENGINE SECTION FIRST PASS WEIGHT ESTIMATES LOCATIONS 151 THRU 161	
151	2.0	RAMP EST. WT. EQUATION - CONSTANT	
152	10.0	- CONSTANT	
153	0.5	- EXPONENT	
154	4.0	DUCT UNIT WEIGHT ESTIMATE	PSF
155	1.5	DESIGN PRESSURE CALC. - CONSTANT	
156	10.0	- CONSTANT	
157	0.5	- EXPONENT	
158	1.0	- INDEX FACTOR	
159	2.5	NACELLE UNIT WEIGHT	PSF
160	12.0	PYLON UNIT WEIGHT	PSF
161	0.015	ENGINE MOUNT WT. EST. FACTOR	LB/LB
		CONSTANTS - WING FIRST PASS WEIGHT ESTIMATES LOCATIONS 162 THRU 173	
162	0.437	WING WEIGHT EST. EQUATION - EXPONENT	
163	0.132	- EXPONENT	
164	0.758	- EXPONENT	
165	0.600	- EXPONENT	
166	0.296	- EXPONENT	
167	0.040	- EXPONENT	
168	1.050	- L. G. FACTOR	
169	1.35	- PIVOT CONSTANT	
170	0.35	- PIVOT CONSTANT	
171	27.67	- CONSTANT	
172	1.0	- INDEX FACTOR	
173	0.43	CG ESTIMATING FACTOR	
		CONSTANTS - HORIZONTAL TAIL FIRST PASS WEIGHT ESTIMATES LOCATIONS 174 THRU 182	

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

174	0.414	H. TAIL WEIGHT EST. EQUATION - EXPONENT
175	0.168	- EXPONENT
176	0.896	- EXPONENT
177	0.043	- EXPONENT
178	0.121	- EXPONENT
179	0.025	- EXPONENT
180	63.27	- CONSTANT
181	1.0	-INDEX FACTOR
182	0.43	CG ESTIMATING FACTOR

CONSTANTS - VERTICAL TAIL FIRST PASS WEIGHT ESTIMATES
LOCATIONS 183 THRU 191

183	0.376	V. TAIL WEIGHT EST. EQUATION - EXPONENT
184	0.122	- EXPONENT
185	0.873	- EXPONENT
186	0.357	- EXPONENT
187	0.489	- EXPONENT
188	0.039	- EXPONENT
189	13.72	- CONSTANT
190	1.0	- INDEX FACTOR
191	0.43	CG ESTIMATING FACTOR

CONSTANTS - LANDING GEAR FIRST PASS WEIGHT ESTIMATES
LOCATIONS 192 THRU 195

192	0.4116	LANDING GEAR WT. EST. EQUATION - EXPONENT
193	0.7756	- EXPONENT
194	0.2136	- EXPONENT
195	0.2192	- CONSTANT
196-197	NOT USED.	

CONSTANTS - FUSELAGE FIRST PASS WEIGHT ESTIMATES
LOCATIONS 198 THRU 203

198	1.124	FUSELAGE WEIGHT EST. EQUATION - EXPONENT
199	0.172	- EXPONENT
200	0.047	- EXPONENT
201	0.065	- EXPONENT
202	0.241	- EXPONENT
203	0.053	- EXPONENT

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
204      1.0                                                  - INDEX FACTOR
205      0.55          CG ESTIMATING FACTOR
206      0.48          CG ESTIMATING FACTOR
207      NOT USED
             CONSTANTS - SURFACE CONTROLS DISTRIBUTION FACTORS
                         LOCATIONS 208 THRU 215
208      0.532         S.C. WEIGHT DISTRIBUTION FACTORS - WING
209      0.128                                            - H. TAIL
210      0.124                                            - V. TAIL
211      0.039                                            - FUSELAGE
212      0.178                                            - FUSELAGE
213      0.724                                            - WING
214      0.274                                            - H. TAIL
215      0.290                                            - V. TAIL
             CONSTANTS - MISCELLANEOUS DISTRIBUTION FACTORS
                         LOCATIONS 216 THRU 223
216      0.90                                            - ARMAMENT
217      0.10                                            - INSTRUMENTS
218      0.70                                            - INSTRUMENTS
219      0.330                                           - HYDRAULICS
220      0.25                                            - ELECTRICAL
221      0.20                                            - AIR COND.
222      0.50                                            - ELECTRONICS
223      500.0                                           - ARMAMENT
224      1.05          FUSELAGE NOSE SECTION GEOMETRY CALC.
                        CROSS-SECTION FACTOR.
225      0.98          TOLERANCE LIMIT ON SHAPE CORRECTION FACTORS-LWR
226      1.02          TOLERANCE LIMIT ON SHAPE CORRECTION FACTORS-UPP
227-700  NOT USED

    ...........................................................
    .     VARIABLE DATA REGION LOCATIONS 701-1449              .
    ...........................................................

701      VEHICLE CLASS.
          ELEVEN         (11.0)=FIGHTERS AND ATTACK.
          TWENTY-ONE     (21.0)=BOMBERS.
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
         THIRTY-ONE    (31.0)=TRANSPORTS FOR WHEELED VEHICLES >100K .
         THIRTY-TWO    (32.0)=                                0-100K.
         THIRTY-THREE  (33.0)=TRANSPORTS FOR BULK CARGO.      >100K .
         THIRTY-FOUR   (34.0)=                                0-100K.
         THIRTY-FIVE   (35.0)=TRANSPORTS FOR PERSONNEL.       >100K .
         THIRTY-SIX    (36.0)=                                0-100K.
702     VARIABLE SWEEP INDICATOR.
         ZERO (0.0) OR BLANK ( )=FIXED.
         PLUS (+)               =VARIABLE.
703     LANDING GEAR INDICATOR.
         ZERO (0.0) OR BLANK ( )=FUSELAGE MOUNTED.
         ONE  (1.0)             =WING MOUNTED.
704     HORIZONTAL TAIL INDICATOR.
         ZERO (0.0) OR BLANK ( )=SHEAR TIE - SLAB TAIL.
         ONE (1.0)              =SHEAR AND MOMENT TIE.
         TWO (2.0)              =SPINDLE MOUNTED.
705     VERTICAL TAIL INDICATOR.
         ZERO (0.0) OR BLANK ( )=SHEAR TIE - SLAB TAIL.
         ONE (1.0)              =SHEAR AND MOMENT TIE.
         TWO (2.0)              =SPINDLE MOUNTED.
706     AUXILIARY POWER UNIT (APU).
         ZERO (0.0) OR BLANK ( )=NACELLE MOUNTED.
         PLUS (+)               =FUSELAGE MOUNTED.
707     NACELLE LOCATION INDICATOR.
         ZERO (0.0) OR BLANK ( )=WING.
         ONE  (1.0)             =FUSELAGE.
708     HORIZONTAL TAIL LOCATION INDICATOR.
         ZERO (0.0) OR BLANK ( )=FUSELAGE MOUNTED.
         PLUS (+)               =TEE TAIL - VERTICAL TAIL MOUNTED.
709     WING CARRY-THRU STRUCTURE INDICATOR.
         ZERO (0.0) OR BLANK ( )=SHEAR TIE.
         PLUS (+)               =SHEAR AND MOMENT TIE.
710-715 NOT USED.

         LOCATIONS 716-718 ARE USED TO DEFINE CARRY-OVER LIFT
         REDUCTION FACTORS.  A ZERO (0.0), BLANK ( ), OR ONE (1.0)
         IN THESE LOCATIONS INDICATE NO REDUCTION.
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

716	CARRY-OVER LIFT REDUCTION FACTOR - WING	
717	CARRY-OVER LIFT REDUCTION FACTOR - HORIZONTAL TAIL	
718	CARRY-OVER LIFT REDUCTION FACTOR - VERTICAL TAIL	
	THE LOADS MODULE USES SPEED-ALTITUDE DATA FROM THE INPUT DATA SET. REFERRING TO FIGURE 17, POINTS 1, 2, AND 4 OF THE INPUT SET ARE AT THE SAME ALTITUDES AS POINTS 1, 2, AND 3 RESPECTIVELY OF THE LOAD EVALUATION POINTS. SHOULD DIFFERENT EVALUATION POINTS BE DESIRED, LOCATIONS 719 AND 720 MAY BE USED TO SPECIFY THE SPEED PROFILE POINTS BY DESIGNATING THE POINT FROM THE INPUT SET AT M(H) WHICH CORRESPONDS IN ALTITUDE TO THE DESIRED POINT IN THE LOAD SET AT M(L).	
719	SPEED-ALTITUDE POINT FOR FLIGHT LOAD INVESTIGATION IF NOT INPUT, LOADING POINT 8 ON THE M(L) PROFILE IS USED. INPUT MAY BE EITHER 2.0, 4.0, OR 5.0.	
720	SPEED-ALTITUDE POINT FOR FLIGHT LOAD INVESTIGATION IF NOT INPUT, LOADING POINT 9 ON THE M(L) PROFILE IS USED. INPUT MAY BE EITHER 2.0, 3.0, OR 5.0.	
721	MAXIMUM DESIGN WEIGHT (MDW)	POUNDS
722	NOT USED.	
723	BASIC FLIGHT DESIGN WEIGHT (BFDW)	POUNDS
724	CENTER OF GRAVITY STATION (X) AT BFDW THE MOST FORWARD VEHICLE C.G. USUALLY RESULTS IN THE CRITICAL DESIGN LOADS. THE USEFUL LOAD TABLE, LOCATIONS 921-930, SHOULD BE COMPATIBLE WITH THIS C.G.	INCHES
725	LANDING DESIGN WEIGHT (LDW)	POUNDS
726	NOT USED.	
727	AIR VEHICLE SERVICE LIFE.	HOURS
728	NUMBER OF LANDINGS DURING SERVICE LIFE.	
729	TAXI GROSS WEIGHT FOR FATIGUE EVALUATION. INPUT ONLY IF DIFFERENT FROM MAXIMUM DESIGN WEIGHT IN LOCATION 721.	
730	LANDING DESIGN WEIGHT FOR FATIGUE EVALUATION. INPUT ONLY IF DIFFERENT FROM LANDING DESIGN WEIGHT IN LOCATION 725.	
731	N(Z) - LIMIT LOAD FACTOR AT BFDW - SUBSONIC	
732	- SUPERSONIC	

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

Location	Description	Units
733	NEGATIVE N(Z) - LIMIT NEGATIVE LOAD FACTOR AT BFDW NEGATIVE SIGN (-) IS REQUIRED	
734	N(Z) - LIMIT LOAD FACTOR FOR FLAP DOWN MANUEVER AT MDW	
735	PITCHING ACCELERATION AT M(L) FOR BFDW	RAD./SECOND SQUARED
736	YAWING ACCELERATION AT M(L) FOR BFDW	RAD./SECOND SQUARED
737	MINIMUM SPEED FLAPS UP AT MDW	KNOTS
738	MINIMUM SPEED FLAPS DOWN AT LDW	KNOTS
739	DESIGN SINK SPEED AT MDW	FT/SEC
740	DESIGN SINK SPEED AT LDW	FT/SEC
741	MAIN LANDING GEAR STROKE - FULLY EXTENDED TO FULLY COMPRESSED	INCHES
742	NOSE LANDING GEAR STROKE	INCHES
743	MAIN LANDING GEAR LENGTH - OLEO EXTENDED - AXLE TO CENTER LINE TRUNNION.	INCHES
744	NOSE LANDING GEAR LENGTH	INCHES
745	CENTER OF GRAVITY STATION (X) - MAIN GEAR UP	INCHES
746	CENTER OF AXLE STATION (X) - MAIN GEAR DOWN	INCHES
747	- NOSE GEAR DOWN	INCHES
748	GROUND LINE AT MAIN GEAR-WATER LINE (Z).	INCHES
749	CENTER OF AXLE STATION (Y) - MAIN GEAR DOWN	INCHES
750	NOT USED.	

---- LOCATIONS 751-780 MUST BE COMPATIBLE DATA SETS ----

LOCATIONS 751-760 FORM THE SPEED ALTITUDE PROFILE & MUST BE INPUT. FIVE (5) POINTS ARE REQUIRED, IF LESS THAN 5 ARE DESIRED THE LAST VALUES SHOULD BE REPEATED TO FILL THE TABLES.

Location	Description	Units
751-755	SPEED PROFILE POINTS - SPEED M(H)	MACH NUMBER
756-760	- ALTITUDE	FEET

LOCATIONS 761 THRU 798 ARE OPTIONAL.

761-765 INCREMENT FOR ESTABLISHING M(L) AT MACH NO'S IN LOC 751-755.

- BLANK ( ) OR ZERO (0.0)= USE VALUE IN 781.
- LESS THAN ONE (<1.0)= DECIMAL TO ADD TO M(H)
- GREATER THAN ONE (>1.0)= MULTIPLIER FOR M(H)
- MINUS VALUE (-0.XX) = FRACTION OF M(H) TO ADD TO M(H)

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
766-770 INLET PRESSURE RECOVERY RATIO -
          (PRESSURE AT ENGINE FACE/AMBIENT PRESSURE)
                                 - AT MACH NO'S. M(H) IN 751-755.
771-775                          - AT MACH NO'S. M(L) IN 761-765.

776-780 M(2). MACH NUMBERS OF AIRFLOW AT ENGINE FACE
          THAT CORRESPOND  TO AIR VEHICLE MACH NO'S. IN 751-755.
          IF ZERO IS INPUT IN THESE LOCATIONS, PROGRAM ESTIMATES
          VALUE.
781     GENERAL INCREMENT FOR ESTABLISHING M(L)
          USED IF LOCATIONS 761 THRU 765 CONTAIN ZERO (0.0)
          ZERO (0.0) OR BLANK ( ) = M(L) = M(H)
782     GENERAL PRESSURE RECOVERY RATIO.
          USED IF LOCATIONS 766 THRU 775 CONTAIN ZERO (0.0)
          IF THIS LOCATION IS ALSO ZERO OR BLANK PROGRAM ESTIMATES
          VALUE.

LOCATIONS 783 THRU 788 FOR VARIABLE SWEEP WING ONLY ----------------
 783-785 ALTITUDE LIMIT FOR FORWARD WING POSITION (SEE 786-788)  FEET
 786-788 MACH NO. CORRESPONDING TO MAXIMUM LEVEL FLIGHT SPEED M(H)
          FOR ALTITUDES IN LOCATIONS 783-785.              MACH NUMBER

 789     CABIN PRESSURE ALTITUDE                                 FEET
 790     NOT USED.

 ---- WEIGHTS MARKED WITH THREE ASTERISKS (***) NEED NOT BE LOADED --
        THE PROGRAM USES THE GEOMETRY DATA TO DEVELOP AN INITIAL
        ESTIMATE FOR THESE ITEMS.

 791     WEIGHT-WING. ***                                       POUNDS
               -HORIZONTAL TAIL. ***                            POUNDS
 792
 793           -VERTICAL TAIL. ***                              POUNDS
 794           -FUSELAGE. ***                                   POUNDS
 795           -LANDING GEAR-MAIN. ***                          POUNDS
 796                         -NOSE. ***                         POUNDS
 797           -SURFACE CONTROLS.                               POUNDS
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

798	-ENGINE SECTION AND NACELLE. ***	POUNDS
799	-OTHER STRUCTURE.	POUNDS
	******(WEIGHTS IN LOCATIONS 800-810 ARE TOTALS PER A/C)******	
800	WEIGHT-ENGINE.	POUNDS
801	-AUXILIARY GEAR BOXES AND DRIVES.	POUNDS
802	-AIR INDUCTION SYSTEM-STRUCTURE. ***	POUNDS
803	-ACTUATORS AND CONTROLS.	POUNDS
804	-EXHAUST SYSTEM.	POUNDS
805	-COOLING AND DRAIN.	POUNDS
806	-LUBRICATION SYSTEM.	POUNDS
807	-FUEL SYSTEM.	POUNDS
808	-ENGINE CONTROLS.	POUNDS
809	-STARTING SYSTEM.	POUNDS
810	-AUXILIARY POWER UNIT.	POUNDS
811	WEIGHT-INSTRUMENTS.	POUNDS
812	-HYDRAULICS.	POUNDS
813	-ELECTRICAL.	POUNDS
814	-ELECTRONICS.	POUNDS
815	-ARMAMENT.	POUNDS
816	-FURNISHINGS.	POUNDS
817	-AIR CONDITIONING AND ANTI-ICE.	POUNDS
818	-PHOTOGRAPHIC.	POUNDS
819	-AUXILIARY GEAR.	POUNDS
820	-OTHER ITEMS.	POUNDS
821	WEIGHT-CREW.	POUNDS
822	-TRAPPED FUEL.	POUNDS
823	-OIL.	POUNDS
824	-LIQUID NITROGEN (LN2)	POUNDS
825	-MISCELLANEOUS.	POUNDS
826	-GUNS.	POUNDS
827	-WING PYLONS.	POUNDS
828	-WING EXTERNAL TANKS.	POUNDS
829	-FUSELAGE PYLONS.	POUNDS
830	-FUSELAGE EXTERNAL TANKS.	POUNDS

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

CENTER OF GRAVITY-STATION (X) FOR ITEMS LISTED. ALL LOCATIONS MUST BE ENTERED IF WEIGHT WAS ENTERED IN LOCATIONS 791-830.

331	STATION (X)-WING.	INCHES
332	-HORIZONTAL TAIL.	INCHES
333	-VERTICAL TAIL.	INCHES
334	-FUSELAGE.	INCHES
335	-LANDING GEAR-MAIN.	INCHES
336	-NOSE.	INCHES
337	-SURFACE CONTROLS.	INCHES
338	-ENGINE SECTION AND NACELLE.	INCHES
339	-OTHER STRUCTURE.	INCHES
340	STATION (X)-ENGINE.	INCHES
341	-AUXILIARY GEAR BOXES AND DRIVES.	INCHES
342	-AIR INDUCTION-STRUCTURE.	INCHES
343	-ACTUATORS AND CONTROLS.	INCHES
344	-EXHAUST SYSTEM.	INCHES
345	-COOLING AND DRAIN.	INCHES
346	-LUBRICATION SYSTEM.	INCHES
347	-FUEL SYSTEM.	INCHES
348	-ENGINE CONTROLS.	INCHES
349	-STARTING SYSTEM.	INCHES
350	-AUXILIARY POWER UNIT.	INCHES
351	STATION (X)-INSTRUMENTS.	INCHES
352	-HYDRAULICS.	INCHES
353	-ELECTRICAL.	INCHES
354	-ELECTRONICS.	INCHES
355	-ARMAMENT.	INCHES
356	-FURNISHINGS.	INCHES
357	-AIR CONDITIONING AND ANTI-ICE.	INCHES
358	-PHOTOGRAPHIC.	INCHES
359	-AUXILIARY GEAR.	INCHES
360	-OTHER ITEMS.	INCHES

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

861	STATION (X)-CREW.	INCHES
862	-TRAPPED FUEL.	INCHES
863	-OIL.	INCHES
864	-LIQUID NITROGEN (LN2)	INCHES
865	-MISCELLANEOUS.	INCHES
866	-GUNS.	INCHES
867	-WING-PYLONS.	INCHES
868	-EXTERNAL TANKS.	INCHES
869	-FUSELAGE-PYLONS.	INCHES
870	-EXTERNAL TANKS.	INCHES
	LOCATIONS 871-908 DEFINE THE WEIGHTS AND LOCATIONS OF THE EXPENDABLE USEFUL LOAD ITEMS. THE DISTRIBUTION AS IT IS DEFINED HERE IS SET SO AS TO ALLOW A LIMITED DEGREE OF FLEXIBILITY FOR THE PURPOSE OF SIMULATING INERTIA EFFECTS ON THE STRUCTURAL COMPONENTS.	
871	WEIGHT-PAYLOAD-FUSELAGE.	POUNDS
872	-WING.	POUNDS
873	-AMMUNITION.	POUNDS
874	-WING FUEL-TANK-ONE.	POUNDS
875	-TWO.	POUNDS
876	-FUSELAGE FUEL-TANK-ONE.	POUNDS
877	-TWO.	POUNDS
878	-THREE.	POUNDS
879	-FOUR.	POUNDS
880	-FIVE.	POUNDS
881	STATION (X)-PAYLOAD-FUSELAGE.	INCHES
882	-WING.	INCHES
883	-AMMUNITION.	INCHES
884	-WING FUEL TANK-ONE.	INCHES
885	-TWO.	INCHES
886	-FUSELAGE FUEL TANK-ONE.	INCHES
887	-TWO.	INCHES
888	-THREE.	INCHES
889	-FOUR.	INCHES
890	-FIVE.	INCHES

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

	VARIOUS KEY GEOMETRIC LOCATIONS	
891	STATION (X)-FUSELAGE PAYLOAD-FORWARD END.	INCHES
892	-AFT END.	INCHES
893	BUTT LINE (Y)-WING PAYLOAD-INBOARD STORE LOCATION	INCHES
894	-OUTBOARD STORE LOCATION	INCHES
895	-WING FUEL-TANK ONE-INBOARD END.	INCHES
896	-OUTBOARD END.	INCHES
897	-TANK TWO-INBOARD END.	INCHES
898	-OUTBOARD END.	INCHES
899	STATION (X)-FUSELAGE FUEL-TANK ONE-FORWARD END.	INCHES
900	-AFT END.	INCHES
901	-TANK TWO-FORWARD END.	INCHES
902	-AFT END.	INCHES
903	-TANK THREE-FORWARD END.	INCHES
904	-AFT END.	INCHES
905	-TANK FOUR-FORWARD END.	INCHES
906	-AFT END.	INCHES
907	-TANK FIVE-FORWARD END.	INCHES
908	-AFT END.	INCHES
909-910	NOT USED.	

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
      * VARIOUS KEY PAYLOAD FACTORS *

    VALUES MUST BE THE FRACTION OF THE LISTED ITEM THAT IS ABOARD
      THE VEHICLE AT THE NOTED WEIGHT (USUALLY 0.0 THRU 1.0)

911     FRACTION OF FUSELAGE PAYLOAD ABOARD AT MAXIMUM DESIGN WEIGHT
912                WING       PAYLOAD
913                AMMUNITION......
914                WING TANK 1 FUEL
915                          2.....
916                FUSE TANK 1 FUEL
917                          2.....
918                          3.....
919                          4.....
920                          5.....
921     FRACTION OF FUSELAGE PAYLOAD ABOARD AT BASIC FLIGHT DESIGN
                   WEIGHT.
922                WING       PAYLOAD
923                AMMUNITION......
924                WING TANK 1 FUEL
925                          2.....
926                FUSE TANK 1 FUEL
927                          2.....
928                          3.....
929                          4.....
930                          5.....

931     FRACTION OF FUSELAGE PAYLOAD ABOARD AT LANDING DESIGN WEIGHT
932                WING       PAYLOAD
933                AMMUNITION......
934                WING TANK 1 FUEL
935                          2.....
936                FUSE TANK 1 FUEL
937                          2.....
938                          3.....
939                          4.....
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
940                        5.....

        *MISCELLANEOUS DATA*
        LOCATIONS 941-943 ARE USED TO LOCATE THE ELECTRONICS IN
        THE FUSELAGE FOR INERTIA PURPOSES.  AT LEAST TWO (941-942)
        ELECTRONICS COMPARTMENTS MUST BE DEFINED. IF ONLY TWO
        COMPARTMENTS ARE USED THEY MUST BE INPUT IN THE FIRST
        TWO LOCATIONS (941,942).

941      STATION (X) - ELECTRONICS COMPARTMENT - FORWARD        INCHES
942                                            - INTERMEDIATE   INCHES
943                                            - AFT            INCHES
944      NUMBER OF CREW.
945      NUMBER OF GUNS.
946-950  NOT USED.

              * WING GEOMETRY DATA - LOC. 951-990 *
951      TRAPEZOIDAL WING-AREA.                            SQUARE FEET
952                      -ASPECT RATIO.
953                      -TAPER RATIO.
954                      -SWEEP ANGLE. SEE 955.                DEGREES
955                      -PERCENT OF CHORD OF SWEEP ANGLE.     DECIMAL
956      NOT USED.
957      BUTT LINE (Y) OF WING TO FUSELAGE SHEAR TIE.           INCHES

-------  WING IS LOCATED ON THE AIR VEHICLE BY INPUT IN EITHER
             LOCATION 958 OR LOCATION 959.
958      STATION(X)-INTERSECTION OF WING LEADING EDGE AND FUSELAGE
             CENTER LINE.                                       INCHES
959      STATION(X)-25% ELEMENT OF MEAN AERODYNAMIC CHORD(MAC)  INCHES
960      DIHEDRAL OF WING                                      DEGREES
961      WATER LINE (Z)-WING REFERENCE PLANE.                   INCHES
962      WING-(THICKNESS/CHORD)ROOT.                           DECIMAL
963          -(THICKNESS/CHORD)TIP/(THICKNESS/CHORD)ROOT.      DECIMAL
964-965  NOT USED.

966      WING-PERCENT OF CHORD OF ELASTIC AXIS (EA).           DECIMAL
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
        LOCATIONS 967-979 ARE USED TO DEFINE THE WING SYNTHESIS
        CUTS.  IF THESE LOCATIONS ARE LEFT BLANK, THE PROGRAM
        WILL ASSUME CUTS AT TEN PERCENT INCREMENTS ALONG THE
        EXPOSED SPAN FROM THE SHEAR TIE POINT TO THE TIP.
967    INPUT TYPE INDICATOR (ELASTIC AXIS)
        ZERO (0.0) OR BLANK ( )=UNSWEPT AXIS OR INPUT PERCENT
                                  EXPOSED SPAN.
        ONE (1.0)                =SWEPT STATIONS.
968    INPUT CUT INDICATOR.
        NEGATIVE (-), ZERO (0.0) OR BLANK ( )=NO INPUT.
        POSITIVE VALUE SUCH AS ONE (1.0)      =INPUT
        ALL ELEVEN CUTS ALL ELEVEN CUTS FROM ROOT TO TIP.
        LOCATIONS 969-979.
969    WING SYNTHESIS CUT - ONE.   ( 1).
        BUTT LINE (Y) FROM VEHICLE CENTER LINE                    INCHES
        OR ELASTIC AXIS STATION (Y) - SWEPT                       INCHES
        OR PERCENT EXPOSED SPAN                                   DECIMAL
970    WING SYNTHESIS CUT - TWO.   ( 2).
971                       - THREE. ( 3).
972                       - FOUR.  ( 4).
973                       - FIVE.  ( 5).
974                       - SIX.   ( 6).
975                       - SEVEN. ( 7).
976                       - EIGHT. ( 8).
977                       - NINE.  ( 9).
978                       - TEN.   (10).
979                       - ELEVEN (11).
980    FUEL DENSITY-SET TO .026 LB/CU. IN, BASED ON 6.5 LB/GAL.
                 WITH 6% LOSS IN VOLUME-

        *MISCELLANEOUS WING GEOMETRY DATA*
981    PIVOTING WING-PIVOT-BUTT LINE (Y).                         INCHES
982                      -STATION (X).                            INCHES
983              -SWEEP AT AFT POSITION.     SEE 955.    DEGREES
                  USED WITH MANUEVER LOAD FACTOR IN LOCATION 732
984              -SWEEP AT FORWARD POSITION. SEE 955.    DEGREES
                  USED WITH MANUEVER LOAD FACTOR IN LOCATION 731
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

985-986	NOT USED.	
987	BUTT LINE (Y)-FLAP-INBOARD END.	INCHES
988	-OUTBOARD.	INCHES
989	FLAP CHORD/WING CHORD. (AERODYNAMIC)	DECIMAL
990	MAXIMUM FLAP DEFLECTION. USED FOR FLAP MANUEVER.	DEGREES
991-1000	NOT USED.	
	* HORIZONTAL TAIL GEOMETRY DATA - LOC. 1001-1041 *	
1001	HORIZONTAL TAIL-AREA SEE 1030.	SQUARE FEET
1002	-ASPECT RATIO.	DECIMAL
1003	-TAPER RATIO.	DECIMAL
1004	-SWEEP ANGLE. SEE 1005.	DEGREES
1005	-PERCENT OF CHORD OF SWEEP ANGLE.	DECIMAL
1006	NOT USED.	
1007	BUTT LINE (Y) OF HORIZONTAL TO FUSELAGE SHEAR TIE. ENTER ZERO(0.0) FOR T-TAIL.	INCHES
-------	HORIZONTAL IS LOCATED ON AIR VEHICLE BY INPUT IN EITHER LOCATION 1008 OR LOCATION 1009.	
1008	STATION(X)-INTERSECTION OF HORIZONTAL LEADING EDGE AND FUSELAGE CENTER LINE IF LOCATION 1030 IS ZERO OR BLANK.	INCHES
	-INTERSECTION OF EXPOSED HORIZONTAL LEADING AND FUSELAGE MOLD LINE IF LOCATION 1030 IS POSITIVE.	INCHES
1009	STATION(X)-25% ELEMENT OF MEAN AERODYNAMIC CHORD(MAC) MAC IS FOR GROSS SURFACE IF 1030 IS ZERO OR BLANK. MAC IS FOR EXPOSED SURFACE IF 1030 IS POSITIVE.	INCHES
1010	DIHEDRAL OF H. TAIL	DEGREE
1011	WATER LINE (Z)-HORIZONTAL TAIL REFERENCE PLANE.	INCHES
1012	(THICKNESS/CHORD)ROOT.	DECIMAL
1013	(THICKNESS/CHORD)TIP/(THICKNESS/CHORD)ROOT.	DECIMAL
1014-1015	NOT USED.	
1016	PERCENT OF CHORD OF ELASTIC AXIS (EA). LOCATIONS 1017-1029 ARE USED TO DEFINE THE HORIZONTAL TAIL SYNTHESIS CUTS. IF THESE LOCATIONS ARE LEFT BLANK, THE PROGRAM WILL ASSUME CUTS AT TEN PERCENT INCREMENTS ALONG	DECIMAL

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
         THE EXPOSED SPAN FROM THE SHEAR TIE POINT TO THE TIP.
1017     INPUT TYPE INDICATOR (ELASTIC AXIS)
          ZERO (0.0) OR BLANK ( )=UNSWEPT AXIS OR INPUT PERCENT
                                  EXPOSED SPAN.
          ONE (1.0)              =SWEPT STATIONS.
1018     INPUT CUT INDICATOR.
          NEGATIVE (-), ZERO (0.0) OR BLANK ( )=NO INPUT.
          POSITIVE VALUE SUCH AS ONE (1.0)     =INPUT
          ALL ELEVEN CUTS FROM ROOT TO TIP.  LOCATIONS 1019-1029.

1019-1029 HORIZONTAL SYNTHESIS CUTS-ONE THRU ELEVEN (1-11).
          IF LOCATION 1030 IS MINUS OR ZERO,
           BUTT LINE (Y) FROM VEHICLE CENTER LINE                INCHES
           OR ELASTIC AXIS STATION (Y) - SWEPT                   INCHES
           OR PERCENT EXPOSED SPAN                               DECIMAL
          IF LOCATION 1030 IS POSITIVE,
           BUTT LINE (Y) FROM EXPOSED ROOT                       INCHES
           OR EXPOSED ELASTIC AXIS STATION (Y) - SWEPT           INCHES
           OR PERCENT EXPOSED SPAN                               DECIMAL
1030     EXPOSED OR GROSS AREA INDICATOR.
          MINUS (-), ZERO (0.0) OR BLANK ( )=GROSS AREA GIVEN.
          POSITIVE VALUE SUCH AS ONE (1.0)  =EXPOSED AREA GIVEN.
1031-1040 NOT USED.

              * VERTICAL TAIL GEOMETRY DATA - LOC. 1041-1070 *
1041     VERTICAL TAIL (EACH)-AREA. SEE 1047.              SQUARE FEET
1042                         -ASPECT RATIO.                    DECIMAL
1043                         -TAPER RATIO.                     DECIMAL
1044                         -SWEEP. SEE 1045.                 DEGREES
1045                         -PERCENT OF CHORD OF SWEEP.       DECIMAL
1046     NOT USED.
1047                         -BUTT PLANE (Y).                   INCHES
          ZERO (0.0) OR BLANK ( )        =ONE ON CENTER LINE
          POSITIVE VALUE SUCH AS TEN (10.0)=TWO, ONE ON EACH SIDE.

 ------- VERTICAL IS LOCATED ON AIR VEHICLE BY INPUT IN EITHER
            LOCATION 1048 OR LOCATION 1049.
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
1048      STATION(X)-INTERSECTION OF VERTICAL LEADING EDGE AND
              FUSELAGE MOLD LINE.                                    INCHES
1049      STATION(X)-25% ELEMENT OF MEAN AERODYNAMIC CHORD(MAC)  INCHES
1050      DIHEDRAL OF V. TAIL                                       DEGREE
1051      DISTANCE WATER LINE (Z)-ROOT TO ZERO WATER LINE.         INCHES
1052      (THICKNESS/CHORD)ROOT.                                   DECIMAL
1053      (THICKNESS/CHORD)TIP/(THICKNESS/CHORD)ROOT.              DECIMAL
1054-1055 NOT USED.
1056      PERCENT OF (HCE) AT ELASTIC AXIS (EA).                   DECIMAL
           LOCATIONS 1057-1069 ARE USED TO DEFINE THE VERTICAL TAIL
           SYNTHESIS CUTS.  IF THESE LOCATIONS ARE LEFT BLANK, THE
           PROGRAM WILL ASSUME CUTS AT TEN PERCENT INCREMENTS ALONG
           THE EXPOSED SPAN FROM THE SHEAR TIE POINT TO THE TIP.
1057      INPUT TYPE INDICATOR (ELASTIC AXIS)
           ZERO (0.0) OR BLANK ( )=UNSWEPT AXIS OR INPUT PERCENT
                                  EXPOSED SPAN.
           ONE (1.0)              =SWEPT STATIONS.
1058      INPUT CUT INDICATOR.
           NEGATIVE (-), ZERO (0.0) OR BLANK ( )=NO INPUT.
           POSITIVE VALUE SUCH AS ONE (1.0)     =INPUT
           ALL ELEVEN CUTS FROM ROOT TO TIP. LOCATIONS 1059-1069.

1059-1069 VERTICAL SYNTHESIS CUTS-ONE THRU ELEVEN (1-11).
           WATER LINE (Z) FROM EXPOSED ROOT                         INCHES
           OR ELASTIC AXIS STATION (Z) - SWEPT                      INCHES
           OR PERCENT EXPOSED SPAN                                 DECIMAL
1070      VERTICAL TAIL LOCATION INDICATOR
              0=FUSELAGE
              +=WING
1071-1080 NOT USED.

              * FUSELAGE GEOMETRY DATA - LOC. 1081-1155 *
1081 PERIMETER CODE - MUST AGREE WITH DATA IN LOCATIONS 1126-1135.
           ONE (1.0)=PERIMETER IS INPUT.
           TWO (2.0)=PERIMETER CORRECTION FACTOR IS INPUT - USE
           CURVES IN FIGURE 25 FOR INPUT IN LOCATIONS 1126-1135
1082      NUMBER OF CUTS FOR SHELL SYNTHESIS - 10 CUTS MAXIMUM.
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
                MUST AGREE WITH DATA INPUT IN LOCATIONS 1136-1154.
1083-1085 NOT USED.

        LOCATIONS 1086-1135 DEFINE THE FUSELAGE GEOMETRY AND COORDINATES.
              ALL OF THESE LOCATIONS MUST BE ENTERED (ALL 10 CUTS).
 1086         FIRST CUT - AT NOSE TIP                   STATION (X) INCHES.
1087-1094     INTERMEDIATE CUTS (8)                     STATION (X) INCHES.
 1095         LAST CUT - AT TAIL TIP                    STATION (X) INCHES.
1096-1105     DISTANCE FROM ZERO WATER LINE REFERENCE TO FUSELAGE HALF
                DEPTH AT FUSELAGE CUTS.               WATER LINE (Z) INCHES.
1106-1115     FUSELAGE DEPTH AT FUSELAGE CUTS                       INCHES.
1116-1125     FUSELAGE WIDTH AT FUSELAGE CUTS                       INCHES.
1126-1135     FUSELAGE PERIMETER AT FUSELAGE CUTS IF  1081=1.0      INCHES.
              FUSELAGE PERIMETER CORRECTION FACTOR IF 1081=2.0
1136-1154     FUSELAGE SYNTHESIS CUTS ** MUST ENTER FROM 1 TO 19 STATIONS*
                   NUMBER OF CUTS USED MUST BE ENTERED IN LOCATION 1082.
                   FIRST CUT MUST BE AFT OF NOSE REFERENCE LOC. 1086.
                   LAST CUT MUST BE FORWARD OF TAIL REFERENCE LOC. 1095.
 1155         NOT AVAILABLE.
1156-1160     NOT USED.

                * NACELLE AND AIR INDUCTION SYSTEM DATA *
                          LOCATIONS 1161-1360.
 1161         NUMBER OF NACELLES/AIR VEHICLE.
 1162         ENGINE BY-PASS RATIO.
 1163         INLET TYPE INDICATOR.
               ONE    (1.0)=FIXED DUCT.
               TWO    (2.0)=FIXED SPIKE.
               THREE  (3.0)=HORIZONTAL RAMP.
               FOUR   (4.0)=VERTICAL RAMP.
               FIVE   (5.0)=TRANSLATABLE SPIKE.
               SIX    (6.0)=EXPANDABLE SPIKE.

 1164         CAPTURE AREA/INLET - FOR SPIKE TYPE ONLY          SQ. INCHES
 1165         NUMBER OF INLETS/AIR VEHICLE.
 1166         DISTANCE-LEADING EDGE OF DUCT TO THROAT (X REF.)      INCHES
 1167         ENGINE-NUMBER/AIR VEHICLE.
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
1168        -THRUST/ENGINE (MAX SEA LEVEL STATIC).                  POUNDS
1169        -WEIGHT/ENGINE.                                         POUNDS
1170        -LENGTH.                                                INCHES
1171        -MAXIMUM DIAMETER.                                      INCHES
1172        -DISTANCE, FRONT FACE TO CENTER OF GRAVITY.             INCHES
1173    STATION (X) DUCT LEADING EDGE OF INBOARD ENGINE
         PACKAGE.                                                   INCHES
1174    INBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                BUTT LINE (Y)       INCHES
1175    INBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                WATER LINE (Z)      INCHES
1176    STATION (X) DUCT LEADING EDGE OF OUTBOARD ENGINE
         PACKAGE.                                                   INCHES
1177    OUTBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                BUTT LINE (Y)       INCHES
1178    OUTBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                WATER LINE (Z)      INCHES
1179    NOT USED.

1180    PYLON-SWEEP OF LEADING EDGE.                               DEGREES
1181         -TYPE OF MOUNTING. ZERO (0.0)=VERTICAL.
                                ONE  (1.0)=HORIZONTAL.
1182         -CHORD OF INBOARD.                                     INCHES
1183         -SPAN  OF INBOARD.                                     INCHES
1184         -CHORD OF OUTBOARD.                                    INCHES
1185         -SPAN  OF OUTBOARD.                                    INCHES
1186         -THICKNESS/CHORD RATIO.                               DECIMAL
1187    AREA-AUXILLIARY INLET/NACELLE.                         SQUARE FEET
1188        -DUCT BY-PASS DOOR/NACELLE.                        SQUARE FEET
1189        -MISCELLANEOUS DOOR/NACELLE.                       SQUARE FEET
1190    SHROUD INDICATOR. ZERO              (0.0) =NO.
                          ONE               (1.0) =YES.
                          GREATER THAN ONE  (1.0+)=AREA.       SQUARE FEET
1191-1200 NOT USED.

        LOCATIONS 1201-1270 ARE USED TO DESCRIBE THE DUCT GEOMETRY
1201 PERIMETER CODE - MUST AGREE WITH DATA IN LOCATIONS 1261-1270.
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

	ONE (1.0)=PERIMETER IS INPUT.	
	TWO (2.0)=PERIMETER CORRECTION FACTOR IS INPUT - USE CURVES IN FIGURE 23 FOR INPUT IN LOCATIONS 1261-1270	
1202	NUMBER OF CUTS THRU DUCT **MAY ENTER 2 THRU 10** MUST AGREE WITH DATA INPUT IN LOCATIONS 1211-1220.	
1203-1210	NOT USED.	
1211-1220	DUCT CUTS REF. FROM DUCT LEADING EDGE STATION (X)	INCHES
	FIRST CUT AT LEADING EDGE (1211 = 0.0)	
	LAST CUT AT ENGINE FACE	
	TOTAL NUMBER OF CUTS MUST AGREE WITH LOCATION 1202.	
1221-1230	DUCT CENTERLINE-	
	DISTANCE FROM CENTERLINE OF VEHICLE TO CENTERLINE OF DUCT FOR FUSELAGE BURIED ENGINE CONCEPT (OR)	INCHE
	DISTANCE FROM CENTERLINE OF NACELLE TO <u>CENTERLINE OF DUCT FOR NACELLE MOUNTED</u> ENGINES.	INCHE
1231-1240	NOT USED.	
1241-1250	DUCT DEPTH AT DUCT CUTS.	INCHES
1251-1260	DUCT WIDTH AT DUCT CUTS.	INCHES
1261-1270	DUCT PERIMETER AT DUCT CUTS IF 1201 = 1.0 .	INCHES
	DUCT PERIMETER CORRECTION FACTOR IF 1201 = 2.0 .	
1271	NUMBER OF RAMPS.	
1272-1273	NOT USED.	
1274	LENGTH RAMP NUMBER ONE (1)	INCHES
1275	TWO (2)	INCHES
1276	THREE (3)	INCHES
1277	FOUR (4)	INCHES
1278	WIDTH RAMP NUMBER ONE (1)	INCHES
1279	TWO (2)	INCHES
1280	THREE (3)	INCHES
1281	FOUR (4)	INCHES
1282-1286	NOT USED.	
1287	DISTANCE-LEADING EDGE OF NACELLE TO FIRST RAMP HINGE.	INCHES

TABLE 8. GENERAL DATA DESCRIPTIONS (CONT)

```
1281-1290 NOT USED.
 1291 PERIMETER CODE - MUST AGREE WITH DATA IN LOCATIONS 1351-1360.
           ONE (1.0)=PERIMETER IS INPUT.
           TWO (2.0)=PERIMETER CORRECTION FACTOR IS INPUT - USE
           CURVES IN FIGURE 23 FOR INPUT IN LOCATIONS 1351-1360.
 1292     NUMBER OF CUTS THRU NACELLE. **MAY ENTER 2 THRU 10**
           MUST AGREE WITH DATA INPUT IN LOCATIONS 1301-1310.
1293-1298 NOT USED.
 1299     NACELLE MAXIMUM DEPTH.                                    INCHES
 1300                     WIDTH.                                    INCHES
1301-1310 NACELLE CUTS REF. FROM DUCT LEADING EDGE STATION (X)   INCHES
           FIRST CUT AT LEADING EDGE (1301 = 0.0)
           LAST CUT AT LAST FULL SECTION OF NACELLE
           TOTAL NUMBER OF CUTS MUST AGREE WITH LOCATION 1292.
1311-1330 NOT USED.
1331-1340 NACELLE DEPTH AT NACELLE CUTS                             INCHES
1341-1350 NACELLE WIDTH AT NACELLE CUTS                             INCHES
1351-1360 NACELLE PERIMETER AT NACELLE CUTS IF 1291=1.0             INCHES
          NACELLE PERIMETER CORRECTION FACTOR IF 1291=2.0
1361-1400 NOT USED.

       ** LOCATIONS 1401-1448 ARE USED TO OVER-RIDE PERMANENT MISSION
          SEGMENT DATA FOR FATIGUE EVALUATION - CURRENT PERMANENT
          DATA IS FOR FIXED WING AIRCRAFT - ALL EIGHT SEGMENTS ARE
          REQUIRED. **
1401-1408 SEGMENT TYPES (EIGHT BLOCKED MISSION SEGMENTS).
           INPUT   A/V CLASS              DESCRIPTION
            1.0      F,A       ASCENT, CRUISE, LOITER, OR DESCENT
            2.0      F,A       AIR TO GROUND COMBAT
            3.0      F,A       SUBSONIC AIR TO AIR COMBAT
            4.0      F,A       SUPERSONIC AIR TO AIR COMBAT
            1.0      BI        ALL MISSION SEGMENTS
            1.0      BII       ASCENT, DESCENT, OR REFUELING
            2.0      BII       CRUISE OR HIGH ALTITUDE PENETRATION
            3.0      BII       LOW ALTITUDE PENETRATION
            1.0      CA,CT     ASCENT, DESCENT, OR REFUELING
            2.0      CA,CT     CRUISE
```

TABLE 8. GENERAL DATA DESCRIPTIONS (CONCL)

```
1409-1416 MACH NUMBER CORRESPONDING TO BLOCKED SEGMENTS.
1417-1424 ALTITUDE CORRESPONDING TO BLOCKED SEGMENTS.
1425-1432 WING SWEEP INDICATOR CORRESPONDING TO BLOCKED SEGMENTS.
            1.0 = FIXED WING AIR VEHICLE
            2.0 = VARIABLE SWEEP WING - WING FORWARD
            3.0 = VARIABLE SWEEP WING - WING AFT
1433-1440 (W/WO) VEHICLE WEIGHT/MAXIMUM DESIGN WEIGHT CORRESPONDING
           TO BLOCKED SEGMENTS.
1441-1448 (T/TL) SEGMENT FLIGHT TIME/TOTAL VEHICLE FLIGHT TIME
           CORRESPONDING TO BLOCKED SEGMENTS.

          *** END ***
```

Section III

FATIGUE DATA

INTRODUCTION

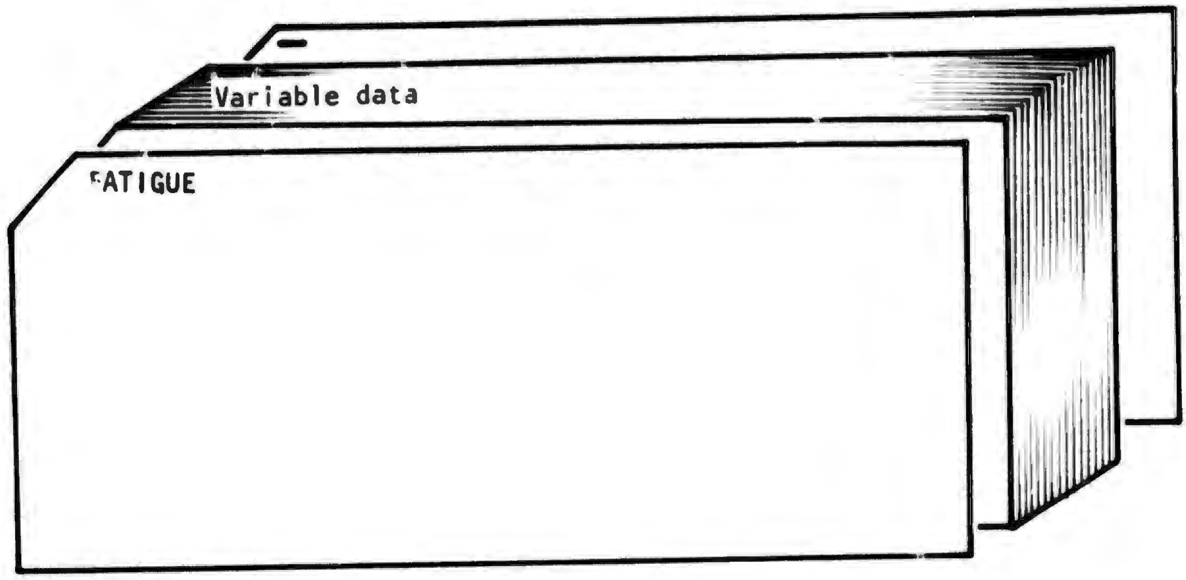
The fatigue module, level (5,0) overlay, of SWEEP uses fatigue data to develop the maximum allowable stress for two points on the wing and for pressurized fuselage panels to satisfy vehicle service life. The endurance limit of fuselage panels is also estimated. This fatigue prediction method is based on material strain. The maximum operating stress calculated by this module is stored in the material record for use in the appropriate synthesis module. This module may be operated as a stand-alone program by input of the fatigue data block. In the integrated SWEEP program, the module would be operated in conjunction with the GENERAL data and FATIGUE data blocks. Wing spectrum data for fatigue analysis is computed by the airloads module. The following paragraphs describe the program and user inputs.

GENERAL DESCRIPTION

The fatigue module converts input loads-exceedance data into stress-occurrence tables. The stress-load relationship is determined by proportionality constants. The wing spectrum data consist of gust, maneuver, taxi, and ground-air-ground segments. The taxi spectrum data are not considered since all bending moments are negative (lower cover in compression). The lower cover spectrum stress tables are evaluated for life; stresses are systematically modified until specified vehicle service life is satisfied. Stress concentration factor and scatter factor are also considered in analysis. The fuselage pressure-occurrence data are evaluated in the same manner to determine the maximum allowable stress. The fuselage panel material endurance Limit stress is estimated for an unnotched specimen under reversed loading.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 9. All of the variables in the input list are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card "FATIGUE." The last data card must have a minus sign in column 1. The FATIGUE deck setup is as follows:



Expanded explanations for those variables which may be subject to misinterpretation are presented below:

> Locations 113, 114, and 117 specify the scatter factor for the spectrum data. Spectrum data is given for one vehicle lifetime. In a very gross sense, scatter factor and fatigue could be considered analogous to factor of safety and strength design. In general practice, the scatter factor is 4.
>
> Locations 115, 116, and 118 specify the stress concentration factor. The stress concentration factor of vehicle structures varies with construction and joint design. A rule-of-thumb stress concentration factor of 3 would be representative of riveted vehicle structure. The concentration factor at panel splices could be considerably higher than this value.
>
> Locations 1162 and 1163 specify the net limit wing design bending moment at the side of fuselage and at wing synthesis cut No. 2. These moments are used to determine the relationship between spectrum and design loads.

TABLE 9. FATIGUE DATA LIST

------ IF FATIGUE IS TO BE RUN THE CONSTANT DATA MUST BE INPUT WITH VARIABLE DATA USING THE 'FATIGUE   ' CONTROL CARD.

LOCATION	DESCRIPTIONS
1	CONSTANT = 1.0
2	CONSTANT = 2.0
3	CONSTANT = 3.0
4	CONSTANT = 4.0
5	CONSTANT = 5.0
6	CONSTANT = 6.0
7	CONSTANT = 7.0
8	CONSTANT = 8.0
9	CONSTANT = 9.0
10	CONSTANT = 10.0
11	CONSTANT = 11.0
12	CONSTANT = 12.0
13	CONSTANT = 20.0
14	CONSTANT = 1000.0
15	CONSTANT = 3.1415927 (PI)
16	CONSTANT = 0.01745329 (PI/180)
17	CONSTANT = 144.0
18	CONSTANT = 24.0
19	CONSTANT = 0.5
20	CONSTANT = 1.5
21	CONSTANT = 0.33333333 (1/3)
22	CONSTANT = 0.95
23	CONSTANT = 0.25
24	CONSTANT = 0.0
25-50	NOT USED
51	CONSTANT = 1.12
52	CONSTANT = 0.893
53	CONSTANT = 0.0792
54	CONSTANT = 0.179
55	CONSTANT = 3.31
56	CONSTANT = 0.25
57	CONSTANT = 21.4

TABLE 9. FATIGUE DATA LIST (CONT)

58	CONSTANT = 0.75
59	CONSTANT = 1000000000.0
60	CONSTANT = 1000000.0
61	CONSTANT = 0.015 (TOLERANCE FOR ROOT IN ALIFE)
62	CONSTANT = 0.001 (TOLERANCE FOR ACURVE AND BCURVE)
63	CONSTANT = 0.01 (TOLERANCE FOR FATIGUE LIFE)
64	CONSTANT = -0.1666667 (INITIAL SLOPE FOR LIFE ESTIMATE IN FATIGU)
65-77	NOT AVAILABLE
78	CONSTANT = 0.5 (FRACTION OF FTU INITIAL BENDING MOMENT)
79	CONSTANT = 1000000000.0 (CYCLES FOR ENDURANCE LIMIT)
80	CONSTANT = 1.0 (STRESS CONCENTRATION FACTOR FOR ENDURANCE LIMIT)
81	CONSTANT = 0.05 (FRACTION OF LIFE PER BLOCK)
82-100	NOT USED
101	REQUIRED SERVICE LIFE - HOURS (FROM GENERAL DATA IF PRESENT)
102-108	NOT AVAILABLE
109	MATERIAL NO. FOR WING AT THE SIDE OF THE FUSELAGE (SOF) IF = 0.0 SET FROM WING DATA IF WING IS LOADED OTHERWISE NO CALCULATION THIS STATION IF = +VALUE USE THIS VALUE IF = -VALUE DO NOT CALCULATE FOR THIS STATION
110	MATERIAL NO. FOR WING AT OUTER PANEL (WOP) (SEE NOTE FOR 109)
111	MATERIAL NUMBER FOR FUSELAGE COVER IF = 0.0 SET FROM FUSELAGE DATA IF FUSELAGE LOADED OTHERWISE NO CALCULATION IF = +VALUE USE THIS VALUE IF = -VALUE DO NOT CALCULATE FUSELAGE FATIGUE
112	MATERIAL NUMBER FOR FUSELAGE MINOR FRAMES SEE NOTES FOR 111
113	SCATTER FACTOR FOR SOF REQUIRED IF WING FATIGUE CALC.
114	SCATTER FACTOR FOR WOP REQUIRED IF WING FATIGUE CALC.
115	STRESS CONCENTRATION FACTOR,SOF REQ. IF WING FATIGUE CALC.
116	STRESS CONCENTRATION FACTOR,WOP REQ. IF WING FATIGUE CALC.
117	SCATTER FACTOR FOR FUSELAGE PRESSURE CYCLE, REQUIRED IF CALC
118	STRESS CONC. FACT.,FUSELAGE PRESSURE CYCLE, REQUIRED IF CALC

TABLE 9. FATIGUE DATA LIST (CONT)

```
 119-200  NOT USED
 201-1100 NOT AVAILABLE
1101-1160 NOT USED
1161      NOT AVAILABLE
             LOCATIONS 1162 AND 1163 ARE NOT REQUIRED WHEN BENDING
             SPECTRA DATA FROM THE LOADS MODULE ARE USED.
1162      MAXIMUM NET LIMIT DESIGN BENDING MOMENT AT SIDE          IN-LBS
           OF FUSELAGE.
1163      MAXIMUM NET LIMIT DESIGN BENDING MOMENT AT DESIGN        IN-LBS
           POINT ON WING OUTER PANEL.
1164-1199 NOT USED

           --- LOCATIONS 1200 THRU 1500 ARE DATA LOCATIONS ---
               FOR FUSELAGE PRESSURE FATIGUE DESIGN.

1200      NUMBER OF PRESSURE DESIGN POINTS FOR CABIN PRESSURIZATION
           FATIGUE CHECK.
1201-1300 MAXIMUM PRESSURE                                             PSI
1301-1400 MINIMUM PRESSURE                                             PSI
1401-1500 NUMBER OF CYCLES FOR EACH MAXIMUM-MINIMUM PRESSURE OCCURANCE
-------------------------------------------------------------------------

           1501-2300 IS NOT REQUIRED IF SPECTRUM DATA IS CALCULATED
           IN THE LOADS MODULE.

1501-1560 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK
           SEGMENT NO. 1.
           DATA IS TO BE ARRANGED IN THE FOLLOWING MANNER.
                  1501 BENDING MOMENT AT SIDE OF FUSELAGE
                  1502 BENDING MOMENT AT POINT ON WING OUTER PANEL
                  1503 EXCEEDANCE FOR GUST, SEE ALSO 2101...
                   ETC.
           EACH BLOCK SEGMENT IS COMPOSED OF 20 DATA POINTS.
           SEE PAGE XXX FOR SAMPLE INPUT.
1561-1620 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK
           SEGMENT NO. 2.                                          IN-LBS
```

TABLE 9. FATIGUE DATA LIST (CONCL)

```
1621-1680 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 3.
1681-1740 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 4.
1741-1800 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 5.
1801-1860 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 6.
1861-1920 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 7.
1921-1980 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 8.
1981-2040 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 9.
2041-2100 BENDING MOMENT SPECTRA DATA FOR VEHICLE MISSION BLOCK      IN-LBS
          SEGMENT NO. 10.
2101-2106 BENDING MOMENT SPECTRA DATA FOR GROUND-AIR-GROUND          IN-LBS
          SEGMENT NO. 11.
          DATA IS TO BE ARRANGED IN THE FOLLOWING MANNER.
                2101 BENDING MOMENT AT SIDE OF FUSELAGE
                2102 BENDING MOMENT AT POINT ON WING OUTER PANEL
                2103 OCCURANCES
2107-2116 10 REFERENCE BENDING MOMENTS FOR SOF                       IN-LBS
2117-2126 10 REFERENCE BENDING MOMENTS FOR WOP                       IN-LBS
2127-2146 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 1
2147-2166 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 2
2167-2186 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 3
2187-2206 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 4
2207-2226 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 5
2227-2246 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 6
2247-2266 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 7
2267-2286 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 8
2287-2306 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 9
2307-2326 EXCEEDANCES FOR MANEUVER FOR SPECTRA SEGMENT NUMBER 10
2327-2400 NOT USED

                          --- END ---
```

Section IV

LANDING GEAR DATA

INTRODUCTION

The landing gear module, level (6,0) overlay, of SWEEP requires landing gear data to estimate the weight of tricycle-type landing gear. The programmed procedure combines the effects of loads and basic geometry to determine the shock strut component weights. The weights of wheels, tires, and tubes may be input or derived from tire size. The weight of brakes may be input or estimated from vehicle kinetic energy. The following paragraphs describe the input data and methods used in this module.

GENERAL DESCRIPTION

The module develops an inner cylinder and strut synthesis based on loads at four points on the strut. The method is representative for conventional oleo systems rather than articulated or leaf-spring-type gears. Loads for two-point landing, drift landing, spin-up, spring-back, braked roll, unsymmetrical braking, turning, and towing conditions are derived to be in compliance with MIL-A-8862.

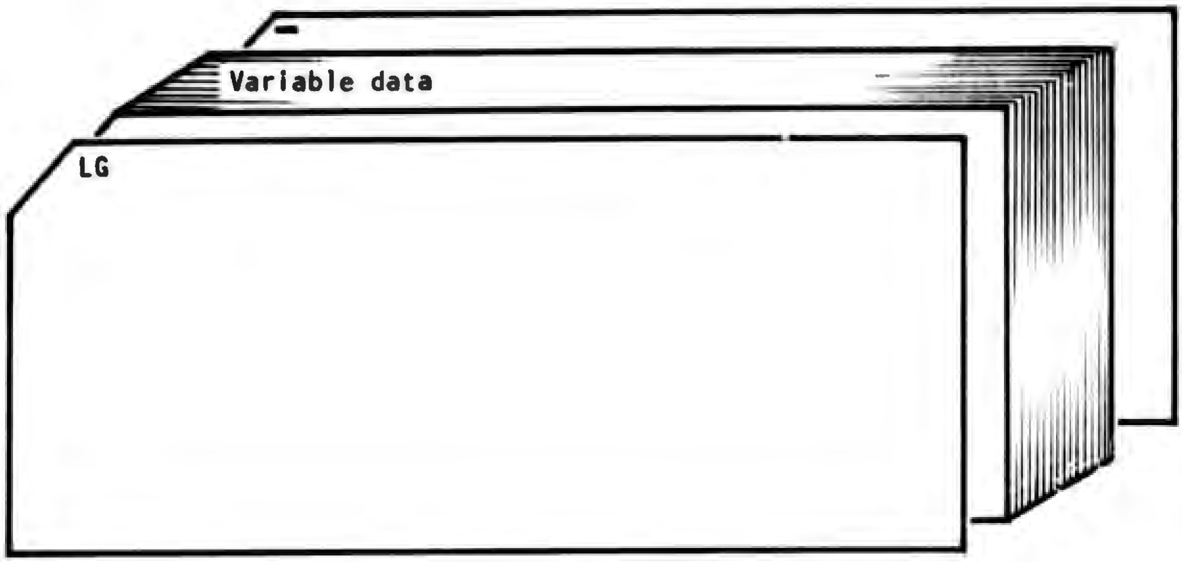
Mathematical expressions have been programmed for bending and torsional modulus of rupture as functions of b/t and material properties. An envelope of design bending and torsional moments is calculated to determine critical loads at the synthesis points. Maximum and minimum practical b/t's are specified for the analysis. The optimum cross-section search is conducted within these limits

Design loads at the four strut design stations may be computed with or without the effects of strut deflection as designated by the deflection indicator in the input data. A maximum of five iterations is allowed to determine the effects of strut deflection. Drag and side brace estimates are derived from geometric relationships. Weight allowance for lugs, axles, bearings, retract mechanisms, etc, is statistically derived.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 10. All of the variables in the input list are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card "LG."

The last data card must have a minus sign in column 1. The LG deck setup is as follows:



Input geometric definitions which may be subject to misinterpretation are shown in Figure 26.

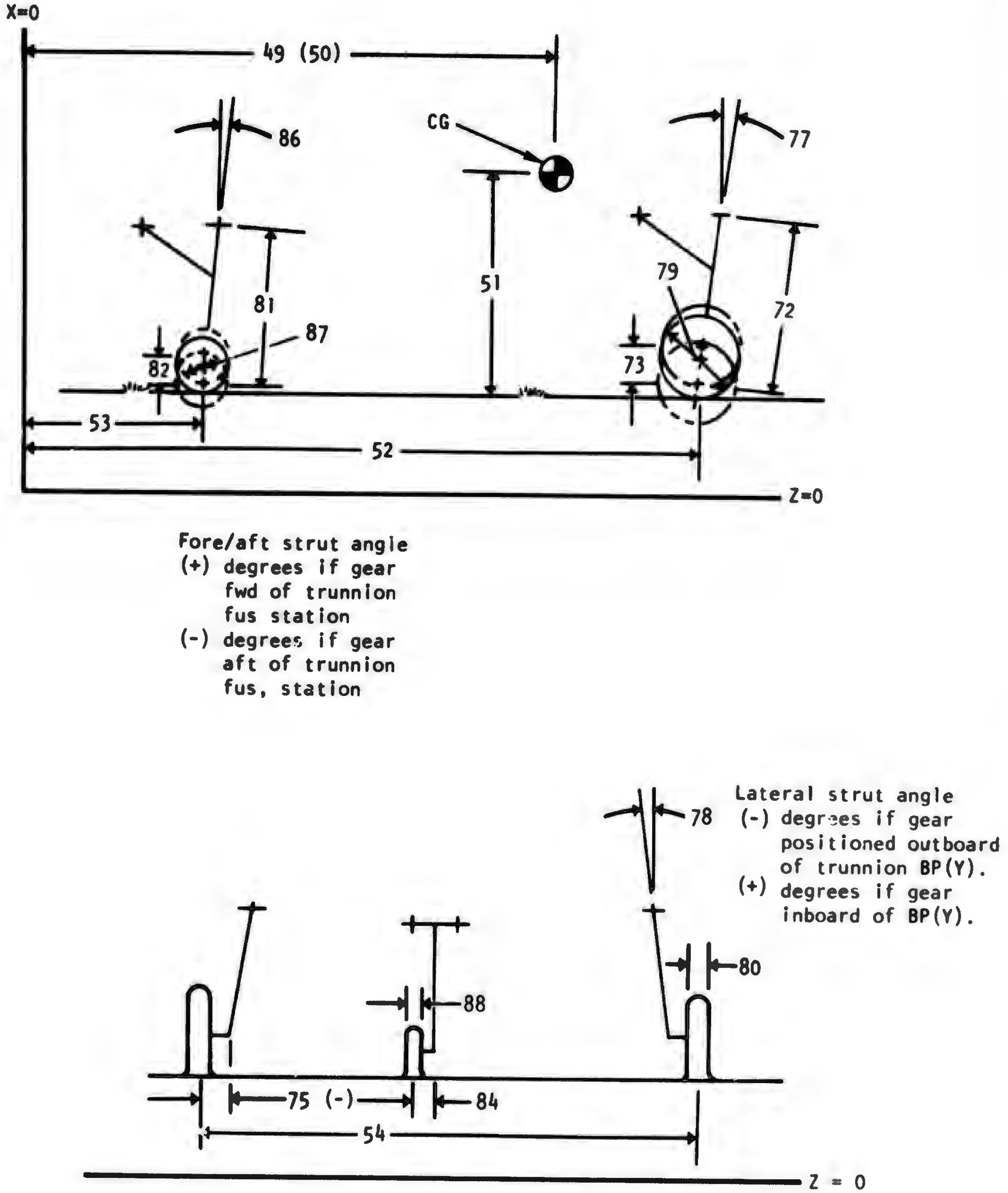


Figure 26. Landing gear geometry.

TABLE 10. LANDING GEAR DATA LIST

CONSTANT DATA AREA - LOCATIONS 1-42.

LOCATIONS	DESCRIPTIONS		
1	PERCENT ENERGY ABSORBED.	LOADED VALUE	0.10
2	NOSE GEAR PISTON DIAMETER FACTOR.		0.60
3	K-(SPIN-UP).		1.4
4	K-(SPRING BACK).		.892857140
5	MAIN GEAR MISCELLANEOUS WEIGHT FACTORS.		0.25
6			0.50
7			0.001
8	NOSE GEAR MISCELLANEOUS WEIGHT FACTORS.		0.25
9			0.50
10	TWO POINT COEFFICIENT.		0.25
11	DRIFT LANDING COEFFICIENT.	LOADED VALUE	0.80
12	AREA TOLERANCE.		0.10
13	LANDING SPEED CONSTANT.		34.7776
14	LOAD FACTOR CONSTANTS.		0.98
15			0.08
16			0.80
17	TAIL WHEEL ECUATION EXPCNENTS.		2.024
18			0.2963
19			0.6238
20	RATIO CONSTANTS.	LOADED VALUES	0.80
21			1.00
22			1.20
23	MAIN GEAR STROKE COEFFICIENT-AT TAKE-OFF.		1.00
24	-AT LANDING.		1.00
25	POUNDS OF BRAKES/FT-LB KINETIC ENERGY.		0.00000408
26	D/T PISTON.		50.00
27	NEGLIGABLE LOAD CHECK.		100.00
28	D/T BOGIE.		20.00

TABLE 10. LANDING GEAR DATA LIST (CONT)

```
29      ASSUMED D/T RATIOS.                        LOADED VALUE      10.00
30                                                                   30.00
31                                                                   50.00
32      D/T AXLE.                                                    10.00
33      NOSE GEAR STROKE COEFFICIENT-AT TAKE-OFF.                     1.00
34                                  -AT LANDING.                      1.00
35      NUMBER OF STRUTS-MAIN GEAR.                                   2.00
36      DENSITY OF OIL.                                               0.03
37      BRAKED ROLL CONSTANTS.                                        1.00
38                                                                    1.20

39      PERCENT AXLE LENGTH TO SECTIONS.           LOADED VALUE       1.00
40                                                                    0.60
41                                                                    0.20
42                                                                    0.12
43      ULTIMATE TO LIMIT LOAD RATIO                                  1.5
44-45   NOT USED

 .....................................................................
 .      VARIABLE DATA AREA LOCATIONS 46-116                          .
 .         *** NOTE THOSE INPUT DATA LOCATIONS PRECEEDED BY           .
 .         ASTERISKS (*) ARE DEVELOPED IN THE DATA MANAGEMENT         .
 .         MODULE.  THESE ASTERISKS SIGNIFY THAT THESE SPECIFIC       .
 .         INPUTS ARE NOT REQUIRED WHEN THE GENERAL DATA ARRAY IS     .
 .         PART OF THE CASE DATA SET, AND LOCATION 46 IS ZERO (0.0).  .
 .....................................................................

*46     TOGW AND G.D. TRANSFER ID. IF YOU WANT THE LG DATA
        BLOCK (46-54,72,73,81,82,89-92) TRANSFERRED FROM G.D.
        THEN SET D(46)=0.0
*47     LANDING WEIGHT.                                             POUNDS
*48     ABORTED TAKE-OFF INCREMENT. (DELTA WEIGHT)                  POUNDS
*49     CENTER OF GRAVITY-TAKE-OFF                    STATION (X)  INCHES
*50                      -LANDING                     STATION (X)  INCHES
*51     DISTANCE CENTER OF GRAVITY TO GROUND.                       INCHES
*52     FUSELAGE STATION-OF MAIN GEAR.                              INCHES
*53                     -OF NOSE GEAR.                              INCHES
```

TABLE 10. LANDING GEAR DATA LIST (CONT)

*54	LATERAL DISTANCE BETWEEN MAIN GEARS.		INCHES
55	FTU -ULTIMATE TENSIL STRENGTH OF MATERIAL		POUNDS/SQ. IN.
56	POISSON'S RATIO OF MATERIAL.		
57	F SUB CY (YIELD COMPRESSION STRENGTH).		POUNDS/SQUARE INCH
58	E (MODULUS OF ELASTICITY).		POUNDS/SQUARE INCH
59	DENSITY OF MATERIAL.		POUNDS/CUBIC INCH
60	DEFLECTION INDICATOR-MAIN GEAR.	ZERO (0.0)=DEFLECTION. ONE (1.0)=NO DEFLECTION.	
61	-NOSE GEAR.	ZERO (0.0)=DEFLECTION. ONE (1.0)=NO DEFLECTION.	
62	TAIL WHEEL INDICATOR.	ZERO (0.0)=TAIL WHEEL. ONE (1.0)=NOSE WHEEL.	
63	INDEX-MAIN GEAR.		
64	-NOSE GEAR.		
65	-OUTER CYLINDER-MAIN AND NOSE GEAR.		
66	-INNER CYLINDER-MAIN AND NOSE GEAR.		
67	-BOGIE.		
68	-DRAG STRUT-MAIN GEAR.		
69	-SIDE STRUT-MAIN GEAR.		
70	-DRAG STRUT-NOSE GEAR.		
71	-SIDE STRUT-NOSE GEAR.		
*72	MAIN GEAR-AXLE TO TRUNNION (EXTENDED) LENGTH.		INCHES
*73	-STROKE.		INCHES
74	-PISTON DIAMETER **OPTIONAL ENTRY**		INCHES
75	-ECCENTRICITY. *POSITIVE IF C.G. OF MAIN GEAR WHEEL IS INBOARD OF MAIN GEAR STRUT CENTER LINE. *NEGATIVE IF C.G. OF MAIN GEAR WHEEL IS OUTBOARD OF MAIN GEAR STRUT CENTER LINE. *ZERO IF C.G. OF MAIN GEAR WHEEL IS AT THE MAIN GEAR STRUT CENTER LINE.		INCHES
76	-NUMBER OF WHEELS PER STRUT.		
77	-STRUT ANGLE(FORE AND AFT).		DEGREES
78	-STRUT ANGLE(LATERAL).		DEGREES
79	-TIRE OUTSIDE DIAMETER.		INCHES
80	-TIRE WIDTH.		INCHES

TABLE 10. LANDING GEAR DATA LIST (CONT)

```
*91    NOSE GEAR-AXLE TO TRUNNION (EXTENDED) LENGTH.                  INCHES
*92              -STROKE                                              INCHES
 93              -PISTON DIAMETER **OPTIONAL ENTRY**                  INCHES
 84              -ECCENTRICITY.                                       INCHES
                   *LATERAL DISTANCE FROM C.G. OF THE NOSE GEAR
                    WHEEL TO THE NOSE GEAR STRUT CENTER LINE.
 85              -NUMBER OF WHEELS PER STRUT.
 86              -STRUT ANGLE(FORE AND AFT)                          DEGREES
 87              -TIRE OUTSIDE DIAMETER.                              INCHES
 88              -TIRE WIDTH.                                         INCHES

*89    SINK SPEED AT TAKE-OFF GROSS WEIGHT                       FEET/SECOND
        A ZERO (0.0) OR BLANK ( ) HERE MEANS LOADING AREA 107-116.
*90    SINK SPEED AT LANDING GROSS WEIGHT                        FEET/SECOND
*91    LANDING SPEED AT TAKE-OFF GROSS WEIGHT                    FEET/SECOND
        A ZERO (0.0) OR BLANK ( ) HERE MEANS LOADING AREA 95 - 97.
*92    LANDING SPEED AT LANDING GROSS WEIGHT                     FEET/SECOND
             USUAL VALUE = 1.2 * STALL SPEED,     (1.2V(S))
 93    LOAD FACTOR-TAKE-OFF WEIGHT. **OPTIONAL**
 94               -LANDING WEIGHT. **OPTIONAL**
 95    COEFFICIENT OF LIFT-AT TAKE-OFF WEIGHT **MUST LOAD IF 91=0**
 96                       -AT LANDING WEIGHT  **MUST LOAD IF 91=0**
 97    WING AREA **MUST LOAD IF 91=0**                           SQUARE FEET
 98    WING LIFT AT LANDING /WEIGHT  (RECOMMENDED VALUE = 1.0)
                                       RECOMMENDED VALUE = 1.0
 99    NOT USED
100    MAIN LANDING GEAR WHEEL WEIGHT/VEHICLE **OPTIONAL**        POUNDS
       **IF LOCATION 100 IS USED LOCATIONS 102,103,105,106 MUST BE
       LOADED**
101    INERTIA OF MAIN GEAR WHEELS **OPTIONAL**     SLUG-FEET SQUARED
102    MAIN GEAR TIRE WEIGHT/VEHICLE.    *SEE LOCATION 100*        POUNDS
103    BRAKE WEIGHT/VEHICLE.             *SEE LOCATION 100*        POUNDS
104    MAIN GEAR MISCELLANEOUS WEIGHT/VEHICLE.                     POUNDS
105    NOSE GEAR-WHEEL WEIGHT/VEHICLE.   *SEE LOCATION 100*        POUNDS
106             -TIRE WEIGHT/VEHICLE.    *SEE LOCATION 100*        POUNDS
```

TABLE 10. LANDING GEAR DATA LIST (CONCL)

```
    IF LOCATION 89 = ZERO(0.), LOCATIONS 107 THRU 116 MUST BE LOADED
107     MAIN GEAR-AXIAL LOAD  (FORE AND AFT).                  POUNDS
108              -NORMAL LOAD (FORE AND AFT).                  POUNDS
109              -AXIAL LOAD (DRIFT LANDING).                  POUNDS
110              -NORMAL LOAD (DRIFT LANDING).                 POUNDS
111              -AXIAL LOAD (TURNING).                        POUNDS
112              -NORMAL LOAD (TURNING).                       POUNDS
113     NOSE GEAR-AXIAL LOAD (FORE AND AFT).                   POUNDS
114              -NORMAL LOAD (FORE AND AFT).                  POUNDS
115              -AXIAL LOAD (TURNING).                        POUNDS
116              -NORMAL LOAD (TURNING).                       POUNDS

        *** END ***
```

Section V

AIR INDUCTION SYSTEM DATA

INTRODUCTION

The air induction system module, level (7,0) overlay, of SWEEP requires air induction system data to estimate the weight of propulsion-system-oriented structural components. The following paragraphs describe the input data and some of the program methods.

GENERAL DESCRIPTION

The air induction system module estimates the weights of inlet-duct systems, engine mounts, nacelles, and pylons. The module does not estimate the variable-geometry inlet controllers and actuators.

The inlet system estimating approach accounts for geometry, pressure, and temperature. Inlet pressure and temperature are determined for the vehicle limit speed-altitude profile. Nine points on the level-flight maximum speed (V_H) and limit speed (V_L) are evaluated for design pressure data. Total pressure is computed using the isentropic compressible flow equations and the MIL-E-5008B pressure recovery equation or input pressure recovery ratio.

Static pressure is calculated as a function of total pressure and airflow; mach number of the air at the engine face may be input or estimated by the program. Transient overpressure, referred to as hammershock, is calculated as a function of duct total pressure.

The program estimates weights for either fixed or movable spikes or for variable geometry ramps. Statistical weight estimation equations are used to calculate spike weights. An analytical approach is used for estimating two-, three-, and four-ramp variable geometry systems. The analytical approach uses as variables ramp delta pressure, geometry, material properties, and construction. The geometric descriptions of length, width, and angles are input; ramp angles if not input are assumed by the program. Actuator locations are assumed for the different systems, and combined with the pressure and geometry data to develop individual ramp load diagrams. The ramps are then synthesized for either conventional stiffened construction or for honeycomb design.

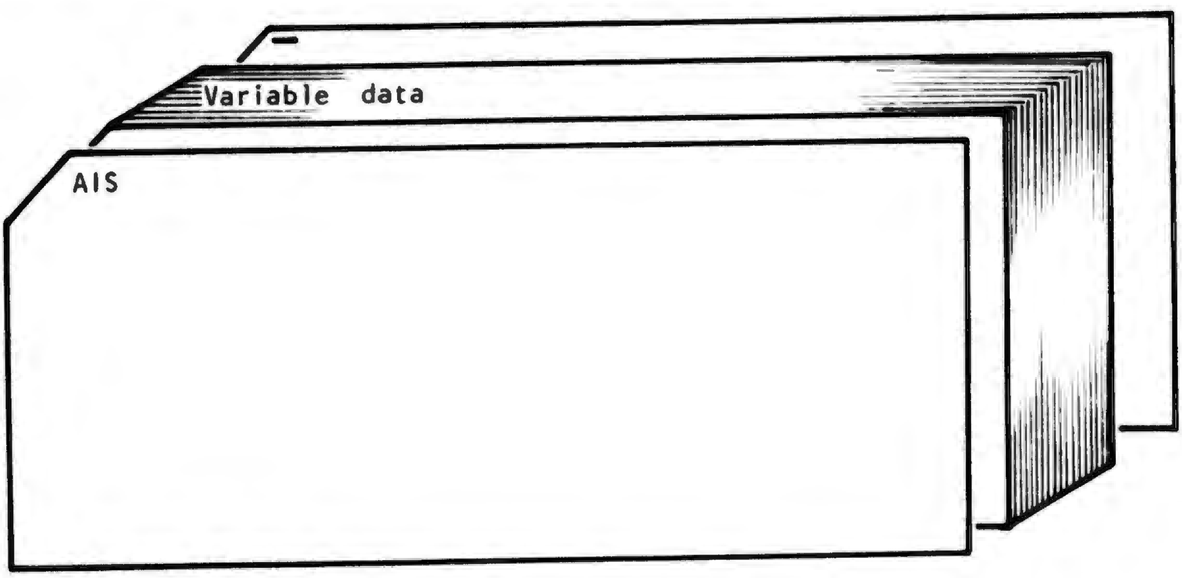
Ducts are synthesized for sheet frame type construction. Geometry is input at as many as 10 duct sections. The input data is in the form of longitudinal and lateral coordinates, depth, width, and perimeter, or perimeter correction factor. Sectional geometry is generated from this data as a family of shapes that may be defined by straight lines and circular arcs. Strength, deflection restraint, and fabrication minimums are the variables in the synthesis of ducts. Frame spacing may be either fixed or variable, the variable frame spacing search operation is conducted between predetermined minimum and maximum limits.

Nacelle structure estimates are made for external engine installations only. The nacelle geometry is defined in the same manner as for the ducts. The current estimating procedure is limited to accounting for local flutter and structural minimums. Within this scope, frame spacing compatibility with duct structure is maintained forward of the engine compresor face. Frame spacing aft of the engine is defined by the user.

Pylons (should they exist), engine mounts, and miscellaneous doors are derived by statistical weight estimation equations.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 11. All of the variables in the list are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card "AIS." The last data card must have a minus sign in column 1. The AIS deck setup is as follows:



The input data are organized into functional subsets. Explanations of these subsets and variables which may be subject to misinterpretations are as follows:

- Locations 271 through 317 specify general nacelle and air induction design and location data. These locations are used to determine the engine package coordinates, basic engine specifications, component material selection, correlation factors, and program control specifications.

- Location 281 specifies the number of nacelles. Internal installation is defined as one having the engines mounted within the fuselage structure. For this situation, zero would be input in this location, and locations 297 through 310 are left blank. External installations may be specified by input of 2 or 4. Odd-numbered external engine installations are not within the current program capabilities.

- Location 283 specifies the inlet type. Input of 1.0 specifies a fixed duct with no spike or variable geometry capability. Input of 2.0 specifies a fixed duct with a fixed spike. Input of 3.0 or 4.0 specifies a variable-geometry ramp system, and requires input of data in locations 401 through 419. Should ramp systems be specified, the program deletes that portion of duct which is blanketed by the ramps. Input of 5.0 or 6.0 specifies translating or translating and expandable spikes, respectively.

- Locations 311 through 313 specify the material number for the ducts, ramps, and nacelle structure.

- Locations 321 through 390 specify duct design and geometry data. Should the duct leading edge be one-dimensional, the appropriate depth (location 361) or width (location 371) would be input, and zero would be input in location 381. Input geometry is to be for a single duct.

- Locations 341 through 350 specify lateral duct coordinates relative to the fuselage or nacelle centerline. Any positive value automatically signifies two ducts within the fuselage or nacelle centerline. Should the situation exist where two ducts merge into a single duct, two synthesis cuts (locations 331 through 340), a finite distance apart, should be used to specify the two-duct and the single duct-sections.

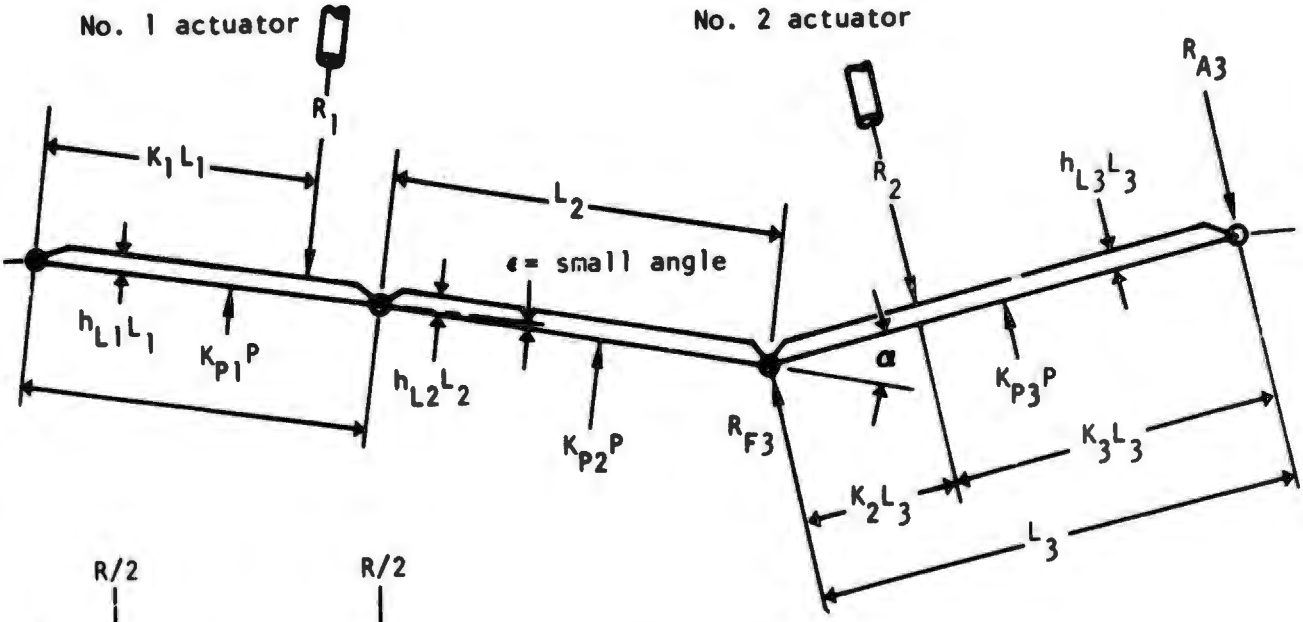
- Locations 401 through 419 specify ramp design and dimensional data. These locations are used when 3.0 or 4.0 are input in location 283 specifying horizontal or vertical variable geometry ramp inlets.

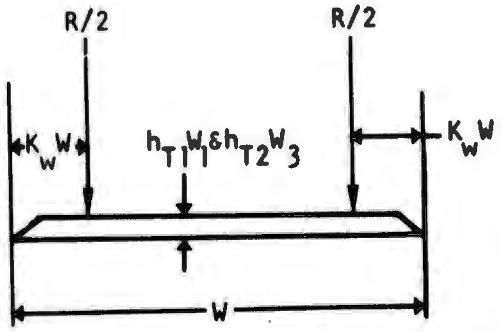
* Locations 421 through 513 contains permanent data used in the two-, three-, and four-ramp systems weight synthesis. These locations define beam positions, ramp depths, actuator locations, reaction points, and weight index coefficients. A pictorial description of a typical three-ramp system is shown in Figure 27.

* Locations 521 through 590 are used to specify nacelle design and geometry data. These locations are used to describe one nacelle and are required when a positive valve (2.0 or 4.0) is input in location 281.

* Locations 601 through 632 are used to specify the speed-altitude profile data and inlet and engine airflow characteristics.

A pictorial description of the required nacelle, duct and ramp geometric data is shown in Figures 25 and 29.





Typical transverse beam

Values calculated in program

P(ult)	= hammershock pressure
R_1	= fwd actuator reaction
R_2	= aft actuator reaction
R_{F3}	= fwd hinge reaction - ramp 3
R_{A3}	= aft hinge reaction - ramp 3

Input values		Loc
L_1	= length - ramp 1	404
L_2	= length - ramp 2	405
L_3	= length - ramp 3	406
W	= ramp widths	408-410
K_1	= fraction of L for ramp 1 reaction PT	459
K_2	= fraction of L_3 for ramp 3 reaction PT	460
K_3	= fraction of L_3 for ramp 3 reaction PT	461
K_W	= fraction of widths for reaction points	424
K_{P1}	= fraction of hammer shock P(ult) for ramp 2 ΔP	456
K_{P2}	= fraction of hammer shock P(ult) for ramp 2 ΔP	457
K_{P3}	= fraction of hammer shock P(ult) for ramp 3 ΔP	458
α	= angle between ramp 2 projection & ramp 3	467
h_{L1}	= fraction of L for ramp 1 depth	462
h_{L2}	= fraction of L_3 for ramp 2 depth	463
h_{L3}	= fraction of L_3 for ramp 3 depth	464
h_{T1}	= fraction of W_1, W_2, or W_3 for transverse beam depths	465
h_{T2}	= fraction of W_3 for actuator beam depth	466
ϵ	= negligible value	

Figure 27. Three-ramp system.

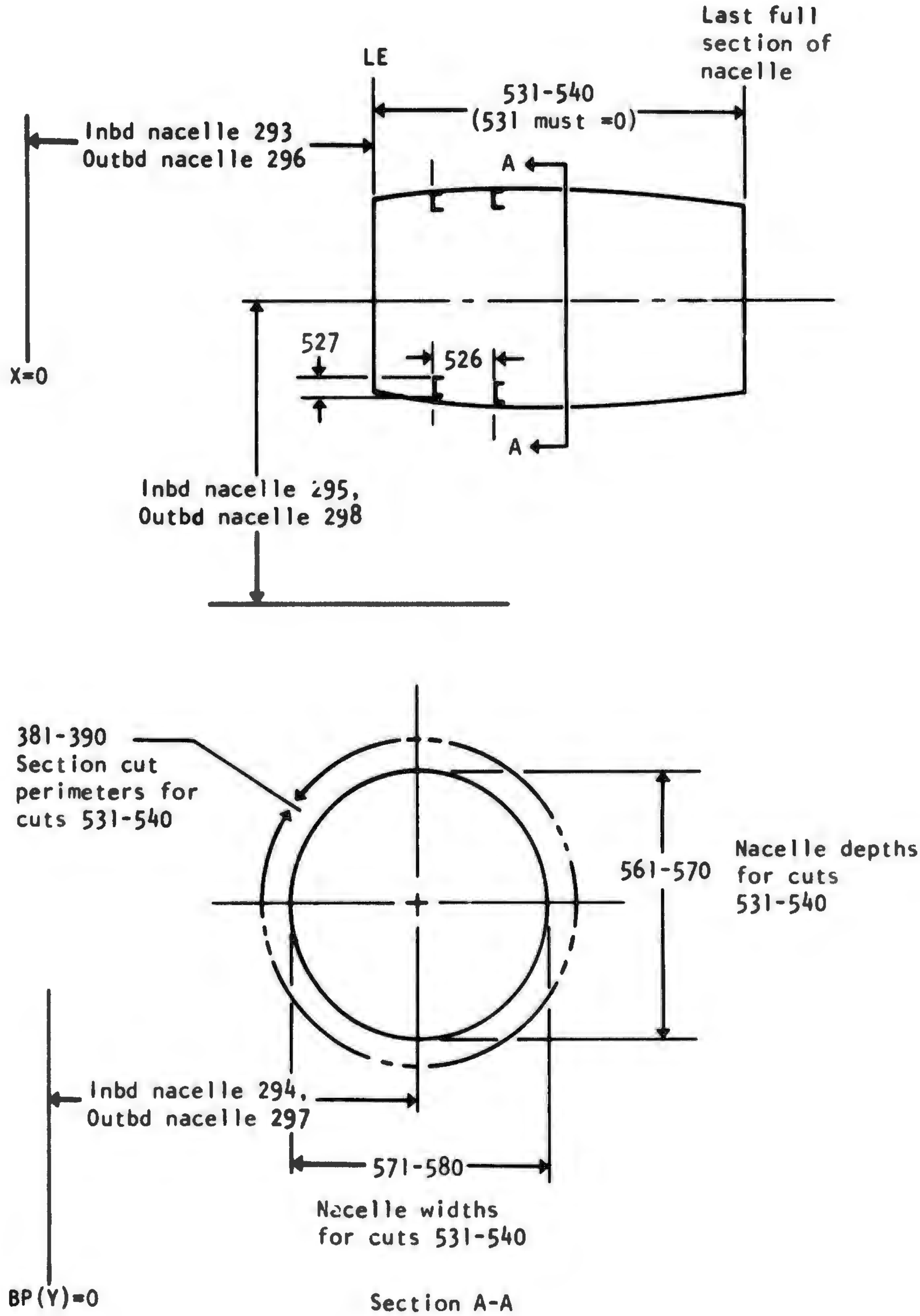


Figure 28. Nacelle geometry.

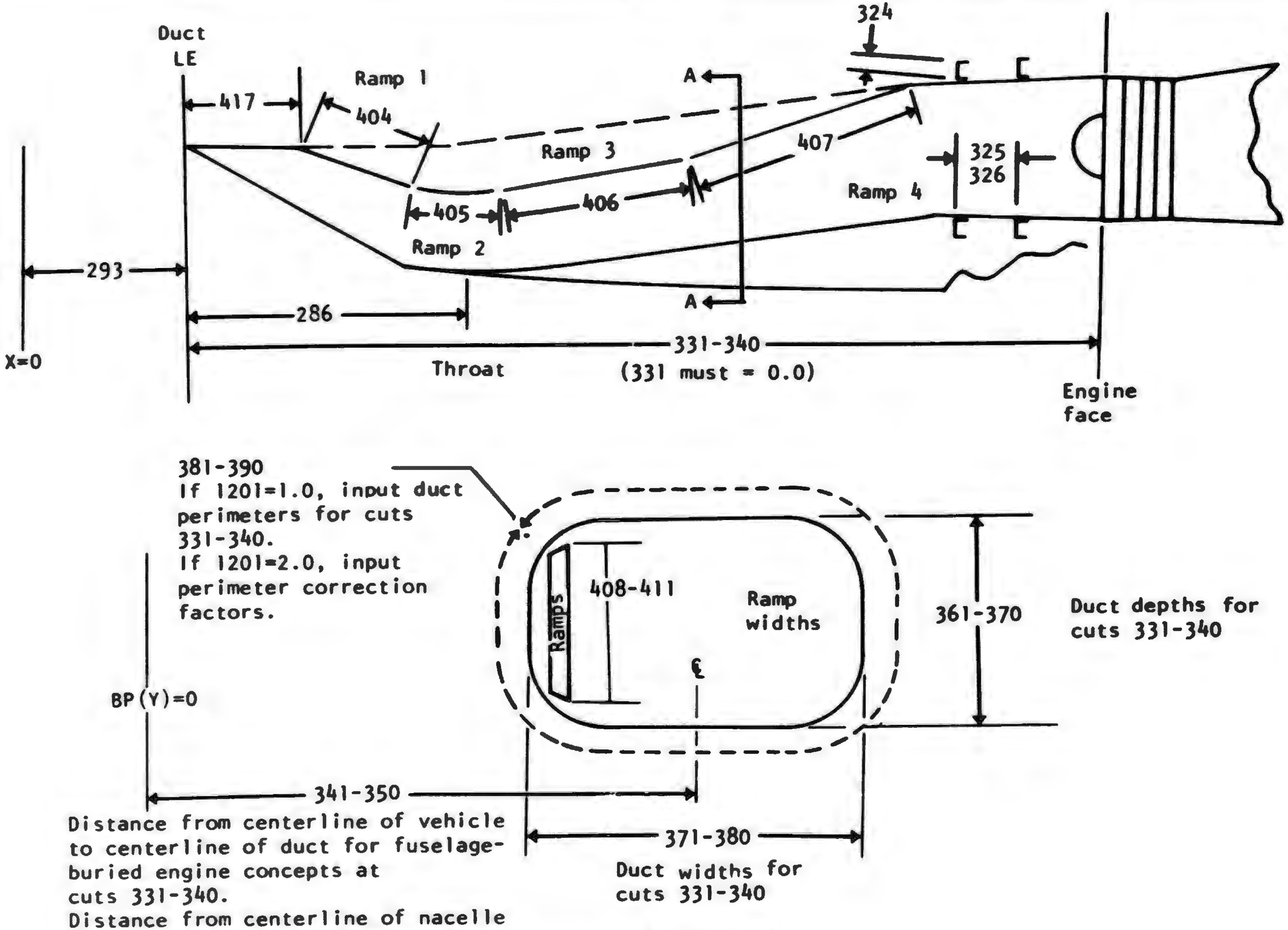


Figure 29. Duct and ramp geometry.

TABLE 11. AIR INDUCTION SYSTEM DATA LIST

```
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
•     CCNSTANT CATA AREA LOCATICNS 1-270.
•     CCNSTANTS IN THESE LCCATICNS ARE STCREC CN PERMANENT FILE.    •
•     INPUT MAY BE LSEC TC CVERRIDE THESE CCNSTANTS.                •
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
LOCATICNS                         DESCRIPTIONS
---------                         ------------

    1     CCNSTANT = 1.C
    2     CCNSTANT = 2.C
    3     CCNSTANT = 3.C
    4     CCNSTANT = 4.0
    5     CCNSTANT = 5.C
    6     CCNSTANT = 6.C
    7     CCNSTANT = 7.0
    8     CCNSTANT = 8.0
    9     CCNSTANT = 9.0
   10     CCNSTANT = 1C.0
   11     CCNSTANT = 11.0
   12     CCNSTANT = 12.0
   13     CCNSTANT = 20.0
   14     CCNSTANT = 1000.0
   15     CCNSTANT = 3.1415927 (PI)
   16     CCNSTANT = 0.C1745329 (PI/180)
   17     CCNSTANT = 144.0
   18     CCNSTANT = 24.0
   19     CCNSTANT = 0.5
   20     CCNSTANT = 1.5
   21     CCNSTANT = 0.33333333 (1/3)
   22     CCNSTANT = C.95
   23     CCNSTANT = 0.25
   24     CCNSTANT = 0.C
   25     CCNSTANT = 1.414213562  SCUARE RCOT OF TWO
   26     CCNSTANT = 32.174049    GRAVITATICNAL ACCELERATICN
   27     CCNSTANT = 180.0
   28     CCNSTANT = 1.732051     SCUARE RCCT OF THREE
   29     2.5          LANC TC COVER RATIC - MAXIMUM
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

30	CONSTANT = 1.333333		
31	CONSTANT = 0.5		
32-38	NOT USED.		
39	1.5	LIMIT TO ULTIMATE FACTOR - HAMMERSHOCK AT VH AND STATIC PRESSURE AT VL	
40	1.2	LIMIT TO ULTIMATE FACTOR - HAMMERSHOCK AT VL	
41	5.0	NUMBER OF FRAME CUTS PER QUADRANT - MAXIMUM = 15	
42	0.426	FLANGE CRIPPLING COEFFICIENT - ONE EDGE FREE	
43	4.0	FLANGE CRIPPLING COEFFICIENT - EDGES FIXED	
44	7.5	SHEAR CRIPPLING COEFFICIENT	
45	1.0	RIVET FACTOR - FRAME WEB	
46	0.9	REDUCTION FACTOR - FRAME FCY	
47	0.75	RIVET FACTOR - COVER	
48	0.005	ONE GAGE FOR FRAME STIFFENERS	IN
49	2.0	LAND WIDTH - FRAME ATTACHMENT	IN
50	2.0	LAND WIDTH - LONGERON ATTACHMENT	IN
51	0.050	MINIMUM GAGE - LAND FOR COVER	IN
52	0.032	MINIMUM GAGE - COVER	IN
53	0.145	MINIMUM AREA - LONGERON	SQ IN
54	0.050	MINIMUM GAGE - FRAME CAP	IN
55	0.032	MINIMUM GAGE - FRAME WEB	IN
56	1.0	MINIMUM WIDTH - FRAME CAP	IN
57	0.050	MINIMUM GAGE - MINOR FRAME CAP	IN
58	0.025	MINIMUM GAGE - MINOR FRAME WEB	IN
59	1.0	MINIMUM WIDTH - MINOR FRAME CAP	IN
60	0.9	REDUCTION FACTOR - LONGERON FCY	
61	0.875	MINIMUM WIDTH - STRINGER WEB	IN
62	0.3263434	RATIO - STRINGER WEB/STRINGER FLANGE	
63	0.050	MINIMUM GAGE - BULKHEAD	IN
64-80	NOT USED.		
	CONSTANTS - STANDARD DAY ATMOSPHERIC PARAMETERS LOCATIONS 81 THRU 108		
81	36.089239	ALTITUDE	1000-FT
82	2116.22	AMBIENT PRESSURE AT SEA LEVEL	PSF
83	0.0068755?	CURVE FIT CONSTANT	
84	5.25591	CURVE FIT CONSTANT	
85	65.61688	ALTITUDE	1000-FT

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

86	20.80556	CURVE FIT CONSTANT	PSF
87	472.68	AMBIENT PRESSURE AT 36K FT	PSF
88	104.98588	ALTITUDE	1000-FT
89	114.345	AMBIENT PRESSURE AT 66K FT	PSF
90	389.970	CURVE FIT CONSTANT	
91	-34.1634	CURVE FIT CONSTANT	
92	0.548641	CURVE FIT CONSTANT	
93	18.131	AMBIENT PRESSURE AT 105K FT	PSF
94	1.536195	CURVE FIT CONSTANT	
95	411.57	AMBIENT TEMP. AT 105K FT	DEGREES R
96	-12.2012	CURVE FIT CONSTANT	
97	154.19948	ALTITUDE	1000-FT
98	518.670	AMBIENT AT SEA LEVEL	DEGREES R
99	3.56616	CURVE FIT CONSTANT	
100	389.970	AMBIENT TEMP. BETWEEN 36K AND 66K FT	DEGREES R
101	0.00000304	CURVE FIT CONSTANT	
102	53.3	GAS CONSTANT	FT-LB/LB/DEG R
103	1.4	RATIO OF SPECIFIC HEATS	
104	0.075	CONSTANT PRESSURE RECOVERY CALC.	
105	1.35	CONSTANT PRESSURE RECOVERY CALC.	
106	0.3	CONSTANT FLOW AT ENGINE	MN
107	0.5	CONSTANT FLOW AT ENGINE	MN
108	460.0	CONVERSION DEGREES R TO DEGREES F	
	CONSTANTS - SPIKE WEIGHT EQUATIONS - LOC. 109 THRU 111		
109	12.53	SPIKE WT. EST. EQUATION FACTORS - FIX	
110	15.65	- TRANSLATING	
111	51.8	- EXPANDING	
	CONSTANTS - DUCT DESIGN PARAMETERS LOCATIONS 112 THRU 144		
112	0.8	CONSTANT-STATIC PRESSURE CALC.	
113	0.05	CONSTANT-STATIC PRESSURE CALC.	
114	400.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.	
115	1.019056	CONSTANT-HAMMERSHOCK PRESSURE CALC.	
116	0.0289156	CONSTANT-HAMMERSHOCK PRESSURE CALC.	
117	1.350112	CONSTANT-HAMMERSHOCK PRESSURE CALC.	
118	0.664319	CONSTANT-HAMMERSHOCK PRESSURE CALC.	
119	1.5	CONSTANT-HAMMERSHOCK PRESSURE CALC.	

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

120	0.00602627	CONSTANT-HAMMERSHOCK PRESSURE CALC.
121	0.080725	CONSTANT-HAMMERSHOCK PRESSURE CALC.
122	3.16503	CONSTANT-HAMMERSHOCK PRESSURE CALC.
123	1.588524	CONSTANT-HAMMERSHOCK PRESSURE CALC.
124	1100.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
125	2.5	CONSTANT-HAMMERSHOCK PRESSURE CALC.
126	0.770476	CONSTANT-HAMMERSHOCK PRESSURE CALC.
127	0.1482515	CONSTANT-HAMMERSHOCK PRESSURE CALC.
128	4.371758	CONSTANT-HAMMERSHOCK PRESSURE CALC.
129	2.114969	CONSTANT-HAMMERSHOCK PRESSURE CALC.
130	900.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
131	1.538116	CONSTANT-HAMMERSHOCK PRESSURE CALC.
132	0.3029697	CONSTANT-HAMMERSHOCK PRESSURE CALC.
133	0.4872335	CONSTANT-HAMMERSHOCK PRESSURE CALC.
134	0.4653126	CONSTANT-HAMMERSHOCK PRESSURE CALC.
135	700.0	CONSTANT-HAMMERSHOCK PRESSURE CALC.
136-140	NOT USED.	
141	1.6	CONSTANT-HAMMERSHOCK PRESSURE CALC.
142	0.984	CONSTANT-HAMMERSHOCK PRESSURE CALC.
143	0.0074	CONSTANT-HAMMERSHOCK PRESSURE CALC.
144	0.0263	CONSTANT-HAMMERSHOCK PRESSURE CALC.
145-160	NOT USED.	
	CONSTANTS - DUCT DEFLECTION CRITERIA - LOC. 161 THRU 166	
161	0.03	DEFLECTION FWD. OF THROAT IN/IN
162	0.06	DEFLECTION AFT. OF THROAT IN/IN
163	0.071853	THICKNESS EQUATION FOR DEFLECTION - CONSTANT
164	0.666667	- EXPONENT
165	2.666667	- EXPONENT
166	1.666667	- EXPONENT
	CONSTANTS - PRESSURE CENTER OF PANEL - LOC. 167 THRU 170	
167	1.3769	THICKNESS EQUATION AT MID-SPAN - CONSTANT
168	2.484	- EXPONENT
169	1.984	- EXPONENT
170	4.467	- EXPONENT
	CONSTANTS - PRESSURE EDGE OF PANEL - LOC. 171 THRU 174	
171	1.646	THICKNESS EQUATION AT EDGE OF PANEL - CONSTANT
172	0.894	- EXPONENT

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
173      0.394                                                   - EXPONENT
174      1.288                                                   - EXPONENT
175      2.5          MAXIMUM - LAND TO COVER RATIO
176      4.0          DUCT LIP UNIT WEIGHT                                   PSF
             CONSTANTS - FLUTTER PARAMETERS - LOC. 177 THRU 187
177      0.4851674   CALC. OF FLUTTER PARAMETER - CONSTANT
178      1.166456                                - CONSTANT
179      0.488412                                - CONSTANT
180      0.4037203                               - CONSTANT
181      1.4                                     - CONSTANT
182      0.6                                     - CONSTANT
183      0.4849271                               - CONSTANT
184      0.555184    CALC. OF COVER THICKNESS PARAMETER - CONSTANT
185      0.1686944                                         - CONSTANT
186      0.02169992                                        - CONSTANT
187      0.000963694                                       - CONSTANT
188      12.0         PYLON UNIT WEIGHT                                      PSF
189      141.3125       FITTING WEIGHT PARAMETER
190      78.20          FITTING WEIGHT PARAMETER
191      0.000025       FITTING WEIGHT PARAMETER
192      0.015        ENGINE MOUNTS                                        LB/LB
193      12.0         UNIT WEIGHT AUXILIARY INLET DOORS                      PSF
194      15.0         UNIT WEIGHT DUCT BYPASS DOORS                          PSF
195      2.93         UNIT WEIGHT ENGINE REMOVAL DOOR                        PSF
196      2.5          UNIT WEIGHT MISCELLANEOUS DOORS                        PSF
197      0.8          UNIT WEIGHT FIREWALLS AND SHROUDS                      PSF
198      5.0          ENGINE CLEARANCE                                    INCHES
199      0.026        UNIT WEIGHT EXTERIOR FINISH                            PSF
200      1.0          NACELLE LONGITUDINAL MEMBERS WEIGHT
201-270 NOT USED.
  ...........................................................................
  .     VARIABLE DATA REGION LOCATIONS 271-640.                             .
  ...........................................................................
         *******************************************************
           *** NOTE THOSE INPUT DATA LOCATIONS PRECEDED BY
           ASTERISKS (*) ARE INPUT INTO GENERAL DATA.  THESE
           ASTERISKS SIGNIFY THAT THESE SPECIFIC INPUTS ARE NOT
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
           REQUIRED WHEN THE GENERAL DATA ARRAY IS PART OF
           THE CASE DATA SET. ***
          ***************************************************
 271      INDEX FACTOR-DUCTS
 272                  -FRAMES
 273                  -COVERS
 274                  -LONGERONS
 275-280  NOT USED

*281      NUMBER OF NACELLES.
*282      BYPASS RATIO.
*283      INLET TYPE INDICATOR.
           ONE   (1.0)=FIXED DUCT.
           TWO   (2.0)=FIXED SPIKE.
           THREE (3.0)=HORIZONTAL RAMP.
           FOUR  (4.0)=VERTICAL RAMP.
           FIVE  (5.0)=TRANSLATABLE SPIKE.
           SIX   (6.0)=EXPANDABLE SPIKE.

*284      CAPTURE AREA/INLET                               SQUARE INCHES
*285      NUMBER OF INLETS.
*286      DISTANCE--LEADING EDGE OF DUCT TO THROAT (X REF.)       INCHES
*287      ENGINE-NUMBER.
*288            -THRUST/ENGINE (MAX SEA LEVEL STATIC).            POUNDS
*289            -WEIGHT/ENGINE.                                   POUNDS
*290            -LENGTH.                                          INCHES
*291            -MAXIMUM DIAMETER.                                INCHES
*292            -DISTANCE, FRONT FACE TO CENTER OF GRAVITY.       INCHES
*293      STATION (X) DUCT LEADING EDGE OF INBOARD ENGINE
           PACKAGE.                                               INCHES
*294      INBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                 BUTT LINE (Y)    INCHES
*295      INBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                WATER LINE (Z)    INCHES
*296      STATION (X) DUCT LEADING EDGE OF OUTBOARD ENGINE
           PACKAGE.                                               INCHES
*297      OUTBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
                                                  BUTT LINE (Y)      INCHES
*298     OUTBOARD NACELLE CENTER LINE AT ENGINE FRONT FACE -
                                                  WATER LINE (Z)     INCHES

 299     NOT USED
*300     PYLON-SWEEP OF LEADING EDGE.                                DEGREES
*301         -TYPE OF MOUNTING. ZERO (0.0)=VERTICAL.
                                ONE  (1.0)=HORIZONTAL.
*302         -CHORD OF INBOARD.                                      INCHES
*303         -SPAN OF INBOARD.                                       INCHES
*304         -CHORD OF OUTBOARD.                                     INCHES
*305         -SPAN OF OUTBOARD.                                      INCHES
*306         -THICKNESS/CHORD RATIO.                                 DECIMAL
*307     AREA-AUXILIARY INLET/NACELLE.                               SQUARE FEET
*308        -DUCT BY-PASS DOOR/NACELLE.                              SQUARE FEET
*309        -MISCELLANEOUS DOORS/NACELLE.                            SQUARE FEET

*310     ENGINE SHROUD INDICATOR.
                          ZERO (0.0)             =NO.
                          ONE  (1.0)             =YES.
                          GREATER THAN ONE (1.0)=AREA.               SQUARE FEET

 311     MATERIAL NUMBER FROM LIBRARY-DUCT.
 312                                  -RAMP.
 313                                  -NACELLE.
 314     NOT USED
 315     NOT AVAILABLE (USED INTERNALLY FOR PRINT CONTROL)
 316     YAW VELOCITY                                                RADIANS/SECOND
*317     NZ - VEHICLE LIMIT VERTICAL LOAD FACTOR.
 318-320 NOT USED
*321     NUMBER OF CUTS THRU DUCT **MAY ENTER 2 THRU 10**
          MUST AGREE WITH DATA INPUT IN LOCATIONS 381-390.
*322     PERIMETER CODE - MUST AGREE WITH DATA IN LOCATIONS 381-390
          ONE (1.0)=PERIMETER IS INPUT.
          TWO (2.0)=PERIMETER CORRECTION FACTOR IS INPUT - USE
          CURVES IN FIGURE 23 FOR INPUT IN LOCATIONS 381-390
 323     NOT USED
 324     FRAME DEPTH.                                                INCHES
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
 325      FRAME SPACING-MINIMUM.                                      INCHES
           THIS LOCATION IS USED TO INDICATE MINIMUM FRAME SPACING
           WHEN FRAME SPACING SEARCH IS DESIRED, OR FIXED FRAME
           SPACING WHEN NO SEARCH IS REQUIRED.  FOR FRAME SPACING
           SEARCH, ENTER SPECIFIED MINIMUM VALUE (INCHES).  FOR
           FIXED FRAME SPACING ENTER DESIRED FRAME SPACING ADDED TO
           1000.  EXAMPLE 1006.0 DESIGNATES A FIXED FRAME SPACING OF
           6 INCHES.
 326      FRAME SPACING-MAXIMUM. (INPUT ONLY WHEN FRAME SPACING
           SEARCH REQUIRED)                                           INCHES
 327      DUCT PANEL MILLING INDICATOR-ZERO (0.0)=NO.
                                      -ONE  (1.0)=YES.

 328-330 NOT USED
*331-340 DUCT CUTS REF. FROM DUCT LEADING EDGE STATION (X)            INCHES
           FIRST CUT AT LEADING EDGE (331 = 0.0)
           LAST CUT AT ENGINE FACE
           TOTAL NUMBER OF CUTS MUST AGREE WITH LOCATION 321

*341-350 DUCT CENTERLINE-
              DISTANCE FROM CENTERLINE OF VEHICLE TO                  INCHES
                  CENTERLINE OF DUCT FOR FUSELAGE BURRIED
                  ENGINE CONCEPT    (OR)
              DISTANCE FROM CENTERLINE OF NACELLE TO                  INCHES
                  CENTERLINE OF DUCT FOR NACELLE MOUNTED
                  ENGINES.
 351-360 NOT USED
*361-370 DUCT DEPTH AT DUCT CUTS                                      INCHES
*371-380 DUCT WIDTH AT DUCT CUTS                                      INCHES
*381-390 DUCT PERIMETER AT DUCT CUTS IF 322=1.0
         DUCT PERIMETER CORRECTION FACTOR IF 322=2.0
 391-400 NOT USED

*401      NUMBER OF RAMPS.
 402      CONSTRUCTION INDICATOR-ZERO (0.0) OR BLANK ( )=STANDARD.
                                -ONE  (1.0)             =HONEYCOMB.
 403      HAMMERSHOCK PRESSURE, ULTIMATE - PROGRAM GENERATED DATA
           SEE LOCATION 418                          POUNDS/SQUARE INCH
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
*404     LENGTH RAMP NUMBER ONE    (1)                            INCHES
*405                        TWO    (2)                            INCHES
*406                        THREE  (3)                            INCHES
*407                        FOUR   (4)                            INCHES
*408     WIDTH  RAMP NUMBER ONE    (1)                            INCHES
*409                        TWO    (2)                            INCHES
*410                        THREE  (3)                            INCHES
*411                        FOUR   (4)                            INCHES

         ** LOCATIONS 412-416 ARE GENERATED BY THE PROGRAM FOR
            MATERIAL DESIGNATED IN LOCATION 312 **
            THESE LOCATIONS MAY BE USED TO OVERRIDE THE PROGRAM
            CALCULATED DATA BY INPUT OF 1.0 IN LOCATION 418.
 412     STRESS-COMPRESION YIELD (F SUB CY)          POUNDS/SQUARE INCH
 413          -SHEAR ULTIMATE    (F SUB SU)          POUNDS/SQUARE INCH
 414     DENSITY OF MATERIAL (RHO)                    POUNDS/CUBIC INCH
 415     MATERIAL INDICATOR-ONE    (1.0)=ALUMINUM.
                           -TWO    (2.0)=TITANIUM.
                           -THREE  (3.0)=STEEL.
 416     FACTOR-LIMIT TO ULTIMATE.
*417     DISTANCE-LEADING EDGE OF DUCT TO FIRST RAMP HINGE.     INCHES
 418     INDICATOR-ONE (1.0)=INPUT IN LOCATIONS 403 AND 412-416.
 419              -ONE (1.0)=CALCULATE RAMPS ONLY.
          THIS LOCATION WOULD BE USED FOR A SITUATION WHERE ONLY
          RAMP SYNTHESIS DATA IS NEEDED.
 420     NOT USED

         ** LOCATIONS 421-513 TAKE ON VALUES STORED ON PERMANENT
         FILE IN LOCATIONS 641-733 AND SHOULD BE USED ONLY TO
         OVERRIDE THOSE NOTED VALUES.  DATA IN LOCATIONS 641-733 ARE
         TRANSFERRED TO LOCATIONS 421-513 PRIOR TO READING OF
         VARIABLE DATA.  HENCE, DEFINITIONS FOR LOCATIONS 641-733
         ARE IDENTICAL TO THOSE FOR LOCATIONS 421-513. **

 421     K(CL)-COUPLE CORRECTION FACTOR FOR
          LONGITUDINAL BENDING, RATIO OF AVAILABLE
          BEAM DEPTH TO TOTAL DEPTH.                       VALUE=0.90
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

422	REDUCTION FACTOR FOR FCY TO OBTAIN ALLOWABLE COMPRESSION STRESS.	VALUE=0.50
423	REDUCTION FACTOR FOR FSL TO OBTAIN ALLOWABLE SHEAR STRESS.	VALUE=0.50
424	K(W)-FRACTION OF RAMP WIDTH FOR TRANSVERSE BEAM REACTION POINTS.	VALUE=0.25
425	K(CT)-COUPLE CORRECTION FACTOR FOR TRANSVERSE BENDING, RATIO OF AVAILABLE BEAM DEPTH TO TOTAL DEPTH.	VALUE=0.90
426	DENSITY-CORE	4.40 LBS/SQ.FT
427	DENSITY-ADHESIVE(TWO SURFACES)	0.10 LBS/SQ.FT

FOR TWO (2) RAMP SYSTEM LOAD 428 THRU 444

-- 428-435 ARE WEIGHT AND MINIMUM GAGE INDEX -- COEFFICIENTS. THESE PARAMETERS HAVE BEEN INITIALIZED TO ONE (1.0).

428	INDEX-RAMP ONE (1) LONGITUDINAL.	VALUE=1.0
429	TRANSVERSE.	VALUE=1.0
430	MINIMUM GAGE.	VALUE=1.0
431	TWO (2) LONGITUDINAL.	VALUE=1.0
432	FORWARD HINGE BEAM.	VALUE=1.0
433	ACTUATOR BEAM	VALUE=1.0
434	AFT HINGE BEAM.	VALUE=1.0
435	MINIMUM GAGE.	VALUE=1.0
436	HAMMERSHOCK-PERCENT ON RAMP ONE (1). *TYPICAL VALUE	DECIMAL 0.50*LOADED.
437	TWO (2) *TYPICAL VALUE	DECIMAL 0.40*LOADED.
438	DISTANCE TO REACTION POINT FROM FRONT/LENGTH RAMP 2 *TYPICAL VALUE	0.20*LOADED.
439	DISTANCE TO REACTION POINT FROM BACK /LENGTH RAMP 2 *TYPICAL VALUE	0.80*LOADED.
440	DEPTH RAMP 1 / LENGTH RAMP 1 *TYPICAL VALUE	0.10*LOADED.
441	DEPTH RAMP 2 / LENGTH RAMP 2	

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
                                               *TYPICAL VALUE  0.07*LOADED.
442   TRANSVERSE BEAM DEPTH/WIDTH RAMP 1,2
                                               *TYPICAL VALUE  0.10*LOADED.
443   ACTUATOR BEAM DEPTH/WIDTH RAMP 2
                                               *TYPICAL VALUE  0.15*LOADED.
444   ANGLE BETWEEN PROJECTION OF RAMP 1 FACE AND RAMP 2.   DEGREES
                                               *TYPICAL VALUE 30.00*LOADED.

      **FOR THREE (3) RAMP SYSTEM LOAD 445 THRU 467**

      -- 445-455 ARE WEIGHT AND MINIMUM GAGE INDEX --
         COEFFICIENTS. THESE PARAMETERS HAVE BEEN
         INITIALIZED TO ONE (1.0).

445   INDEX-RAMP ONE   (1)-LONGITUDINAL.                    VALUE=1.0
446                       -TRANSVERSE.                      VALUE=1.0
447                       -MINIMUM GAGE.                    VALUE=1.0
448              TWO   (2)-LONGITUDINAL.                    VALUE=1.0
449                       -TRANSVERSE.                      VALUE=1.0
450                       -MINIMUM GAGE.                    VALUE=1.0
451              THREE (3)-LONGITUDINAL.                    VALUE=1.0
452                       -FORWARD HINGE BEAM.              VALUE=1.0
453                       -ACTUATOR BEAM.                   VALUE=1.0
454                       -AFT HINGE BEAM.                  VALUE=1.0
455                       -MINIMUM GAGE.                    VALUE=1.0
456   HAMMERSHOCK-PERCENT ON RAMP ONE    (1)                  DECIMAL
                                               *TYPICAL VALUE  0.20*LOADED.
457                                TWO   (2)                  DECIMAL
                                               *TYPICAL VALUE  0.50*LOADED.
458                                THREE (3)                  DECIMAL
                                               *TYPICAL VALUE  0.40*LOADED.
459   DISTANCE TO REACTION POINT FROM FRONT/LENGTH RAMP 1
                                               *TYPICAL VALUE  0.90*LOADED.
460   DISTANCE TO REACTION POINT FROM FRONT/LENGTH RAMP 3
                                               *TYPICAL VALUE  0.20*LOADED.
461   DISTANCE TO REACTION POINT FROM BACK /LENGTH RAMP 3
                                               *TYPICAL VALUE  0.80*LOADED.
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
462     DEPTH RAMP 1/LENGTH RAMP 1
                                            *TYPICAL VALUE  0.10*LOADED.
463     DEPTH RAMP 2/LENGTH RAMP 2
                                            *TYPICAL VALUE  0.10*LOADED.
464     DEPTH RAMP 3/LENGTH RAMP 3
                                            *TYPICAL VALUE  0.07*LOADED.
465     TRANSVERSE BEAM DEPTH/WIDTH RAMP 1,2,3
                                            *TYPICAL VALUE  0.10*LOADED.
466     ACTUATOR BEAM DEPTH/WIDTH RAMP 3
                                            *TYPICAL VALUE  0.15*LOADED.
467     ANGLE BETWEEN PROJECTION OF RAMP 2 FACE AND RAMP 3.  DEGREES
                                            *TYPICAL VALUE 30.00*LOADED.

        **FOR FOUR (4) RAMP SYSTEM LOAD 468 THRU 498**

        -- 468-482 ARE WEIGHT AND MINIMUM GAGE INDEX --
           COEFFICIENTS. THESE PARAMETERS HAVE BEEN
           INITIALIZED TO ONE (1.0).

468     INDEX-RAMP ONE   (1)-LONGITUDINAL.                VALUE=1.0
469                         -TRANSVERSE.                  VALUE=1.0
470                         -MINIMUM GAGE.                VALUE=1.0
471              TWO     (2)-LONGITUDINAL.                VALUE=1.0
472                         -TRANSVERSE.                  VALUE=1.0
473                         -MINIMUM GAGE.                VALUE=1.0
474              THREE   (3)-LONGITUDINAL.                VALUE=1.0
475                         -FORWARD HINGE BEAM.          VALUE=1.0
476                         -FORWARD ACTUATOR BEAM.       VALUE=1.0
477                         -AFT ACTUATOR BEAM.           VALUE=1.0
478                         -AFT HINGE BEAM.              VALUE=1.0
479                         -MINIMUM GAGE.                VALUE=1.0
480              FOUR    (4)-LONGITUDINAL.                VALUE=1.0
481                         -TRANSVERSE.                  VALUE=1.0
482                         -MINIMUM GAGE.                VALUE=1.0
483     HAMMERSHOCK-PERCENT ON RAMP ONE   (1).             DECIMAL
                                            *TYPICAL VALUE  0.60*LOADED.
484                                TWO    (2).             DECIMAL
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
                                             *TYPICAL VALUE  1.00*LOADED.
485                                    THREE (3).              DECIMAL
                                             *TYPICAL VALUE  1.00*LOADED.
486                                    FOUR  (4).              DECIMAL
                                             *TYPICAL VALUE  0.40*LOADED.
487   DISTANCE TO REACTION POINT FROM FRONT/LENGTH RAMP 3
                                             *TYPICAL VALUE  0.10*LOADED.
488   DISTANCE BETWEEN REACTION POINTS/LENGTH RAMP 3
                                             *TYPICAL VALUE  0.75*LOADED.
489   DISTANCE TO REACTION POINT FROM BACK /LENGTH RAMP 3
                                             *TYPICAL VALUE  0.15*LOADED.
490   DISTANCE TO REACTION POINT FROM FRONT/LENGTH RAMP 1
                                             *TYPICAL VALUE  0.90*LOADED.
491   DEPTH RAMP 1/LENGTH RAMP 1
                                             *TYPICAL VALUE  0.10*LOADED.
492   DEPTH RAMP 2/LENGTH RAMP 2
                                             *TYPICAL VALUE  0.10*LOADED.
493   DEPTH RAMP 3/LENGTH RAMP 3
                                             *TYPICAL VALUE  0.08*LOADED.
494   DEPTH RAMP 4/LENGTH RAMP 4
                                             *TYPICAL VALUE  0.10*LOADED.
495   TRANSVERSE BEAM DEPTH/WIDTH RAMPS 1,2,3,4,
                                             *TYPICAL VALUE  0.10*LOADED.
496   ACTUATOR BEAM DEPTH/WIDTH RAMP 3
                                             *TYPICAL VALUE  0.125LOADED.
497   ANGLE-PROJECTION RAMP 2 FACE AND RAMP 3.                 DEGREES
                                             *TYPICAL VALUE 20.00*LOADED.
498        -PROJECTION RAMP 3 FACE AND RAMP 4.                 DEGREES
                                             *TYPICAL VALUE 10.00*LOADED.

      **MINIMUM GAGE INPUT AREA**

499   ALUMINUM-CAP THICKNESS.                                  INCHES
                                             *TYPICAL VALUE  0.04*LOADED.
500           -WEB THICKNESS.                                  INCHES
                                             *TYPICAL VALUE  0.02*LOADED.
501           -FACE SHEET THICKNESS (HONEYCOMB).               INCHES
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
                                                    *TYPICAL VALUE  0.015LOADED.
 502            -FRONT PANEL SKIN THICKNESS.                           INCHES
                                                    *TYPICAL VALUE  0.04*LOADED.
 503            -REAR  PANEL SKIN THICKNESS.                           INCHES
                                                    *TYPICAL VALUE  0.01*LOADED.
 504      TITANIUM-CAP THICKNESS.                                      INCHES
                                                    *TYPICAL VALUE  0.025LOADED.
 505            -WEB THICKNESS.                                        INCHES
                                                    *TYPICAL VALUE  0.013LOADED.
 506            -FACE SHEET THICKNESS (HONEYCOMB).                     INCHES
                                                    *TYPICAL VALUE  0.01*LOADED.
 507            -FRONT PANEL SKIN THICKNESS.                           INCHES
                                                    *TYPICAL VALUE  0.025LOADED.
 508            -REAR  PANEL SKIN THICKNESS.                           INCHES
                                                    *TYPICAL VALUE  0.01*LOADED.
 509      STEEL -CAP THICKNESS.                                        INCHES
                                                    *TYPICAL VALUE  0.02*LOADED.
 510            -WEB THICKNESS.                                        INCHES
                                                    *TYPICAL VALUE  0.01*LOADED.
 511            -FACE SHEET THICKNESS (HONEYCOMB).                     INCHES
                                                    *TYPICAL VALUE  0.01*LOADED.
 512            -FRONT PANEL SKIN THICKNESS.                           INCHES
                                                    *TYPICAL VALUE  0.02*LOADED.
 513            -REAR  PANEL SKIN THICKNESS.                           INCHES
                                                    *TYPICAL VALUE  0.01*LOADED.
 514-520 NOT USED

         **GENERAL INPUTS**

         ** LOCATIONS 521-590 ARE NOT NEEDED IF LOCATION 281 IS 0.0 *
*521     NUMBER OF CUTS THRU NACELLE. **MAY ENTER 2 THRU 10**
          MUST AGREE WITH DATA INPUT IN LOCATIONS 531-540.
*522     PERIMETER CODE - MUST AGREE WITH DATA IN LOCATIONS 581-590.
          ONE (1.0)=PERIMETER IS INPUT.
          TWO (2.0)=PERIMETER CORRECTION FACTOR IS INPUT - USE
          CURVES IN FIGURE 23 FOR INPUT IN LOCATIONS 581-590
 523     CONSTRUCTION INDICATOR-ZERO (0.0)=DIRECT TIE FOR ENGINE.
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONT)

```
                                   -ONE   (1.0)=ENGINE TO NACELLE TO
                                                SUPPORT.
 524-525 NOT USED
 526      FRAME SPACING.                                              INCHES
 527      FRAME DEPTH.                                                INCHES
 528      ENGINE DOOR(S)-WIDTH.                                       INCHES
*529      NACELLE-MAXIMUM DEPTH.                                      INCHES
*530             -MAXIMUM WIDTH.                                      INCHES
*531-540 NACELLE CUTS REF. FROM DUCT LEADING EDGE STATION (X)         INCHES
          FIRST CUT AT LEADING EDGE (531 = 0.0)
          LAST CUT AT LAST FULL SECTION OF NACELLE
          TOTAL NUMBER OF CUTS MUST AGREE WITH LOCATION 521.
 541-560 NOT USED
*561-570 NACELLE DEPTH AT NACELLE CUTS                                INCHES
*571-580 NACELLE WIDTH AT NACELLE CUTS                                INCHES
*581-590 NACELLE PERIMETER AT NACELLE CUTS IF 522=1.0                 INCHES
         NACELLE PERIMETER CORRECTION FACTOR IF 522=2.0

     LOCATIONS 591-595 ARE USED BY THE PROGRAM TO STORE THE CRITICAL
     LOCAL PANEL FLUTTER DATA DUE TO SUPERSONIC FLIGHT.  NO INPUT IS
     REQUIRED IN THESE DATA LOCATIONS.
 591      MACH NUMBER.
 592      ALTITUDE.                                                     FEET
 593      Q (DYNAMIC PRESSURE).                          POUNDS/SQUARE FEET
 594      PROGRAM CALCULATED VALUE. (BETA)
 595      MODULUS OF ELASTICITY (E). **CRITICAL FLUTTER**
 596-600 NOT USED
          ---- LOCATIONS 601-630 MUST BE COMPATIBLE DATA SETS ----
   LOCATIONS 601-605 FORM THE SPEED ALTITUDE PROFILE & MUST BE INPUT.
          FIVE (5) POINTS ARE REQUIRED, IF LESS THAN 5 ARE DESIRED
          THE LAST VALUES SHOULD BE REPEATED TO FILL THE TABLES.

*601-605 SPEED PROFILE POINTS - SPEED M(H)                    MACH NUMBER
*606-610                      - ALTITUDE                             FEET

     LOCATIONS 611 THRU 632 ARE OPTIONAL.
*611-615 INCREMENT FOR ESTABLISHING M(L) AT MACH NO'S IN LOC 601-605
```

TABLE 11. AIR INDUCTION SYSTEM DATA LIST (CONCL)

```
          BLANK ( ) OR ZERO (0.0)= USE VALUE IN 631.
          LESS THAN ONE     (<1.0)= DECIMAL TO ADD TO M(H)
          GREATER THAN ONE (>1.0)= MULTIPLIER FOR M(H)
          MINUS VALUE  (-0.XX)    = FRACTION OF M(H) TO ADD TO M(H)

*616-620 INLET PRESSURE RECOVERY RATIO -
          (PRESSURE AT ENGINE FACE/AMBIENT PRESSURE)
                                     - AT MACH NO'S. M(H) IN 601-605
*621-625                             - AT MACH NO'S. M(L) IN 611-615

*626-630 M(2), MACH NUMBERS OF AIRFLOW AT ENGINE FACE
          THAT CORRESPOND  TO AIR VEHICLE MACH NO'S. IN 601-605.
          IF ZERO IS INPUT IN THESE LOCATIONS, PROGRAM ESTIMATES
          VALUE.
*631     GENERAL INCREMENT FOR ESTABLISHING M(L)
          USED IF LOCATIONS 611 THRU 615 CONTAIN ZERO (0.0)
          ZERO (0.C) OR BLANK ( ) = M(L) = M(H)
*632     GENERAL PRESSURE RECOVERY RATIO.
          USED IF LOCATIONS 616 THRU 625 CONTAIN ZERO (0.0)
          IF THIS LOCATION IS ALSO ZERO OR BLANK PROGRAM ESTIMATES
          VALUE.
 633-640 NOT USED

 641-733 NOT AVAILABLE.  USED TO STORE PERMANENT FILE DATA.  SEE
         DISCUSSION OF LOCATIONS 421-513 FOR PERMANENT DATA VALUES.

         *** END ***
```

Section VI

WING, HORIZONTAL TAIL, AND VERTICAL TAIL DATA

INTRODUCTION

The wing and empennage module of SWEEP develops structure weight and mass distribution estimates for wing, horizontal tail, and vertical tail surfaces. The procedure used is designed to analytically evaluate the effects important to design parameters such as air vehicle design criteria, surface geometry and structural arrangements, materials and constructions, etc. This is accomplished through a close approximation design and analysis procedure programmed to describe detail surface geometry properties and structural design requirements. These are used to synthesize structural geometries and material requirements so that analysis for weights and mass distributions can be made.

Separate input data decks are necessary for each surface analyzed. The elements of each deck are identical and are explained in detail in this section. The discussion describes wing structure estimation procedures which are also applicable to empennage analysis. Special input data deck WHV LOADS can also be used to input design airloads data to the module. Use of this deck is explained in Section VIII of this volume.

GENERAL DESCRIPTION

The module consists of routines in level (8,0), (9,0), (10,0), (14,0), (15,0), (16,0), (17,0), and (18,0) overlays of SWEEP. It is executed once for each surface analyzed during a problem case. Design data are processed into component data arrays for the module in accordance with design requirements for surface type and analysis control information on case control card 2. Logic is programmed to permit module execution for each component analysis in stand-alone mode or integrated with other SWEEP analysis modules.

In the stand-alone mode, all design data are input through the input data decks for the surfaces. The module is executed in conjunction with the input data processing module in SWEEP, overlay (1,0), and the output module, overlay (13,0).

In the integrated mode of operation, analysis data are computed by SWEEP design data development modules. The data are transmitted to the wing and empennage module through mass storage file records to be processed and used in accordance to control and analysis information in the input data decks for the component.

The wing and empennage module consists of major subroutine groupings designed to perform computational functions related to:

1. Module input data processing of problems design information from component input data decks, SWEEP data bank, and mass storage file records containing criteria and design information developed by other SWEEP modules.

2. Surface geometry calculation to define and locate all structural components of the surface.

3. Surface design requirements calculations to define parameters such as design airloads, required flutter stiffness, material properties, and deadweight inertia loads.

4. Structural synthesis of surface torque-box structures and, if required, pivot structures in variable-sweep wing designs.

5. Detail weight estimates for each element of the torque-box and statistically derived weight estimates for the other major structural components of the surface. Mass characteristics are determined for all structures so that estimates can be made for weight distributions, centroids, and inertias.

6. Module processing of analysis results for the OUTPUT module of SWEEP and for output printing of pertinent data.

All problem data for analysis control and/or input of variables to each of these parts can be made through the input data deck. Module logic is programmed so that variables input through the input data deck supersedes design data stored on mass storage files. Each component input data array is initialized from data blocks of the SWEEP data bank. Except for differences in weight correlation factors, the initial values for each surface are identical. Material properties for metallic structure analysis are obtained from the material library of the data bank. Airfoil and flutter analysis constants for T-tail vertical tails are also obtained, as required, from data sets in the data bank.

Lifting surface designs with unique configuration and physical arrangements which can be analyzed include:

- Variable-sweep wings for which pivot structures and effect of sweep position are evaluated in the loads and flutter requirement analysis.

- Vertical tails in a T-Tail arrangement for which horizontal tail effects on vertical tail design loads and flutter requirements are evaluated.

- Nonlinear surface planforms due to leading edge blending and cranked trailing edges.

- Nonlinear torque-box cross sections due to nonlinear true aerodynamic chords and/or variable-thickness ratios (t/c) along the exposed span.

- Leading and trailing edge control surface arrangements.

These design features are described by input of specific sets of data. Module analysis is controlled by input control data associated with the data set. Internal logic assumes no evaluation to be made for these features in the absence of the control data and associated data sets.

The primary option for torque-box structure evaluation is the analysis of designs with either metallic or advanced composite materials. The default analysis is metallic design which is made by execution of overlays (9,0) and (10,0) in conjunction with overlays (8,0), (14,0), (15,0), (16,0), and (17,0). These overlays can be operated under SWEEP core requirements of 50,000-octal cell locations on the CDC 6600 computer. Advanced composite torque-box designs are analyzed by execution of overlay (18,0) instead of (9,0) and (10,0). This overlay, plus the other module overlays previously listed, must be operated under core requirements of 100,000-octal cells. Execution of the metallic or advanced composite overlays is dictated by control information in columns 39 through 44 of case control card 2, and assumes that compatible design information is provided in the appropriate locations of the input data deck. The advanced composite analysis is based on evaluation of lamina requirements for a balanced, symmetric laminate system, consisting of required plies with fibers oriented 0°, ±45°, and 90° to the direction of applied axial loads.

The structural synthesis/weight analysis for both metallic and advanced composite designs are programmed using similar optimization and evaluation procedures. Synthesis and search options are provided so that torque-box designs can be optimized or evaluated to specified structural arrangements and constraints.

A special option of the wing and empennage module permits the output of design and mass distribution data on punch cards for use as input data to the Flutter Optimization Program and the Flexible Loads Analysis Program. These programs are independent stand-alone programs also developed under this contract and are described in Volumes X and XI, respectively. Descriptions of input and output data for this option can be found in the discussions under "Analysis Options," of this Section.

The program is structured to evaluate weights for up to three assumed gross weights during one case in the stand-alone mode. In the integrated mode of operation, only the second gross weight loop is executed. The three-gross weight loop allows the user to determine weight trends for pre-determined vehicle weight values. Airloads are scaled by the ratios of design gross weights. Logic is programmed also to develop torque-box weight trends in a single case by using the data set in locations 1301 through 1322 to input three sets of design parameter values to be used in the respective gross weight loops. The parameters which are specified include:

1. Minimum and maximum rib spacings

2. Minimum and maximum stringer heights

3. Minimum and maximum stringer spacings

4. Number of stringers

Three constant gross weight values should be specified for this situation so that the gross design airloads will be the same. Although the parameter data set is set up for multirib designs, multispar construction can be evaluated by inputting appropriate data with the data set.

Leading and trailing edge structures, tips, and external store provision weights are assumed to be constant for all three gross weights. Input data in locations 80 through 101 are used to describe the three gross weights. The data set in locations 159 through 174 are used to input fuel and external store loading requirements for the gross weights.

Design results for gross weight No. 2 are used to develop the design and mass properties output data sets for the Flutter Optimization Program and the Flexible Loads Analysis Program.

The weight summary data output from the module include estimated data for all three gross weights, if analyzed. Weights for the major surface components are tabulated, along with details for the torque-box structural elements and the components in the leading and trailing edges.

Module output is printed under control of information found in columns 3 through 38 of case control card 1. Three general types of analysis results are printed as output data; samples of each can be found in Appendix A of this volume. The first type includes analysis summaries printed at the conclusion of each analysis. The second type includes analysis details and array dumps used to supplement the summary outputs. The third type of module output is intermediate dumps of selected data during the structural synthesis search for the torque-box, printed under control of case control card 1 and data locations 574 through 578 of the input data array. All module data are printed under control of one control card in each case setup; therefore, output from module execution for each surface analyzed will be identical.

The major output summaries for design data computed during the various analysis phases of the module are listed below. Associated print control locations on case control card 1, necessary to order these printed outputs, are also included.

- Detail torque-box weight and coefficient summaries, column 37.
- Planform and cross-section geometry data, column 6.
- Leading and trailing edge structure weight and distribution summaries, column 12.
- Fuel distribution summary, column 18.
- Flutter analysis summary, column 22.
- Material properties, metallic and advanced composites, column 19.
- Airloads summaries, columns 19 and 20.
- Initial 1 g inertia loads estimates, column 21.
- Design loads and deadweight adjustment summaries, columns 24 and 25.
- Design synthesis and weight distribution summaries, column 28.
- Total surface calculated inertia summary, column 36.
- Surface structure component and contents calculated mass distribution data arrays, column 38.

ANALYSIS DESCRIPTION

The wing and empennage module analysis treats lifting surfaces as long, slender cantilever beams resisting shears and moments through a system of covers and supporting structures. The wing planform is described by a system of lines developed by the program from required input data. These lines describe the positions of the leading edge, trailing edge, torque box limits, load reference axis, and synthesis cuts. Pertinent geometric coordinates can be specified, as required, to describe the torque-box shape, fuel cell locations, location and geometry of control surface devices, location of internal concentrated and distributed masses, and locations of externally mounted stores or nacelles. Idealized planform and box sections for fixed and variable-sweep wings are shown in Figures 30 and 31. The blended wing planform, shown in Figure 32, is defined with more rigorous input specifications.

The analysis consists of synthesizing and evaluation of structural requirements at 11 analysis control stations on the exposed panel. The first station defines the inboard end of the surface torque-box and the outboard end of the center-section panel, while the eleventh station defines the outboard end of the torque-box and the location of the surface tip structure. Locations of the control stations can be specified by the user; if not specified, the program assumes 11 equally spaced stations. The 10 structural panels bounded by the analysis control stations plus the tip structure make up the surface outer panel. Each panel consists of torque-box structure fixed leading and trailing edge structures, individual control surface structures if applicable, structural fittings for externally mounted stores as required, and secondary structures. The complete surface consists of the outer panel, center section, and pivot structures, if applicable.

A combination of analytical and empirical methods is used to estimate the torque-box weight. A three-dimensional approximation of the main box structure is modeled from planform geometry and airfoil parameters so that cover and support structure weights can be synthezised to satisfy the imposed constraints of vehicle criteria and design. The synthesis technique considers design criteria and loadings, physical geometry, material properties, types of construction, fabrication, and design constraints in the development of structural sections.

Leading edge, tailing edge, tip, and secondary structural component weights are computed from program-derived geometric data, statistical data, and vehicle environment data. Provisions are made in the weight evaluation routines for leading and trailing edge structures to process up to three leading edge devices and six trailing edge devices. Input data sets are provided for each device so that internal calculations can be made to define types, sizes, locations, and weight distribution surfaces for mass properties evaluation. Leading edge structures are assumed to include all components forward of the torque-box front spar, consisting of fixed structures and control surface devices - slats, kruger flaps, or droop leading edge. Type code numbers are used to specify the device to be used with each of the three input data sets. Trailing edge structure are assumed to include all structures aft of the rear spar. Two spoiler and four flap-type devices can be specified through input data sets. The fourth flap-type set is processed as a special data set used to specify ailerons, elevators, or rudder surfaces, as well as flaps. Four flap configurations may be specified. These are

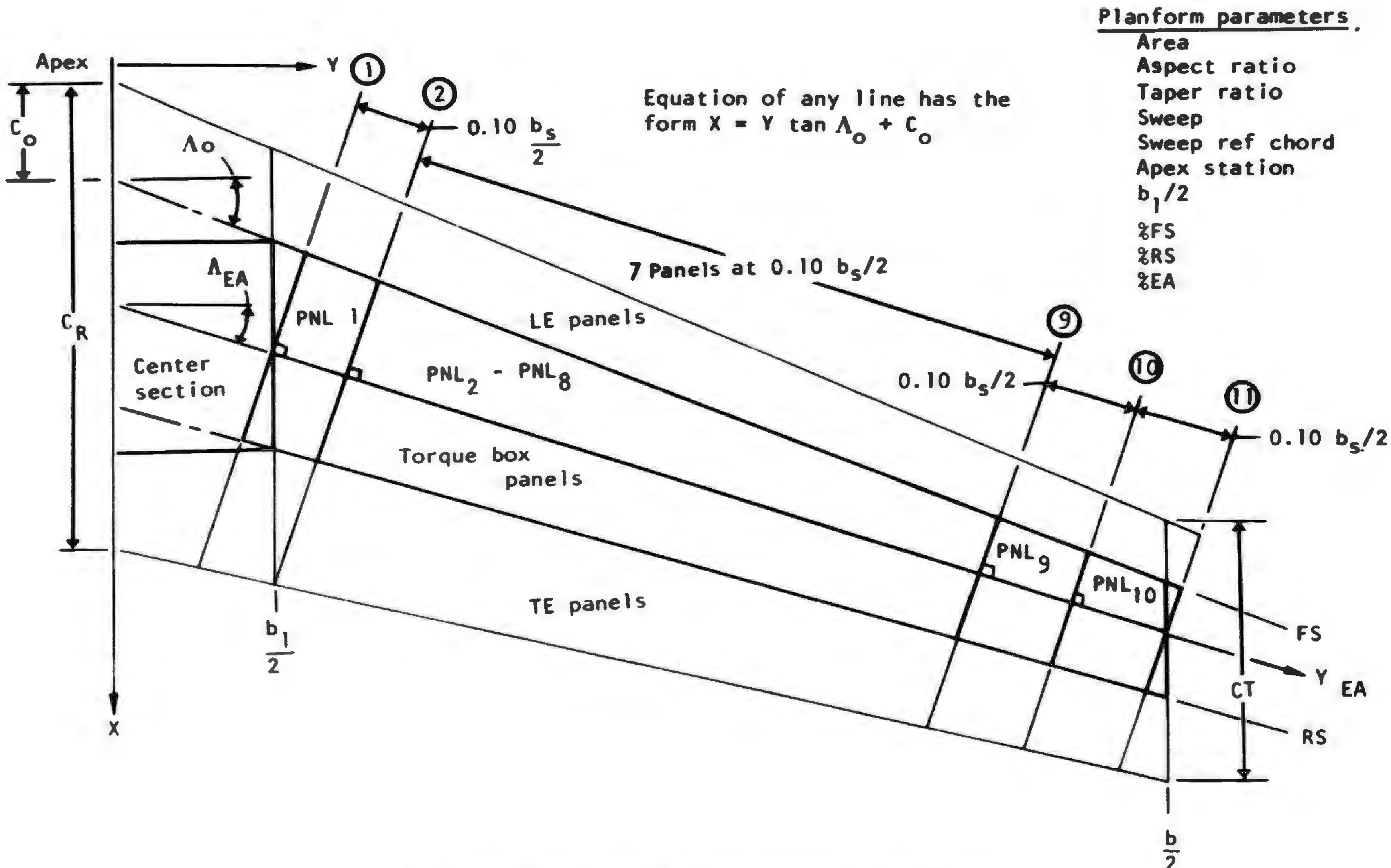
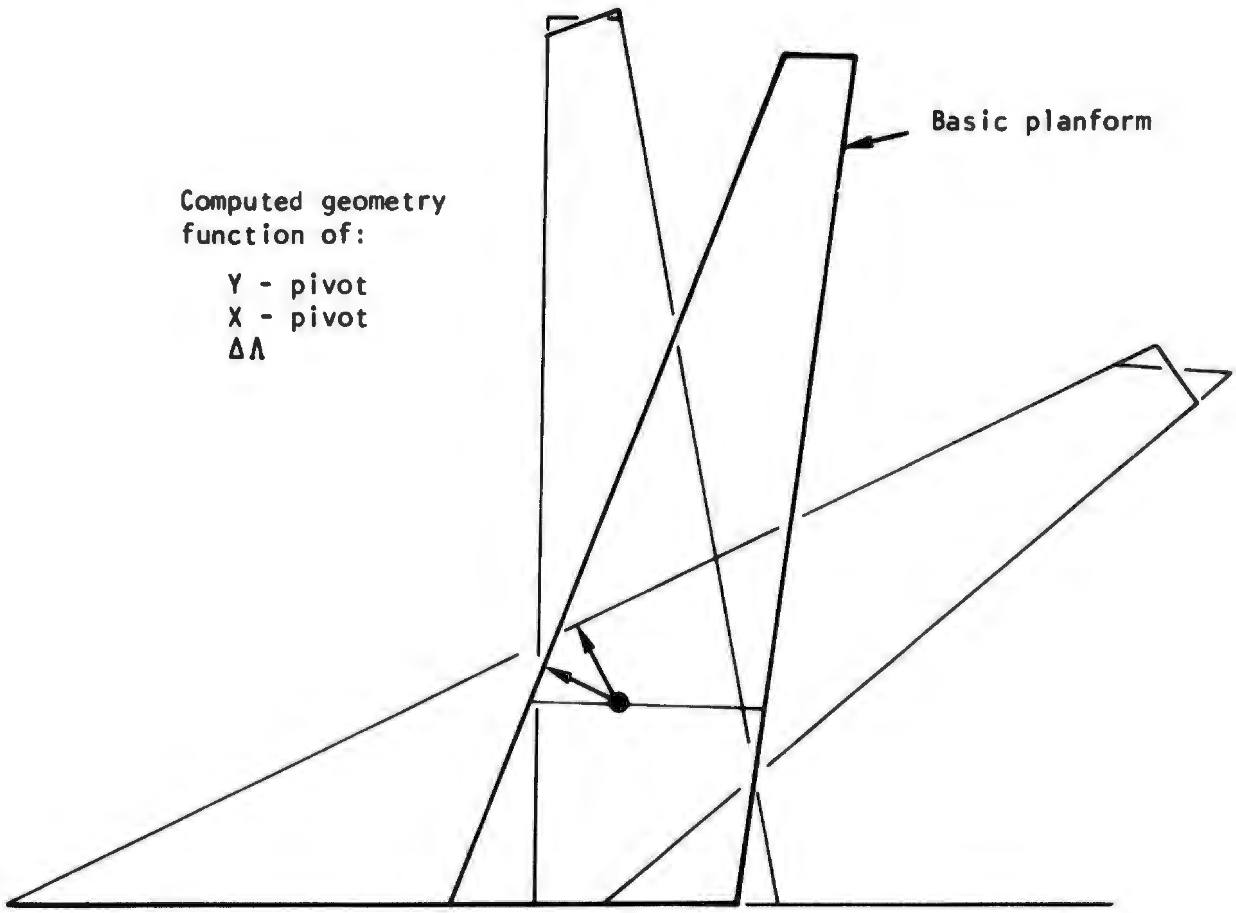
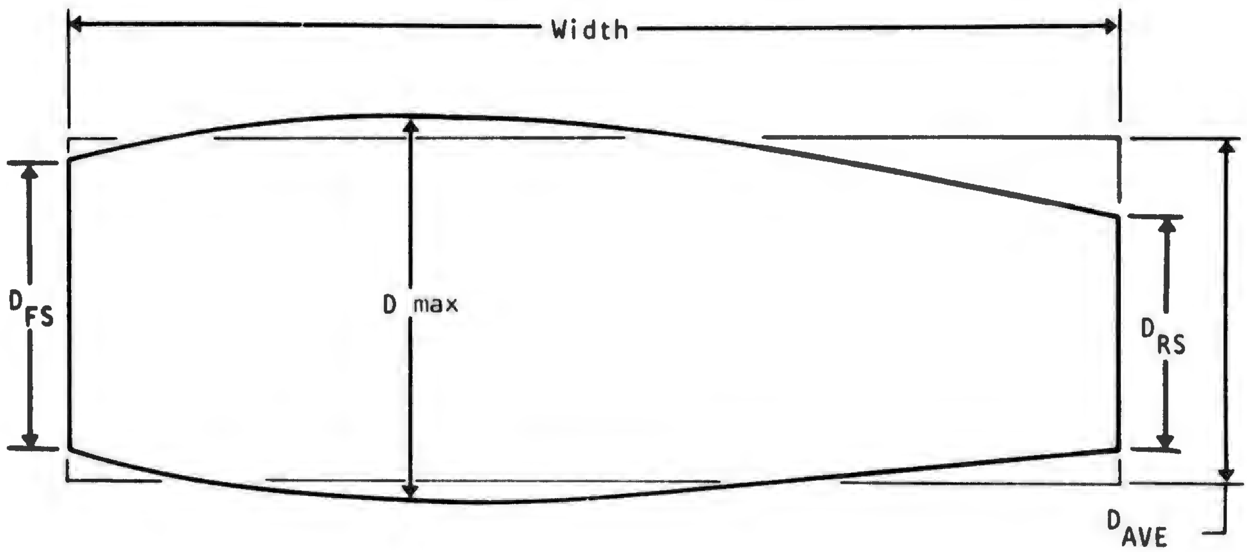


Figure 30. Idealized lifting surface planform.



Variable sweep wing geometry idealization



$$D_{AVE} = \frac{\text{X-section area}}{\text{width}}$$

$$\Sigma ds = 2 \cdot \text{width} + D_{FS} + D_{RS}$$

Figure 31. Idealized box section.

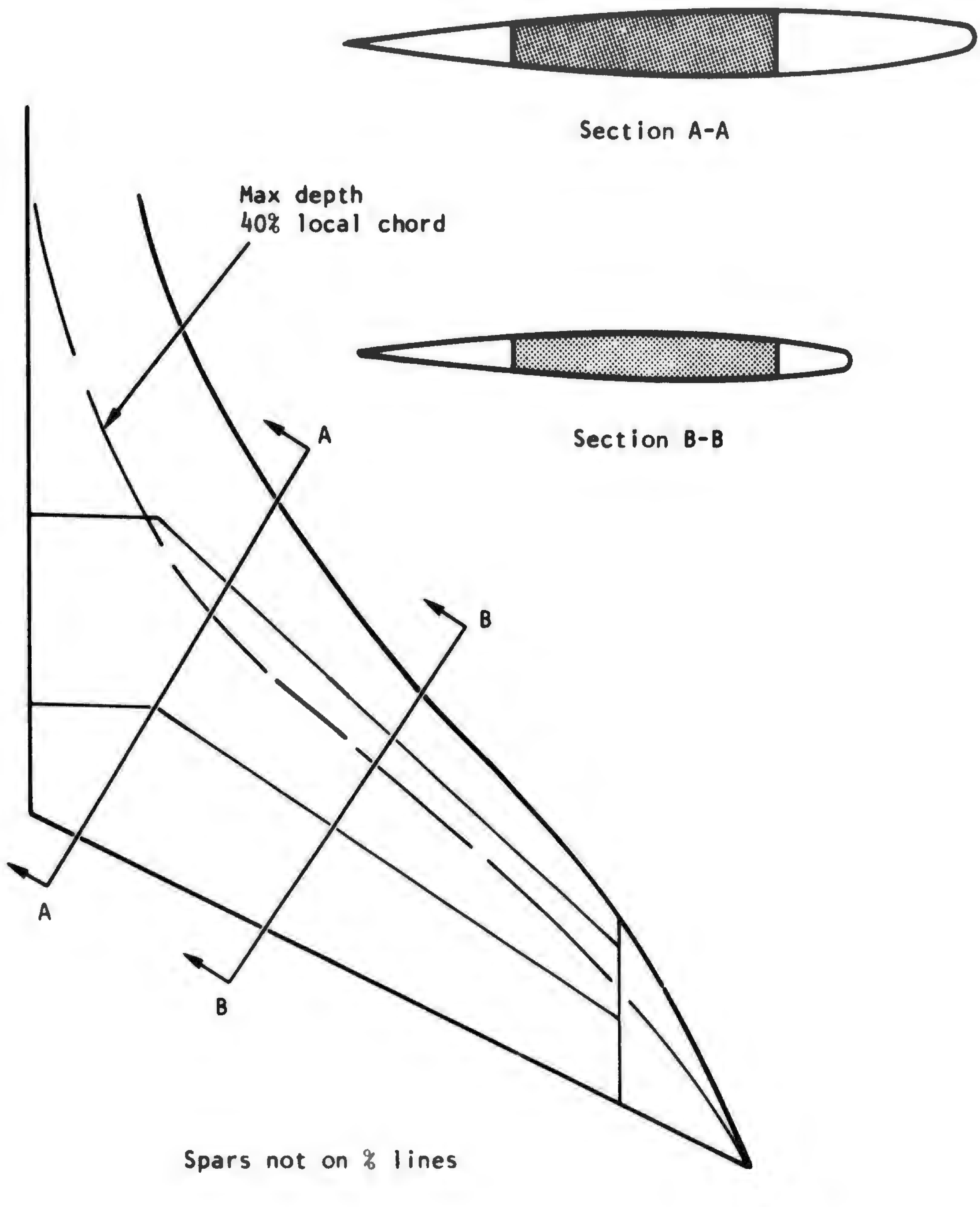


Figure 32. Blended wing planform.

plain, single-slotted, double-slotted and triple-slotted flaps. Each flap-type device may be positioned anywhere along the span, with the panel leading edge anywhere aft of the rear spar. Spoilers may be placed forward of flap structures.

The leading and trailing edge mass properties estimation procedure initially describes an all-fixed structure distribution surface. As control surface devices are identified and positioned, weight distribution surfaces for the devices are estimated and adjustments made to the fixed structure surface by appropriate deletions or reductions of ordinate values in the region where the devices are positioned. Weight distribution surfaces are identified for each component and processed individually.

The tip is assumed to include all structures between the eleventh torque-box structural control station and the theoretical tip station. The 0- and 100-percent chord element lines define the fore and aft boundaries. Secondary structure weights are estimated as a fraction of the total outer panel weight. The weight fraction value may be changed by the user. Weights for structural attachment provisions are estimated for each of the seven concentrated mass items that may be located on the surface. The estimates are based on type of attach, weight of the mass item, and maximum vehicle maneuver load factor, N_z.

Inertia loads are determined at each control station by summation of 1 g shears and moments for structural components, contents, and concentrated mass items. Numerical integration methods are used for estimation of shears and moments from mass distribution surfaces defined for the 10 structural strips plus the tip. Each strip consists of leading edge, torque-box, and trailing edge panels which are divided into rectangular grids by equally spaced chordwise and spanwise lines. Grid geometry and mass distribution surface definitions permit evaluation of mass characteristics of each item within the panel. These are numerically integrated to control stations defined on the structural reference axis to produce estimates for strip mass inertia, weights, and moments. Structure components, contents, and concentrated mass items are evaluated separately so that the results can be processed into inertia loads and mass inertia data compatible with vehicle loadings at flight design points. Grid size for each of the strip panels can be controlled by the user with the control data set in locations 1143 through 1154 of the input data array.

Design airloads, shears and moments in the structural reference system, must be specified at each of the 11 structural analysis stations. The metallic analysis is limited to evaluation of two loading conditions defining critical up-bending and down-bending loads. The advanced composite analysis can evaluate up to 20 different loading conditions. Design loads can be input at each station, either through the component input data deck or by use of special input deck WHV LOADS. Loads inputted through the component input data deck will always be used, even if loads data on mass storage records are available through execution of the airloads module or input through the WHV LOADS deck.

Net design loads at each section are calculated by combining the inertia effects of the torque box, leading and trailing edge fixed structures, leading and trailing edge devices, fuel and fuel system, internally distributed mass items, and externally mounted mass items with the gross airloads values.

Control data in the input data deck locations 159 through 174 are used to specify wing fuel cell levels and external store status at the assumed design conditions. These specifications allow for computations of total inertia loading effects compatible with the gross airloads. The net loads are resolved into average cover loadings, N_x and spar shear flow, q, for evaluation of structural material requirements.

In the determination of design loads, initial estimates are made for the unknown torque-box structure weights and distributions. The total weight value may be input or computed by the program as a fraction of the basic flight design weight. The distributed weights are replaced with computed values after each synthesis/weight analysis pass. Iteration logic is used to reduce discrepancies between assumed and calculated values. In the programmed procedures, adjustments are made for the next weight and distribution sets, to account for changes in cover load intensities due to effects of changes in both design loads and section couple arms. Up to four iteration passes can be specified, using location 369 of the input data array.

Structural stiffness requirements to prevent surface flutter are evaluated by a special analysis routine. A semiemperical method is used to estimate initial values of required torsional stiffness, GJ, at each station. Procedures are programmed for analysis of fixed surfaces, variable-sweep surfaces, and for T-Tail verticals. The techniques used were developed for use in lieu of detailed flutter analysis. Analysis logic allows for bypassing the evaluation routines with user inputs of required stiffness requirement data in locations 346 through 356 of the input data array. The value in location 251, flutter analysis control word, must be specified as 2.0 with these inputs.

Available section stiffness reflected in the synthesized torque-box structure is computed and compared with required values. Thicknesses for the four torque-box webs – upper skin, lower skin, front spar, and rear spar – are increased as required at sections with inadequate stiffness levels. The adjustment procedure is designed to process the webs in the ascending order of their strength gage thicknesses, making adjustments to applicable elements only to meet the given stiffness levels. The thickness increase and identification data for affected webs are saved for later processing by weight analysis and output print routines.

For metallic structures, section stiffnesses are evaluated in terms of section J, assuming that material modules of rigidity, G, is constant. In the section stiffness calculations for advanced composite structures, the evaluation accounts for the different values of G contributed by each web. The value of G for each web laminate is based on the number, stiffness characteristics, and orientations of the constituent plies.

Metallic torque-box structures can be synthesized for either stiffened skin multirib or plate multispar designs. The stiffened skin multirib design options for riveted Z, integral Z, integral I, and riveted angle are shown in Figure 33. Plate and honeycomb cover multispar design options are shown in Figure 34. Advanced composite designs can be evaluated for stiffened skin multirib, plate multispar, and full-depth honeycomb sandwich constructions. Cover stiffener configurations for multirib constructions include integral I, Z, Γ, and hat concepts. Multispar options include single-plate or honeycomb panel covers.

Cover synthesis for stiffened skin multirib construction is based on determining practical cover geometrics that satisfy (1) stress conditions for strength, local stability, or general stability and (2) constraints of specified minimum gages and stringer geometries. The effective cover material resulting at any specified operating stress level during the analysis is distributed into skin and stringer material. Stringer material is further distributed to satisfy stability and minimum gage conditions, resulting in stringer geometries of height, flange widths, and gage. An added constraint in metallic designs is the minimum ratio of stringer thickness to skin thickness, used to account for adverse stringer-skin interface coupling effects.

The synthesis of metallic multirib structures requires three levels of search. In the first level (Figure 35), stringer spacing is the primary search parameter. The second level (Figure 36) involves determination of optimum operating stress levels for the assumed stringer spacing. The third optimization level is designed to determine optimum distributions for available cover material based on assumed stress level and stringer spacing, values assigned by the second and first search levels. The search is made on the basis of assuming search parameter values for skin gages and synthesizing stringer geometries for the specified stringer concept from available material. The distribution logic is programmed to maximize area moment of inertia for the skin/stringer section, selecting designs only within the specified constraints for stringer geometries and element minimum gages.

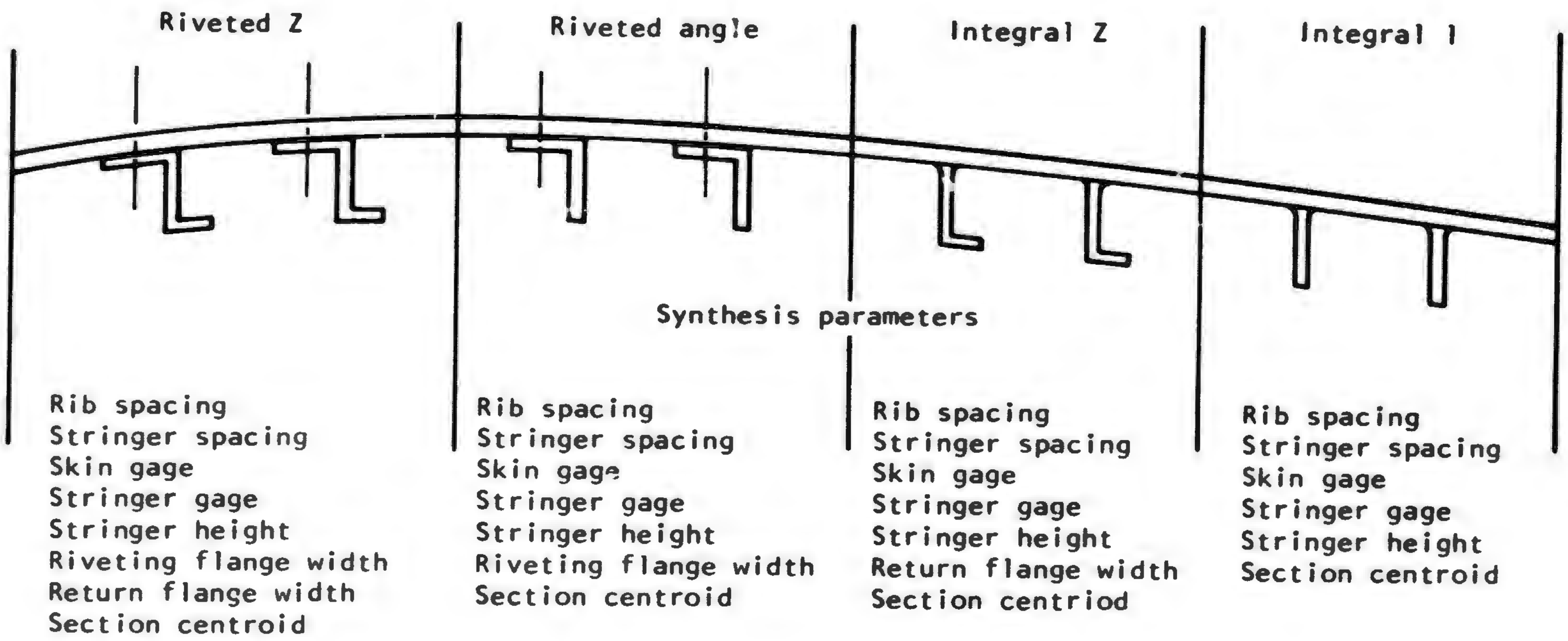


Figure 33. Multirib stringer design options.

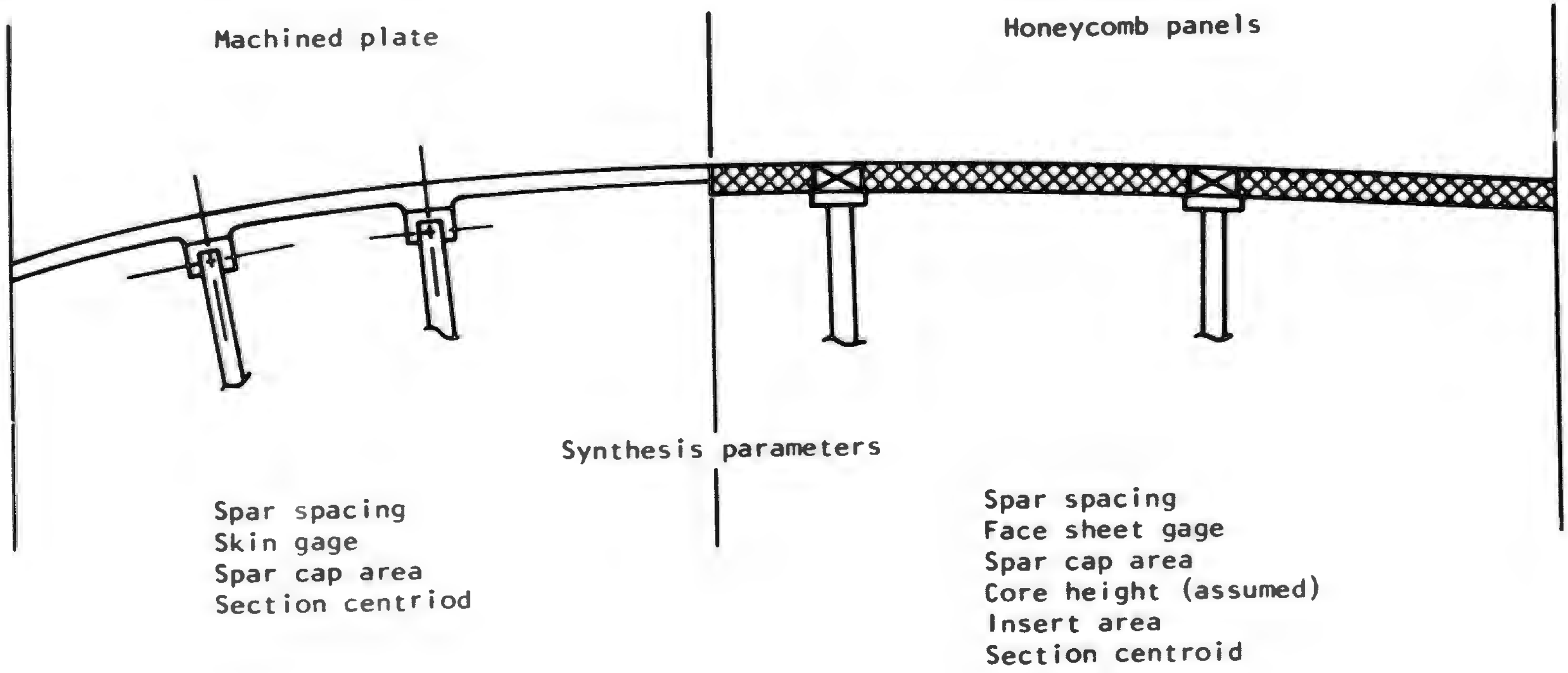


Figure 34. Multispar design options.

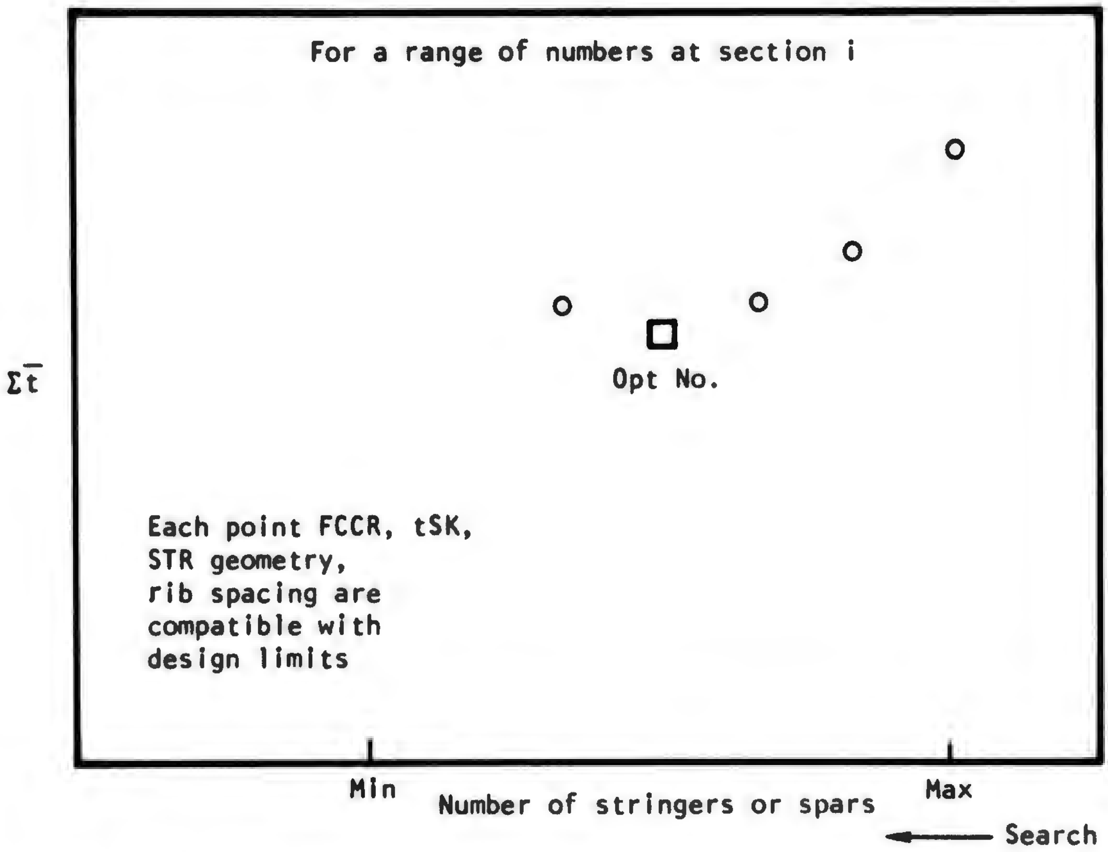


Figure 35. First search level, multirib or multispar construction.

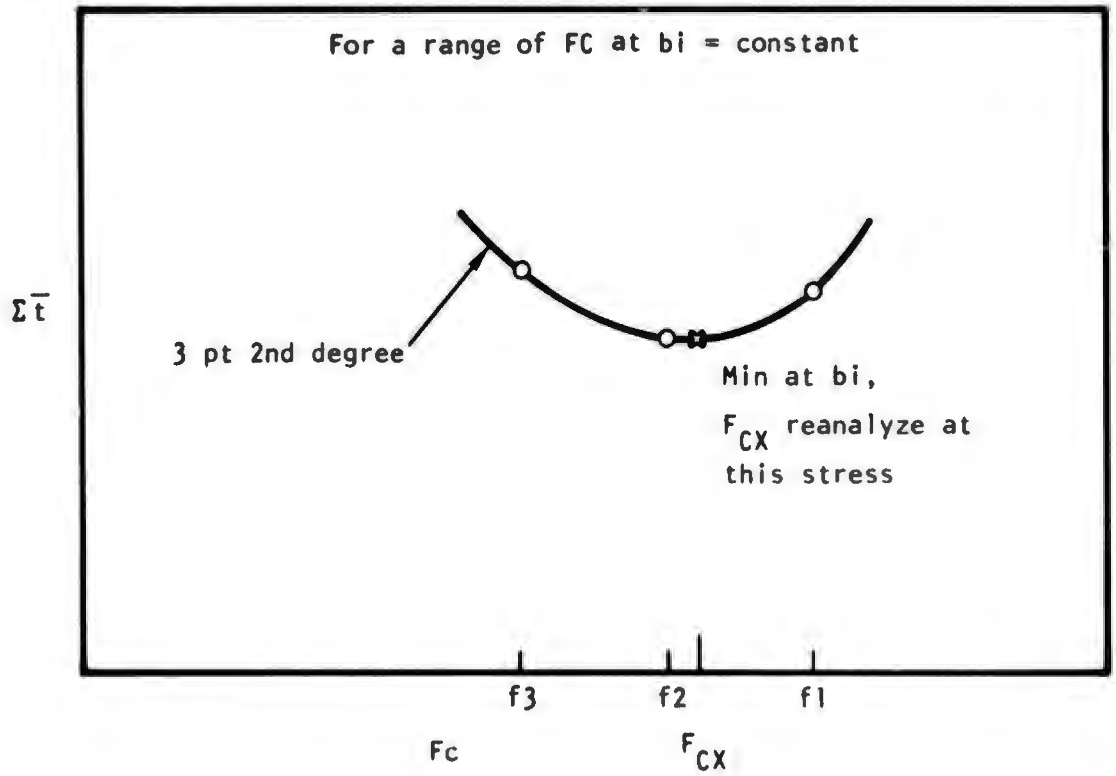


Figure 36. Second search level, multirib.

For each search loop total cover, support structure and attachment requirements are determined for assumed parameter values. The value that produces the minimum total structure requirements is selected. Resulting design information is then used for lower-level search operations. This synthesis approach can be controlled to analyze constant spacing or constant number of stringer arrangements. Rib synthesis is based on spring rate requirements for cover column support and for induced rib loads due to cover flexure.

The metallic multispar design option involves synthesis of skin and cap material for specified spar spacing or constant number of spars. The approach considers the effectiveness of intermediate spar caps in resisting bending loads. Spar webs are sized to similar conditions as rib webs, and are assumed to be corrugated. For honeycomb cover construction, strength effect of inserts at the spars and effect of panel thickness on cover stability are considered.

The search logic programmed to synthesize structures for the construction concepts discussed previously involves the determination of minimum required cover/support structure material necessary to resist design loads. Limits on search parameters constrain the search within discrete values so that the configurations for the selected structures reflect practical designs. User inputs can be used to control search parameter values and thus bias the search toward selections of configurations that are more representative of final design concepts. Multiple options programmed allow the user the select one of three types of search procedures:

1. Optimization at each structural station within minimum and maximum values for applicable search parameters:

   - Stringer or spar spacings
   - Number of stringers or spars
   - Ratio of skin gage to total cover $\bar{t}$
   - Rib spacing
   - Stringer heights

   Search values for these parameters are specified in locations 365 through 384 of the input data array.

2. Total torque-box weight optimization search in which the search procedure determines the single value for spacing or number of stringer/spar elements that produces the lightest torque-box design. The selection is dependent on the construction and the analysis mode - spacing or number-of-element search. Specifications for this type of analysis are defined by data in locations 1365 through 1374. This analysis mode specified by the control word in location 1365 will supersede the optimization mode discussed in item 1.

3. Synthesis of structure to predetermined values of sizing parameters with values specified discretely at each analysis station. Parameter values are input through data sets in locations 721 through 808. These input values supersede the inputs of item 1, and the analysis mode for item 2 should not be used.

In all cases, synthesis results reflect cover/support structure configurations that are sized to strength allowables (P/A stresses), or to allowable stress/material distribution relationships which are based on requirements for (1) general instability as columns or panels or (2) local instability due to crippling or plate buckling.

Front and rear spar webs are synthesized as stiffened plate structures resisting vertical shears. Actual depths of the airfoil at the spars are used for determination of shear loads and material volume. Cap materials are effective bending materials, so are assumed to vary with cover $\bar{t}$ requirements.

Synthesis procedures for multirib and multispar advanced composite structure designs are similar to the approach used for metallic structures. The following items describe the major differences primarily due to assumptions made for analysis of advanced composite structures:

1. Only longitudinal fibers (0-degree plies) resist axial loads, and cross fibers (±45-degree plies) resist shear loads.

2. All plies contribute to laminate panel stability.

3. Skin material requirements are analyzed for axial loads and panel stability requirements due to combined effects of inplane axial and shear loads.

4. Laminates are synthesized with integer number of lamina. Minimum plate thicknesses are based on requirements for a balanced symmetric system, eight lamina layers consisting of two each of 0-, +45-, -45-, and 90-degree plies. Thickness increases are made by additions of two sets of 0- or 90-degree plies, or two each of ±45-degree plies only, or combinations of all. For honeycomb

panels, laminate plies are assumed to be equally divided between the inner and outer face sheets.

5. Addition of ±45-degree plies only are made to increase stiffness levels of panels with inadequate stability stress allowables.

6. Addition of ±45-degree plies only are made to torque-box webs to increase section stiffness to levels required to satisfy torsional stiffness requirements.

7. Different stringer concepts can be specified for the upper and lower covers. However, the spacings or number of elements in each cover will remain the same.

8. Stringer areas consist of 0-degree longitudinal plies only. The synthesis procedures for determining allowable stresses and cover material distributions are programmed to include evaluation of load distribution between skin and stringer elements, based on strain compatibility relationships.

9. Spar/rib web synthesis includes analysis for honeycomb panel designs, as well as corrugated web designs.

10. The covers are assumed to be mechanically attached to ribs and spars. Cover lamina are assumed to be rearranged locally along attachment lines to include filler material, replacing relocated 0-degree lamina, for attachment hole drilling.

11. Lightning protection material (aluminum flame spray) is assumed for all exterior surfaces. Provisions are made for application of sealer films to all interior surfaces.

In the full-depth honeycomb sandwich construction option for advanced composite structures, three optional synthesis procedures are available:

1. Sizing skin requirements so that the sandwich structure will be stable for specified core type and densities.

2. Sizing skin laminates to strength requirements and determining required core densities to satisfy stability requirements.

3. Sizing for optimum skin/core combinations to satisfy strength and stability requirements.

Front and rear spars for these designs are analyzed with the same procedures used for multirib and multispar designs. Evaluation for torsional stiffness is also the same.

Evaluations for structural provisions for major rib bulkheads and chordwise splices are made when user input data directs analysis routines to estimate requirements at each station. Incremental structure weights are predicted by the program based on data set information in locations 650 through 671, and 1475 through 1497 of the input data array. Root rib and wing-to-fuselage shear tie provisions at the first structural station are evaluated based on load, geometry, and material parameters.

Synthesis of variable-sweep wings consists of the evaluation of idealized torque-box structure, as previously discussed, and synthesis of pivot structure. Pivot estimates replace the idealized structure in the appropriate structural location. The pivot system analysis is restricted to vertical pin types utilizing straight Teflon-lined bearings. The program is designed so that the pivot estimate is optimum for the specified set of design data. Spanwise and chordwise locations of the pivot centerline are required input data, locations 200 and 201 of the input data array.

The synthesized structural data are used in determining weight and weight distributions. The estimates are based on volumetric integration of the optimized structural elements to which weight indexing factors are applied. Weight increments for unique and for local structural discontinuities, cutouts, doors, etc, are determined through control indicators and weight factors.

Selection of proper material alloy must be made and specified to the module by the user, with consideration made to the temperature and fatigue environment to which the material will be exposed. Consideration must also be made as to the effects of exposure time at temperature on material allowables. Design concepts will dictate whether the selected material should reflect properties of type of alloy and form - sheet, plate, or extrusion. The selected material is specified in the input data set by a material code number; i.e., in location 258 for the torque-box, and location 196 for the pivot lugs. Materials are selected from sequentially stored material property data sets in the material library of the SWEEP data bank. The selected material is identified by code number corresponding to the data set in the library. The contents of this library is presented in Section XI of this volume.

Practical minimum gages for the selected material should be specified by the user. The values used should be compatible with fabrication requirements for the material and structure concepts being evaluated.

Design temperatures are defined for each material selected in locations 159 and 197, respectively. Zero values in these locations will result in placement of SWEEP computed temperature values for analysis. Temperature properties are determined by straight-line interpolation of properties versus temperature data included in the library data set.

Errors in material code or temperature values will result in continued execution after preprogrammed corrective action and printing of error messages. For material code errors, the following message is printed:

***MATL INPUT ERROR. ASSUMED MATL NO. 1. ***

***TORQUE-BOX MATL = XX. TEMP = YYY.Y

Temperatures outside the range of the data set will result in one of the following messages:

***MATL TEMPERATURE ERROR. MATL NO. XX. REQD TEMP LESS THAN SET (1)
TEMP OF YYY.Y DEG.***

REQD TEMP = ZZZ. DEG. ASSUMED TEMP = YYY.DEG

***MATL TEMPERATURE ERROR. MATL NO. XX. REQD TEMP OUTSIDE RANGE OF
TEMP SETS ON FILE***
N TEMP SETS ON FILE---MIN TEMP = YYY. DEG.,
MAX TEMP = ZZZ. DEG.
REQD TEMP = AAA. DEG. ASSUMED TEMP = ZZZ. DEG.

Material properties for the advanced composite option are input through the input data sets, locations 1155 through 1163 and 1170 through 1204 for lamina properties, and locations 1164 through 1169 and 580 through 596 for honeycomb core foil properties. The program default materials properties are boron/epoxy and 2024-T4 base aluminum sheet. Material changes must be made with data in the input data set of the component.

ANALYSIS OPTIONS

The execution of the wing and empennage module requires case control card 2 information that is compatible with analysis requirements and variable-data input for each surface. Case control card 2 data in columns 1 through 44, 71, 72, 75, 76, 78, 79, and 80 affect processing of module input data blocks and module execution. Execution of module analysis options are affected by control data in the variable-data input for each surface. Setup requirements for four of the major options are explained in the following paragraphs.

Surface Types

Each wing and empennage surface must be described with separate input data blocks. Execution of the module will occur when case control card 2 contains a (0) punch in column 72 for wing, column 75 for horizontal tail, and column 76 for vertical tail. During data processing of case data blocks, a module input data array is set up for each component to be analyzed. The array is initialized from either the SWEEP data bank permanent data sets or the module input data block from the previous case, based on status of column 80 of case control card 2. Component variable data are then read and processed into the array and stored on mass storage records. In any problem case, component variable data are processed only if a data deck with the appropriate deck title appears in the case input data set. Thus, for second and subsequent cases, components may be analyzed without the existance of an input data block.

Internal module logic requires that location 289 of each component input data array contain a code word which identifies the surface type.

0 = Wing surface
-1 = Horizontal tail surface
+N = Vertical tail surface, where N = the number of vertical tail panels

General Data Processing Option

Vehicle and design criteria data input through the GENERAL data deck are processed into design data for the wing and empennage module by the data management and design data development modules of SWEEP. Some of the variable-input and calculated data are identical to the information which is also input through component input data decks. These design data are set up as a separate wing and empennage module input data array. The array data are processed as required during module execution into the component input data array only if the respective variable-data array location is set to zero. For some variables, the transfer is governed initially by a zero value in a control location assigned to the set. Data and control locations affected by module input data processing logic are as follows:

- Vehicle gross weight, load factor, fuel, and useful load data locations 81, 85, 86, 87, 88, 89, 91, 93, 94, 96, 98, 100, and 1280. Control word in location 88.

- Surface-type code in location 289 only for vertical tails. Set to zero for wing.

- Planform geometry parameters in locations 240 through 249 are processed only if location 240 is zero. The value in location 138, planform sweep reference chord element line, is replaced if location 242 is zero.

- Surface positioning data in locations 175, 177, and 178 are always set to zero, and the value in 176 is always set to the transfer value. This value cannot be input.

- Load reference line location in location 239.

- Torque-box analysis control stations, locations 865 through 875, are replaced if location 865 is zero. The code value in location 864 is then set to 2.0.

- Inertia deadweight control word in location 110 is always set to zero for vertical tails, to 1.0 for wing, and is not examined for horizontal tail.

- Torque-box design temperature in location 259.

- Pivot design material, location 196, and design temperature, location 197, are examined only for wings and if location 200, pivot spanwise locator, is not zero. Locations 196 and 197 are set to values in 258 and 259 if zero values are input.

- Pivot design data, locations 200, 201, 202, 203, 197, and 199, are examined and transferred for wing designs only after initial tests for material and temperature.

- Conventional fixed surface flutter Q and material G, locations 253 and 254, and flutter design temperature for advanced composite analysis, location 282.

- Variable-sweep wing flutter data for aft wing position; locations 320, 321, 322, and 323, controlled by value in location 320.

- T-tail vertical tail flutter data, locations 310, 335, 337, 338, 339, 358, 359, and 360, based on control word in location 357, T-Tail analysis for vertical tail flutter. Locations 310, 357, 358, and 359 are set to zero for wing and horizontal tail.

- T-tail code word for horizontal tail inertia calculations for vertical tail flutter analysis in location 204. This item is processed during horizontal tail execution only and is set to zero for vertical tail and wing.

- Fuel cell data, locations 206 through 219. All cell data are processed only if the input fuel density for each cell is zero, locations 208 and 215.

- Miscellaneous surface content weight to be distributed uniformly on the torque-box planform for inertia calculations, location 1820.

- Surface contents to be approximated with a spanwise line distribution for inertia calculations, locations 1821 through 1827. If the weight location 1821 and the outboard point of the distribution line, 1823, are zero, then the data set information is changed to reflect calculated weight distribution along the structural analysis reference line between control station 1 and the tip.

- External concentrated mass items to be located on the wing, seven data sets, 12 items each in locations 1855 through 1938. Each of the seven items is assigned to specific mass components, and transfer of data is made only if the spanwise location parameter (the second data item in each set) is zero. Items 1 through 4 are for external stores, items 5 and 6 are for wing-mounted nacelles and contents, and item 7 is for wing-mounted landing gear structures. Calculated inertia data (pitch, roll, and yaw) are available for transfer only for the nacelles. Therefore,required data must be input for the other mass items for module estimates of inertias. If data for inertia calculations are not input (items 6 through 11 for each data set), the transferred weight (item 1 of the data set) is set to a negative value to indicate that structural provisions only are to be calculated for that set. The longitudinal location for each mass (item 3) is transferred as fuselage station values; thus the spanwise location parameter value (item 2) is set to a negative value to indicate fuselage station values.

Torque-Box Design Option

For each surface, the metallic or advanced composite structure synthesis routines are executed in accordance to the value, (00) and (01), respectively, punched in columns 39 through 44 of case control card 2; 39 and 40 for wing, 41 and 42 for horizontal tail, and 43 and 44 for vertical tail. Torque-box construction is specified with code information in locations 361 and 461 for metallic structures. Advanced composite construction information is specified by code in locations 430 through 438.

Design Data Generation Option for the Flutter Optimization and Flexible Loads Analysis Programs

Design data for the stand-alone Flexible Loads Analysis and Flutter Optimization Programs can be calculated and punched on data cards for use as input data sets for these programs. Calculations for these options are based on code information in location 271. Output of calculated data is governed by the code in location 280. Related data are input through data sets in locations 272 through 279 and 290 through 309.

The computational procedures, assumptions, and output design information are described in the following paragraphs.

Each program requires data which are evaluated at predetermined control stations and referenced to one of the two basic lifting surfaces coordinate reference systems. Data describing the mass characteristics for all items contained in the mold line of the exposed wing are processed as distributed masses, 10 equal width aerodynamic strips for the Flexible Loads Analysis Program (Figure 37), and 11 structural system strips for the Flutter Optimization Program (Figure 38).

Mass properties data must also be evaluated separately for each program since the flutter design point and vehicle design loading may not be the same as for the critical design loads condition. Furthermore, the critical design point and vehicle loading resulting from the flexible loads analysis may also be different from that resulting from the rigid loads analysis. Thus, mass properties of wing fuel and externally mounted expendable items are evaluated individually for each program, based on user specifications defined in locations 272 through 279. Mass properties summation logic in each system is designed to compute for output the total mass distribution for a specified vehicle loading condition. Remaining wing fuel for the output design data is determined from a fuel usage schedule array in the input data set. Separate data sets are provided to define fuel status for flexible loads design loading and flutter design loading. Estimated full-capacity fuel mass properties data for each fuel cell are scaled to the desired fuel level.

Provisions are made to process two sets of externally mounted concentrated mass items so that effects of store/external fuel configurations can be evaluated by the flexible loads and flutter optimization programs. Loading status schedule similar to that for fuel usage is provided.

During the structural synthesis/weight analysis of lifting surfaces, geometry, design loads, and structural design requirements are evaluated at 11 control stations. Torque-box structures are synthesized at these stations. Unit spanwise weights are determined, then estimated weights are

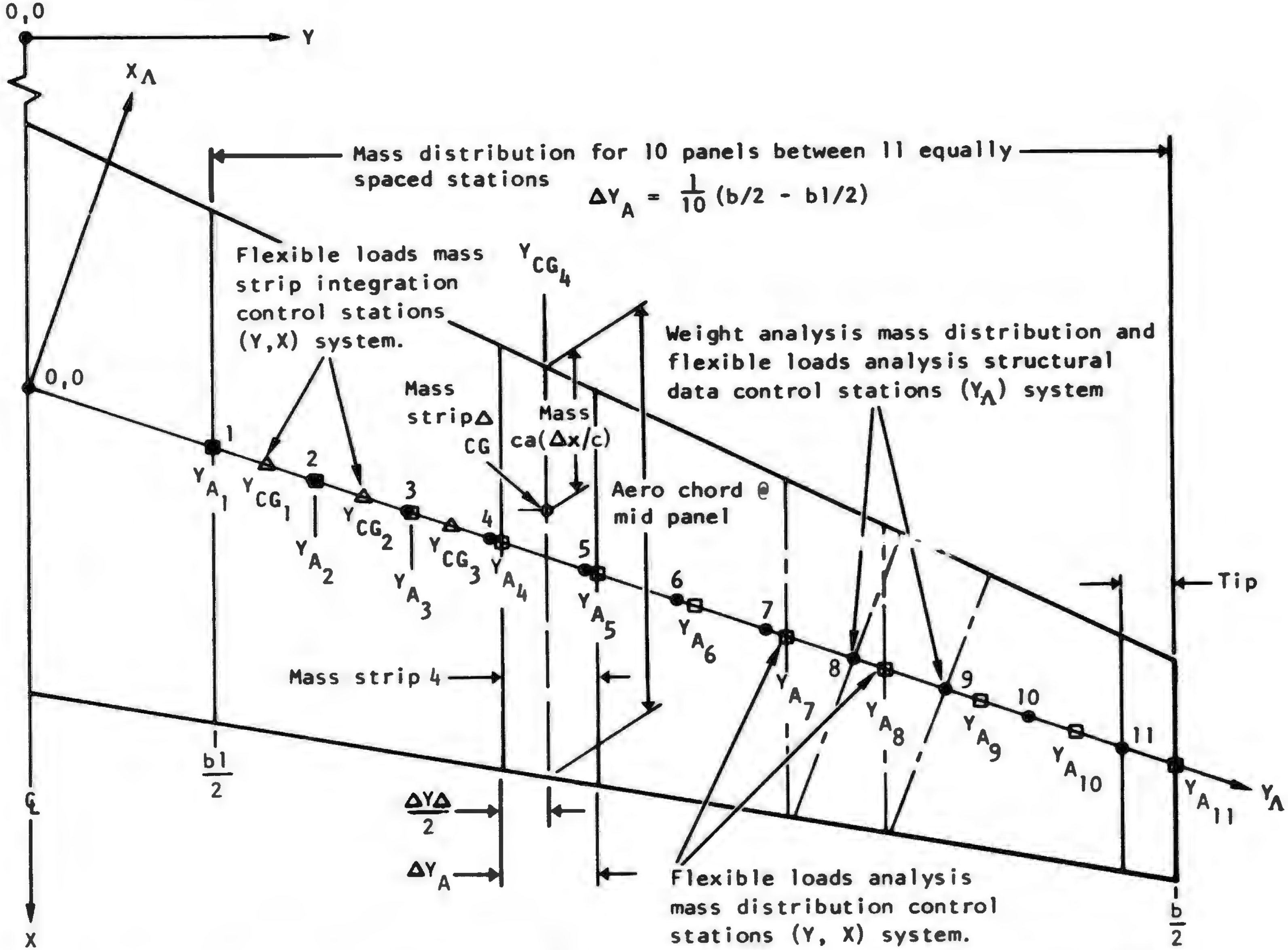


Figure 37. Flexible loads analysis mass distribution and integration reference system.

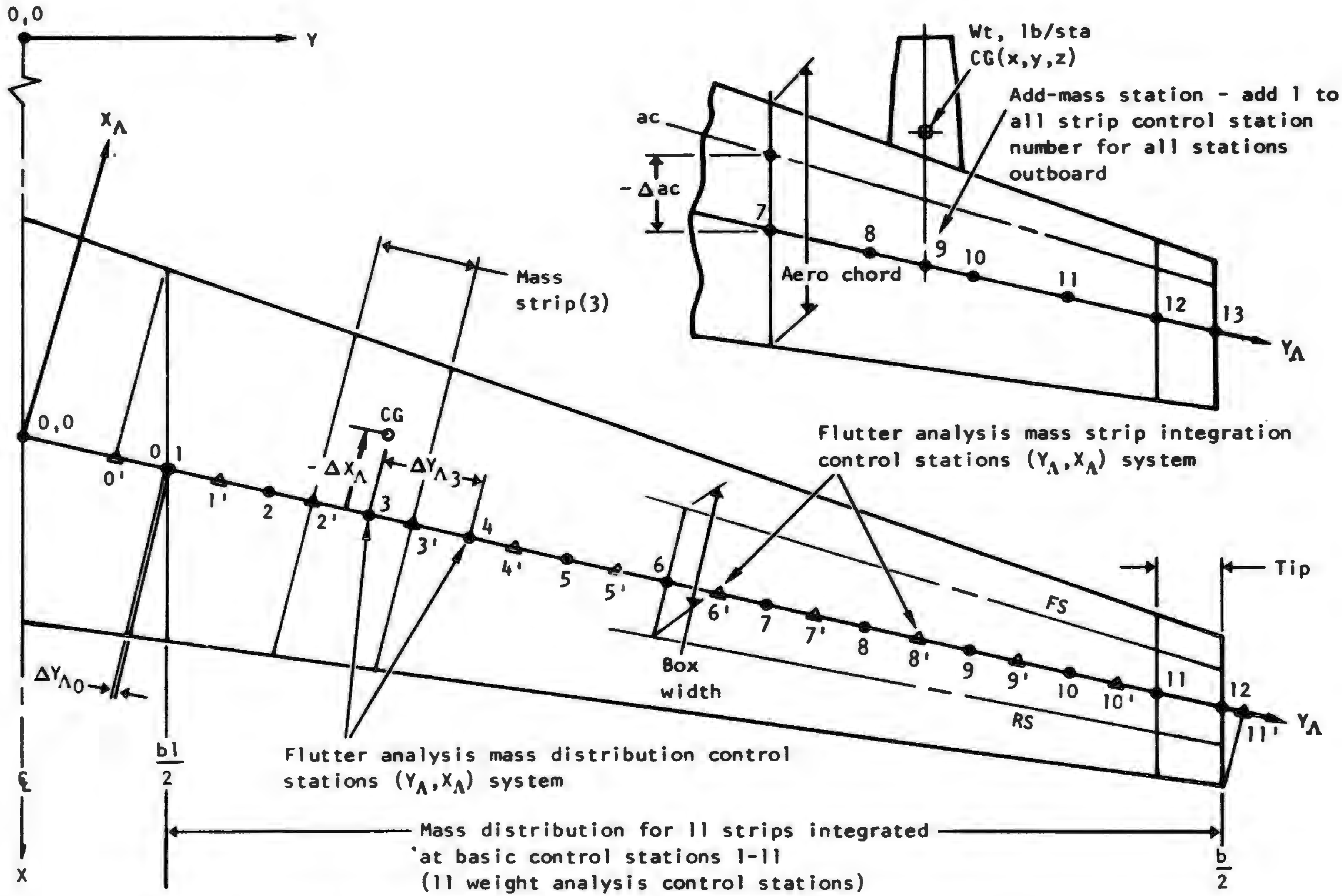


Figure 38. Flutter optimization analysis mass distribution and integration reference system.

calculated by integration between these stations. Bending stiffness, EI, and torsional stiffness, GJ, are computed from the synthesis data at each station. These synthesized data provide the necessary distribution data for computing the required data for the flutter optimization and flexible loads analysis programs.

Output Data for Flexible Loads Analysis Program

Two sets of reference systems are used for the development of data necessary for the flexible loads analysis program. Mass properties data are evaluated for 10 exposed wing panel strips with boundaries defined by 11 equally spaced aerodynamic cuts (Figure 37). Integration of the weight distribution surface is based on aerodynamic reference system coordinates. Total panel mass and chordwise centroids are summed to mass distribution control stations at panel midpoints on the structural reference axis. The strip mass centroid is then ordered for output as the chord distance from the centroid to the leading edge at the mass control station.

Concentrated mass items are included as part of distributed strip data. Location of each concentrated mass item (up to seven items may be described in the input data set) is determined relative to the mass integration control stations. The mass items are assumed to affect the two control stations that straddle the mass coordinate point on the reference axis; thus, these weights are beamed to the stations, using simple beam statics equations for determining reactions. Mass items which are adjusted for design condition status are adjusted before processing to the proper strip control stations.

Structural stiffness data, EI and GJ, are based on analysis control stations resulting from the structural synthesis/weight analysis. Structural station values and the EI and GJ estimates resulting from the torque-box synthesis are processed into 12 control station sets for output. A control stations is added between analysis control stations 1 and 2 to provide EI and GJ values close to the root station to allow the curve fit/curve evaluation preocedure of the Flexible Loads Analysis Program to properly approximate inboard spanwise stiffness distributions. The added station is at a station increment based on the smaller of the two values: (1) one-fourth of the distance between analysis stations 1 and 2, and (2) one-tenth of the distance between station 1 and the centerline, along the structural reference axis.

Two data decks are output for the Flexible Loads Analysis Program, with all punched data formatted for read by subprogram DECRD. The first data set consists of BC array data calculated by the data management module of SWEEP for use by the airloads module. The Flexible Loads Analysis Program uses the same data array. BC array definitions can be found in Volume II, "Program Integration and Data Management Module." The second data set includes calculated design and mass properties ordered for read into the BF array of the program. The last card in each deck contains a minus punch in column 1 to denote end of deck and is addressed to an array location not used to describe variable data. Data deck punch can be suppressed by code information in location 280. Execution of the data generation option automatically results in printing of card image data (Figures 39 and 40).

Deck identification and card sequencing information are punched in columns 73 through 80 on all output data cards. Definitions for data card sequencing information are as follows:

Column	Punch
73	The integer "2" for SWEEP option
74-76	Current case number
77	The letter "C" for BC array data, and "F" for BF array data
78-80	Array location of the first field data

Data items in BC array locations 1 through 169 are punch on the first 34 cards of the C - deck. The last card is addressed to array location 170, with data value of 0.0 punched in the first field.

The BF array data in the second data deck consists of values for array locations 1 through 106, punched on 23 data cards, plus a deck termination card addressed to array location 107. Data items for the BF array deck are as follows:

BF Loc	Data Item
1	Mach number at 20,000 feet altitude, fixed wings, and aft sweep position for variable-sweep wings
2	Same as 1, except for wings forward for variable-sweep wings
3	Sweep of the structural reference line (EA) for fixed wings and wings aft position for variable-sweep wings (degrees)
4	Centerline fuselage station for the structural reference line for 3.

** WFLDD **

CASE NO. 1 [illegible] BC ARRAY DATA***

1	[illegible]	[illegible]	[illegible]	[illegible]		2	1C 1
5	[illegible]	[illegible]	[illegible]	[illegible]	0.12616413E+08	2	1C 5
10	[illegible]	[illegible]	[illegible]	[illegible]	0.20000000E+01	2	1C 10
15	[illegible]	[illegible]	[illegible]	[illegible]	0.0	2	1C 15
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	1C 20
25	0.0	[illegible]	0.0	0.0	0.0	2	1C 25
30	0.0	[illegible]	[illegible]	[illegible]	0.72160001E+03	2	1C 30
35	[illegible]	[illegible]	[illegible]	[illegible]	0.24764511E+02	2	1C 35
40	[illegible]	[illegible]	[illegible]	[illegible]	0.30028301E+04	2	1C 40
45	[illegible]	[illegible]	[illegible]	[illegible]	0.34229614E+03	2	1C 45
50	[illegible]	[illegible]	[illegible]	[illegible]	0.78328579E+03	2	1C 50
55	[illegible]	[illegible]	[illegible]	0.0	0.0	2	1C 55
60	0.0	0.0	0.0	0.0	0.0	2	1C 60
65	0.0	0.0	0.0	0.0	0.0	2	1C 65
70	0.0	0.0	0.0	0.0	0.0	2	1C 70
75	0.0	0.0	0.0	0.0	0.0	2	1C 75
80	0.0	0.0	0.0	0.0	0.0	2	1C 80
85	0.0	0.0	0.0	0.0	0.0	2	1C 85
90	0.0	0.0	0.0	0.0	0.0	2	1C 90
95	0.0	0.0	0.0	0.0	0.0	2	1C 95
100	[illegible]	[illegible]	[illegible]	[illegible]	0.29656154E+03	2	1C100
105	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	1C105
110	[illegible]	[illegible]	[illegible]	0.0	0.0	2	1C110
115	[illegible]	[illegible]	[illegible]	[illegible]	0.15103989E+03	2	1C115
120	[illegible]	[illegible]	[illegible]	[illegible]	0.29452759E+03	2	1C120
125	[illegible]	0.0	0.0	0.0	0.0	2	1C125
130	0.0	0.0	0.0	0.0	0.0	2	1C130
135	0.0	0.0	[illegible]	[illegible]	0.15257073E+04	2	1C135
140	[illegible]	[illegible]	[illegible]	[illegible]	0.24714722E+02	2	1C140
145	[illegible]	[illegible]	[illegible]	[illegible]	0.10571814E+03	2	1C145
150	[illegible]	[illegible]	[illegible]	[illegible]	0.24204565E+03	2	1C150
155	[illegible]	[illegible]	[illegible]	[illegible]	0.0	2	1C155
160	0.0	0.0	0.0	0.0	0.0	2	1C160
165	0.0	[illegible]	[illegible]	[illegible]	0.0	2	1C165
170	0.0					2	1C170

Figure 39. Output for flexible loads analysis program, BC array data.

CASE NO. 1 ****FLEXIBLE LOADS INERTIA DATA. BF ARRAY DATA*** ** WFLDD **

1	0.80000	0.0				2	1F 1
3	23.6[illegible]147	7[illegible].744[illegible]				2	1F 3
5	0.1941[illegible]E+05	0.170[illegible]E+05	0.129[illegible]E+05	0.4[illegible]29214E+04	0.14412219E+05	2	1F 5
10	0.6[illegible]E+04	0.[illegible]E+04	0.424[illegible]E+04	0.33871221E+04	0.22573250E+04	2	1F 10
15	0.411[illegible]E+00	0.[illegible]E+00	0.[illegible]E-01	0.241520[illegible]1E+00	0.93785167E-01	2	1F 15
20	0.3[illegible]E+00	0.[illegible]E+00	0.3[illegible]E+00	0.38793194E+00	0.36077082E+00	2	1F 20
25	0.0	0.0				2	1F 25
27	0.0	0.0	0.0	0.0	0.0	2	1F 27
32	0.0	0.0	0.0	0.0	0.0	2	1F 32
37	0.0	0.0	0.0	0.0	0.0	2	1F 37
42	0.0	0.0	0.0	0.0	0.0	2	1F 42
47	0.[illegible]E+02	0.[illegible]E+02	0.111[illegible]E+03	0.27778174E+03	0.37420117E+03	2	1F 47
52	0.470[illegible]E+03	0.[illegible]E+03	0.[illegible]E+03	0.7[illegible]879[illegible]E+03	0.856[illegible]E+03	2	1F 52
57	0.95271[illegible]E+03	0.102[illegible]E+04	0.0	0.0	0.0	2	1F 57
62	0.0	0.0	0.0	0.0	0.0	2	1F 62
67	0.5[illegible]E+12	0.[illegible]E+12	0.3[illegible]E+12	0.2772946[illegible]E+12	0.1[illegible]E+12	2	1F 67
72	0.13[illegible]E+12	0.102[illegible]E+12	0.70[illegible]E+11	0.4[illegible]7F+11	0.23714[illegible]07E+11	2	1F 72
77	0.97271316E+10	0.41[illegible]E+10	0.0	0.0	0.0	2	1F 77
82	0.0	0.0	0.0	0.0	0.0	2	1F 82
87	0.3134[illegible]E+12	0.[illegible]E+12	0.2[illegible]E+12	0.2[illegible]E+12	0.16653451E+12	2	1F 87
92	0.13[illegible]E+12	0.[illegible]E+11	0.[illegible]E+11	0.417[illegible]E+11	0.22352634E+11	2	1F 92
97	0.[illegible]E+10	0.[illegible]E+10	0.0	0.0	0.0	2	1F 97
102	0.0	0.0	0.0	0.0	0.0	2	1F102
107	0.0					2	1F107

Figure 40. Output for flexible loads analysis program, BF array data.

BF Loc	Data Item
5-14	Strip mass weights for 3 (pounds per strip)
15-24	Strip centroid data for the preceding strip mass (inches)
25	Same as 3, except for wings forward for variable-sweep wings
26	Same as 4, except for wings forward for variable-sweep wings
27-36	Same as 5-14, except for wings forward for variable-sweep wings
37-46	Same as 15-24, except for wings forward for variable-sweep wings
47-66	Stations on the structural reference axis for the control stations where EI and GJ values are given (inches)
67-86	EI values for stations defined in 47-66 (pound-inches squared)
87-106	GJ values for stations defined in 47-66 (pound-inches squared)

Output Data for Flutter Optimization Program

The reference coordinate system for flutter optimization analysis is the same as the structural reference coordinate system. All mass properties and structural design data are computed for strips normal to, and at stations on, the spanwise reference axis, Y_Λ. The structural analysis control stations are used as control stations for the flutter optimization analysis, and computed data are ordered in array format required by that program. Figure 38 shows the control numbering used for determining the data requirements. Thirteen flutter optimization control stations are normally created, 11 for strip data plus an inboard and an outboard control station required by the flutter program. Two additional control stations may be added for a maximum of 15 stations. These added stations are created for each of two externally mounted masses on the wing at the flutter design condition, if these masses are specified in the input data set for analysis.

Presence of add-mass items require that control station numbers for stations outboard of the mass be increased by one, and associated data processed to conform to the revised station numbers. Thus, for the inserted sketch in Figure 38, the initial control stations 9-12 are assigned control station numbers 10-13, and the station at the add-mass coordinate on the reference axis is assigned station number 9.

Two sets of add-mass data are prepared for output for flutter analysis, based on data subset specifications in the input data set describing these masses. Elements of a matrix describing the mass are determined and included as special data sets for output, along with associated stiffness, geometry, and required control indicators. These adjustments are made by subroutine WVFDD so that design data are ordered properly for compatibility with the control stations and the data read routine of the flutter program.

Concentrated mass items which are not processed as add-mass items for the Flutter Optimization Program are integrated with the mass properties of the strip in which the mass Y coordinate intersects the structural reference axis (same as shown for the add-mass item in Figure 38).

Mass properties data for distributed masses are determined for 11 strips. The strips are associated with the 11 weight analysis stations and are bounded by the structural stations at the centroids of the 10 trapezoidal panels occurring between the 11 analysis stations. The mass distribution surface is integrated between these boundaries to the control stations based on structural reference system coordinates. Strip mass, mass centroid distance from the reference axis, and pitch and roll inertias about the mass centroid (structural reference system) are computed for each strip and ordered for output.

Other data ordered for output include:

1. EI and GJ at the control stations (pound-inches squared)

2. Structural box width and average depth (inches)

3. Aerodynamic wing chord at the control station (inches)

4. Incremental structural span distance to the next outboard control station (inches)

5. Change in the sweep of the reference axis at the control station, if any (degrees)

6. Node control indicators for each control station

7. Distance from the control station to the local aerodynamic center of pressure, assumed to be at the 25-percent chord line (inches)

8. Local slope of the lift curve, assumed to have the value equal to $2\pi \cos(\Lambda_{25c})$, per radian

EI and GJ values at add-mass stations created from the input data set specifications are based on a three-point parabolic fit/interpolation procedure. Torque-box geometry at these stations is based on straight-line interpolation for width and depth.

General configuration-oriented design data are also required for output. These data can be specified in the input data set for inclusion in the output data set or, if the data cell is set to zero, the program will use internally generated data for output. These include:

1. E, modulus of elasticity for the torque-box material (psi)

2. G, modulus of rigidity for the torque-box material (psi)

3. ρ, density of the torque-box material (lb/cu in.)

4. Density of air at the critical flutter speed and altitude for which the output data set is being created. This critical point, in general, is assumed to be at maximum limit speed, V_L, at sea level. The value of the critical flutter speed is determined by applying a factor of safety to this speed - 1.15 for military designs and 1.20 for commercial design (lb/cu in.).

5. Buttock line station of the root station (inches)

6. Required flutter speed (defined by item 4) (knots)

7. Vehicle less wing and contents mass properties data:

   a. Weight (pounds/side)

   b. Distance to the mass centroid of item a. from the fuselage station of the root control station (inches) positive if the mass is aft of the root station

   c. Pitch moment of inertia of a. about the mass centroid (pound-inches squared)

   d. Roll moment of inertia of a. about the vehicle centerline (pound-inches squared)

Data for the Flutter Optimization Program must be included on 12 types of data cards read under control of format read statements. These cards, therefore, must be ordered in proper sequence for this program. Punching of data deck can be suppressed by code information in location 280. Execution of the data generation option automatically results in output printing of calculated data in card image format (Figure 41).

The data cards punched for the flutter optimization program are sequenced in columns 73-80, with the following sequencing information:

Column	Punch
73	The integer "2" for SWEEP option
74-76	Current case number
77-78	Flutter Optimization Program card type (2, 4-8, 11, or 12)
79-80	Card sequence number, starting with 1

Flutter Optimization Program card types 1, 3, 9, and 10 are not included in the punched output data set. These data cards must be prepared by the user and included with the punched data deck. They include case title identifications (card type 1), analysis and program control information (card type 3), and root flexibility and stiffness insertion information (card types 9 and 10).

The punched data deck includes the following card types, with design data and punched data format as specified:

Card Type	Format	Data List
2	5E12.8	1. E, modulus of elasticity
		2. G, modulus of rigidity
		3. Material density
		4. Density of air
		5. Required flutter speed
4	6E12.8	1. Blank
		2. Weight less wing and contents
		3. Delta CG (from preceding weight centroid to root station)

Card Type	Format	Data List
		4. Pitch inertia for preceding weight
5	6E12.8	1. Root station buttock station
		2. Roll inertia for preceding weight
6	6E12.8	1. Strip panel weight
		2. Strip roll inertia
		3. Strip pitch inertia
		4. Strip mass centroid distance from strip control station
		5. Density of structural material of strip, if different from data on card type 2
7-1	I12	1. Control station at which to insert add-mass data that follow (3 by 3 matrix)
	5E12.8	2. 1, 1 element of add-mass matrix
		3. 2, 1 element of add-mass matrix
		4. 3, 1 element of add-mass matrix
		5. 1, 2 element of add-mass matrix
		6. 2, 2 element of add-mass matrix
7-2	4E12.8	1. 3, 2 element of add-mass matrix
		2. 1, 3 element of add-mass matrix
		3. 2, 3 element of add-mass matrix
		5. 3, 3 element of add-mass matrix

Card Type	Format	Data List
8	4F6.2	1. Structural box depth
		2. Distance to next outboard station
		3. Structural box width
		4. Change in sweep angle of EA, with respect to previous station sweep angle
	4E12.8	5. Structural box EI
		6. Structural box GJ
		7 Modulus of elasticity, if changed
		8. Modulus of rigitidy, if changed
11	4I12	1. First inboard boundary control station
		2. Second inboard boundary control station
		3. First outboard boundary control station
		4. Second outboard boundary control station
12	6E12.8	1. Aerodynamic chord at control station
		2. Distance from EA to AC at control station (positive for AC aft of EA)
		3. Local slope of lift curve $dC_\ell/d\alpha$)

CASE NO. 1 ***FLUTTER OPTIMIZATION DATA. (MOD. CARD IMAGE DATA)*** ** PINTO **

0.10500000E+06		0.39000000E+07		0.10100001E+00		0.44276298E-04		0.62756152E+03		2	1 2 1
		0.66050000E+05		0.12693335E+03		0.11699999E+11				2	1 4 2
0.77699997E+02		-0.28323951E+11								2	1 5 3
0.95151269E+04		0.72323040E+07		0.17240320E+08		0.77016079E+00		0.0		2	1 6 4
0.17431840E+05		0.15169420E+08		0.35396672E+08		0.45398893E+01		0.0		2	1 6 5
0.13362449E+05		0.10371216E+08		0.27463564E+08		0.63645575E+01		0.0		2	1 6 6
0.10000000E+01		0.0		0.0		0.0		0.0		2	1 6 7
0.20265117E+04		0.17261066E+07		0.67645240E+07		0.26215399E+02		0.0		2	1 6 8
0.66246367E+04		0.41606620E+07		0.97207480E+07		0.57076663E+01		0.0		2	1 6 9
0.10000000E+01		0.0		0.0		0.0		0.0		2	1 610
0.72032617E+04		0.58756660E+07		0.86645850E+07		0.44479694E+01		0.0		2	1 611
0.60408398E+04		0.46919460E+07		0.62526640E+07		0.43013477E+01		0.0		2	1 612
0.48889219E+04		0.39610910E 07		0.41665620E+07		0.34796945E+01		0.0		2	1 613
0.38912544E+04		0.31166540E+07		0.28737660E+07		0.36261462E+01		0.0		2	1 614
0.26406306E+04		0.17099810E+07		0.16469730E+07		0.35989428E+01		0.0		2	1 615
0.11929739E+04		0.41104762E+06		0.69896419E+06		0.50888090E+01		0.0		2	1 616
	5	0.76080000E+04		0.46397012E+06		0.10503990E+07		0.46397012E+06	0.89632256E+08	2	1 717
		0.70771952E+06		0.10503990E+07		0.70771912E+06		0.21879501E+09		2	1 718
	6	0.78080000E+04		0.43326637E+06		0.96093294E+06		0.43326637E+06	0.63745216E+08	2	1 719
		0.62789248E+06		0.98093294E+06		0.62789248E+06		0.19816165E+09		2	1 720
43.08	1.00	142.72	0.0	0.52735906E+12		0.31341930E+12		0.0	0.0	2	1 821
43.08	95.42	142.72	23.83	0.52735900E+12		0.31341930E+12		0.0	0.0	2	1 822
38.12	96.42	134.70	0.0	0.38115148E+12		0.23986006E+12		0.0	0.0	2	1 823
33.08	33.78	126.68	0.0	0.27729461E+12		0.20283825E+12		0.0	0.0	2	1 824
31.20	62.64	123.87	0.0	0.24132026E+12		0.19009966E+12		0.0	0.0	2	1 825
27.94	96.42	118.66	0.0	0.18788640E+12		0.16653451E+12		0.0	0.0	2	1 826
23.53	32.26	110.64	0.0	0.13932023E+12		0.13039396E+12		0.0	0.0	2	1 827
22.89	64.16	107.96	0.0	0.12646921E+12		0.11864460E+12		0.0	0.0	2	1 828
21.61	96.62	102.62	0.0	0.10261370E+12		0.96576471E+11		0.0	0.0	2	1 829
19.70	96.42	94.61	0.0	0.70041660E+11		0.66678419E+11		0.0	0.0	2	1 830
17.79	96.42	86.59	0.0	0.43722367E+11		0.41754829E+11		0.0	0.0	2	1 831
15.88	96.42	78.57	0.0	0.23714607E+11		0.22352634E+11		0.0	0.0	2	1 832
13.97	72.32	70.55	0.0	0.97271316E+10		0.85437768E+10		0.0	0.0	2	1 833
12.94	24.06	64.54	0.0	0.41669233E+10		0.35006459[illegible]E+10		0.0	0.0	2	1 834
12.06	0.0	62.53	0.0	0.39585769E+10		0.33256133E+10		0.0	0.0	2	1 835
	1		1		2		3			2	11136
	2		3		3		4			2	11137
	3		4		4		5			2	11138
	4		5		5		6			2	11139
	5		6		6		7			2	11140
	6		7		7		8			2	11141
	7		8		8		9			2	11142
	8		9		9		10			2	11143
	9		10		10		11			2	11144
	10		11		11		12			2	11145
	11		12		12		13			2	11146
	12		13		13		14			2	11147
	13		14		15		15			2	11148
0.36669434E+03		0.36613027E+02		0.56945009E+01						2	11249
0.33247388E+03		0.36443604E+02		0.56945009E+01						2	11250
0.29825391E+03		0.34274170E+02		0.56945009E+01						2	11251
0.39684106E+03		0.40524656E+02		0.56945009E+01						2	11252
0.26403369E+03		0.32104492E+02		0.56945009E+01						2	11253
0.23478662E+03		0.29934814E+02		0.56945009E+01						2	11254
0.39684106E+03		0.40524656E+02		0.56945009E+01						2	11255
0.21777075E+03		0.27765381E+02		0.56945009E+01						2	11256
0.20075464E+03		0.25595947E+02		0.56945009E+01						2	11257
0.18373877E+03		0.23426514E+02		0.56945009E+01						2	11258
0.16672290E+03		0.21256836E+02		0.56945009E+01						2	11259
0.14970703E+03		0.19087402E+02		0.56945009E+01						2	11260
0.13269482E+03		0.17460205E+02		0.56945009E+01						2	11261

Figure 41. Output for flutter optimization program.

DESIGN FEATURES

Data requirements and descriptions for analysis of surface design features and program analysis options are described in the following paragraphs. Data array locations for data sets and control information are defined. Refer to the input data array list definitions for further descriptions of data sets, control words and data locations discussed.

Surface Geometry

The basis for input geometric descriptions and module calculations of surface geometry data is a system of straight lines approximating planform and cross-section characteristics. General reference lines are computed to describe theoretical trapezoidal planform properties from standard aerodynamic geometry parameters of lifting surfaces; i.e., area, aspect ratio, taper ratio, sweep, and thickness ratio. Descriptive details are specified in terms of either actual dimensions in inches or fractional values of trapezoidal parameters. Locations 240 through 249 are used to describe the basic geometry of the surface (Figure 42). Detail surface characteristics are described through data sets assigned to input specific types of geometry information, as described follows:

Nonlinear Planforms

Blended leading edge and cranked trailing edge planforms are described with data sets in locations 1985 through 2007 and 2008 through 2030, respectively (Figure 43). The data set control word is item 12 of each set. The input information is used to describe local delta chords from the trapezoidal leading and trailing edge lines at up to 11 spanwise points. Interpolations of straight lines between adjacent points are used in computations of true aerodynamic chords.

Cross Sections

Depths at chordwise locations of airfoils at any spanwise station are computed as functions of the maximum airfoil depths at that station. Values for the reference depth are evaluated as functions of the spanwise location and assuming linear depth variations between spanwise control stations; the maximum depths at the control stations are derived as the product of the true aerodynamic chord and the specified thickness ratio as that station. Thus, cross-sections of lifting surfaces are described by values defining surface maximum depths and airfoil type at discrete spanwise locations. One of two data sets can be used for these specifications.

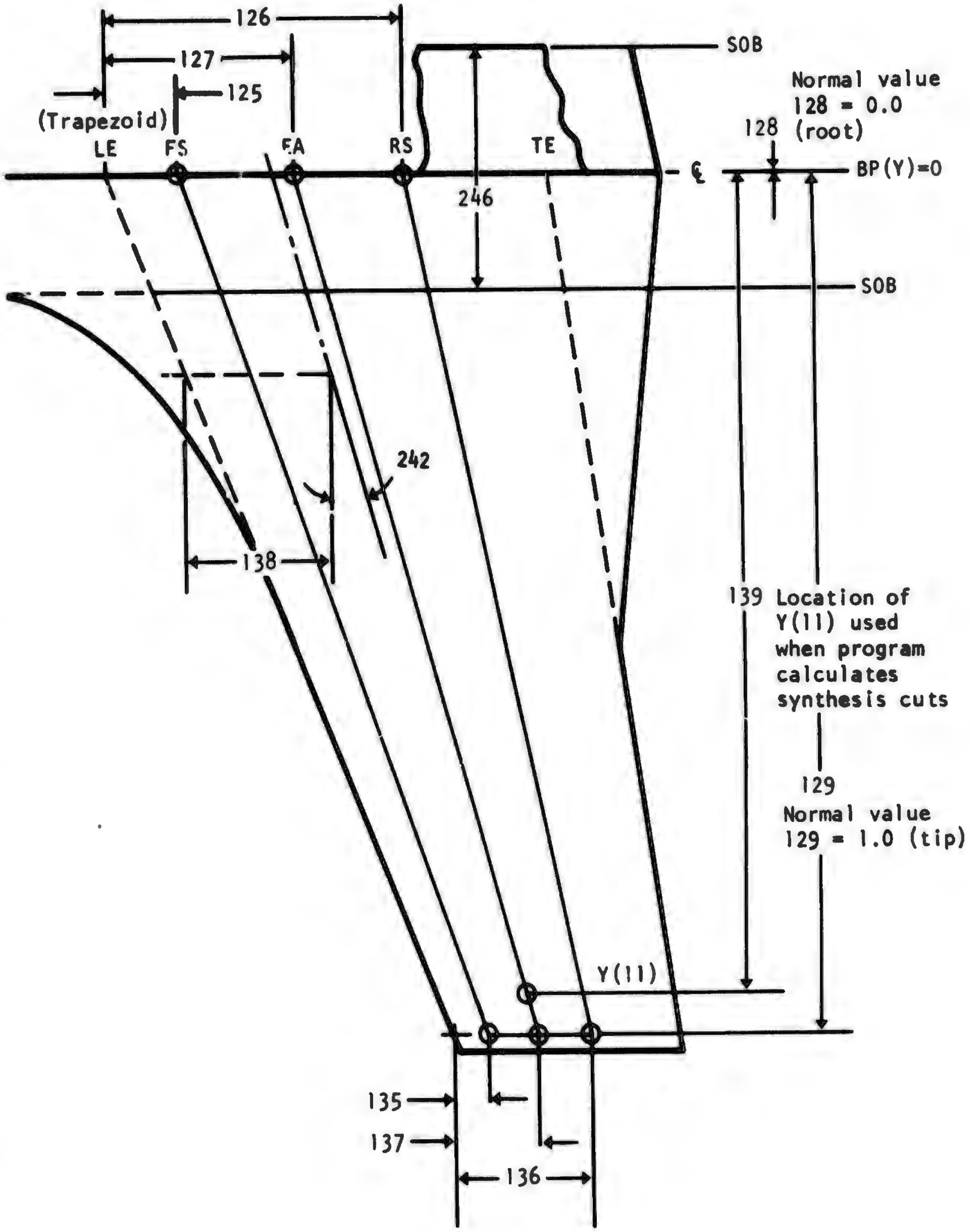


Figure 42. Basic wing geometry.

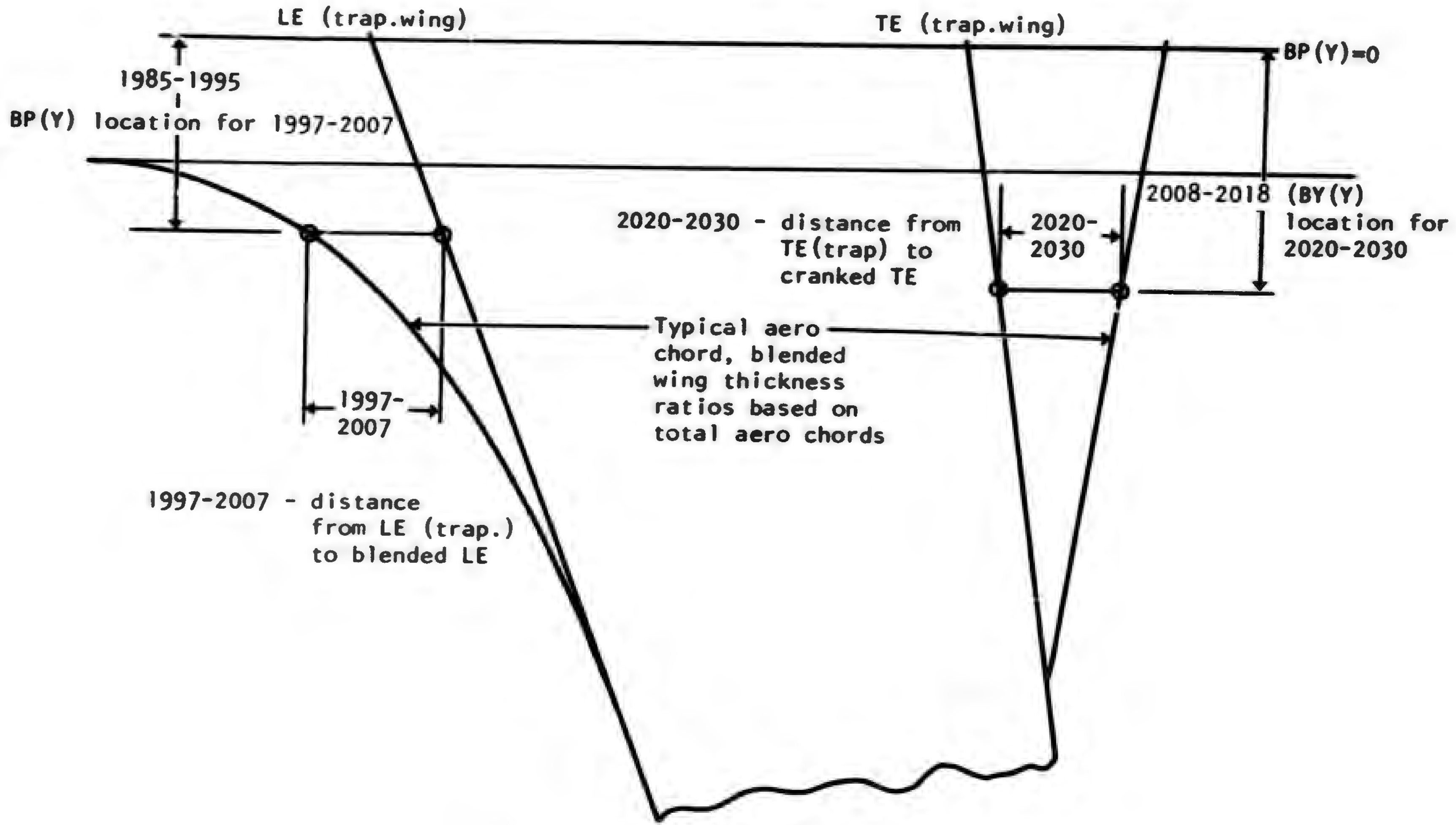


Figure 43. Blended wing geometry.

The first data set, locations 243, 245, 141 and 142, is required input used to specify linear variations in airfoil maximum depths between two spanwise stations, generally the centerline and the theoretical tip. Locations 243 and 245 are thickness ratio values to be used at the spanwise station defined in locations 141 and 142, respectively. If the station values of 141 and/or 142 locate control stations at intermediate spanwise locations, additional control data for the centerline and/or tip station is generated. The maximum depths of these stations are based on the thickness ratio specified in locations 243 and 245, respectively (assumes constant thickness ratio between these created control station and the adjacent input control station).

The second data set, locations 2031 through 2052, is used to specify airfoil depth and control stations at up to 11 spanwise locations. This data set is used to describe planforms with nonlinear spanwise thickness ratio distributions and for closer depth definitions for planforms with blended leading edges and/or cranked trailing edges. Processing of data set information is specified by a nonzero value in item 2 of the data set. During detail evaluation of cross sections, specifications from this data set are used in lieu of data input through the first data set.

Depths at chordwise locations on airfoils are calculated based on code word value in location 143. The code value indicated to the geometry routines the evaluation procedure and data sets to be used: (1) evaluation based on curve fit equations of airfoil depths, or (2) evaluation based on straight-line interpolation of normalized depth versus chordwise location table data.

Value of 1 through 8 will result in data set selection of polynominal constants for airfoil depths from the SWEEP data bank (locations 1 through 99 of the airfoil data array). This option will result in constant airfoil shapes for all spanwise stations, as represented by the code. Code values and corresponding airfoil shapes are as follows:

1 = 6300-series airfoil

2 = 6400-series airfoil

3 = 6500-series airfoil

4 = 6600-series airfoil

5 = Wedge airfoil

6 = Arc airfoil

7 and 8 are not used

Code value of 9 specified in location 143 identifies the straight-line interpolation option. Data in locations 145 through 152 are required. This subset provides the option of specifying airfoil shapes at up to four spanwise control stations, locations 145 through 148. Airfoil shapes to be used are identified by code in locations 149 through 152. These code values correspond to the numerical airfoil depth tables found in locations 150 through 399 of the SWEEP data bank airfoil data array.

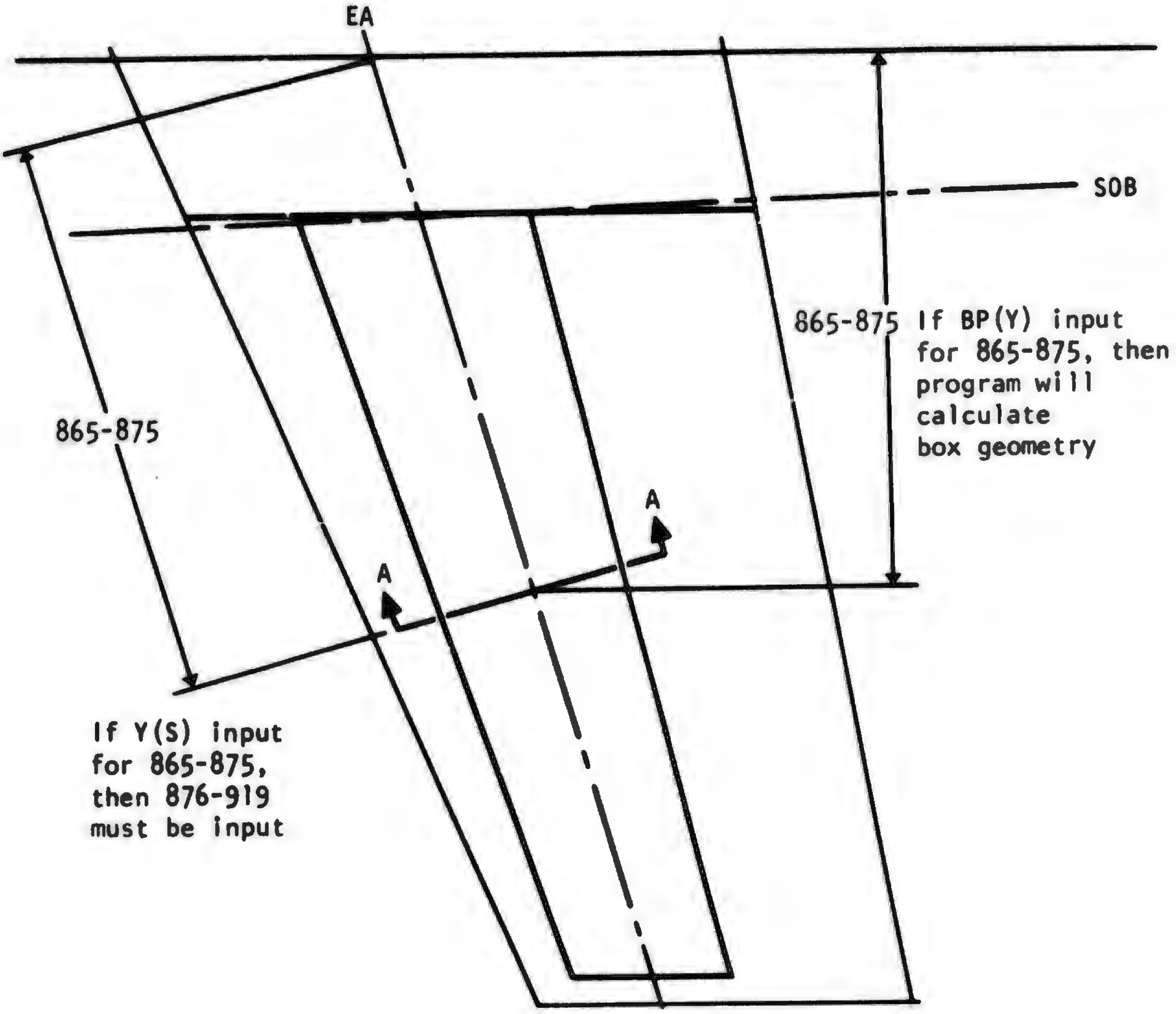
Torque-Box Description

Torque-box planform geometry information is specified in locations 125 through 129, 135, 136, 137, and 139. Locations 125 through 129, 135, 136, and 137 are used to describe front spar, rear spar, and structural analysis reference line locations on the surface planform (Figure 42). Torque-box reference lines not on constant chord element lines can be positioned properly by using the inboard/outboard control station specifications in this data set. Location 139 is used to specify the spanwise location of the outboard closeout rib. This value is used when (1) the geometry routine is directed to compute equally spaced structural analysis control station data, or (2) fractional values are specified for station positioning in data array locations 865 through 875, under control of torque-box geometry control word in location 864.

Detail torque-box geometry can be input by using the data set in locations 864 through 919 (Figure 44). Processing of input data is dictated by the code value of location 864. This data set is organized into 11-element subsets for input of structural analysis station locations, torque-box structural widths and average depths, front spar depths, and rear spar depths.

In surfaces where flutter requirements are calculated by the module, location 340 must contain the theoretical trapezoidal surface area value when options for blended leading edge, cranked trailing edge, or variable-thickness ratio descriptions are used, or when input torque-box depths describe nonlinear variations between the exposed root chord and the eleventh station. The area value in location 340 directs the geometry evaluation routine to compute station chord and depth data for flutter analysis based on trapezoidal properties, in accordance with derivation assumptions for the estimation equations.

Values for locations 341 through 345 may also be input. Location 340 causes the geometry routine to examine these locations for nonzero parameter values to be used in lieu of data in locations 241 through 246. The data set in 340 through 345 may be used also to specify adjusted planform geometry parameters for flutter analysis, particularly location 343, used to compute the exposed panel length for flutter requirement estimates.



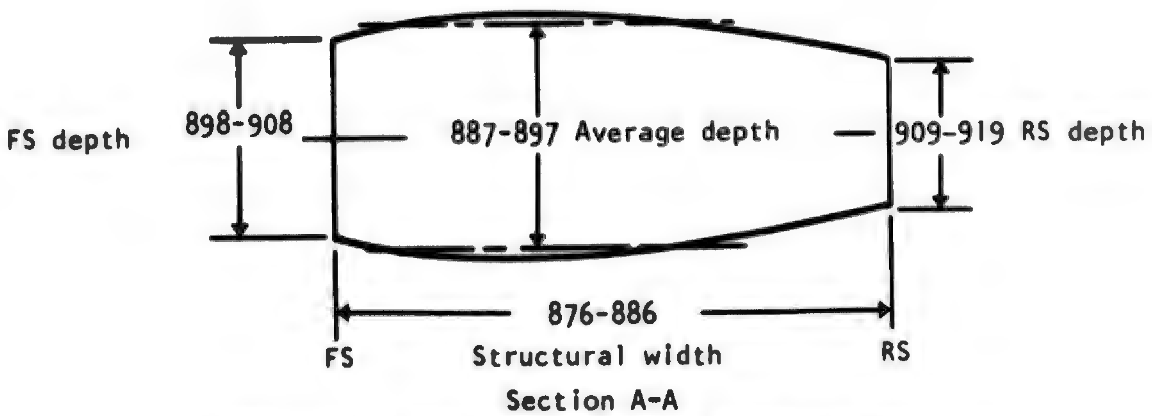


Figure 44. Wing synthesis cuts and box geometry.

Surface Configuration

Variable-Sweep Wing Designs

Data for variable sweep wing pivot analysis are input in locations 195 through 203 (Figure 45), with location 200 as the control data for module execution. Columns 3 and 4 of case control card 2 must contain control code value of (01) for SWEEP evaluation of pertinent airloads and flutter design data. Flutter requirement evaluation by the wing and empennage module consists of determining the envelope of stiffness requirements between the flutter design points for forward and aft wing sweep positions. Flutter analysis control word, location 251, must be specified with the proper value by the user. Required data must be available in locations 252, 253, and 254 for the forward position, and locations 320 through 324 for the aft sweep position. The geometry routines of the module computes the necessary geometric parameters for flutter analysis of the wing in the aft sweep position.

T-Tail Empennage Designs

Empennage configuration is indicated to SWEEP through code information in columns 5 and 6 of case control card 2; T-Tail code is (01). This code will cause proper evaluation of airload and flutter analysis data for the wing and empennage module evaluation of the vertical tail. Input data for the vertical tail must contain additional information for module analysis of T-Tail vertical tail flutter requirements. These are input in locations 310, 335 through 339, and 357 through 360, with location 357 as the analysis control word for T-tail evaluation, and location 251 as the general flutter evaluation control word. Data in locations 252, 253, and 254 must be available, since the flutter analysis is based on envelope requirements for the vertical tail evaluated as a conventional surface and as a T-tail vertical. The T-Tail vertical analysis requires estimates for horizontal tail yaw inertia. One of two methods may be used to provide the proper values for analysis. Method one is to specify the value through input data location 360. The second method is to execute the horizontal tail so that the calculated yaw inertia value will be available for the vertical tail analysis. This option will be executed if location 205 of the horizontal tail input data array is specified as 1.0, and location 360 of the vertical tail input data array is set to zero.

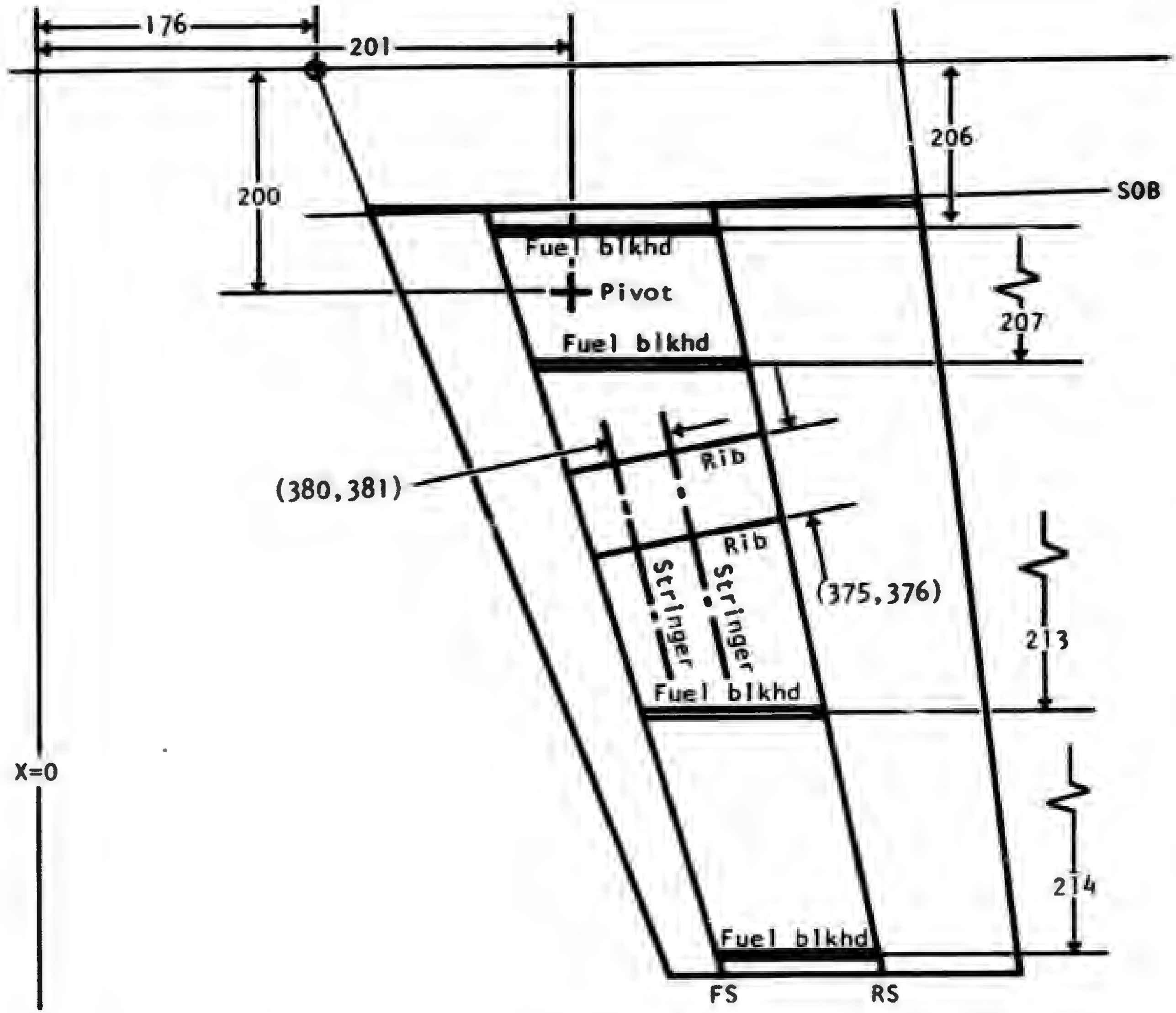


Figure 45. Ribs, stringers, fuel bulkheads, pivot and wing apex locations.

Leading and Trailing Edge Structures

Fixed leading and trailing edge estimates are made from data sets in locations 1205 through 1234 and 1235 through 1279, respectively, organized into separate subsets for wing, horizontal tail, and vertical tail data. The first item for each subset, input unit weight, is the control location to indicate use of the input value or if the value is zero, to estimate the weights based on data found in the other locations.

Input data sets for leading edge control surface device descriptions are in data array locations 1500 through 1575. Locations 1500 through 1529 are used to specify device type and position of three devices (Figures 46 and 47). The control word for existance of a leading edge device is item 1 for each device. Program estimates for the specified device are made based on input geometry and statistical constants if zero is specified in the input unit weight location, item 9. Weight estimation constants for the three different types of leading edge devices that can be analyzed are in 1530 through 1575.

Trailing edge control surface device data sets are in data array locations 1580 through 1819, consisting of subsets for device type and location specifications, weight estimation constants, and weight distribution constants. Spoiler types are defined in locations 1580 through 1609 (Figure 48), with item 1 as the control word for evaluation, and item 8 as the control word for statistical weight estimation. Locations 1610 through 1729 are organized into six subsets of 20 items each for specifying the flap-type devices (Figures 48 and 49). Subsets 1-4 are used for wing analysis; the first three for flaps, and the fourth set to be used to identify ailerons or flaps. Elevators for horizontal tails are defined with the fifth set. The sixth set is used for vertical tail rudder descriptions. Item 2 of each set is used as the control location to identify existance of a device. Item 19 is the input unit weight location which determines if program statistical estimates are to be made. Weight estimation constants for all device types are in 1730 through 1794. Locations 1795 through 1819 contain constants for breakdown of flap-type weights into panel and support components and for estimates of chordwise distributions of support weights.

Miscellaneous Structure and Deadweight Mass Items

Secondary Structure

Estimated weights for secondary structural provisions, fillets, exterior finish, doors, etc, are assumed to be a fractional amount of the estimated

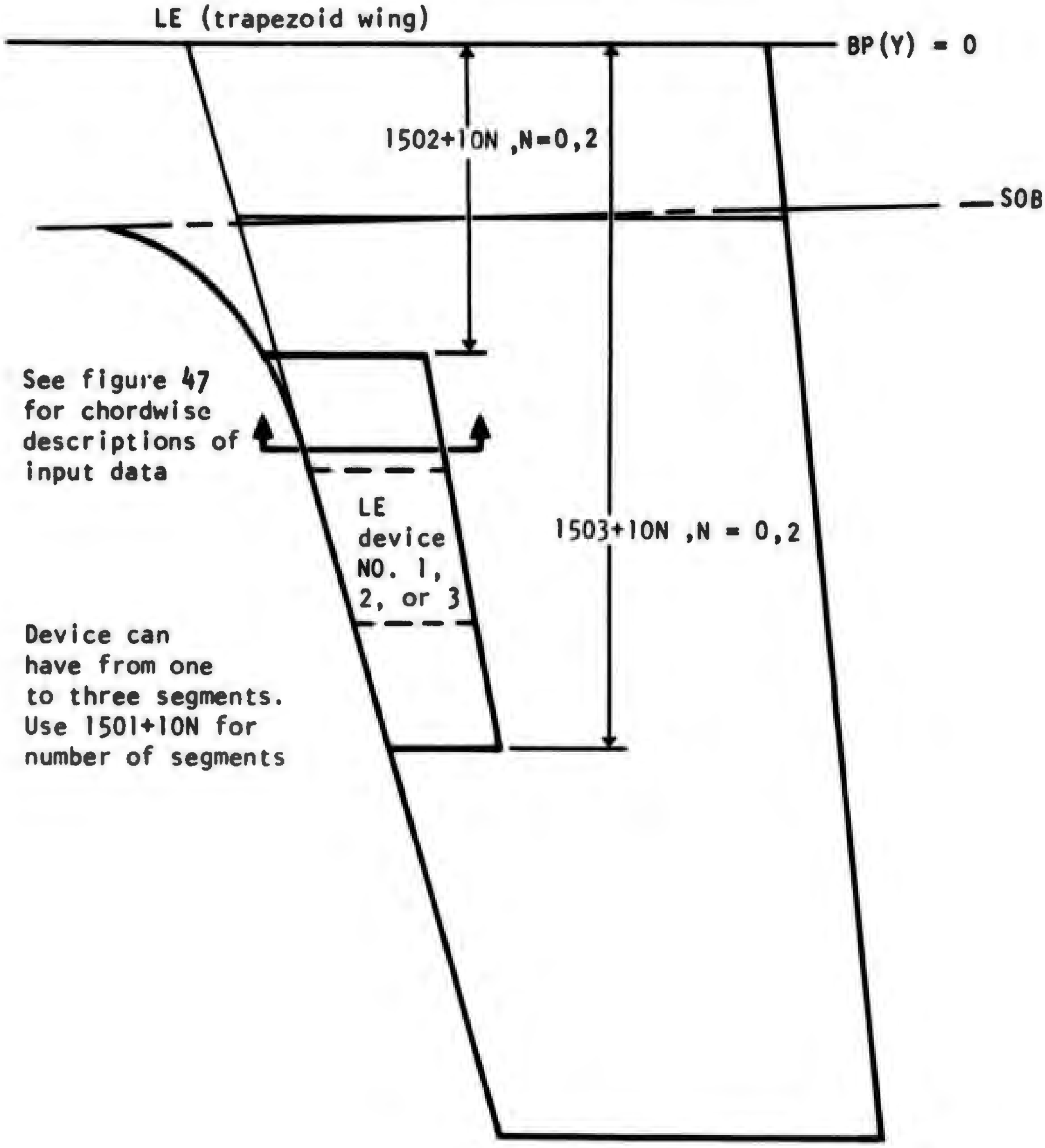


Figure 46. Leading edge device planform.

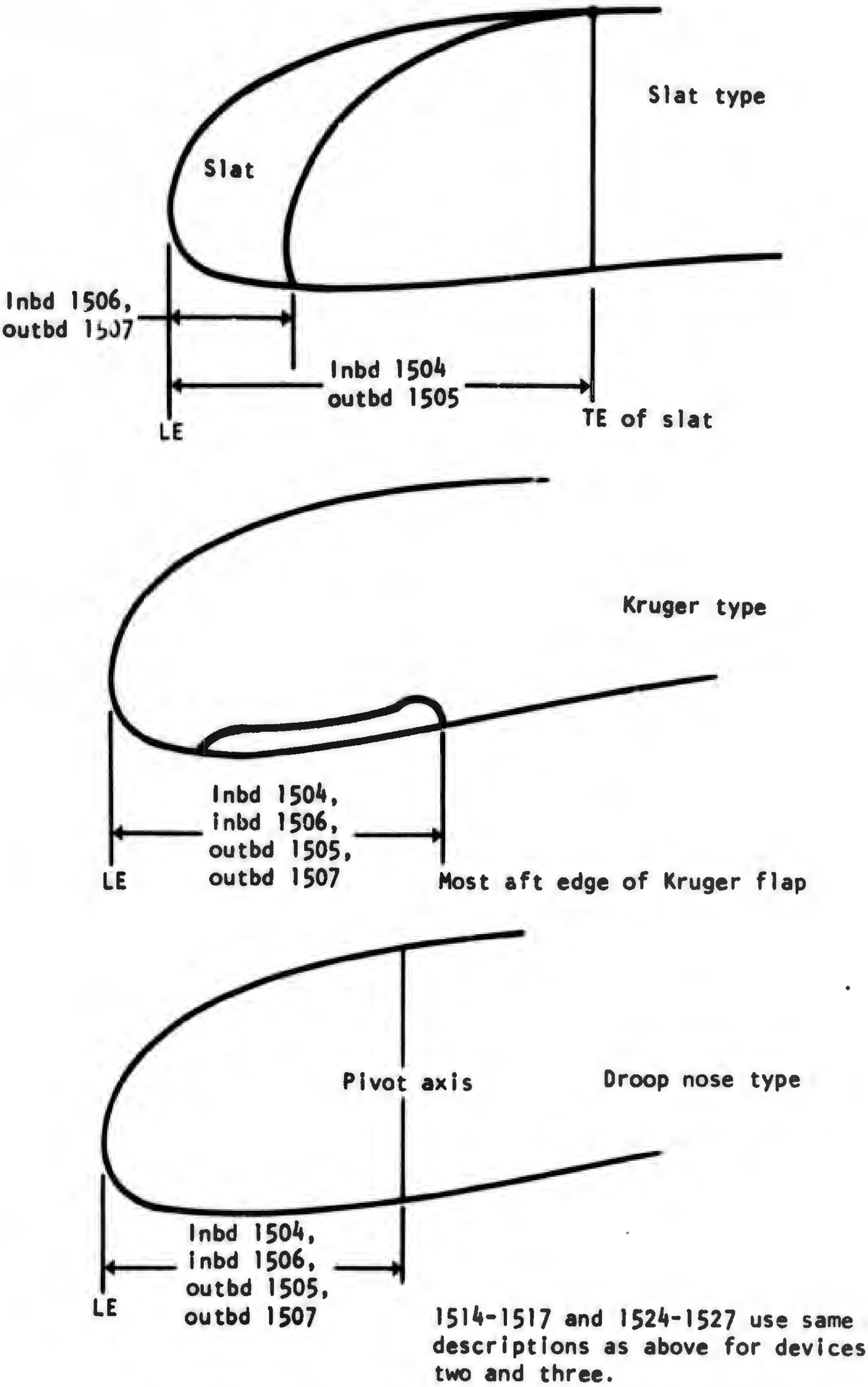


Figure 47. Leading edge device cross sections.

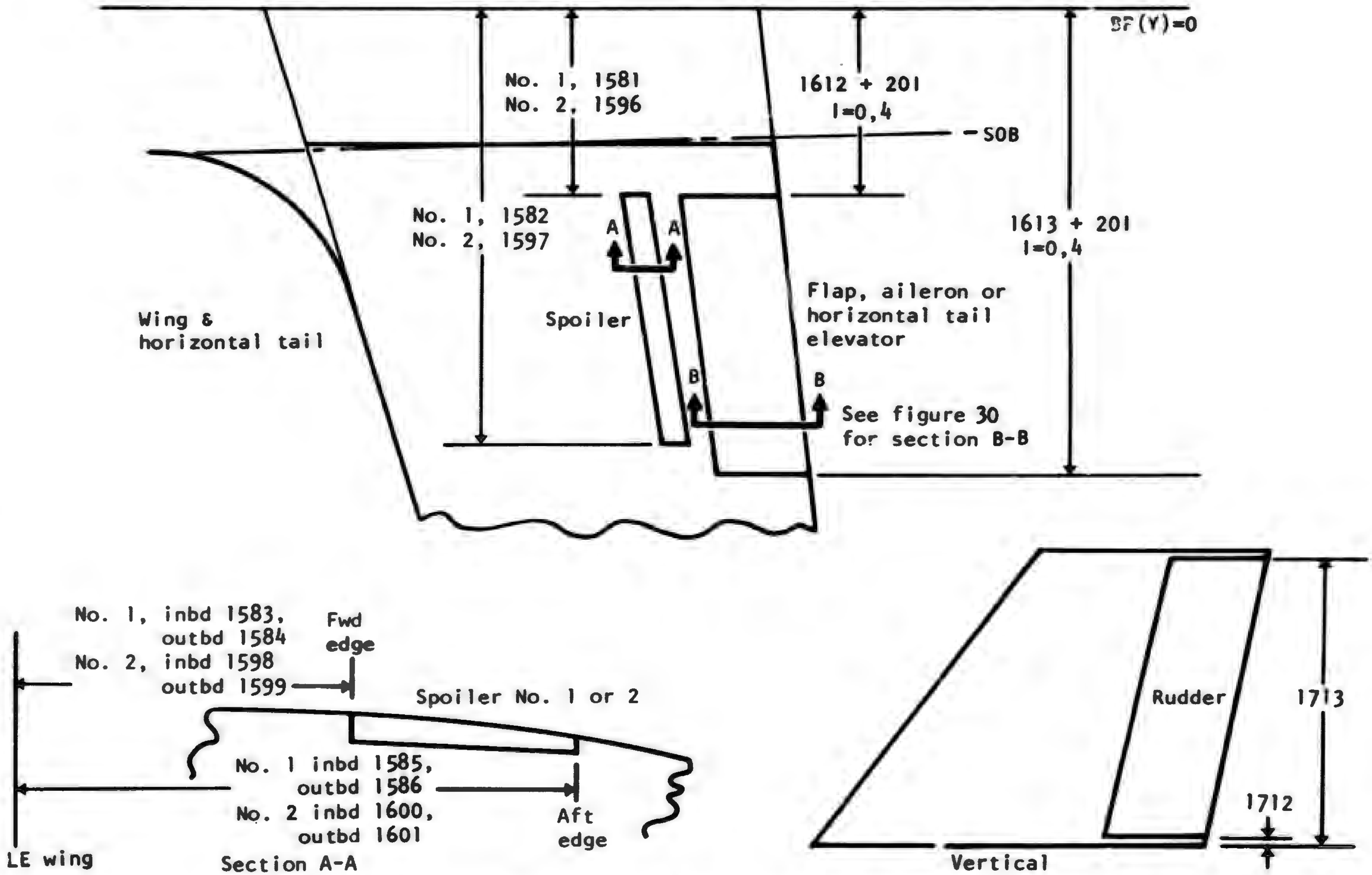
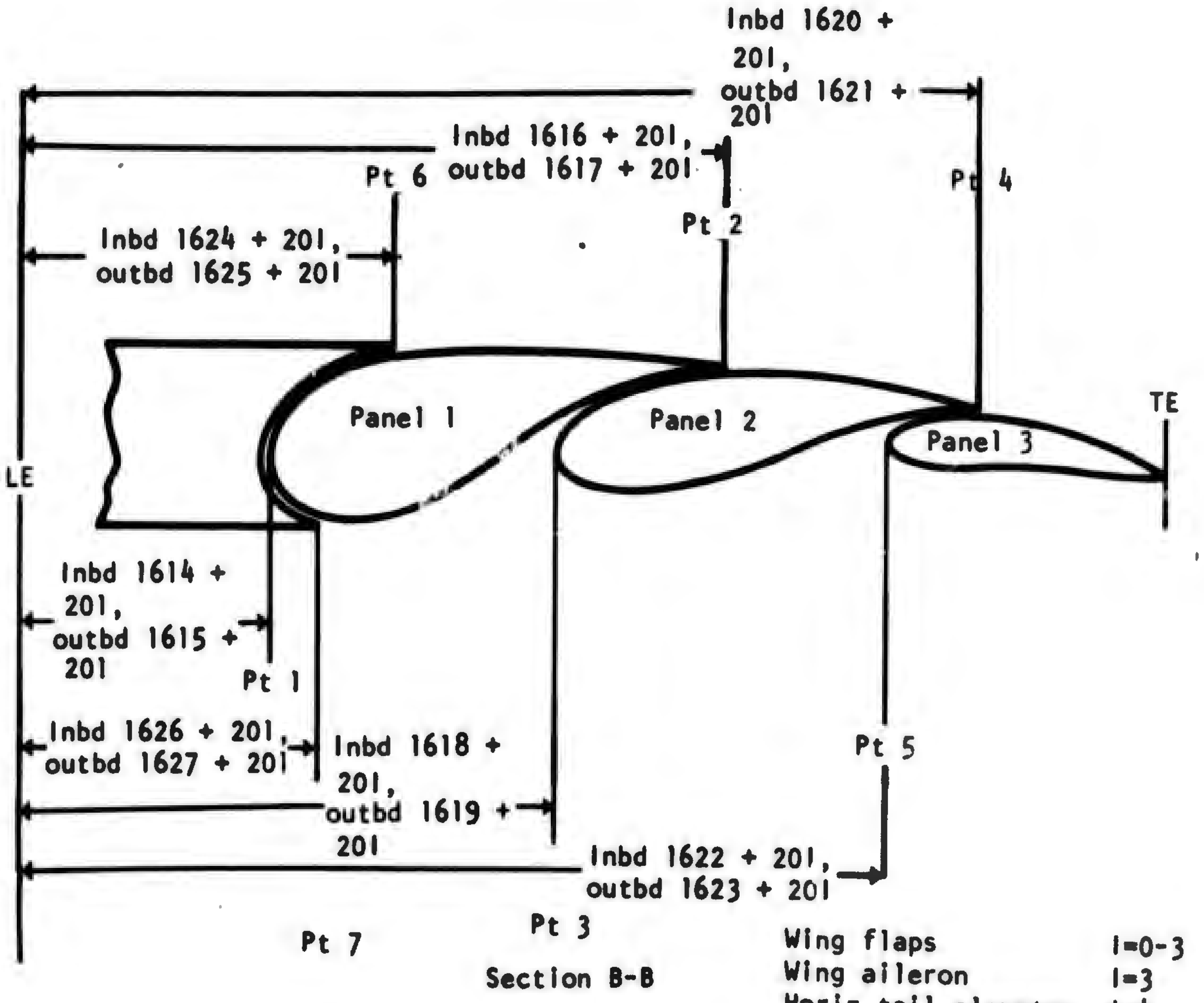


Figure 48. Trailing edge device planforms.



Wing flaps	I=0-3
Wing aileron	I=3
Horiz tail elevator	I=4
Vert tail rudder	I=5

Suggested inputs for different type devices:

Triple-slotted flap - data for all seven pt required.
Double-slotted flap - delete requirements for panel 3; 1620 - 1623 all equal zero.
Single-slotted flap & simple flap - pt 2, 3, 4 & 5 set to zero; 1616-1623 all equal zero.
Aileron - pt 2, 3, 4 & 5 set to zero; 1676-1683 all equal zero.
Elevator - pt 2, 3, 4 & 5 set to zero; 1696-1703 all equal zero.
Rudder - pt 2, 3, 4 & 5 set to zero; 1716-1723 all equal zero. Also, set 1724 equal to 1726 and 1725 equal to 1727.

Figure 49. Trailing edge device cross sections.

outer panel weight. Location 603 contains the weight factor value used to compute this weight. The spanwise distribution is assumed to be proportional to the torque-box weight distribution.

Tip Structure

Tip panel weights for the surface are estimated if the value in data array location 139 is less than 1.0. The data set in locations 1955 through 1969 is used in the statistical estimation.

Internal Fuel

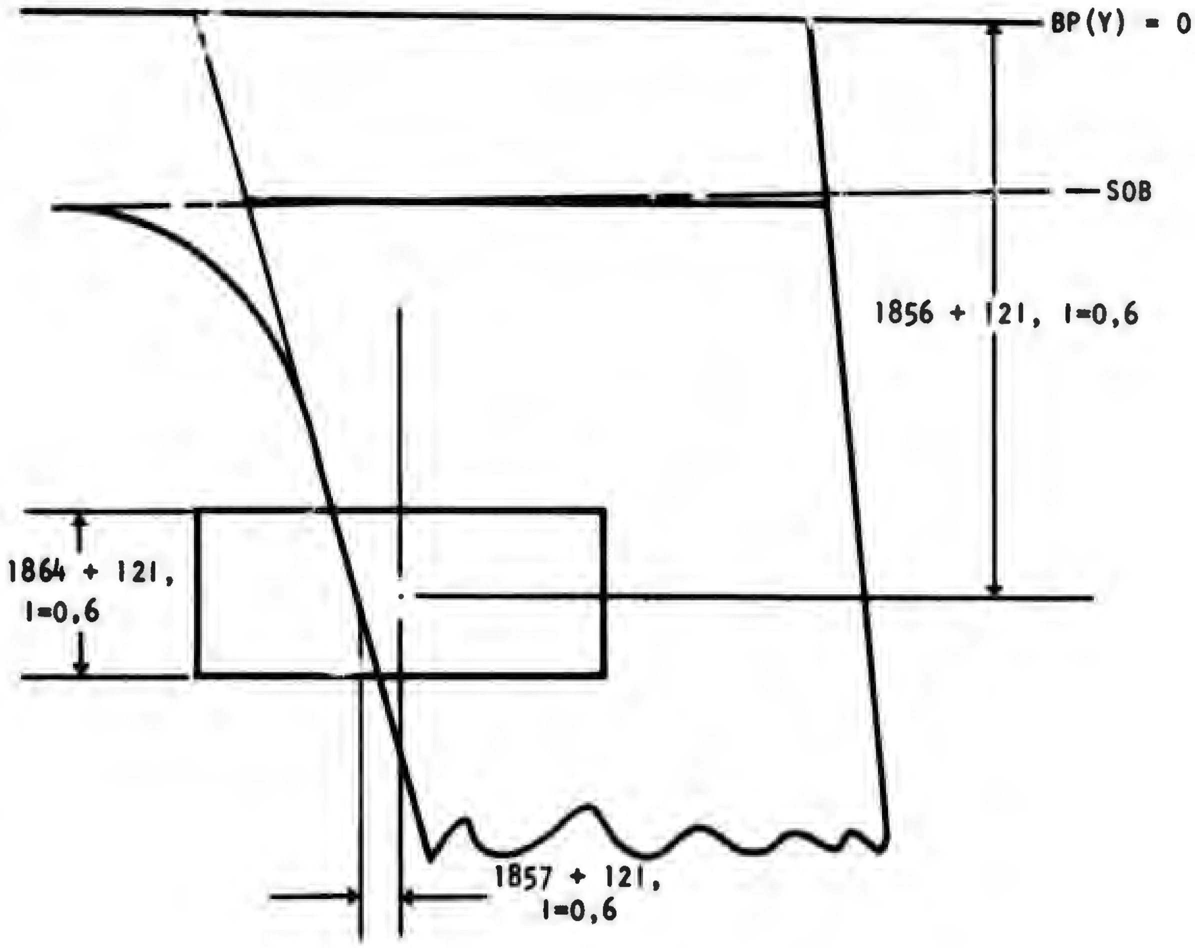
Internal fuel and fuel system descriptions are defined by data in locations 206 through 219 (Figure 43). Two fuel cells can be located within the torque-box. Full-capacity fuel cell mass distributions are estimated first and scaled into required design level values for airload and inertia calculations. Data in locations 89 through 97 and 159 through 166 are used to determine fuel cell content inertia data for net design loads calculations. Data in locations 272 and 273 are used to specify fuel cell loads for computations of mass distribution data for the Flexible Loads Analysis Program. Locations 276 and 277 are used for Flutter Optimization Program data calculations.

External Concentrated Mass Items

Seven external concentrated masses can be described through data array locations 1855 through 1938. Twelve locations are used for mass item (Figure 50). The first four locations are weight and location data, the other eight are used for mass inertia calculations, if required. The mass weight data are used as the control word for each set. Mass items 1 and 2, locations 1855 through 1878, define the masses to be treated as expendable items. Inertia load effects for computations of net design airloads are controlled by data in locations 98 through 101 and 167 through 174. Inertia effects for mass data calculations for the Flexible Loads Analysis Program and the Flutter Optimization Program are controlled with data in locations 274 and 275, and 278 and 279, respectively.

Miscellaneous Internal Contents

Internal mass items other than structure, fuel, and fuel systems are described in locations 1820 through 1854 (Figure 51). Mass data described by this data set is used for inertia loads and mass inertia calculations. Three



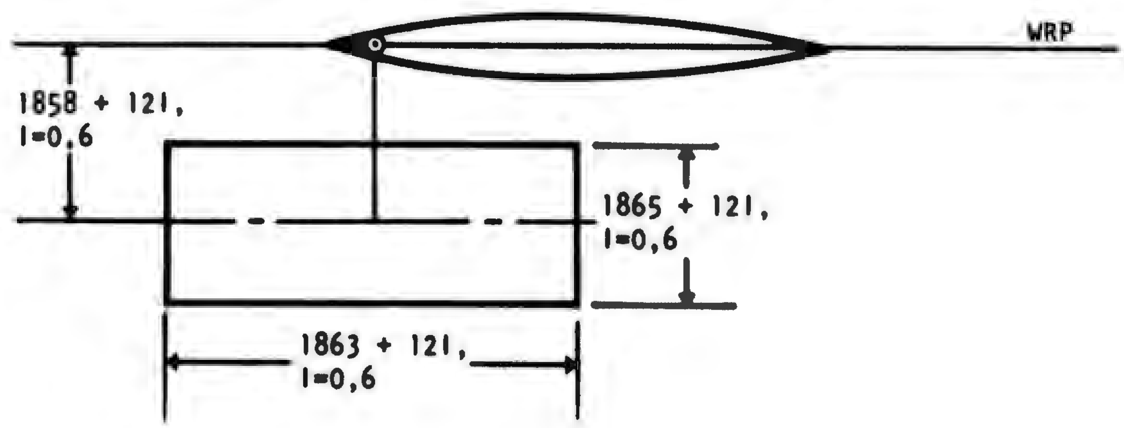


Figure 50. Externally mounted weights.

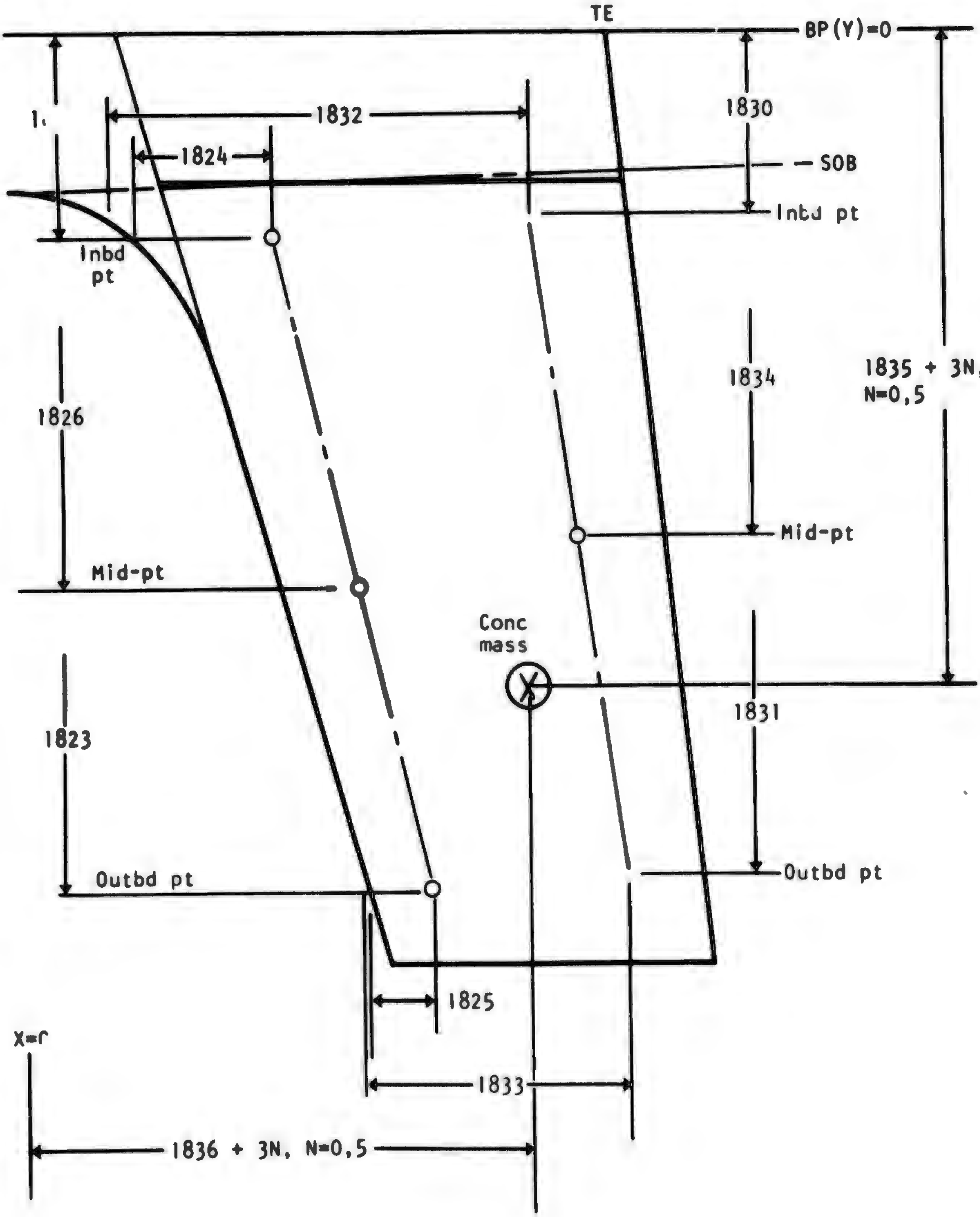


Figure 51. Distributed and concentrated weights.

data subsets are available for describing the mass and distributions. The first, location 1820, defines uniformly distributed weights within the torquebox. The second, locations 1821 through 1836, is for describing items that may be approximated as distributed weights along spanwise lines such as control surface actuation, controls and power lines. Two sets of distribution lines are provided for; each set requiring weight, distribution line position, and spanwise weight distribution specifications. The third set, locations 1837 through 1854, is used to specify weight and locations for up to six concentrated masses, such as large control surface actuators and fittings.

Structural Design Data

Deadweight

Structure weight and mass distribution calculations are always made by the module. The surface weight value to be used during the initial calculations can be specified with location 144. Distribution factors for this weight are in 111, 112, and 113. The control word in location 110 is used to specify whether or not deadweight data are to be used during calculation of net design loads.

Torsional Flutter Requirements

Module calculations of flutter stiffness requirements are controlled with data in locations 251 through 254, 312 through 318, 320 through 324, and 335 through 360. The flutter analysis control word is in 251. Design stiffness values for the 11 structural analysis stations can be input using locations 346 through 356. Flutter analysis results can be scaled using data in locations 312 and 313 through 316, or input of scaling factors for each station in locations 346 through 356.

Design Loads

Airloads data for module analysis can be defined by three options:

1. Analysis by the SWEEP airloads module or input through the WHV LOADS data deck.

2. Module calculations of required airloads data.

3. Input of design load values in the component input data deck

The first option requires no data inputs in the component data deck except for a control word in location 205 to indicate the type of loads data processing to be used. The second option required appropriate data in locations 205, 255, 256, 257 and, as required, in locations 232 through 239. The input area value, location 235, may be used to specify the use of a planform area other than the nominal value in location 240. The input geometry set, locations 235 through 238, may be used to approximate nonlinear planforms with equivalent trapezoidal parameters for use under option 2. Processing of this data set is made only if location 235 is specified as a nonzero, positive number.

The data set in locations 220 through 231 is used to define concentrated airloads data at two locations on the planform, if applicable. Load values computed from this data set are additive to the values computed from distributed airloads. In the third option, design values for airloads are input using the data set in locations 260 through 270, 686 through 719, and 1019 through 1040. Input of torque-box average load intensities instead of shears and moments can be made with data in locations 953 through 1007. These data are processed under control of the code value in location 686. Use of this option results in replacement of SWEEP or module calculated loads data with the input values.

All calculated or input load values are assumed to be for the limit load condition. Computed net design loads are factored with the value found in location 122 to derive ultimate design loads. The synthesis and stress analysis procedures are based on ultimate loads and stress allowables.

The constants in locations 931 through 952 are cover compression and tension load calibration factors. Computed cover load intensity values are multiplied by these factors to account for the crowning effects of the true torque-box section relative to the assumed average rectangular torque-box section. Factors for shear load on the front spar and rear spar are in 842 through 863.

Torque-Box Design Synthesis

Data sets used for definitions of torque-box design are in 361 through 470, 521 through 528, 597, 598, 599, 650 through 671, and 721 through 830. Some of the more important data items in these locations are discussed in the following paragraphs.

Construction Concepts

The torque-box constuction concept for metallic design is specified by code word in locations 361 and 461. Location 361 specifies the stringer type to be used for multirib designs, while location 461 specifies multispar/plate or multispar/honeycomb panel designs. Multirib analysis requires that location 461 be zero and, for multispar designs, locations 361 should be set to 2.0. The values in locations 365, 366, and 375 through 384 must be compatible with the construction concepts. These items are organized for multirib designs. In the multispar analysis, data assigned for ribs and stringers pertain to intermediate spars; the webs are defined by rib data, and the caps are defined by stringer data. The value in location 382 is the number of stringer or intermediate spar elements, with internal arrangement specified by the code value in location 383.

The control code in location 367 indicates if the analysis will be made using data input in locations 721 through 808. Multispar/honeycomb panel data are defined in locations 462 through 468.

Advanced composite construction concepts are specified in locations 430 through 438. Data in locations 375 through 384 and 399 are used for multirib analysis, and data in locations 380 through 383 and 399 are used for multispar plate and honecomb panel designs. The honeycomb panel data in locations 462 and 464 through 468 also are used for the multispar honeycomb panel analysis. Analysis of advanced composite full-depth honeycomb sandwich structures requires bond density value in location 464. The control value in locations 361 and 461 should be compatible with the construction concept code specified in locations 430 and 431 for advanced composite analysis.

Support structure concepts for metallic designs are limited to corrugated sine wave webs for ribs and intermediate spars, and stiffened plate webs for the front and rear spars. Data for these components are specified in locations 400 through 406 for ribs and intermediate spars, and 410 through 426 for the front and rear spars. Corrugated web or honeycomb panel concepts can be specified for advanced composite structures, using construction code values in locations 435, 436, and 437. Honeycomb panel core thickness for these structures are defined in locations 457, 458, and 459, respectively. Data in locations 427 and 428 are needed for the front and rear spar advanced composite analysis. Advanced composite intermediate spar cap areas are derived from cover skin thicknesses based on the factor in location 429.

Torque-Box Analysis Constants

Minimum gage values for metallic analysis are in 370 through 374 and 394. The constants in locations 61, 1472, 1479, and 1480 are used as minimum thickness values for splice and bulkhead calculations. Minimum gages for advanced composite structures are based on minimum laminate layup consisting of eight layers of lamina. Lamina thickness is specified in data location 1162 as part of the material properties data set for advanced composite analysis. Locations 440 through 443 are minimum number of 0-degree plies to be used for upper and lower cover stringer designs.

Stability equation constants for metallic analysis are as follows:

- Locations 362, 363, 364 - Plate buckling coefficients for cover design
- Locations 408 and 409 - Sheet crippling coefficients for cover design
- Location 407 - End fixity coefficient for skin-stringer columns
- Locations 401 and 402 - Local and general-stability coefficients for rib and intermediate spar webs, sine wage corrugation
- Locations 550 through 573 - Table of plate aspect ratio versus stability coefficients for evaluation of shear stress allowables for front and rear spar webs

Stability coefficients for all advanced composite plates and webs, except stringer elements, are analysis routine constants or derived values. Stringer element coefficients are in 598 and 599.

Ultimate Allowable Stresses

Ultimate allowable stress cutoff values for metallic designs can be specified in terms of actual stress values or fractions of the material ultimate stresses. Data locations for input of these values are 385 through 388, 398, 412, and 413. Cutoff stresses for advanced composite analysis can only be specified by adjustments of ultimate stresses specified for 0-degree lamina in locations 1159, 1160, and 1161.

Weight Calibration Factors

The final estimated weights for lifting surfaces are computed by the application of weight factors to derived weights for each of the major structural components of the surface. Specified coefficients are first applied to the structural elements assigned to these components. The total sum of all the major components is then adjusted by a single total surface coefficient, specified in data array location 250.

The major structural components and the weight coefficient data locations are listed in the following paragraphs. Data sets containing element weight coefficients are also identified.

Torque-Box Structure

The coefficient value in location 600 is applied to the outer panel torque-box weight. This coefficient is not applied to the incremental weights necessary to satisfy flutter stiffness requirements. Torque-box element coefficients are in 604 through 627. Shear-tie weight factor is in 520. Locations 1288 through 1294 contain weight factors for the structural attach weights computed for the seven external concentrated masses. The data set in locations 650 through 660 is used to indicate locations of major bulkheads and as weight factors. Locations 1088 through 1107 contain individual panel weight factors and input incremental weights for calibration of torque-box weight and panel distributions.

Pivot Structure

The data set in locations 530 through 536 contains weight coefficients for the pivot structures. Location 530 is the total pivot factor.

Center-Section Structure

Locations 481 through 505 contain the center-section weight coefficient data set. The total center-section factor is location 481. The other factors are organized and used in the same manner as the outer-panel torque-box data.

Leading Edge Structure

The total leading edge structure weight coefficient is in 601. Individual fixed leading edge factors for wing, horizontal tail, and vertical tail are in 1206, 1216, and 1226, respectively. Weight factors for the three control surface devices that may be specified are in 1509, 1519, and 1529.

Trailing Edge Structures

The total trailing edge structure weight coefficient is in 602. Individual fixed trailing edge factors for each surface type are in 1236, 1251, and 1266. Spoiler coefficients are in 1588 and 1603; wing flap-type control surface coefficients in 1629, 1649, 1669, and 1689; elevator coefficient in 1709; and rudder coefficient in 1729.

Tip Structure

Location 1956 contains the weight coefficient for surface tip structure.

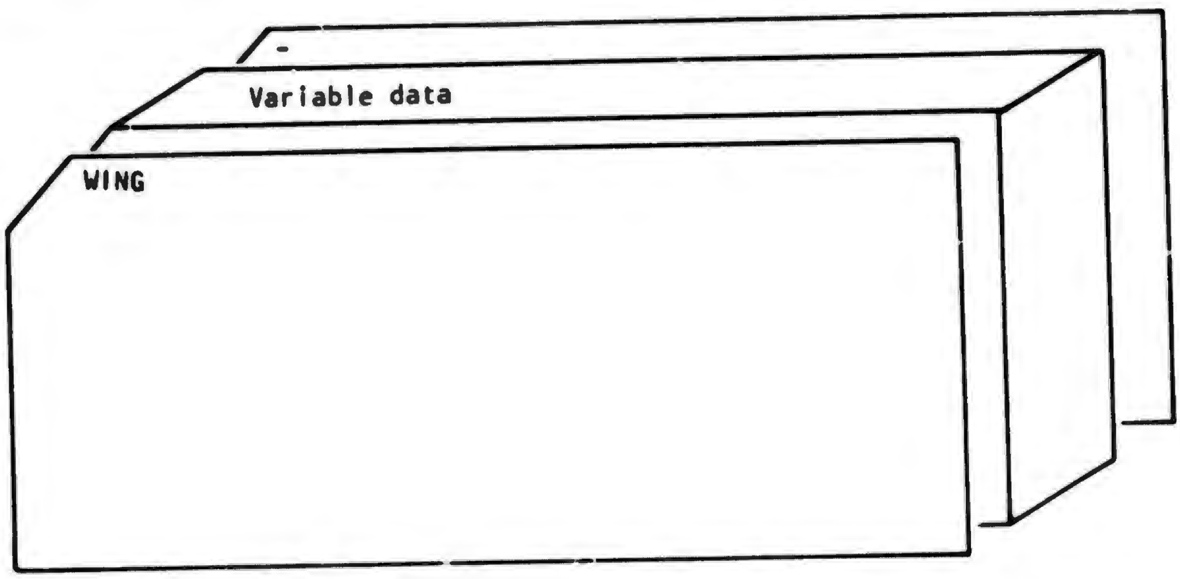
Secondary Structure

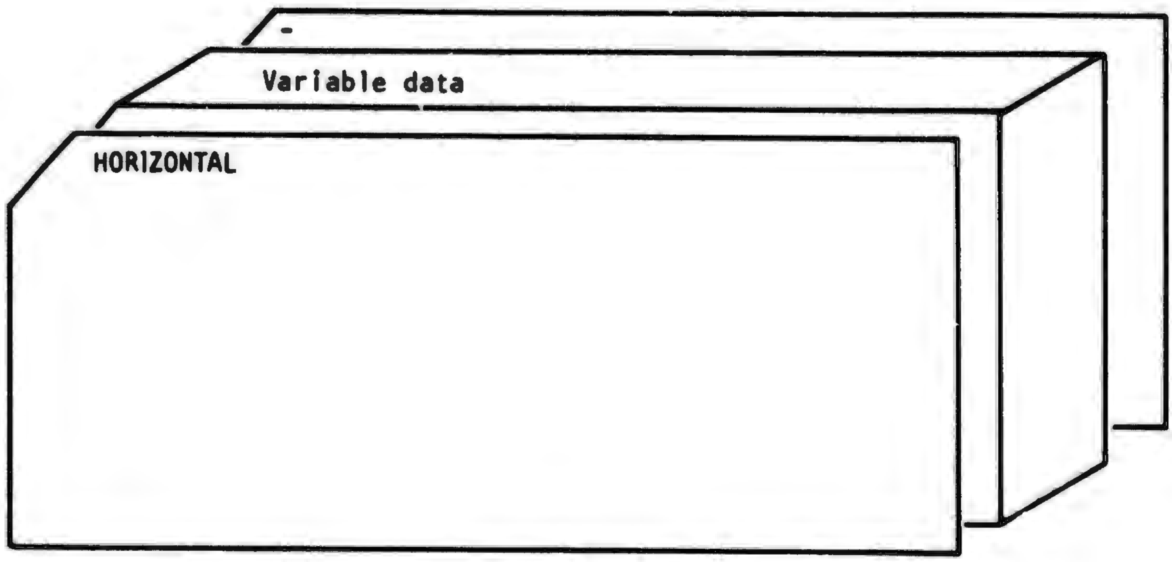
Location 603 contains the weight coefficient for secondary structures. Secondary structure weights are estimated with this factor applied to the total weights computed for the surface, before application of the specified total surface factor in location 250.

INPUT DESCRIPTION

A separate data set is required for each of the wing and empennage components. A complete description of this data set is presented in Table 12. Surface planform geometry descriptions, leading and trailing control surface descriptions, and the type of surface indicator are the only differences in the use of this data.

All of the variables are in the form to be read by subroutine DECRD. This data block must be preceded by one of the appropriate deck identification title cards. The last data card must have a minus sign in column 1. The wing, horizontal, and vertical deck setups are as follows:




Variable data
HORIZONTAL

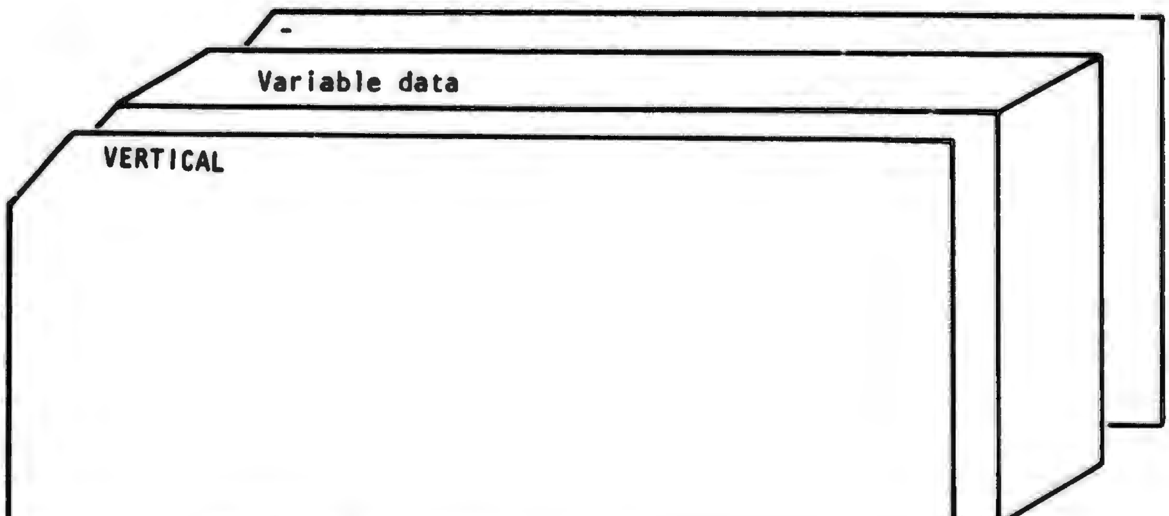

Variable data
VERTICAL

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST

D. LOC	INITIAL VALUE	***DATA DESCRIPTION***
		---- ALL LOCATIONS PRECEDED BY AN ASTERISKS(*) HAVE ---- THE OPTION OF DATA INPUT OR DATA TRANSFERRED FROM THE DATA MANAGEMENT MODULE. THE OPTIONS FOR DATA TRANSFER ARE EXPLAINED IN THE INPUT DESCRIPTIONS BELOW.
1	1.0	CONSTANT=1.0
2	2.0	CONSTANT=2.0
3	3.0	CONSTANT=3.0
4	4.0	CONSTANT=4.0
5	5.0	CONSTANT=5.0
6	6.0	CONSTANT=6.0
7	7.0	CONSTANT=7.0
8	8.0	CONSTANT=8.0
9	9.0	CONSTANT=9.0
10	10.0	CONSTANT=10.0
11	11.0	CONSTANT=11.0
12	12.0	CONSTANT=12.0
13	20.0	CONSTANT=20.0
14	1000.0	CONSTANT=1000.0
15	3.1415927	CONSTANT=PI
16	0.01745329	CONSTANT=PI/180
17	144.0	CONSTANT=144.0
18	24.0	CONSTANT=24.0
19	0.50	CONSTANT=1/2
20	1.5	CONSTANT=1.5
21	0.33333333	CONSTANT=1/3
22	0.95	CONSTANT=0.95
23	1.5	ATT. MISC. FACTOR, SUBR STEAR, STWER
24	1.050	ATT. MISC. FACTOR, SUBR STRIB, NAME=DKMIP
25	0.75	CONSTANT, SUBR STRIB

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

26	0.3555	OPTIMUM RATIO OF STRINGER FLANGE TO WEB
27	0.125	COVER MISC. CONSTANT
28	0.4292	COVER MISC. CONSTANT
29	0.75	RIVET SPACING
30	0.001	SEARCH CONSTANT, SUBR STBAR
31	1.01	SEARCH CONSTANT, SUBR TSCH
32	0.05	SEARCH CONSTANT, SUBR TSCH
33	10.0	SEARCH CONSTANT, SUBR TSCH
34	0.01	SEARCH CONSTANT, SUBR TSCH
35	0.045	SEARCH CONSTANT, SUBR TSCH
36	0.95	SEARCH CONSTANT, SUBR BOT
37	0.995	SEARCH CONSTANT, SUBR SFSCH
38	0.9	SEARCH CONSTANT, SUBR SFSCH
39	0.1	SEARCH CONSTANT, SUBR SFSCH
40	1.5	ROOT RIB CAP CONSTANT
41	0.5	REDUCED MODULUS(ER) CONSTANT FOR FLAT PLATES
42	0.5	REDUCED MODULUS(ER) CONSTANT FOR FLAT PLATES
43	0.25	REDUCED MODULUS(ER) CONSTANT FOR FLAT PLATES
44	0.75	REDUCED MODULUS(ER) CONSTANT FOR FLAT PLATES
45	0.83	SPAR WEB GEN. INSTAB. RED. MOD.(ERG) CONSTANT
46	0.17	SPAR WEB GEN. INSTAB. RED. MOD.(ERG) CONSTANT
47	0.0	NOT USED
48	0.0	NOT USED
49	0.0	NOT USED
50	0.25	CONSTANT (1/4)
51	0.66667	CONSTANT (2/3)
52	0.002	CONSTANT (.002)
53	0.0	NOT USED
54	0.78539795	CONSTANT, SUBR BHDJT, STWER
55	0.0	NOT USED

56	1.5	CONSTANT, SUBR BHDJT
57	0.25	CONSTANT, SUBR BHDJT
58	0.25	CONSTANT, SUBR BHDJT, LSPLO(1)
59	0.75	CONSTANT, SUBR BHDJT, USPLO(2)
60	1.5	CONSTANT, SUBR BHDJT, USPLO(3)
61	0.156	CONSTANT, SUBR BHDJT, LSPLO(4)
62	1.3333	CONSTANT, SUBR BHDJT, LSPLO(5)
63	1.25	CONSTANT, SUBR BHDJT, USPLO(6)
64	0.0001	SEARCH CONSTANT, SUBR EOT, TSCH, SFSCH, STRIB
65	50.0	CONSTANT, MIN STRESS, SUBR, CNSTC, CNSTR
66	25.0	CONSTANT, MIN STRESS, SUBR CNSTC
67	0.50	CONSTANT, MIN RATIO, TSKIN/TBAR, SUBR CNSTC
68	0.70	CONSTANT, MAX RATIO, TSKIN/TBAR, SUBR CNSTC
69	1.0750	ATT. MISC FACTOR, SUBR RTRIB
70	0.656	EFFICIENCY FACTOR, INTEGRAL I-STR
71	1.03	EFFICIENCY FACTOR, INTEGRAL Z-STR
72	0.911	EFFICIENCY FACTOR, RIVETED Z-STR
73	0.05	WING MISC. WT. FACTOR
74	0.50	LOWER COVER COMP. NX FACTOR(CKNX1), SUBR CNSTR
75	0.0	NOT USED
76	0.0	NOT USED
77	0.0	NOT USED
78	0.0	NOT USED
79	0.5	FUEL VOL. CALC FACTOR(DLFLD), SUBR FDIS
80	0.0	TAKE-OFF GROSS WEIGHT 1 =TOGW(1) POUNDS
* 81	0.0	TAKE-OFF GROSS WEIGHT 2 =TOGW(2) POUNDS
		-- IF D(81)&D(82)=0.0, DATA TRANSFERRED --
82	0.0	TAKE-OFF GROSS WEIGHT 3 =TOGW(3) POUNDS
83	0.0	CURRENT CASE NUMBER. LOAD DESIRED CASE NUMBER. IF ZERO IN FIRST CASE, 1 IS

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                     ASSUMED.  FOR ALL FOLLOWING CASES IF=0,
                     1 IS ADDED TO LAST CASE NC.  IF NOT 0,
                     CASE NO IS NOT CHANGED

   84     0.0       NOT USED
 * 85     0.0       POSITIVE VERTICAL LOAD FACTOR-LIMIT =DPNZ
                 -- IF D(85)&D(88)=0.0, DATA TRANSFERRED --

 * 86     0.0       NEGATIVE VERTICAL LOAD FACTOR-LIMIT =DNNZ
                 -- IF D(86)&D(88)=0.0, DATA TRANSFERRED --

 * 87     0.0       MAX DYNAMIC PRESSURE, Q, AT V(L) = QVL   LB/SQ FT
                 -- IF D(87)&D(88)=0.0, DATA TRANSFERRED --

 * 88     0.0       BASIC TAKE-OFF GROSS WEIGHT = TOGWO        POUNDS
                 -- CONTROL LOC. FOR DATA BLOCK (81,85,86, --
                   87,89,91,93,94,96,98,100 & 1280)
                      OPTIONS: >0.0 SKIP TRANS. OF DATA
                                    BLK. AND INPUT TOGW FOR
                                    D(88).                    POUNDS
                               =0.0 TEST EACH LOC. OF DATA
                                    BLOCK FOR TRANSFER. D(83)
                                    TRANSFERRED FROM G.D.

 * 89     0.0       TOTAL FUEL FOR BASIC TAKE-OFF GW = TOFL(1) LB/AV
                      USED FOR CALC. BASIC FLIGHT DESIGN GW,
                      DGWO, FOUND IN D(105).
                      IF POUNDS, SET D(93) = 1.0
                      IF GALLONS, SET D(93) = LB/GAL
                 -- IF D(88)&D(89)=0.0, DATA TRANSFERRED --

   90     0.0       FUEL IN TOGW(1) = TOFL(2).                  LB/AV
                      SIMILAR TO D(89)
 * 91     0.0       FUEL IN TOGW(2) = TOFL(3)                   LB/AV
                      SIMILAR TO D(89)
                 -- IF D(88)&D(91)=0.0, DATA TRANSFERRED --
```

```
   92       0.0      FUEL IN TOGW(3) = TOFL(4)                          LB/AV
                        SIMILAR TO D(89)

 * 93       0.0      FUEL DENSITY = DFUEL                               LB/UNIT
                        TO BE USED WITH D(89-92) TO CALCULATE
                        FUEL LOAD FOR TOGWO, TOGW(1,2,3)
                    -- IF D(88)&D(93)=0.0, DATA TRANSFERRED --

 * 94       0.0      CONSUMED FUEL OUT TO DESIGN GW = DLFL(1)
                        FOR TOGWO, TO COMPUTE DGWO
                        IF LESS THAN 1, FRACTION OF FUEL
                        INDICATED IN D(89).
                        IF GREATER THAN 1, POUNDS OR GALLONS
                    -- IF D(88)&D(94)=0.0, DATA TRANSFERRED --

   95       0.0      CONSUMED FUEL FOR TOGW(1) = DLFL(2)
                        SIMILAR TO D(94)
 * 96       0.0      CONSUMED FUEL FOR TOGW(2) = DLFL(3)
                        SIMILAR TO D(94)
                    -- IF D(88)&D(96)=0.0, DATA TRANSFERRED --

   97       0.0      CONSUMED FUEL FOR TOGW(3) = DLFL(4)
                        SIMILAR TO D(94)

 * 98       0.0      USEFUL LOAD DELTA WT. REMOVED FROM
                      TOGW(0),D(88), TO OBTAIN DGW(0)                   LBS/AV
                    -- IF D(88)&D(94)=0.0, DATA TRANSFERRED --

   99       0.0      USEFUL LOAD DELTA WT. REMOVED FROM
                      TOGW(1), D(80), TO OBTAIN DGW(1)                  LBS/AV

 * 100      0.0      USEFUL LOAD DELTA WT. REMOVED FROM
                      TOGW(2), D(81), TO OBTAIN DGW(2)                  LBS/AV
                    -- IF D(88)&D(100)=0.0, DATA TRANSFERED --

   101      0.0      USEFUL LOAD DELTA WT. REMOVED FROM
                      TOGW(3), D(82), TO OBTAIN DGW(3)                  LBS/AV
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		NOTE: LOC D(102) THRU D(105) ARE COMPUTED BY SURP CASE. NO INPUT REQD.
106-109		NOT USED
110	1.0	ID DEAD WT. DISTRIBUTION, INERTIA LOADS CALC OPTIONS: 0.0 NO DEAD WT. DIST. THIS CONDITION MAY BE DESIRED WHEN NET LOADS ARE INPUTED. 1.0 DO DEAD WT. DIST.
111	0.0	NOT USED
112	0.0	NOT USED
113	0.725	CONSTANT DATA-DWT ADJUSTMENT FOR NEXT ITERATION OF WING BOX.
114	0.667	CONSTANT DATA-Y-BAR ADJUSTMENT FOR NEXT ITERATION OF WING BOX.
115	1.0	CONSTANT DATA-ADJUSTMENT TO PANEL CENTROID FOR CHANGE IN NX - STRINGERS ONLY-
116	0.6	CONSTANT DATA-SAME AS D(115) EXCEPT FOR PLATES ONLY-
117	0.985	CONSTANT DATA-CENTROID OF PANEL AS FRACTION OF TOTAL DEPTH.
118-121	0.0	NOT USED
122	1.5	LOAD SAFETY FACTOR-TO CONVERT FROM LIM TO ULT
123		NOT USED
124	0.920	CONSTANT DATA-PIVOT
125	0.15	FS LOC AS FRACTION OF WING CHORD AT BP

		INDICATED IN LOC. D(128)-YOU HAVE OPTION TO CHANGE.
126	0.60	RS LOC. AS FRACTION OF WING CHORD AT BP. INDICATED IN LOC. D(128)-YOU HAVE OPTION TO CHANGE.
127	0.40	EA LOC. AS FRACTION OF WING CHORD AT BP INDICATED IN LOC. D(128)-YOU HAVE OPTION TO CHANGE.
128	0.0	SPANWISE LOC. FOR INBD BOX DATA D(125)-D(127) OPTIONS: 0.X FRACTION OF SEMISPAN; XX.X BUTTOCK PLANE INCHES
129	1.0	SPANWISE LOC. FOR OUTBD BOX DATA D(135)-D(137) OPTIONS: 0.X FRACTION OF SEMISPAN; XX.X BUTTOCK PLANE INCHES
130	0.0	NOT USED
131	0.0	NOT USED
132	0.0	NOT USED
133	0.0	NOT USED
134	0.0	NOT USED
135	0.15	FS LOC. AT BP IN D(129)-SEE D(125) FOR OPTIONS.
136	0.60	RS LOC. AT BP IN D(129)-SEE D(126) FOR OPTIONS.
137	0.40	EA LOC. AT BP IN D(129)-SEE D(127) FOR OPTIONS.
* 138	0.25	FRACTION OF CHORD FOR ELEMENT ANGLE IN D(242). -- IF D(138),D(242)&D(240)=0.0, DATA TRANS. --

NOTE: DATA LOC D(139) = OUTBOARD CONTROL STATION USED TO LOCATE TORQUE-BOX ON THE EXPOSED PANEL, IF STRUCTURAL STATIONS ARE NOT INPUT. BUTTOCK PLANE STATION CALC FROM THIS ITEM = BP OF STRUCT STA 11. PROGRAM

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		WILL TREAT STRUCTURES OUTBD OF THIS STA- TION TO THE TIP STA AS THE SURFACE TIP STRUCTURE.	
139	0.975	SPANWISE CONTROL STATION FOR Y(11). OPTIONS: 0.0, 1.0 USE B/2 STATION 0.XX FRACTION OF B/2 XX.X BUTTOCK PLANE STATION	IN
140		NOT USED	
141	0.0	SPANWISE LOC. FOR T/C VALUE IN D(243). OPTIONS: 0.X FRACTION OF SEMISPAN XX.X BUTTOCK PLANE	INCHES
142	1.0	SPANWISE LOC. FOR T/C(TP)/T/C(RT) VALUE IN D(245). OPTIONS: SAME AS D(141)	
		NOTE: D(143), D(145) THRU D(152) USED FOR AIRFOIL DESCRIPTION. LOCAL DEPTH AT X/C PT ON AIRFOIL, EVALUATED: A. F(POLYNOMIAL FIT). EQUATION CONSTANTS STORED IN DATA BANK, DAF ARRAY, LOC 1-99. B. F(ST. LINE INTERPOLATION OF DEPTH VS X/C TABLES). DATA SET STORED IN DATA BANK, DAF ARRAY, LOC 101-500.	
143	2.0	IC TYPE OF AIRFOIL AND DATA SET EVALUATION. OPTIONS: 1.0 - 8.0 AIRFOIL TYPE BASED ON CURVE FIT DATA-- 1.0 = NACA 6300 AIRFOIL 2.0 = NACA 6400 AIRFOIL 3.0 = NACA 6500 AIRFOIL 4.0 = NACA 6600 AIRFOIL 5.0 = WEDGE AIRFOIL 6.0 = ARC AIRFOIL 7.0, 8.0 NOT USED NOTE: THIS OPTION WILL RESULT IN	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		CONSTANT SHAPE AIRFOIL FROM ROOT TO TIP. DATA IN D(145) THRU D(152) NOT REQUIRED.
		5.0 = AIRFOIL TYPE BASED ON ST LINE FIT DATA. DATA REQUIRED IN D(145) THRU D(152) TO SPECIFY SHAPE DATA SET TO BE USED AND TO LOCATE REF. LOC. ON SURFACE SPAN. ONE TO FOUR DIFF. SHAPES CAN BE SPECIFIED. WITH INTERMEDIATE LOCAL DEPTHS BASED ON DOUBLE INTERPOLATION OF NORMALIZED DEPTH DATA.
• 144	0.0350	SURFACE WT (LB/SIDE) FOR INITIAL STRUCT WT DIST OPTIONS: 0.XXX FRACTION OF DGWO XXX.X TOTAL WT/SIDE 0.0 EST. TRANSFERED FROM GD
145	0.0	SPANWISE LOC. FOR AIRFOIL NO.1 OPTIONS: 0.0 NOT USED 0.X FRACTION OF SEMISPAN XX.X BUTTOCK PLANE INCHES
146	0.0	SPANWISE LOC FOR AIRFOIL NO.2-SAME OPTIONS AS D(145)
147	0.0	SPANWISE LOC. FOR AIRFOIL NO.3-SAME OPTIONS AS D(145)
148	0.0	SPANWISE LOC. FOR AIRFOIL NO.4-SAME OPTIONS AS D(145)
149	0.0	ID TYPE OF AIRFOIL TO BE LOCATED AT STA. SPECIFIED IN D(145). USE NOS 1.0 TO 5.0 TO DENOTE

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                  THE TABULATED DEPTH DATA SET TO BE USED FROM
                  DATA BANK ARRAY DAF, LOC(150-399).
                     NOTE: AIRFOIL DEPTH ORDINATES STORED IN SETS
                           OF 50 ITEMS/BLOCK STARTING AT DAF(150)
                           DAF(100-149) CONTAINS THE REF X/C DATA
                              **X/C BLOCK**
                             DAF(100) = NO. OF X/C PTS.
                             DAF(101-148) = X/C VALUES.
                             DAF(149) NOT USED
                               **DEPTH BLOCK 1**
                             DAF(150) = AIRFOIL ID -- REF ONLY
                             DAF(151-198) = AIRFOIL DEPTHS AT X/C
                                     POINTS IN DAF(101-148).
                             DAF(199) = MAX VALUE OF AIRFOIL
                                     DEPTHS IN SET.  VALUE USED
                                     FOR NORMALIZING.
                               **OTHER BLOCKS SAME SETUP AS 1**

                           FOR 2 OR MORE AIRFOILS SPECIFIED:
                             CONSTANT AIRFOILS ARE ASSUMED INBD
                             OF THE FIRST PT. AND OUTBD OF THE
                             OUTER MOST PT.

                           CURRENT SETUP FOR DAF(100-399):
                             NO. OF X/C PTS = 0.0
                             DEPTH BLOCK 1 =  NO DATA
                                         2 =  NO DATA
                                         3 =  NO DATA
                                         4 =  NO DATA
                                         5 =  NO DATA

                           ACTUAL CHORD LENGTHS ARE USED FOR CALC
                             OF X/C AND LOCAL AIRFOIL DEPTHS--FOR
                             BLENDED AND CRANKED WING PLANFORMS,
                             THE DELTA CHORD LENGTH DATA ARE USED

150      0.0          ID TYPE OF AIRFOIL TO BE LOCATED AT STA. SPECI-
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		FIED IN D(146). SAME AS D(149).
151	0.0	ID TYPE OF AIRFOIL TO BE LOCATED AT STA. SPECIFIED IN D(147). SAME AS D(149).
152	0.0	ID TYPE OF AIRFOIL TO BE LOCATED AT STA. SPECIFIED IN D(148). SAME AS D(149).
153	20.0	NO OF EQUALLY SPACED CHORDWISE CUTS FOR NUMERICAL INTEG. OF T-BOX X-SEC AREA AT EACH STA
154	0.0	NOT USED
155	0.0	NOT USED
156	1.5	CONSTANT DATA-PIVOT E/D=EDGE DISTANCE/DIAMETER
157	5.5	-PIVOT D/T=DIAMETER/THICKNESS
158		NOT USED

* D(159)-D(174) IS USED FOR SEQUENCING THE REMOVAL OF FUEL AND USEFUL LOAD FROM FUEL CELLS 1&2 AND STORE STATIONS 1&2 FOR CALC OF INERTIA LOADS AT THE DESIGN GROSS WT. CONDITION. MAX AMOUNT REMOVED WILL BE DEPENDANT ON A). WING FUEL AND STORE LOADING DATA B). DELTA FUEL AND USEFUL LOAD DATA IN D(94) THRU D(101).

OPTIONAL INPUTS FOR D(159)-D(174)-

0.0=NO FUEL WT. OR STORES REMOVED FROM INDICATED FUEL CELL OF STORE STATION.

1.0=REMOVE WT. FROM INDICATED FUEL CELL OR STORE STATION FIRST.

2.0=REMOVE WT. FROM INDICATED FUEL CELL OF STORE STATION SECOND.

NOTE: AFTER REMOVING FUEL AND USEFUL LOAD DELTA WTS. FROM THE FUEL CELLS AND STORE STATIONS THE REMAINDER(IF ANY) IS REMOVED FROM THE FUSELAGE FUEL &

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		USEFUL LOAD WTS. TO ARRIVE AT THE DGW(S) DEFINED IN D(80) THRU D(101).	
159	1.0	IF FUEL CELL NO.1-TOGW(0) D(88)	
160	1.0	-TOGW(1) D(80)	
161	1.0	-TOGW(2) D(81)	
162	1.0	-TOGW(3) D(82)	
163	2.0	IF FUEL CELL NO.2-TOGW(0)-D(88)	
164	2.0	-TOGW(1)-D(80)	
165	2.0	-TOGW(2)-D(81)	
166	2.0	-TOGW(3)-D(82)	
167	0.0	IF STORE STATION NO.1-TOGW(0)-D(88)	
168	0.0	-TOGW(1)-D(80)	
169	0.0	-TOGW(2)-D(81)	
170	0.0	-TOGW(3)-D(82)	
171	0.0	IF STORE STATION NO.2-TOGW(0)-D(88)	
172	0.0	-TOGW(1)-D(80)	
173	0.0	-TOGW(2)-D(81)	
174	0.0	-TOGW(3)-D(82)	
		** D(175) THRU D(178) DEFINE THE WING ** REFERENCE POINT FOR THE LOCATION OF THE WING WITH RESPECT TO THE BODY	
* 175	0.0	SPANWISE REFERENCE FOR WING REFERENCE POINT -BP(Y) -- IF DM RUN THEN D(175) ALWAYS SET =0.0 --	INCHES
* 176	1000.0	FUSELAGE REFERENCE FOR INTERSECTION OF WING REFERENCE POINT & FUSELAGE STATION --IF DM RUN THEN D(176) ALWAYS SET = WING APEX --	INCHES
* 177	0.0	WING REFERENCE CHORD FOR BP(Y) IN D(175) -- IF DM RUN THEN D(177) ALWAYS SET =0.0 --	INCHES

* 178	0.0	X/C OR DISTANCE FROM LE FOR PT. IN D(178) -- IF DM RUN THEN D(178) ALWAYS SET =0.0 --
179-185		NOT USED
186	1.0	ID PIVOT DEPTH OPTIONS: 0.0 DEPTH WITHIN W.M.L. 1.0 OUTBD LUG WITH IN W.M.L. >1.0 DEPTH INCHES
187-188		NOT USED
189	0.85	REDUCTION FACTOR FOR TENSION ULT. STRESS ALLOWABLE FOR PIVOT MAT'L. YOU HAVE OPTION TO CHANGE.
190	1.0	RATIO - FSU(PIN)/FSU(PIVOT)
191	1.0	RATIO - DENSITY(PIN)/DENSITY(PIVOT)
192	4.831350	CKA-CONSTANT FOR CURVE FIT, BUCKLING CONSTANT VS. PANEL ASPECT RATIO.
193	0.72065	CKB-CONSTANT FOR CURVE FIT-SEE 192
194	4.-0	CKC-CONSTANT FOR CURVE FIT-SEE 192
195	0.0	PIVOT BEARING STRESS-DESIRED LEVEL FOR THE DESIGN LBS/SQ IN
* 196	0.0	PIVOT MAT'L NUMBER-SEE MAT'L LIBRARY IF ZERO PROGRAM USES WING MATERIAL
*197	0.0	PIVOT MAT'L TEMPERATURE. DEGREES FAHRENHEIT
198	0.0	PIN OUTER DIAMETER. OPTIONS: 0.0 USE STRESS IN D(195) X.X BEARING STRESS CALC. FROM INPUT DATA.
* 199	0.0	NUMBER OF SWEEP POSITIONS OF THE PIVOT TO BE CONSIDERED IN ADDITION TO THE INITIAL

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                          POSITION.
                       -- IF =0.0, TRANSFER DATA --

* 200      0.0           SPANWISE LOC. FOR PIVOT
                             OPTIONS:  0.X FRACTION OF SEMISPAN
                                      XX.X BUTTOCK PLANE              INCHES
                       -- IF =0.0, TRANSFER DATA --

* 201      0.0           CHORDWISE LOC. FOR PIVOT
                             OPTIONS: 0.X FRACTION OF LOCAL CHORD
                                          FROM LE.
                                     XX.X DIST.FROM LE                INCHES
                       -- IF =0.0, TRANSFER DATA --

* 202      0.0           SWEEP ANGLE OF LE-FWD POSITION              DEGREES
                       -- IF =0.0, TRANSFER DATA --
* 203      0.0           SWEEP ANGLE OF LE-AFT POSITION              DEGREES
                       -- IF =0.0, TRANSFER DATA --
* 204      0.0           ID T-TAIL(FOR H.TAIL INPUT ONLY)
                             OPTIONS: 0.0 DATA TRANSFERRED FROM GD
                                      1.0 T-TAIL(H.TAIL INPUT ONLY)

* 205      0.0           ID DESIGN AIRLOADS DATA TRANSFER.
                             OPTIONS: 0.0 = DATA FROM VARIABLE DATA SET
                                            FOR SURFACE.
                                      1.0 = DATA FROM LOADS MODULE.

                         NOTE: DATA LOC D(206) THRU D(219) DESCRIBES FUEL
                               CELL AND CONTENTS.  TWO FUEL CELLS CAN BE
                               LOCATED WITHIN THE SURFACE TORQUE-BOX.

* 206      0.0           SPANWISE LOC. INBD(Y)-CELL NO.1
                             OPTIONS: 0.X FRACTION OF SEMISPAN
                                     XX.X BUTTOCK PLANE               INCHES
                       -- IF D(206)&D(208)=0.0, TRANSFER DATA --

* 207      0.0           SPANWISE LOC. OUTBD(Y)-CELL NO.1
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                         SAME OPTIONS AS INBD(Y)-SEE D(206)
                   -- IF D(207)&D(208)=0.0, TRANSFER DATA --

* 208      0.026        FUEL DENSITY AND FUEL CELL #1 DATA BLOCK
                         (206-212) ID-
                           OPTIONS: 0.0 D(208) DATA TRANSFERRED
                                        FROM GD AND DATA BLOCK
                                        LOCATIONS TESTED FOR TRANSFER
                                    0.X INPUT DENSITY AND NO
                                        DATA BLK TEST.

* 209      0.0          WT. OF FUEL IN CELL NO.1 FOR DGW CONDITION
                           OPTIONS: <1.0 FRACTION OF CELL CAPACITY
                                         FOR DGN CONDITION
                                    >1.0 WEIGHT REQUIRED          LBS/SIDE
                   -- IF D(208)&D(209)=0.0, TRANSFER DATA --

* 210      0.0          CAPACITY OF CELL NO.1
                           OPTIONS:  0.0 PROG. USES CAPACITY
                                         CALC. FROM INPUT DATA.
                                    XX.X WEIGHT/SIDE              LBS/SIDE
                   -- IF D(208)&D(210)=0.0, TRANSFER DATA --

* 211      0.0222       WT. OF FUEL SYSTEM/SIDE AS % OF CAPACITY
                         FOR CELL NO.1. YOU HAVE OPTION TO CHANGE.
                   -- IF D(208)&D(211)=0.0, TRANSFER DATA --

  212                   NOT USED

                        * D(213) THRU D(219) INPUT DATA BLOCK FOR
                          FUEL CELL NUMBER TWO. THE INPUT AND TRANSFER
                          OPTIONS FOR CELL NO.2 ARE EXACTLY THE SAME
                          AS FOR CELL NO.1.

* 213      0.0          INBD(Y) CELL NO.2-SEE D(206)                 INCHES
* 214      0.0          OUTBD(Y) CELL NO.2-SEE D(207)                INCHES
* 215      0.026        FUEL DENSITY-SEE D(208)                   LBS/CU IN
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

*	216	0.0	WT. FUEL FOR DGW CELL NO.2-SEE D(209)	LBS/SIDE
*	217	0.0	WT. FUEL CAPACITY CELL NO.2-SEE D(210)	LBS/SIDE
*	218	0.0[illegible]	% OF CAPACITY FOR FUEL SYS. WT-SEE D(211)	
	219		NOT USED	
			NOTE: DATA LOC D(220) THRU D(231) DESCRIBES EXTERNAL CONC. AIRLOADS TO BE ADDED TO DISTRIBUTED AIRLOADS. THE LOADS MUST BE LIMIT VALUES FOR DGWO AND IN THE REF. SYSTEM SPECIFIED BY THE CONTROL ID OF EACH SET.	
	220	0.0	ID CONC. AIRLOAD NO.1 OPTIONS: 0.0 NO AIRLOAD 1.0 = LOADS IN FUSELAGE REF SYSTEM. 2.0 = LOADS IN SURFACE REF SYSTEM.	
	221	0.0	SPANWISE LOC. FOR AIRLOAD NO.1 OPTIONS: 0.X FRACTION OF SEMISPAN. XX.X BUTTOCK PLANE	 INCHES
	222	0.0	CHORDWISE LOC. FOR AIRLOAD NO.1 OPTIONS: 0.X FRACTION OF LOCAL CHORD FROM LE XX.X DIST. FROM LE	 INCHES
	223	0.0	VERTICAL SHEAR PER SIDE	LBS/SIDE
	224	0.0	B. MOM. OF LOAD AT SPECIFIED COORD.	IN-LB
	225	0.0	T. MOM. OF LOAD AT SPECIFIED COORD.	IN-LB
			*. D(226)-D(231) ARE THE INPUT LOC. FOR CONC. AIRLOAD NO.2. THESE LOC. REQUIRE THE DATA & OPTIONS AS D(220) THRU D(225).	
	226	0.0	ID-CONC. AIRLOAD NO.2-SEE D(220)	
	227	0.0	BP(Y)-SEE D(221)	INCHES
	228	0.0	X(FUS)-SEE D(222)	INCHES
	229	0.0	SHEAR/SIDE-SEE D(223)	LBS/SIDE
	230	0.0	B. MOM. OF LOAD AT SPECIFIED COORD.	IN-LB

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

231	0.0	T. MOM. OF LOAD AT SPECIFIED COORD.	IN-LB
		NOTE: DATA LOC D(232) THRU D(239), D(255), D(256) AND D(257) ARE USED FOR DESIGN AIRLOADS CALC BY THIS MODULE IF LOADS ARE NOT TRANSFERED FROM THE LOADS MODULE.	
232	0.60	CONSTANT USED AS EXPONENT OF R USED IN ASSUMED LOAD DIST. CALC. FOR UNIT LOAD ON EXP. AREA. R=RATIO OF(EXP.SW/EXP. B) TO (GROSS SW/B)	
233	1.0	FACTOR FOR TAPER RATIO OF ASSUMED AIRLOAD ON EXP. WING. YOU CAN CHANGE.	
234	1.0	FACTOR FOR AIRLOAD SHEAR. YOU CAN CHANGE.	
235	0.0	WING AREA SUBJECT TO AIRLOAD-IF ZERO D(240),D(241)&D(244) WILL BE USED.	SQ FT
236	0.0	ASPECT RATIO FOR D(235)	
237	0.0	TAPER RATIO FOR D(235)	
238	0.0	SPAN OF WCS-USED IN ASSUMED LOAD CALC.	INCHES
•239	0.0	FRACTION OF CHORD (X/C) TO DEFINE LOAD REF LINE IF DIFF FROM EA.	
		NOTE: DATA LOC D(240) THRU D(249) DESCRIBES THE THEORETICAL PLANFORM GEOMETRY OF THE SURFACE.	
• 240	0.0	WING AREA AND BASIC WING GEOMETRY DATA BLOCK (138,240-248) ID- OPTIONS: =0.0 AREA FOR 240 TRANSFERRED FROM GD AND TEST EACH LOC. OF DATA BLOCK FOR TRANSFER OPTION. >0.0 INPUT WING BASIC AREA AND NO TEST OF DATA BLOCK. NOTE: USE DOUBLE THE AREA OF ONE PANEL FOR V.T.	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
* 241     0.0      D(240) ASPECT RATIO. USE DOUBLE THE ASPECT
                    RATIO OF ONE PANEL FOR THE V.TAIL.
                 -- IF D(240)&D(241)=0.0, TRANSFER DATA --

* 242     0.C      SWEEP OF REF CHORD ELEMENT (X/C OF D(138))     DEG
                 -- IF D(240)&D(242)=0.0, TRANSFER DATA --

* 243     0.0       THICKNESS RATIO AT SPANWISE LOCATION IN
                     D(141).
                 -- IF D(240)&D(243)=0.0, TRANSFER DATA --
* 244     0.0      D(240) TAPER RATIO
                 -- IF D(240)&D(244)=0.0, TRANSFER DATA --

* 245     0.0       RATIO OF THICKNESS RATIOS.
                     T/C AT SPANWISE LOCATION IN D(142) DIVIDED
                     BY T/C IN D(243).
                 -- IF D(240)&D(245)=0.0, TRANSFER DATA --

* 246     0.C       FUSELAGE SPAN AT SHEAR TIE POINTS.          INCHES
                 -- IF D(240)&D(246)=0.0, TRANSFER DATA --
                  NOTE: VALUE IN D(246)/2.0 = REF BP LOC OF
                        INBD STA OF EXPOSED SURFACE USED TO
                        LOCATE STRUCT. STA 1 AND EXPOSED
                        SPAN FOR LOADS AND FLUTTER ANALYSIS
                        IF APPROPRIATE OPTIONAL INPUTS
                        ARE NOT INPUT:
                           --D(364-875) FOR INPUT STATIONS
                           --D(238) FOR LOADS EXPOSED SPAN
                           --D(343) FOR FLUTTER EXPOSED SPAN
* 247     C.0       WING DIHEDRAL ANGLE
                           OPTIONS: +XX.X=ANGLE ABOVE WRP.  DEGREES
                                    -XX.X=ANGLE BELOW WRP.  DEGREES
                 -- IF D(240)&D(247)=0.0, TRANSFER DATA --

* 248     C.0       DISTANCE OF WING REFERENCE FROM FUS.
                     REFERENCE PLANE AT CENTERLINE OF
                     VEHICLE.
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                              OPTIONS: +XX.X=DISTANCE WRP IS     INCHES
                                            ABOVE FRP.
                                       -XX.X=DISTANCE WRP IS     INCHES
                                            BELOW FRP.
                        -- IF D(240)&D(248)=0.0, TRANSFER DATA --

249                     NOT USED
250        1.0          TOTAL WING WEIGHT COEFFICIENT

251        C.0          INDICATOR OF CALCULATIONS.
                              OPTIONS: 0.0 NO ANALYSIS
                                       1.0 CALCULATE GJ
                                       2.0 INPUT GJ OR J IN D(346)
                                           THRU D(356)
                                      -1.0 CALC GJ BUT WITH CONSTANT
                                           REQD GJ FOR STRUCT STATIONS
                                           INBD OF STA INDICATED BY
                                           D(313) AND OUTBD OF STA OF
                                           D(315). THE GJ VALUES =
                                           CALC VALUES AT THE CONTROL
                                           STATIONS.
252        1.15         FACTOR FOR FLUTTER OVERSPEED.
                              OPTIONS: 1.0 WHEN Q IS CALC. BY
                                           FLUTTER PROGRAM OR IF
                                           D(253) INCLUDES FLUTTER
                                           MARGIN.
                                       1.15 THEN D(1441)=1.0
                                       1.20 THEN D(1441)=1.1
* 253      0.0          MAXIMUM CRITICAL COMPRESSIBLE DYNAMIC
                         PRESSURE FOR SURFACE FLUTTER.
                              OPTIONS: XXX.X Q              LBS/SQ. FOOT
                                         0.0 USE Q FROM
                                             FLUTTER PROGRAM
* 254      C.0          MODULUS OF RIGIDITY, G, OF T-BOX MATL AT FLUTTER
                         DESIGN POINT--USED FOR CALC OF MAX REQD STRUCT
                         J.  VALUE SHOULD BE COMPATIBLE WITH FLUTTER
                         DESIGN TEMP INDICATED IN D(282). IF NOT, THE
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                    INDICATED REQD GJ VALUE WILL BE A SCALED VALUE
                    BUT THE REQD STRUCTURAL J VALUE WILL NOT CHANGE
                       OPTIONS: 0.0 A).  MUST NOT BE ZERO IF G IS
                                         NOT TRANSFERED THRU DATA
                                         MANAGEMENT LOGIC.
                                     B). MUST BE ZERO IF DATA MANA-
                                         GEMENT VALUE IS REQD.
                                10.0 OR LESS.  G = MATL G AT ROOM
                                                   TEMP * INPUT
                                                     VALUE.
                                GREATER THAN 10.0. G = INPUT       PSI

255     0.0         AIRLOAD SHEAR PER SIDE.                      LBS(LIM)
                     OPTIONS IF LOADS DATA TO BE CALC BY MODULE:
                            0.0 EST EXPOSED SURFACE LOAD = F(NZ,
                                DGW, GROSS AREA AND SPAN, EXPOSED
                                AREA AND SPAN)
                            XXX.X LIMIT LOAD                      LB/SIDE
                     NOTE: LOAD TO BE DISTRIBUTED ON EXPOSED
                            SPAN BASED ON CP DATA FROM D(256)
                            AND D(257).
                          D(255,256,257) NOT REQD IF:
                            D(205) = 1.0 - USE LOAD DATA FROM LOADS
                                           MODULE, OR
                            D(994) NOT 0.0 - INPUT LOADS AT 11 STA.
256     0.0         SPANWISE LOCATION FOR CENTER OF PRESSURE.
                           OPTIONS: 0.XX FRACTION OF EXPOSED
                                         SEMISPAN.
                                   XX.XX DISTANCE FROM EXP.   INCHES
                                         WING ROOT CHORD TO
                                         C.P.
                                    0.0  ASSUMES CONDITIONS.
                                   -0.XX FRACTION OF SEMISPAN
                                  -XX.XX DISTANCE FROM FUS.   INCHES
                                         CENTERLINE TO C.P.
257     0.40        CHORDWISE LOCATION FOR CENTER OF PRESSURE.
                           OPTIONS: 0.XX FRACTION OF CHORD AT CP
```

```
258      0.0        ID MATERIAL FOR TORQUE-BOX DESIGN--COVERS, SPARS
                     AND RIBS--METALLIC STRUCTURES.  MATL DATA FROM
                     DATA BANK MATERIAL LIBRARY. SEE TABLE 16
                         NOTE: A MATL NO MUST BE INDICATED WHEN THE
                               ADV. COMP OPTION IS USED.
* 259    0.0         MATERIAL TEMPERATURE-TORQUE BOX          DEGREES F
                    -- IF D(259)=0.0, TRANSFER DATA --

260-270  0.0        INPUT B. MOM, POSI. LOAD CONDITION, LIMIT  IN/LB
                     FOR UGWC AT THE 11 STRUCTURAL DESIGN
                     STATIONS.
                     DATA REQD IF INPUT LOAD CONTROL ID D(666)
                     IS 1.0 OR 2.0 AND LOADS MODULE DATA TRANSFER
                     ID D(265) IS 0.0.
                         NOTE: GM VALUES MUST BE IN THE SURFACE
                               STRUCTURAL REF SYSTEM.

271      0.0        ID MASS DISTRIBUTION AND DESIGN DATA GENERATION
                     FOR FLEX LOADS AND FLUTTER OPT PROGRAMS.
                         OPTIONS: 0.0 NO CALC NECESSARY
                                  1.0 DATA CALC FOR BOTH PROGRAMS
                                  2.0 DATA CALC FOR FLEX LOADS ONLY
                                  3.0 DATA CALC FOR FLUTTER OPT ONLY
                         NOTE: THIS ID CONTROLS ANALYSIS ONLY. PUNCH-
                               ED CARD OUTPUT IS CONTROLLED BY DATA
                               LOC D(280).

                    NOTE: DATA LOC D(272) THRU D(279) ARE USED TO
                          CONTROL INTERNAL FUEL AND EXTERNAL STORES
                          AT THE DESIGN LOADING CONDITIONS FOR FLEX
                          LOADS AND FLUTTER OPT ANALYSIS.
272      0.0         FRACTION OF WT OUT-FLEX LOAD COND-FULL CELL NO.1
273      0.0                                          -FUEL CELL NO.2
274      0.0                                          -STORE STA NO.1
275      0.0                                          -STORE STA NO.2
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

276	0.0	FRACTION OF WT OUT-VF CONDITION-FUEL CELL NO.1	
277	0.0	-FUEL CELL NO.2	
278	0.0	-STORE STA. NO.1	
279	0.0	-STORE STA. NO.2	
280	0.0	IF DATA CARD PUNCH OF MASS DISTRIBUTION AND DESIGN DATA FOR FLEX LOADS AND FLUTTER OPT PROGRAMS. OPTIONS: 0.0 NO DATA CARDS 1.0 PUNCH DATA CARDS	
		NOTES ON D(281) THRU D(284): DESIGN TEMPERATURES TO BE USED IN STIFFNESS CALC ONLY. D(282) FOR METALLIC AND ADV. COMP, D(281),D(283) AND D(284) FOR ADV. COMP ONLY.	
281	0.0	REF TEMP FOR OUTPUT OF EI AND GJ FOR ST. DESIGN, ADV. COMP ANALYSIS. IF 0.0, THE BASIC DESIGN TEMP IN D(259) WILL BE USED.	DEG
*282	0.0	DESIGN TEMP FOR FLUTTER ANALYSIS, METALLIC AND ADV. COMP ANALYSIS. IF 0.0: A). BASIC DESIGN TEMP IN D(259) WILL BE USED OR B). CALC TEMP AT CRITICAL FLUTTER PT WILL BE TRANSFERRED THRU DATA MANAGEMENT LOGIC.	DEG
283	0.0	REF TEMP FOR CALC OF EI AND GJ FOR FLEX LOADS ANALYSIS, ADV. COMP ONLY. IF 0.0, TEMP SPECIFIED FOR ST DESIGN EI AND GJ WILL BE USED. NOT REQD IF FLEX LOADS DATA ARE NOT CALC.	DEG
284	0.0	REF TEMP FOR CALC OF EI AND GJ FOR FLUTTER OPT ANALYSIS, ADV. COMP ONLY. OPTIONS SAME AS FOR D(283).	DEG
285-288	0.0	DO NOT USE. FOR INTERNAL PROGRAM USE ONLY.	
* 289	0.0	INDICATOR FOR TYPE SURFACE OPTIONS: 0.0 WING	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		-1.0 HORIZONTAL TAIL +N.0 VERTICAL TAIL(N=NUMBER OF PANELS). -- D(289) AUTOMATICALLY SET TO WING OR H. -- TAIL ID BY G.D. TRANSFER. IF V.TAIL IS RUN THEN USER MUST INPUT NO. OF PANELS.	
		NOTE: DATA LOC D(290) THRU D(309) FOR MASS AND DESIGN DATA GENERATION OPTION.	
290	0.0	MN AT 20K FEET FOR FIXED OR SWEPT AFT WING. FLEX LOAD DESIGN CONDITION. OPTIONS: 0.0 PROG. CALC. VALUE FOR MN X.X INPUT MN	
291	0.0	MN AT 20K FEET FOR VARIABLE SWEEP WING,FWD POSITION. FLEX LOAD DESIGN CONDITION. SAME OPTIONS AS D(290).	
292	0.0	ELASTIC MODULUS, E, FOR STIFFNESS CALC, FLEX LOADS DESIGN CONDITION. METALLIC DESIGN ONLY.	PSI
293	0.0	SHEAR MODULUS, G, FOR STIFFNESS CALC, FLEX LOAD DESIGN CONDITION. METALLIC DESIGN ONLY.	PSI
294		NOT USED	
295	0.0	DGW FOR VF CONDITION.	LBS
296	0.0	X.CG (FUS. STATION) FOR D(295)	INCHES
297	0.0	IYY PITCH INERTIA FOR D(295)	LB-IN SQ
298	0.0	IXX ROLL INERTIA FOR D(295)	LB-IN SQ
299	0.0	WEIGHT-EXPOSED WING AND CONTENTS PER SIDE.	LBS/SIDE
300	0.0	Y-CG FOR WT. IN D(299)	INCHES
301	0.0	X-CG FOR WT. IN D(299)	INCHES
302	0.0	IYY PITCH INERTIA FOR D(299)	LB-IN SQ

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

303	0.0	IXX ROLL INERTIA FOR D(299)	LB-IN SQ
304	0.0	MN FOR VF CONDITION	
305	0.0	ALTITUDE FOR MN IN D(304)	FEET
306	0.0	DENSITY OF AIR FOR DESIGN POINT IN D(304). IF ZERO THEN PROG. CALC DENSITY FROM D(304) & D(305).	LBS/CU IN
307	0.0	ELASTIC MODULUS, E, FOR STIFFNESS CALC, FLUTTER OPT DESIGN CONDITION. METALLIC DESIGN ONLY.	PSI
308	0.0	SHEAR MODULUS, G, FOR STIFFNESS CALC, FLUTTER OPT DESIGN CONDITION. METALLIC DESIGN ONLY.	PSI
309	1.15	VF SPEED FACTOR- OPTIONS: 1.15 MILITARY 1.20 COMMERCIAL	
*310	0.0	DIHEDRAL OF H.TAIL WHEN RUNNING T-TAIL FOR V.TAIL PORTION ONLY. SEE D(357) THRU D(360). REQD FOR VERT TAIL FLUTTER REQMT CALC IF CONFIG. IS T-TAIL.	DEGREES
311		NOT USED	
312	1.0	FACTOR FOR GJ CALCULATION.	
313	0.90	SPANWISE LOCATION FOR WHICH D(314) APPLIES. OPTIONS: 1-FRACTION OF EXP. 2-BUTTOCK STATION IF D(251)=-1.0 THEN GJ FROM D(313) INBD. HELD CONSTANT.	INCHES
314	1.0	GJ COEFF. FOR STRUCTURE INBD OF STATION D(313)	
315	0.99	SPANWISE LOCATION FOR WHICH D(316) APPLIES. OPTIONS: 1-FRACTION OF EXP. SEMI-SPAN	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		2-BUTTOCK STATION IF D(251)=-1.0 THEN GJ FROM D(315) OUTBD. HELD CONSTANT.	INCHES
316	0.001	GJ COEFF. FOR STRUCTURE OUTBD OF STATION D(315)	
317	0.0	CONSTANT DATA RELATIVE ROTATION AT ROOT STA FOR FLUTTER ANALYSIS--ART.	
318	1.0	CONSTANT DATA RELATIVE ROTATION AT TIP STA FOR FLUTTER ANALYSIS--ATIP.	
319	0.0	NOT USED.	
		NOTE: DATA LOC D(320) THRU D(324)--FLUTTER REQMT ANALYSIS DATA FOR WING POSITION OF VARIABLE SWEEP DESIGNS OTHER THAN THAT INDICATED IN D(242). USED ONLY IF D(200) IS INPUT NON-ZERO NO (PIVOT REQD) AND AND D(251) IS 1.0 OR -1.0 (FLUTTER CALC).	
		ALL DATA REQD FOR FIXED SURFACE FLUTTER ANALYSIS MUST BE SETUP.	
* 320	0.0	DELTA SWEEP OF WING PANEL. (+/-). TO POSITION REQD FOR FLUTTER ANALYSIS. IF 0.0, AND DATA IS REQD, THIS DELTA IS DETERMINED FROM DATA MANAGEMENT C/4 CALC DATA.	DEG
* 321	0.0	CRITICAL FLUTTER Q FOR SWEPT POSITION. SAME AS D(253).	LB/SF
* 322	0.0	STRUCTURAL MATL G FOR FLUTTER ANALYSIS AT SWEPT POSITION. SAME AS D(254).	PSI
* 323	0.0	DESIGN TEMP FOR FLUTTER ANALYSIS AT SWEPT POSITION. SAME AS D(282).	DEG F
324	0.0	FLUTTER OVERSPEED FACTOR, SAME AS D(252).	
325-334	0.0	NOT USED.	
		NOTE: DATA LOC D(335) THRU D(339)--FLUTTER REQMT ANALYSIS DATA FOR VERT TAIL, T-TAIL CONFIG	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                        ONLY.  TWO OPTIONS FOR DATA SET:
                               IF D(336) = 0.0, ASSUMES HORIZONTAL
                                  TAIL EFFECT COEFF. CTT IN D(339)
                                  IS INPUT OR TRANSFERED THRU DATA
                                  MANAGEMENT LOGIC.
                               IF D(336) = X.XX, MODULE WILL CALC
                                  HORIZONTAL TAIL EFFECT COEFF CTT

                        ALL DATA REQD FOR CONVENTIONAL VERT TAIL
                        FLUTTER ANALYSIS MUST BE SETUP.

* 335     0.0       DESIGN TEMP FOR T-TAIL VERT TAIL FLUTTER      DEG F
                     ANALYSIS. IF 0.0, CALC DATA MANAGEMENT
                     FLUTTER TEMP OR BASIC DESIGN TEMP IN
                     D(259) WILL BE USED.
  336     0.0       CRITICAL FLUTTER MACH NO FOR T-TAIL VERT TAIL.
                     MUST BE ZERO IF DATA MANAGEMENT DERIVED CTT
                     VALUE IS TO BE USED.
* 337     0.0       CRITICAL FLUTTER Q FOR T-TAIL VERT TAIL         PSF
                     FLUTTER ANALYSIS. IF 0.0, CALC DATA MANAGE-
                     MENT Q WILL BE USED.
* 338     0.0       STRUCTURAL MATL G FOR T-TAIL VERT TAIL          PSI
                     FLUTTER ANALYSIS. IF 0.0, CALC DATA MANAGE-
                     MENT G WILL BE USED.
* 339     0.0       FLUTTER REQMT COEFF.  FLUTTER OVERSPEED
                     FACTOR (D(252)) IF CTT CALC BY MODULE--D(336)
                     IS INPUT NON-ZERO MACH NO.  IF D(336) = 0.0,
                     THIS VALUE MUST BE OF THE FORM CTT*FLUTTER
                     OVERSPEED FACTOR SQUARED.

                    NOTE: DATA LOC D(340) THRU D(345)--SURFACE PLAN-
                          FORM GEOMETRY TO BE USED IN LIEU OF BASIC
                          GEOMETRY DATA.
                          D(343) CAN BE USED TO SPECIFY EXPOSED
                          SEMI-SPAN OTHER THAN THAT DERIVED FROM
                          BASIC GEOMETRY IN FLUTTER REQMT CALC.
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
  340       0.0        WING AREA USED FOR GJ CALCULATIONS          SQ.FEET
  341       0.0        ASPECT RATIO FOR AREA IN D(340)
  342       0.0        TAPER RATIO FOR AREA IN D(340)
  343       0.0        FUSELAGE WIDTH FOR GJ CALCULATIONS.          INCHES
  344       0.0        THICKNESS RATIO AT CENTERLINE
  345       0.0        RATIO OF THICKNESS RATIOS. T/C AT TIP DIVIDED
                        BY T/C AT ROOT

  346-356   0.0        INPUT GJ OR COEFF.
                           OPTIONS: D(251)= 1.0 INPUT COEFF.
                                    D(251)= 2.0 INPUT GJ AT    LBS-IN-SQ
                                                STATIONS D(865)
                                                THRU D(875)

                           IF D(346) IS NON-ZERO ANY D(347)
                            THRU D(356) THAT IS=0.0 IS SET TO 1.0
                           IF D(346)=0.0  D(313)-D(316) ARE USED

* 357       0.0        IO TO BE USED ON V.TAIL RUN TO INDICATE A
                        T-TAIL. GIVES DIFFERENT GJ REQUIREMENTS FOR
                        VERTICAL.
                           OPTIONS: 0.0 NO T-TAIL OR TRANSFER
                                        OF DATA
                                    1.0 TEST DATA BLOCK(336,337,338,
                                        358,359,360) FOR TRANSFER
                                        OF T-TAIL DATA.

* 358       0.0        IYY PITCH INERTIA OF H.TAIL. USED FOR GJ
                        CALC. OF V.TAIL WHEN RUNNING A T-TAIL
                        ONLY.
                    -- IF D(357)&D(356)=0.0, TRANSFER DATA --

* 359       0.0        IXX ROLL INERTIA OF H. TAIL.-SEE D(358)
                        DESCRIPTION.
                    -- IF D(357)&D(359)=0.0, TRANSFER DATA --

* 360       0.0        IZZ YAW INERTIA OF H. TAIL. SEE D(358)
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		DESCRIPTION. -- IF D(357)&D(360)=0.0, TRANSFER DATA --
361	2.0	ID STRINGER TYPE FOR METALLIC DESIGN. OPTIONS: 0.0= I STRINGER 1.0= INTEGRAL Z 2.0= RIVETED Z NOTE: THIS CONTROL ID IS FOR MULTI-RIB STRINGER STIFFENED COVER DESIGN. THE MULTI-SPAR ID D(461) MUST BE ZERO.
362	4.0	BUCKLING COEFF. FOR SKINS--INFINITELY LONG PLATE SIMPLY SUPPORTED AT BOTH EDGES.
363	0.426	BUCKLING COEFF. FOR I-STRINGER WEB AND Z-STRINGER FLANGES--INFINITELY LONG PLATE, SIMPLY SUPPORTED AT ONE EDGE, FREE AT THE OTHER.
364	4.0	BUCKLING COEFF. FOR Z-STRINGER WEB
365	0.60	RATIO-MIN SKIN T TO T-BAR RECOMMENDED VALUE FOR MULTI-SPAR=0.05
366	0.75	RATIO-MAX SKIN T TO T-BAR RECOMMENDED VALUE FOR MULTI-SPAR=0.995
367	1.0	ID COMPRESSION COVER DESIGN DATA. OPTIONS: 0.0 NO INPUT 1.0 INPUT 2.0 INPUT FOR CONSTANT STRINGER SPACING IN D(765) THRU D(775) IF D(367)=2.0 AND D(383)=3.0 YOU HAVE CONSTANT STRINGER SPACING WITH D(380)=D(381)
368	1.0	ID TYPE OF ANALYSIS TO BE USED FOR COMPARISON OF REQD SECTION GJ(VF) TO AVAILABLE SECTION GJ(ST) AND FOR REVISING TO REQD GJ(VF). OPTIONS: 1.0 USE J COMPARISON WHERE J IS BASED ON THICKNESSES OF INDIVIDUAL REQD J WILL USE STEPWISE PROCEDURE OF SELECTING AND INCREASING THINNEST WEB FIRST.

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		2.0 USE T(VF) REQD COMPARISON WHERE T(VF) = (4*A*A/J*DS), CONSTANT FOR ALL WEBS. RESIZING WILL BE BASED ON INDIVIDUAL DELTA T.	
369	3.0	NO OF WEIGHT CALC PASSES FOR T-BOX ANALYSIS TO MINIMIZE DIFFERENCES IN ASSUMED TO CALC STRUCTURE DEADWEIGHT. VALUES FROM 0.0 TO 4.0 CAN BE USED. PROGRAM WILL ADD 1.0 TO ANY INPUT NO FOR THE FIRST GROSS WEIGHT ANALYSED. THE INPUTTED VALUE, WITH MIN VALUE OF 1.0 WILL BE USED FOR THE OTHER TWO GW, IF ANALYSED. NOTE: IF BOX OPTIMIZATION OPTION THRU ID IN D(1365) IS REQUESTED, THE NO OF DW PASSES MUST BE SET AT 3.0 OR 4.0.	
370	0.040	MIN GAGE-UPPER SKIN	INCHES
371	0.040	-STRINGER OR SPAR CAP(MULTI-SPAR)	INCHES
372	0.040	-RIB WEB OR INTERMED. SPAR WEB	INCHES
373	0.045	-FRONT SPAR WEB	INCHES
374	0.045	-REAR SPAR WEB	INCHES
375	10.0	MIN RIB SPACING OR SPAR SPACING FOR MULTI-SPAR.	INCHES
376	30.0	MAX RIB SPACING OR SPAR SPACING FOR MULTI-SPAR.	INCHES
377	0.75	MIN STRINGER HEIGHT OR CAP WIDTH FOR MULTI-SPAR.	INCHES
378	2.0	MAX STRINGER HEIGHT OR CAP WIDTH FOR MULTI-SPAR.	INCHES
379	1.0	MAX STRINGER FLANGE OR FLANGE OF CHANNEL CAP FOR MULTI-SPAR.	INCHES
380	1.0	MIN STRINGER SPACING OR SPAR SPACING FOR MULTI-SPAR.	INCHES
381	10.0	MAX STRINGER SPACING OR SPAR SPACING FOR MULTI-SPAR.	INCHES
382	4.0	MIN STRINGER NUMBER. NUMBER=(TIP WIDTH/MAX STRINGER SPACING)-1.0	
383	0.0	ID STRINGER ORIENTATION	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                               OPTIONS: 1.0  OPTIMIZE
                                        2.0  CONSTANT NUMBER
                                        3.0  CONSTANT SPACING
384       0.4           MIN STRINGER FLANGE OR FLANGE OF CHANNEL   INCHES
                         CAP FOR MULTI-SPAR.

 ** SPECIAL NOTES FOR MULTI-SPAR RUNS:
       NO SEARCH IS MADE FOR MULTI-SPAR CONSTRUCTION
       YOUR INPUT WILL BE USED FOR THE CONSTRUCTION GEOMETRY

       D(377) AND D(378) MUST BE EQUAL, SUGGEST 1.0
       D(379) AND D(384) MUST BE EQUAL, SUGGEST 0.25
       D(375),D(376),D(390) AND D(381) MUST BE EQUAL
       D(383) CANNOT BE EQUAL TO 1.0
       IF D(383)=2.0:
                        SET D(375),D(376),D(380) AND D(381)=100.0
                        AND D(382)=WHOLE NUMBER OF SPARS YOU WANT.
       IF D(383)=3.0:
                        SET D(382)=1.0 AND D(375),D(376),D(390)
                        AND D(381)=SPAR SPACING YOU WANT.

                        NOTE: DESIGN STRESS DATA IN D(385) THRU D(388)
                              MUST BE TREATED AS ULTIMATE STRESSES.

385       1.0           UPPER COVER COMPRESSION CUTOFF STRESS
                            OPTIONS:  0.X FRACTION OF FCY
                                      XXX.X CUTOFF STRESS              PSI
386       1.0           LOWER COVER TENSION CUTOFF STRESS
                            OPTIONS:  0.X FRACTION OF FTU
                                      XXX.X CUTOFF STRESS              PSI
387       1.0           SHEAR STRESS CUTOFF
                            OPTIONS:  0.X FRACTION OF FSU
                                      XXX.X SHEAR STRESS               PSI
388       1.0           LOWER COVER COMPRESSION CUTOFF STRESS
                            OPTIONS:  0.X FRACTION OF FCY
                                      XXX.X CUTOFF STRESS              PSI
```

```
389   0.0      MODULUS OF ELASTICITY E FOR LOWER COVER
                   OPTIONS: 0.0 USE UPP COVER E
                            XX.X E FOR LOWER COVER            PSI
390   0.0      DENSITY OF LOWER COVER
                   OPTIONS: 0.0 USE UPPER COVER DENSITY
                            0.XX DENSITY OF LWR COVER  LBS/CU IN
391   0.911    LOWER COVER EFFICIENCY FACTOR FOR
                COMPRESSION CHECK OF THE LOWER COVER.
                   OPTIONS: 0.65  FOR INTEGRAL I
                            1.03  FOR INTEGRAL Z
                            0.911 FOR RIVETED Z
                            0.785 FOR MULTI-SPAR

392   0.600    MINIMUM RATIO  -NZ/+NZ
393   0.0      ID COLUMN EQUATION.
                   OPTIONS: 0.0 SHORT COLUMN EQ.
                            1.0 LONG COLUMN EQ.
394   0.0      MIN GAGE LOWER SKIN
                   OPTIONS: 0.0 USES D(370)
                            0.X GAGE FOR LWR SKIN          INCHES
395   0.0      MIN RATIO OF SKIN T TO TBAR FOR LWR COVER
396   0.3125   RIVET DIAMETER                              INCHES
397   0.050    MIN PAD THICKNESS
398   1.0      UPPER COVER TENSION CUTOFF STRESS
                   OPTIONS:  0.X FRACTION OF FTU
                           XXX.X CUTOFF STRESS                PSI
399   20.0     MAX NO OF INTERMEDIATE SPARS--ADV. COMP ONLY.

               * D(400) THRU D(406)-INTERMEDIATE RIBS DATA
                 OR INTERMEDIATE SPARS DATA WHEN MULTI-SPAR
                 CONSTRUCTION.
400   1.210    CORRUGATION FACTOR--1.0 DEG SINE WAVE
401   0.40     LOCAL CRIPPLING FACTOR
402   1.425    GENERAL INSTABILITY FACTOR
403   0.50     MIN CORRUGATION RADIUS
404   1.0      MAX CORRUGATION RADIUS
405   2.0      CAP WIDTH
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

406	0.02	WEB GAGE INCREMENT FOR SEARCH	
407	1.0	COLUMN FIXITY COEFF FOR STRINGER COLUMNS--METALLIC COVER DESIGN. (VARIES FROM 1.0, PIN-ENDED TO 4.0, FIXED ENDED).	
408	0.590	CRIPPLING COEFF FOR PLATES SIMPLY SUPPROTED ON BOTH EDGES--SKIN PLATES AND Z-STR WEBS. USE: 0.590 FOR AL, 0.770 FOR TI.	
409	0.312	CRIPPLING COEFF FOR PLATES SIMPLY SUPPORTED ON ONE EDGE, FREE AT THE OTHER--I-STR WEBS AND Z-STR FLANGES. USE: 0.312 FOR AL, 0.304 FOR TI.	
410	1.025	WT FACTOR FOR MISC ATTACH PROV.--FRONT SPAR	
411	1.025	--REAR SPAR	
412	0.575	F.S. SHEAR ALLOWABLE OPTIONS: 0.X FRACTION OF FSU XXX.X SHEAR STRESS	LBS/SQ IN
413	0.575	R.S. SHEAR ALLOWABLE OPTIONS: 0.X FRACTION OF FSU XXX.X SHEAR STRESS	LBS/SQ IN
414	0.0	F.S. DENSITY-INPUT 0.0 IF=UPP COVER	LBS/CU IN
415	0.0	R.S. DENSITY-INPUT 0.0 IF=UPP COVER	LBS/CU IN
416	0.0	F.S. MODULUS OF ELASTICITY-INPUT 0.0=UPP COVER E	LBS/SQ IN
417	0.0	R.S. MODULUS OF ELASTICITY-INPUT 0.0=UPP COVER E	LBS/SQ IN
418	0.875	WIDTH-FS STIFFENER	INCHES
419	0.875	WIDTH-RS STIFFENER	INCHES
420	6.0	STIFF. SPACING FOR FS-YOU HAVE OPTION TO CHANGE.	INCHES
421	6.0	STIFF. SPACING FOR RS-YOU HAVE OPTION TO CHANGE.	INCHES

```
422    0.02        DELTA T FOR WEB GAGE SEARCH                     INCHES

423    1.750       FACTOR FS CAP AREA = F(TBAR COVER)
424    2.00        FACTOR RS CAP AREA = F(TBAR COVER)
425    1.05        FACTOR FS WEB T BAR
426    1.05        FACTOR RS WEB T BAR

427    1.210       CORRUGATION FACTOR FS SINE WAVE DESIGN--ADV COMP
428    1.210       CORRUGATION FACTOR RS SINE WAVE DESIGN--ADV COMP

                   NOTE: DATA LOC D(429) THRU D(449) CONTROL AND
                         ANALYSIS DATA FOR ADV. COMP OPTION.
429    0.10        RATIO FOR NO OF 90 DEG PLIES (N-PLIES) TO TOTAL
                    NO OF 0 AND 45 DEG PLIES (L,M PLIES).

                   NOTE: D(430) THRU D(439) ARE CONTROL ID FOR
                         T-BOX SYNTHESIS AND DESIGN--ADV. COMP.

430    0.0         ID TORQUE-BOX CONSTRUCTION, ADV. COMP DESIGN.
                    REQUIRES SUPPLEMENTARY ID TO IDENTIFY COVER
                    AND SUPPORT STRUCTURE TYPE.
                       OPTIONS: 0.0, 1.0  MULTI-RIB/STRINGER.  USE
                                      STR TYPE ID D(432)--UPPER COVER
                                      AND D(433)--LOWER COVER.
                                  2.0 MULTI-SPAR/PLATE OR HC PANEL
                                      AND FULL DEPTH HC.  USE TYPE
                                      ID D(431) FOR DETAILS.
431    0.0         ID TYPE ID IF D(430)=2.0, MULTI-SPAR/FDH DESIGN
                       OPTIONS: 1.0 M/S PLATE
                                2.0 M/S HC PANEL
                                3.0 FULL DEPTH HC
432    0.0         ID UPPER COVER STRINGER TYPE IF D(430)=1.0 M/RIB
                       OPTIONS: 1.0 INTEGRAL I-STR
                                2.0 INTEGRAL Z-STR
                                3.0 INTEGRAL T-STR
                                4.0 INTEGRAL HAT-STR
                                5.0 NOT USED
```

```
433     0.0     ID LOWER COVER STRINGER TYPE IF D(430)=1.0 M/RIB
                    OPTIONS: SAME AS UPPER COVER, D(432).
434     0.0     ID TYPE OF SEARCH FOR FOM ANALYSIS.
                    OPTIONS: 0.0 OPTIMIZE SKIN/CORE.
                             1.0 CONSTANT CORE, INPUT DENSITY.
                             2.0 VARIABLE CORE, CALC DENSITY FOR
                                 SKIN GAGE SET BY ST REQMTS.

                NOTE: SPECIFY SUPT STRUCT CONST TYPE WITH DATA
                      CONTROL ID D(435) THRU D(439)

435     1.0     ID INTERMEDIATE SUPT STRUCT TYPE--RIB OR SPARS
                    OPTIONS: 1.0 SINE WAVE CORRUGATED WEBS
                             2.0 HONEYCOMB PANELS
                             3.0 FULL DEPTH HC, REQD ONLY WHEN
                                 D(430)=2.0 AND D(431)=3.0, FOM
436     1.0     ID FRONT SPAR STRUCT TYPE
                    OPTIONS: 1.0 SINE WAVE CORRUGATED WEB
                             2.0 HONEYCOMB PANEL
437     1.0     ID REAR SPAR STRUCT TYPE
                    OPTIONS: SAME AS FOR FRONT SPAR, D(436)
438     0.0     ID TYPE OF SEARCH FOR STRINGER OR SPARS
                    OPTIONS: 0.0 SEARCH FOR OPTIMUM SET OF STR
                                 OR SPARS BASED ON STATUS OF
                                 D(383), ID FOR OPT NO/SPACING
                             1.0 INPUT SPACING FOR STR OR INTERM
                                 SPARS.  DATA IN D(765)-D(775)
                             2.0 INPUT NO OF STR OR INTERM SPARS
                                 DATA IN D(776)-D(786)
439     0.0     NOT USED

                NOTE: DATA LOC D(440) THRU D(449) ARE CONST DATA
                      FOR MULTI-RIB/STRINGER ANALYSIS, ADV. COMP
                      COVER SYNTHESIS SEARCH.

440     2.0     MIN NO OF 0 DEG (L) PLIES--UPPER SKIN
441     2.0                                --LOWER SKIN
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

442	4.0	--UPPER COVER STRINGERS	
443	4.0	--LOWER COVER STRINGERS	
444	0.050	TOLERANCE, STRINGER (B/T)--AVAILABLE VS REQD.	
445	0.020	TOLERANCE, SKIN/STR 0 DEG FLY P/A STRESSES-- APPLIED VS ULT ALLOWABLE.	
446-449	0.0	NOT USED	
450	1.0	MODULUS OF ELASTICITY AT TEMP. TO BE USED FOR EI CALC. OPTIONS: 0.0 USE UPP COVER DATA 0.X FRACTION OF UPP COVER XX.X INPUT E	LBS/SQ IN
		* D(451) THRU D(454) HAVE THE SAME OPTIONS AS D(450)	
451	1.0	G AT TEMP. TO BE USED FOR GJ CALC. SEE D(450) OPTIONS	
452	1.0	G FOR LOWER COVER SEE D(450) OPTIONS	
453	1.0	G FOR FRONT SPAR SEE D(450) OPTIONS	
454	1.0	G FOR REAR SPAR SEE D(450) OPTIONS	
455	0.5	RATIO SKIN GAGE TO STRINGER GAGE-MAX	
456	0.5	-MIN	
		NOTE: DATA LOC D(457) THRU D(460) REQD FOR ADV. COMP OPTION ONLY.	
457	0.250	CAP FACTOR, INTERM SPARS, W/SPAR CONST	
458	0.0	CORE THICKNESS, INTERM RIBS OR SPARS HC PANEL DESIGN--D(435) = 2.0 ONLY.	IN
459	0.0	CORE THICKNESS, FRONT SPAR HC PANEL DESIGN--D(436) = 2.0 ONLY.	IN
460	0.0	CORE THICKNESS, REAR SPAR HC PANEL DESIGN--D(437) = 2.0 ONLY.	IN

```
                 NOTE: DATA LOC D(461) = PRIMARY CONST TYPE ID
                       FOR METALLIC DESIGN ONLY.  HOWEVER, THIS
                       ID SHOULD BE COMPATIBLE WITH CONST TYPE
                       SPECIFIED FOR ADV. COMP DESIGNS.

461    0.0       ID TYPE CONSTRUCTION
                     OPTIONS: 0.0 STRINGER
                              1.0 PLATE(MULTISPAR)
                              2.0 HONEYCOMB PANEL
                              3.0 FULL DEPTH HONEYCOMB

                 NOTE: DATA LOC D(462) THRU D(469) = DESIGN DATA
                       FOR HONEYCOMB PANEL ANALYSIS--METALLIC
                       DESIGN.  REQD ALSO FOR ADV. COMP DESIGN
                       EXCEPT FOR D(463), CORE DENSITY.  CORE
                       DENSITY FOR ADV. COMP CALC FROM DATA SET
                       IN LOC D(1166)-D(1169), ENH ARRAY.

462    0.5       CORE THICKNESS-UPPER COVER
                     OPTIONS: 0.0 FULL DEPTH
                              X.X DEPTH                        INCHES
463    0.0       CORE DENSITY                              LBS/CU FT
464    0.0864    BRAZE DENSITY FOR TWO FACE SHEETS         LBS/SQ FT
465    0.50      INSERT WIDTH FOR UPPER COVER
466    0.375     CORE THICKNESS-LOWER COVER
                     OPTIONS: 0.0 FULL DEPTH
                              X.X DEPTH                        INCHES
467    0.50      INSERT WIDTH FOR LOWER COVER                  INCHES
468    1.0           INSERT WIDTH FOR ROOT RIB                     IN
469    0.075         INSERT DENSITY                         LB/CU IN

470    0.000222  PROTECTIVE FILM FOR ALL EXPOSED            LB/SQ IN
                  INTERNAL SURFACES--ADV. COMP ONLY.
                  UNIT WT FOR TWO SURFACES. (0.032 LB/SQ FT)

                 NOTE: DATA LOC D(471) THRU D(479) ARE BREAKPOINT
                       PRINT ID--STANDALONE VERSION.  DO NOT USE
```

```
471    0.0      PRINT ID-FUEL
                     OPTIONS: 0.0 NO PRINTOUT
                              1.0 COMPLETE PRINTOUT
                              2.0 CONDENSED PRINTOUT

472    0.0      PRINT ID-FUEL.
                     OPTIONS: 0.0 NO PRINTOUT
                              1.0 COMPLETE PRINTOUT
                              2.0 CONDENSED PRINTOUT

473    0.0      PRINT ID-DETAIL WT. SUMMARY.
                     OPTIONS: SAME AS D(471)

474    0.0      PRINT ID-
                     OPTIONS: SAME AS D(471)

475    0.0      PRINT ID-GENERAL DATA
                     OPTIONS: SAME AS D(471)

476    0.0      PRINT ID-GW(1) OUTPUT
                     OPTIONS: SAME AS D(471)

477    0.0      PRINT ID-GW(2) OUTPUT
                     OPTIONS: SAME AS D(471)

478    0.0      PRINT ID-GW(3) OUTPUT
                     OPTIONS: SAME AS D(471)

479    0.0      PRINT ID-FINAL SUMMARY
                     OPTIONS: SAME AS D(471)

480    1.0      ID WING CENTER SECTION.
                     OPTIONS:  0.0 NO WING CENTER SECTION
                               1.0 COMPUTE WIDTH
                             XXX.0 WIDTH OF CENTER          INCHES
                                   SECTION-CHORDWISE
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		DISTANCE
		* D(480) THRU D(505) ARE WING CENTER SECTION WEIGHT COEFFICIENTS AND HAVE BEEN INITIALIZED TO A VALUE OF 1.0-YOU HAVE OPTION TO CHANGE ANY OF THESE VALUES.
481	1.0	W.C.S.-COEFFICIENT
482	1.0	-UPPER COVER COEFF.
483	1.0	-UPPER SKIN COEFF.
484	1.0	-UPPER STRINGER COEFF.
485	1.0	-LOWER COVER COEFF.
486	1.0	W.C.S.-LOWER SKIN COEFF.
487	1.0	-LOWER STRINGER COEFF.
488	1.0	-UPPER AND LOWER MISC-SKIN COEFF.
489	1.0	-ATTACHMENT COEFF.
490	1.0	-INTERMEDIATE RIB COEFF.
491	1.0	W.C.S.-INTERMEDIATE RIB-WEB COEFF.
492	1.0	-MISC. COEFF.
493		NOT USED
494	1.0	-FRONT SPAR-COEFF.
495	1.0	-CAP COEFF.
496	1.0	W.C.S.-FRONT SPAR-WEB COEFF.
497	1.0	-MISC. COEFF.
498	1.0	-REAR SPAR-COEFF.
499	1.0	-CAP COEFF.
500	1.0	-WEB COEFF.
501	1.0	W.C.S.-REAR SPAR-MISC. COEFF.
502	1.0	-CENTERLINE RIB-COEFF.
503	1.0	-CAP COEFF.
504	1.0	-WEB COEFF.
505	1.0	-MISC. COEFF.
506	0.0	FS LOC FOR CENTER-SECTION. <1.0 = X/C AT B1/2 >,=(+1.0) = INCHES AFT OF LE AT B1/2 (-N) = FUS STA. 0.0 = USE OPNL LOC
507-519	0.0	NOT USED

520	1.0	ID DELTA SHEAR TIE CALCULATION. OPTIONS: 0.0 NO CALCULATION. 1.0 CALC. SHEAR TIE DELTA WT.
521	0.0	DENSITY-SHEAR TIE MATL. OPTIONS: 0.0 USE DENSITY FROM INPUT MATERIAL. X.X INPUT DENSITY LBS/CU IN
522	1.0	FC MAX. FOR SHEAR TIE. OPTIONS: 0.0 USES INPUT MATL. FCY. <1.0 FRACTION OF INPUT MATL. FCY. >1.0 INPUT STRESS LEVEL LBS/SQ IN
523	1.0	FT MAX. FOR SHEAR TIE. SAME OPTIONS AS D(522) EXCEPT FTU REPLACES FCY.
524	1.0	FS MAX. FOR SHEAR TIE. SAME OPTIONS AS D(522) EXCEPT FSU REPLACES FCY.
525	1.0	FBF MAX. FOR SHEAR TIE. SAME OPTIONS AS D(522) EXCEPT FBRU REPLACES FCY.
526	141.3125	CONSTANT DATA-SHEAR TIE-C1
527	78.20	-C2
528	0.000025	-C3
529		NOT USED * D(530) THRU D(536) ARE PIVOT WEIGHT COEFFICIENTS-YOU HAVE OPTION OF CHANGING ANY OF THESE VALUES.
530	1.0	PIVOT-WEIGHT COEFF.
531	1.0	-INBOARD LUG WEIGHT COEFF.
532	1.0	-OUTBOARD LUG WEIGHT COEFF.

533	1.0	-FIN WEIGHT COEFF.
534	1.0	-INBOARD RIB WEIGHT COEFF.
535	1.0	-OUTBOARD RIB WEIGHT COEFF.
536	0.1	-MISC. WEIGHT COEFF.
537-549		NOT USED
		* D(550) THRU D(571) IS A TABLE OF SHEAR BUCKLING COEFFICIENT VERSES ASPECT RATIO.
550	0.0	ASPECT RATIO OF PLATE PT NO-1
551	0.1	-2
552	0.2	-3
553	0.3	-4
554	0.4	-5
555	0.5	-6
556	0.6	-7
557	0.7	-8
558	0.8	-9
559	0.9	-10
560	1.0	-11
561	4.25	SHEAR BUCKLING COEFF. FOR PT NO-1
562	4.50	-2
563	4.67	-3
564	4.86	-4
565	5.08	-5
566	5.35	-6
567	5.69	-7
568	6.10	-8
569	6.58	-9
570	7.15	-10
571	7.75	-11
572	0.05	EMPIRICAL CONSTANT USED IN EQUATION TO DETERMINE BUCKLING COEFFICIENT WITH COMBINED SHEAR AND BENDING.
573	100.0	ID CONTROL FOR T/D ANALYSIS.

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		OPTIONS: 100.0 PURE SHEAR WEB ANALYSIS 1.0 COMBINED SHEAR AND BENDING ANALYSIS FOR THE WEB.
		NOTE: DATA LOC D(574) THRU D(578) ARE ID FOR BREAKPOINT PRINT DURING SYNTHESIS SEARCH FOR BOTH METALLIC AND ADV. COMP. AMOUNT OF PRINTED OUTPUT WILL BE DEPENDANT ON THE CONTROLS AND THE NUMBER OF CALC POINTS. FOR METALLIC DESIGN, IP(33) IS THE CONTROL ID FOR PRINT TEST. SINCE IP(33) IS A COMPLETE CASE ID, THE TEST WILL OCCUR DURING EVERY SURFACE ANALYSIS FOR THE CASE. FOR ADV. COMP DESIGN, LOC D(574) IS THE CONTROL ID FOR PRINT TEST--IP(33) IS NOT CHECKED.
574	C.0	ID DETAIL PRINT CONTROL, ADV. COMP ONLY. OPTIONS: 0.0 NO PRINT 1.0 PRINT ANALYSIS SUMMARY DATA AT EACH STATION ONLY FOR DW PASS NO IN D(578)--ALL CONST. 2.0 PRINT SUMMARY DATA PLUS DETAIL STR/SKIN LOAD DIST DATA FOR STR ANALYSIS ONLY DURING DW PASS NO OF D(578) AND FOR STATIONS INDICATED IN D(575), D(576) AND D(577).
		* LOC. 575-578 ARE USED WITH IP(33) TO INDICATE THE DEADWEIGHT PASS AND SECTIONS THAT WILL HAVE A DETAIL BREAK POINT AS OUTPUT.
575	0.0	SECTION TO HAVE DETAILED BREAK POINT PRINT. INDICATE ONE SECTION (Y(1)- Y(11)).

576	0.0	SECOND SECTION USED FOR BREAK POINT PRINT. INDICATE ONE SECTION (Y(1)- Y(11)).
577	0.0	THIRD SECTION USED FOR BREAK POINT PRINT. INDICATE ONE SECTION (Y(1)- Y(11)).
578	0.0	INDICATOR FOR NCOW PASS TO HAVE DETAIL BREAK POINT DATA PRINTED. IT CAN BE EITHER 1,2,3 OR 4
579	0.995	CONSTANT DATA, ADV. COMP--ROUND CONSTANT FOR INTEGER NO OF 0, 45, 90 DEG PLIES/HALF LAMINATE
		NOTE: DATA LOC D(580) THRU D(596) FOR HONEYCOMB PROPERTIES VS TEMP CALC--DATA ARRAY CFMTL(5,3). BASE RATIOS FOR FOIL E,MU AND FCY VS 0, 100, 200, 300, 400 DEG F. REF TO 72 DEG F (ROOM TEMP). REF VALUES: E IN D(1165), MU IN D(595), FCY IN D(596).
		VALUES IN TABLE FOR 2024-T4 BARE AL SHEET. TABLE DATA MUST BE CHANGED IF DIFF CORE MATL IS TO BE USED.
580	102.5	CFMTL(1,1)--FOIL (E) VALUE, % OF D(1165), 0 DEG.
581	99.5	(2,1) , 100 DEG.
582	98.5	(3,1) , 200 DEG.
583	95.5	(4,1) , 300 DEG.
584	89.5	(5,1) , 400 DEG.
585	99.0	CFMTL(1,2)--FOIL MU VALUE, % OF D(595), 0 DEG.
586	100.2	(2,2) , 100 DEG.
587	101.7	(3,2) , 200 DEG.
588	103.2	(4,2) , 300 DEG.
589	104.5	(5,2) , 400 DEG.
590	102.5	CFMTL(1,3)--FOIL FCY VALUE, % OF D(596), 0 DEG.

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591     99.5          (2,3)                          , 100 DEG.
592     96.5          (3,3)                          , 200 DEG.
593     91.5          (4,3)                          , 300 DEG.
594     82.0          (5,3)                          , 400 DEG.

595     0.330       CFBMU--FOIL MU, REF VALUE AT ROOM TEMP, 72 DEG.
596     40000.0     CFBCY--FOIL FCY, REF VALUE AT ROOM TEMP        PSI
597     0.0000312   EXTERNAL PROTECTIVE COVER FOR ADV.        LB/SQ IN
                     COMP SKINS, AL FLAME SPRAY (0.045 PSF).
598     2.0         BUCKLING COEFF, ADV. COMP LONG PLATES, SIMPLY
                     SUPPORTED AT BOTH EDGES, SKINS AND STR WEBS.
599     1.0         BUCKLING COEFF, ADV. COMP LONG PLATES, SIMPLY
                     SUPPORTED AT ONE EDGE, FREE AT THE OTHER, I-STR
                     WEB, Z- AND T-STR OUTSTANDING FLANGES

                    * D(600) THRU D(636) ARE THE WEIGHT INDEXING
                      COEFFICIENTS. YOU HAVE THE OPTION OF CHANGING
                      THESE VALUES-
                        OPTIONS:  0.0 WILL INPUT 1.0 INTO D(XXX)
                                 -1.0 WILL INPUT 0.0 INTO
                                          D(XXX)
                                  X.X WILL INPUT X.X INTO D(XXX)
                                  NO INPUT WILL LET PROGRAM USE
                                   INITIALIZED VALUES AS SHOWN
                                   BELOW.
        WING  HORIZ VERT
600     1.0   1.0   1.0    COEFFICIENT-TORQUE BOX
601     1.0   1.0   1.0               -LEADING EDGE
602     1.0   1.0   1.0               -TRAILING EDGE
603     0.025 0.020 0.030             -WING OUTER PANEL & WCS MISC.
604     1.075 1.075 1.075             -UPPER COVER

605     1.075 1.075 1.075  COEFFICIENT-UPPER SKIN
606     1.075 1.075 1.075             -UPPER STRINGER
607     1.10  1.08  1.07              -LOWER COVER
608     1.10  1.08  1.07              -LOWER SKIN
609     1.10  1.06  1.07              -LOWER STRINGER
```

```
                WING   HORIZ  VERT
010             1.75   1.75   1.75    COEFFICIENT-UPP/LWR SKIN MISC.
011             2.0    2.0    2.0                -UPP/LWR SKIN ATTACH
012             1.75   1.10   1.10               -INTERMEDIATE RIB/SPAR
013             1.25   1.15   1.15               -INTERMEDIATE RIB/SPAR WEB
014             1.25   1.15   1.15               -INTERMEDIATE RIB/SPAR MISC.

015             1.25   1.25   1.25    COEFFICIENT-ATTACHMENT JOINT & BULKHEAD
016             1.10   1.10   1.10               -F.S.
017             1.15   1.15   1.15               -F.S. CAP
018             1.15   1.15   1.15               -F.S. WEB
019             1.15   1.15   1.15               -F.S. MISC.

020             1.10   1.10   1.10    COEFFICIENT-R.S.
021             1.15   1.15   1.15               -R.S. CAP
022             1.15   1.15   1.15               -R.S. WEB
023             1.15   1.15   1.15               -R.S. MISC.
024             1.50   1.10   1.10               -ROOT RIB

025             0.75   0.75   0.75    COEFFICIENT-ROOT RIB CAP
026             1.15   1.15   1.15               -ROOT RIB WEB
027             1.15   1.15   1.15               -ROOT RIB MISC.

028-034                      NOT USED

035-049 1.0                  K FACTORS FOR FCMAX ALLOWABLE AT EACH STATION.
                              ARRAY = 1.0.

050-060 0.0                  10 BULKHEADS. ONE BULKHEAD INSERT AT EACH
                              SECTION INDICATED.
                                 OPTIONS: 0.0 NO BULKHEAD
                                          X.X DELTA COEFF. BULKHEAD WT.=
                                              (1.0+X.X) TIMES RIB WT.
                                          IF SUM OF INPUTS IS LESS THAN
                                          2.1 THEN D(655) IS SET = 2.0

061-071 0.0                  10 CHORDWISE JOINTS.
```

```
                    OPTIONS: 0.0 NO JOINT
                             X.X SPANWISE WIDTH FOR       INCHES
                                 ONE SIDE OF JOINT.
                             SUM OF INPUTS MUST BE > 3.1 IF
                             FOOT AND TIP ARE ZERO, OR
                             PROGRAM WILL SET D(661) AND
                             D(671)=1.0

672-685                 NOT USED

                        NOTE: DATA LOC D(686) IS THE CONTROL ID TO INDI-
                              CATE INPUT LOADS AT THE 11 STRUCT. STA.
                              USE OF THIS ID REQUIRES APPROPRIATE DATA
                              IN DATA LOC D(260)-D(270), D(687)-D(719),
                              D(1019)-D(1040) AND D(953)-D(996).
                              THREE TYPES OF LOADS CAN BE INPUT:
                                A). GROSS LIMIT SHEARS AND MOMENTS, DATA
                                      BLOCKS D(260)-D(270), D(687)-D(719)
                                      AND D(1019)-D(1040).
                                B). NET LIMIT SHEARS AND MOMENTS, SAME
                                      AS (A) ABOVE.
                                C). COVER NX PLUS FRONT AND REAR SPAR
                                      FLOWS, Q, DATA BLOCK D(953)-
                                      D(996).  FOR THIS OPTION D(687) MUST
                                      BE SET TO 0.0.

                              LOGIC IN THE INPUT LOAD DATA PROCESS WILL
                              ALLOW FOR INPUT OF CONSTANT LOAD VALUES.
                              INPUT RECD VALUES FOR STA 1 ONLY AND SET
                              VALUE OF B. MOM FOR STA 2, LOC D(261) TO
                              0.0.

686      0.0            ID INPUT DESIGN LOADS AT 11 STRUCT. STATIONS.
                          OPTIONS: 0.0 NO INPUT, USE CALC LOADS.
                                   1.0 INPUT LOADS, GROSS LIMIT.
                                   2.0 INPUT LOADS, NET LIMIT.
                                   3.0 INPUT LOADS, NX AND Q VALUES.
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		LIMIT. D(239) AND D(687) MUST BE SET TO 0.0.	
687-697	0.0	INPUT SHEAR, POSI. LOAD CONDITION LIMIT D(687)=SECTION NO.1(ROOT) D(697)=SECTION NO.11(TIP)	LB
698-708	0.0	INPUT SHEAR, NEG. LOAD CONDITION, LIMIT D(698)=SECTION NO.1(ROOT) D(708)=SECTION NO.11(TIP)	LB
709-719	0.0	INPUT B. MOM, NEG. LOAD CONDITION, LIMIT D(709)=SECTION NO.1(ROOT) D(719)=SECTION NO.11(TIP) POSITIVE MOMENTS IN D(260)-D(270)	IN-LB
720	0.0	NOT USED.	
		NOTE: DATA BLOCKS IN LOC D(721) THRU D(841) WILL BE USED ONLY IF CONTROL ID IN D(367) IS A NON-ZERO NO. DATA IN THESE BLOCKS ARE USED TO SPECIFY DISCRETE DESIGN/SYNTHESIS VALUES AT EACH OF THE 11 STRUCTURAL STATIONS. THESE INPUTS WILL OVER-RIDE ALL BASIC INPUT IDENTIFIED BELOW AND ALL THE OPTIONAL ANALYSIS INPUTS BASED ON CONTROL ID DATA IN D(1301) AND D(1365).	
721-731	0.0	RATIO OF SKIN T TO TBAR -MIN REF. D(365)	
732-742	0.0	-MAX REF. D(366)	
743-753	0.0	SKIN THICKNESS-UPPER COVER	INCHES
754-764	0.0	-LOWER COVER	INCHES
765-775	0.0	MIN STRINGER SPACING. D(367)=2.0 FOR CONSTANT SPACING.	INCHES
776-786	0.0	MIN NUMBER STRINGERS.	
787-797	0.0	RIB SPACING	INCHES

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

798-808	0.0	STRINGER HEIGHT	INCHES
809-819	0.0	NUMBER OF STRINGER AREAS PER CAP-FS	
820-830	0.0	NUMBER OF STRINGER AREAS PER CAP-RS	
831-841	0.0	MIN RATIO -NX/+NX REF. D(392)	
842-852	1.050	FRONT SPAR SHEAR K FACTOR INITIALIZED TO 1.050, YOU HAVE OPTION TO CHANGE.	
853-863	1.200	REAR SPAR SHEAR K FACTOR INITIALIZED TO 1.20, YOU HAVE OPTION TO CHANGE.	
		NOTE: DATA LOC D(864) IS THE CONTROL ID TO INDICATE INPUT T-BOX GEOMETRY FOR 11 STRUCT. STATIONS TO BE USED FOR SYNTHESIS. USE OF THIS CONTROL REQUIRES ALL THE GENERAL GEOMETRY DATA PLUS APPROPRIATE DATA IN DATA LOC D(865) THRU D(919). THREE GENERAL OPTIONS ARE AVAILABLE WITH PROPER USE OF CONTROL AND DETAIL DATA: A). INPUT OF STRUCT. STATION DEFINITION ONLY, PROGRAM CALC OF DETAIL SECTION GEOMETRY. REQUIRES NON-ZERO NO IN D(864), D(865)-D(875) AND 0.0 IN D(876). B). INPUT OF COMPLETE STRUCT. GEOMETRY DATA. REQUIRES NON-ZERO NO. IN D(864) AND D(865)-D(919). C). INPUT OF CONSTANT X-SECTION DATA AT ALL STATIONS. REQUIRES NON-ZERO NO IN D(864), D(865)-D(875), SECTION DATA FOR STATION 1 AND 0.0 IN D(877) --SECTION WIDTH FOR STATION 2.	
864	0.0	ID INPUT T-BOX GEOMETRY SPECIFICATIONS. SEE NOTES ABOVE FOR DETAILS ON REQD DATA IN LOC	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                    D(865)-D(919).
                      OPTIONS: 0.0 NO INPUTS.  CALC GEOMETRY, SET
                                   UP 11 EQUALLY SPACED STRUCT.
                                   STATIONS BETWEEN BP STATION
                                   DEFINED BY D(246) FOR STA 1 AND
                                   D(139) FOR STA 11.
                               1.0 INPUT DATA.  STRUCT. STATION
                                   DATA DEFINED IN D(865)-D(875)
                                   REF TO BP STATION DEFINED BY
                                   D(246).
                               2.0 INPUT DATA.  SAME AS FOR ID=1.0
                                   EXCEPT THAT REF TO C/L.
                               3.0 INPUT DATA.  INPUT STATION
                                   VALUES ARE IN STRUCTURAL REF
                                   SYSTEM, 0.0 AT C/L.

865-875 0.0         INPUT STATIONS FOR STRUCTURAL SYNTHESIS.
                      OPTIONS: 0.XX FRACTION OF SPAN DEFINED BY
                                    REF INBD AND OBD STATIONS.
                               XX.X DELTA Y VALUES FROM REF       IN
                                      INBD STA IF D(864) = 1.0.
                                    BUTTOCK PLANE STA IF D(864)
                                      = 2.0
                                    STRUCTURAL STATIONS ALONG
                                      EA IF D(864) = 3.0.
                               NOTE:  IF THE INPUT STATION OPTION
                                      IS USED ONLY TO SPECIFY REQD
                                      STATIONS, LOCATION D(876)
                                      MUST BE SET TO 0.0.
                  --IF D(865)=0.0, SECTION CUTS TRANSFERED FROM DM--

876-886 0.0         STRUCTURAL WIDTH OF TORQUE BOX.             INCHES
887-897 0.0         AVERAGE DEPTH OF TORQUE BOX                 INCHES
898-908 0.0         TORQUE BOX DEPTH AT FRONT SPAR              INCHES
909-919 0.0         TORQUE BOX DEPTH AT REAR SPAR               INCHES

920-930 0.0         NOT USED
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

* IN THE SYNTHESIS PROCESS THE NX VALUES ARE MULTIPLIED BY D(931)-D(952) CONSTANTS TO REFLECT THE EFFECTS OF THE PEAK STRESSES OF THE TORQUE BOX WHICH OCCUR AT ITS CROWN. THEY WERE DETERMINED BY CORRELATION TO STRESS SIZING DATA.

931	1.175	K FACTOR TO UPPER COVER NX VALUE FOR SEC. NO.-1
932	1.15	-2
933	1.125	-3
934	1.11	-4
935	1.10	-5
936	1.09	-6
937	1.08	-7
938	1.07	-8
939	1.06	-9
940	1.05	-10
941	1.04	-11
942	1.075	K FACTOR TO LOWER COVER NX VALUE FOR SEC. NO.-1
943	1.065	-2
944	1.055	-3
945	1.045	-4
946	1.035	-5
947	1.025	-6
948	1.015	-7
949	1.005	-8
950	0.995	-9
951	0.985	-10
952	0.975	-11

NOTE: DATA BLOCK D(953)-D(996) IS THE INPUT BLOCK TO BE USED WHEN INPUT LOAD CONTROL ID D(686) = 3.0. INPUT NX AND Q. WHEN THIS OPTION IS USED D(239) AND D(687) MUST BE SET TO 0.0. FINAL DESIGN VALUES FOR NX AND Q WILL DIFFER SLIGHT-

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		LY FROM INPUT VALUES SINCE THE INPUTTED VALUES ARE CONVERTED TO SHEARS AND MOMENTS BY THE PROGRAM AND SUBSEQUENTLY RECALCULATED WITH COUPLE-ARM ADJUSTMENTS AS REQD. FOR THIS TYPE OF ANALYSIS, ONE DW PASS SHOULD BE SPECIFIED, D(369)=0.0 AND/OR VALUES INPUTTED FOR INITIAL COUPLE-ARMS IN DATA LOC D(997)-D(1007) AND D(1041)-D(1051).
953-963	0.0	NOT USED
964-974	0.0	NOT USED
975-985	0.0	NOT USED
986-996	0.0	NOT USED
		* INPUTS FOR D(865)-D(1051) START WITH ROOT SECTIONS AND MOVE OUTBOARD.
997-1007	0.0	DELTA Y-BAR UPPER COVER OPTIONS: 0.0 Y-BAR CALCULATED X.X INPUT Y-BAR INCHES
1008-1018	1.0	K FACTORS FOR FTMAX ALLOWABLE AT EACH STATION. ARRAY = 1.0
1019-1029	0.0	INPUT T. MOM, POSI. LOAD CONDITION, LIMIT IN-LB
1030-1040	0.0	INPUT T. MOM, NEG. LOAD CONDITION, LIMIT IN-LB
1041-1051	0.0	DELTA Y-BAR LOWER COVER OPTIONS: 0.0 Y-BAR CALCULATED X.X INPUT Y-BAR INCHES
1052-1087		NOT USED

NOTE: DATA LOC D(1088) THRU D(1119) = DATA ARRAY

		DTBX(32). THIS BLOCK TO BE USED TO ADJUST CALC WEIGHT OF THE 10 T-BOX PANELS BY: A). DIFF WT FACTORS FOR EACH PANEL. B). DIFF DELTA WT TO BE APPLIED TO EACH CALC PANEL WT. USE THIS BLOCK TO REFINE T-BOX MASS DISTRIBUTION INERTIA CALC FOR DATA GENERATION OPTION. ALL INCREMENTAL WTS FROM THIS BLOCK WILL BE USED IN DW LOAD CALC AND IN FINAL T-BOX WT SUMMARY. WT COEFF IN D(604)-D(627) STILL APPLY.	
1086-1097	0.0	DELTA WT FACTOR FOR EACH T-BOX PANEL DEFINED BY STRUCTURAL STATIONS. IF EQUAL TO 0.0, ARRAY SET TO 1.0	
1098-1107	0.0	DELTA WT TO BE ADDED TO EACH T-BOX PANEL. ARRAY = 0.0.	LB/PNL
1108-1119	0.0	NOT USED	
		NOTE: DATA LOC D(1120) IS CONTROL ID FOR INPUT T-BOX MASS DIST. DATA FOR INITIAL DW CALC.	
1120	0.0	ID INPUT T-BOX WT/IN DATA. OPTIONS: 0.0 NO INPUT 1.0 INPUT T-BOX WT/IN AND/OR CONC. WTS AT EACH STRUCT. STATION.	
1121-1131	0.0	LBS/IN AT SECTION CUTS FOR TORQUE BOX	LBS/IN
1132-1142	0.0	CONC. WTS TO BE ADDED AT SECTION CUTS. ARRAY = 0.0.	LB/SIDE
		NOTE: DATA LOC D(1143) THRU D(1154) = DATA ARRAY LIMIT(12). THIS BLOCK CONTAINS NO. AND SIZE	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		LIMITS FOR STRIP AND GRID CUTS FOR LE, TE AND TR PANEL TO CONTROL GRID SIZE DURING NUMERICAL INTEGRATION OF PANEL MASS DATA.
1143	15.0	MAX NO. OF STRIPS-INERTIA CALC. -BOX
1144	20.0	-LE
1145	20.0	-TE
1146	6.0	MIN STRIP WIDTH-INERTIA CALC. -BOX
1147	4.0	-LE
1148	4.0	-TE
1149	15.0	MAX NO. OF GRIDS-INERTIA CALC.-BOX
1150	20.0	-LE
1151	20.0	-TE
1152	6.0	MIN GRID LENGTH-INERTIA CALC. -BOX
1153	4.0	-LE
1154	4.0	-TE
1155-1204		NOT USED

NOTE: DATA LOC D(1155) THRU D(1204) CONTAINS MATERIAL PROPERTY DATA FOR ADV. COMP ANALYSIS.

D(1155)-D(1163) = ARRAY ENP(9), BASE PROPERTIES FOR LAMINA AT ROOM TEMP (72.0 DEG F).

D(1164)-D(1169) = ARRAY ENH(6), HONEYCOMB CORE PROPERTIES.

D(1170)-D(1204) = ARRAY TC(5,7), BASE PROPERTY VARIATION FACTORS VS TEMP (0,100,200,300,400 DEG) AS PER CENT OF ENP ARRAY ITEMS (1-7).

ARRAYS ENP AND TC CONTAINS PROPERTIES FOR BORON/EPOXY. IF DIFF ADV. COMP MATERIAL IS TO BE USED, DATA MUST BE CHANGED.

ARRAY ENH CONTAINS PROPERTIES FOR 2024-T4 BARE AL SHEET, COMPATIBLE WITH DATA IN ARRAY CEMTL, D(580)-D(594) AND ITEMS IN D(595) AND

D(596). FOR ADV. COMP ANALYSIS OF HC PNLS--COVERS AND WEB--ONLY ENH DATA ARE USED. FOR FULL-DEPTH HC ANALYSIS, ENH, CFMTL AND ITEMS IN D(595) AND D(596) ARE USED. APPROPRIATE DATA CHANGES MUST BE MADE IF DIFF TYPE OF CORE FOIL MATL IS REQD. CHANGES IN CORE CELL SIZE (S) AND FOIL GAGE (TF), DATA LOC D(1168) AND D(1169), CAN BE MADE WITHOUT OTHER CHANGES. CORE DENSITIES AND STIFFNESS CHARACTERISTICS ARE CALC BY THE PROGRAM.

1155	30000000.0	ENP(1)--ELASTIC MODULUS-LONGITUDINAL	PSI
1156	2700000.0	(2)--ELASTIC MODULUS-TRANSVERSE	PSI
1157	700000.0	(3)--SHEAR MODULUS	PSI
1158	0.210	(4)--POISSONS RATIO	IN/IN
1159	180000.0	(5)--ULTIMATE TENSION STRESS 0 DIR.	PSI
1160	400000.0	(6)--ULTIMATE COMPRESSION STRESS 0 DIR.	PSI
1161	67000.0	(7)--ULTIMATE SHEAR STRESS, 45 DEG PLIES	PSI
1162	0.0725	(8)--LAMINA DENSITY	LB/CU IN
1163	0.0050	(9)--LAMINA THICKNESS	IN
1164	0.100	ENH(1)--FOIL DENSITY	LB/CU IN
1165	10700000.0	(2)--FOIL MATL ELASTIC MODULUS	PSI
1166	4026000.0	(3)--FOIL MATL SHEAR MODULUS	PSI
1167	0.50	(4)--PANEL CORE THICKNESS--NOT USED	IN
1168	0.1875	(5)--CORE CELL SIZE	IN
1169	0.0020	(6)--FOIL GAGE	IN
1170	100.0	TC(1,1)--LAMINA (EL), % OF D(1155) VALUE, 0 DEG.	
1171	100.0	(2,1) , 100 DEG.	
1172	99.0	(3,1) , 200 DEG.	
1173	98.0	(4,1) , 300 DEG.	
1174	97.0	(5,1) , 400 DEG.	
1175	117.0	(1,2)--LAMINA (ET), % OF D(1156) VALUE, 0 DEG.	
1176	93.0	(2,2) , 100 DEG.	
1177	65.0	(3,2) , 200 DEG.	
1178	44.0	(4,2) , 300 DEG.	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1179	33.0	(5,2) , 400 DEG.
1180	110.0	(1,3)--LAMINA (GXY), % OF D(1157) VALUE, 0 DEG
1181	54.0	(2,3) , 100 DEG.
1182	75.0	(3,3) , 200 DEG.
1183	55.0	(4,3) , 300 DEG.
1184	37.0	(5,3) , 400 DEG.
1185	58.0	(1,4)--LAMINA MUXY, % OF C(1158) VALUE, 0 DEG.
1186	100.0	(2,4) , 100 DEG.
1187	102.0	(3,4) , 200 DEG.
1188	104.0	(4,4) , 300 DEG.
1189	106.0	(5,4) , 400 DEG.
1190	57.0	(1,5)--LAMINA FTU, % OF C(1159) VALUE, 0 DEG.
1191	85.0	(2,5) , 100 DEG.
1192	82.0	(3,5) , 200 DEG.
1193	65.0	(4,5) , 300 DEG.
1194	43.0	(5,5) , 400 DEG.
1195	103.0	(1,6)--LAMINA FCU, % OF C(1160) VALUE, 0 DEG.
1196	99.0	(2,6) , 100 DEG.
1197	85.0	(3,6) , 200 DEG.
1198	61.0	(4,6) , 300 DEG.
1199	5.0	(5,6) , 400 DEG.
1200	100.0	(1,7)--LAMINA FSU, % OF C(1161) VALUE, 0 DEG.
1201	100.0	(2,7) , 100 DEG.
1202	85.0	(3,7) , 200 DEG.
1203	77.0	(4,7) , 300 DEG.
1204	66.0	(5,7) , 400 DEG.
1205	0.0	WING FIXED LE UNIT WT. OPTIONS: 0.0 PROGRAM CALC. W/S FOR LE STATISTICALLY; X.X INPUT UNIT WT. LBS/SQ FT
1206	1.0	FACTOR FOR FIXED LE WING WT. YOU HAVE OPTION TO CHANGE.
1207	8.0	CONSTANT DATA-FIXED LE-WING
1208	1.5	-WING
1209	0.00077	-WING
1210	0.80	-WING

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1211	0.830	-WING
1212	0.10	-WING
1213	0.25	-WING
1214	0.10	-WING
1215	0.0	HORIZONTAL FIXED LE UNIT WT. SAME OPTIONS AS WING LE UNIT WT-D(1205)
1216	1.0	CONSTANT DATA-FIXED LE-H.TAIL
1217	8.0	-H.TAIL
1218	1.75	-H.TAIL
1219	0.0004	-H.TAIL
1220	0.80	-H.TAIL
1221	0.540	-H.TAIL
1222	0.10	-H.TAIL
1223	0.25	-H.TAIL
1224	0.10	-H.TAIL
1225	0.0	VERTICAL FIXED LE UNIT WT. SAME OPTIONS AS WING LE UNIT WT-D(1205)
1226	1.0	CONSTANT DATA-FIXED LE-V. TAIL
1227	8.0	-V. TAIL
1228	1.5	-V. TAIL
1229	0.0004	-V. TAIL
1230	0.80	-V. TAIL
1231	0.54	-V. TAIL
1232	0.10	-V. TAIL
1233	0.25	-V. TAIL
1234	0.10	-V. TAIL
1235	0.0	WING FIXED TE UNIT WT. OPTIONS: 0.0 PROGRAM CALC. W/S FOR TE STATISTICALLY. X.X INPUT UNIT WT. LBS/SQ FT
1236	1.0	CONSTANT DATA-FIXED TE-WING
1237	0.01	-WING
1238	1.0	-WING
1239	0.35	-WING

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1240   0.0125                                        -WING
1241   1.45                                          -WING
1242   1.0                                           -WING
1243   0.70                                          -WING
1244   950.0                                         -WING
1245   0.01                                          -WING
1246   0.0                                           -WING
1247   0.10                                          -WING
1248   0.25                                          -WING
1249   0.10                                          -WING

1250   0.0     HORIZONTAL FIXED TE UNIT WT.
                    SAME OPTIONS AS WING TE UNIT WT-D(1235)
1251   1.0     CONSTANT DATA-FIXED TE-H. TAIL
1252   0.01                                  -H. TAIL
1253   1.0                                   -H. TAIL
1254   0.35                                  -H. TAIL
1255   0.0145                                -H. TAIL
1256   1.35                                  -H. TAIL
1257   0.75                                  -H. TAIL
1258   0.70                                  -H. TAIL
1259   950.0                                 -H. TAIL
1260   0.01                                  -H. TAIL
1261   0.0                                   -H. TAIL
1262   0.10                                  -H. TAIL
1263   0.25                                  -H. TAIL
1264   0.10                                  -H. TAIL

1265   0.0     VERTICAL FIXED TE UNIT WT.
                    SAME OPTIONS AS WING TE UNIT WT-D(1235)
1266   1.0     CONSTANT DATA-FIXED TE-V. TAIL
1267   0.01                                  -V. TAIL
1268   1.0                                   -V. TAIL
1269   0.35                                  -V. TAIL
1270   0.0145                                -V. TAIL
1271   1.35                                  -V. TAIL
1272   0.75                                  -V. TAIL
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  1273     0.70                            -V. TAIL
  1274     950.0                           -V. TAIL
  1275     0.01                            -V. TAIL
  1276     0.0                             -V. TAIL
  1277     0.10                            -V. TAIL
  1278     0.25                            -V. TAIL
  1279     0.10                            -V. TAIL

* 1280     0.0        LIM LOAD FACTOR FOR CDL FTG WT EST.
                          OPTIONS: 0.0 NZ TRANSFERRED FROM DM
                                       IF D(66)&D(1280)=0.0
                                   X.X NZ YOU WANT CDL HARDPOINT
                                          WTS. BASED ON.
  1281     1.0        NO. OF ATTACH PTS. FOR CDL NO.-1 INPUT 1 OR 2
  1282     1.0                                      -2
  1283     2.0                                      -3
  1284     2.0                                      -4
  1285     2.0                                      -5
  1286     2.0                                      -6
  1287     2.0                                      -7
  1288     1.0        WT. FACTOR FOR CDL HARDPOINT WT.- CDL NO.-1
  1289     1.0                                             -2
  1290     1.0                                             -3
  1291     1.0                                             -4
  1292     1.0                                             -5
  1293     1.0                                             -6
  1294     1.0                                             -7

  1295-               NOT USED
   1300

  1301     0.0        ID DIFF COVER DESIGN CONSTRAINTS FOR EACH GROSS
                       WT.  DATA IN D(1302) THRU D(1322).
                                  0.0 CONDITIONS FOR COVER REMAIN
                                      CONSTANT FOR ALL GROSS WTS.
                                  1.0 INDICATES CONDITIONS MAY
                                      VARY-YOU MUST INPUT D(1302)
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		THRU D(1322).	
1302	0.0	MIN RIB SPACING-GW(1)	INCHES
1303	0.0	-GW(2)	INCHES
1304	0.0	-GW(3)	INCHES
1305	0.0	MAX RIB SPACING-GW(1)	INCHES
1306	0.0	-GW(2)	INCHES
1307	0.0	-GW(3)	INCHES
1308	0.0	MIN STRINGER HEIGHT-GW(1)	INCHES
1309	0.0	-GW(2)	INCHES
1310	0.0	-GW(3)	INCHES
1311	0.0	MAX STRINGER HEIGHT-GW(1)	INCHES
1312	0.0	-GW(2)	INCHES
1313	0.0	-GW(3)	INCHES
1314	0.0	MIN STRINGER SPACING-GW(1)	INCHES
1315	0.0	-GW(2)	INCHES
1316	0.0	-GW(3)	INCHES
1317	0.0	MAX STRINGER SPACING-GW(1)	INCHES
1318	0.0	-GW(2)	INCHES
1319	0.0	-GW(3)	INCHES
1320	0.0	MIN NUMBER OF STRINGERS-GW(1)	
1321	0.0	-GW(2)	
1322	0.0	-GW(3)	
		* FOR D(1320) THRU D(1322), NO.=(TIP WIDTH/ MAX STRG. SPACING)-1.0	
1323-1347		NOT USED	
		NOTE: DATA LOC D(1348) THRU D(1357) = CONSTANT DATA FOR STRINGER ANALYSIS, ADV. COMP.	
1348	1.0	STFNH(1)--NO OF STR WEBS--I-STR	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1349	1.0	(2) --Z-STR	
1350	1.0	(3) --T-STR	
1351	2.0	(4) --HAT-STR	
1352	0.0	(5) --NOT USED	
1353	0.0	STENF(1)--NO OF STR FLANGES--I-STR	
1354	1.0	(2) --Z-STR	
1355	2.0	(3) --T-STR	
1356	1.0	(4) --HAT-STR	
1357	0.0	(5) --NOT USED	
1358-1364		NOT USED	
1365	0.0	INDICATOR FOR STRINGER OPTIMIZATION. OPTIONS: 0.0 NO OPTIMIZATION 1.0 OPTIMIZATION 2.0 CONSTANT NUMBER STRINGERS 3.0 CONSTANT STRINGER SPACING NOTE: SEARCH DATA IN D(1366) THRU D(1374) METAL. D(1369,1370,1373,1374) FOR ADV. COMP	
1366	6.0	SECTION OPTIMIZED WHERE DATA IS PRINTED.	
1367	6.0	MIN NO. STRINGERS	
1368	12.0	MAX NO. STRINGERS	
1369	2.0	INCREMENT USED IN SEARCH FROM D(1367) TO D(1368)	
1370	1.0	INCREMENT USED TO REDUCE OPTIMUM NO. SO THAT POINT MAY BE VARIFIED.	
1371	2.0	MIN STRINGER SPACING	INCHES
1372	5.0	MAX STRINGER SPACING	INCHES
1373	0.5	INCREMENT USED TO SEARCH FROM D(1371) TO D(1372)	INCHES
1374	0.25	INCREMENT TO REDUCE OPT. SPACING BY SO THAT IT MAY BE VARIFIED.	INCHES

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1375-1400		NOT USED		
		D(1401) THRU D(1500) = DATA ARRAY DC(100).		
1401	0.592079	CONSTANT DATA	-FT/SEC TO KNOTS	
1402	4.427635E-05		-DENSITY OF AIR AT SL	LBS/CU IN
1403	0.0		-CONSTANT ZERO	
1404	1.0		-K/EI-6J	
1405	35332.0		-ALTITUDE	
1406	971.1		-CS AT ALT. IN D(1405)	
1407	20786.0		-	
1408	0.3057		-	
1409	4.2561		-	
1410	0.000006375		-	
1411	0.0041023[illegible]		-	
1412	1117.19		-CS AT S.L.	
1413	0.000000001		-CONSTANT (10)-9	
1414	1.0		-M/VF CUT-OFF	
1415	0.01		-[illegible] -Y	
1416	1.0		-E MIN	INCHES
1417-1431		NOT USED		
1432	-1.1160	CONSTANT DATA	-GJ CAL	
1433	1480.0		-GJ CAL	
1434	22.5		-GJ CAL	
1435	0.80		-GJ CAL	
1436	0.40		-GJ CAL	
1437	0.70		-GJ CAL	
1438	0.98481		-GJCAL, COS 10.0 DEG.	
1439	0.17365		- , SIN 10.0 DEG.	
1440	0.0	NOT USED		
1441	1.0		-GJ CAL	
1442	0.00001		-GJ CAL	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1443	32.174		-GJTT, ACCEL. CONST.
1444	25.98		-GJTT, ANALYSIS CONSTANT.
1445-1459		NOT USED	
1460	1.001	CONSTANT DATA	
1461	0.535	CONSTANT DATA	
1462-1469		NOT USED	
1470	0.6	CONSTANT DATA-SLCFS	
1471	1.3	-	
1472	0.156	-	
1473	1.0	-	
1474	1.0	-	
1475	0.188	CONSTANT DATA-DRIS	
1476	0.250	-	
1477	0.375	-	
1478	0.500	-	
1479	0.08	CONSTANT DATA-DBLO	
1430	0.156	-	
1481	1.21	-	
1482	1.375	-	
1483	1.05	-	
1484	4.0	-	
1485	0.375	-	
1486	1.0	-	
1487	0.125	-	
1488	1.333	-	
1489	1.75	-	
1490	0.5	CONSTANT DATA-DSPLI	
1491	2.5	-	
1492	1.0	-	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1493	1.5	-	
1494	2.0	-	
1495	130000.0	-	
1496	0.288	-	
1497	4.5	-	
1498-1499		NOT USED	
1500	0.0	ID LE DEVICE NO ONE. OPTIONS: 0.0 NO DEVICE 1.0 SLAT 2.0 KRUGER 3.0 DROOP NOSE	
1501	0.0	NO. OF SEGMENTS FOR DEVICE NO. 1. YOU HAVE THE OPTION OF ENTERING FROM 1 TO 3 SEGMENTS.	
1502	0.0	SPANWISE LOC. FOR INBOARD EDGE OF DEVICE OPTIONS: 0.X FRACTION OF SEMISPAN XX.X BUTTOCK PLANE	INCHES
1503	0.0	SPANWISE LOC. FOR OUTBOARD EDGE OF DEVICE. OPTIONS: 0.X FRACTION OF SEMISPAN XX.X BUTTOCK PLANE	INCHES
1504	0.0	CHORDWISE DISTANCE FROM WING LE TO DEVICE TE-INBD EDGE OF DEVICE OPTIONS: 0.X FRACTION OF LOCAL TRAP. WING CHORD XX.X DISTANCE	INCHES
1505	0.0	CHORDWISE DISTANCE FROM WING LE TO DEVICE TE-OUTBD EDGE OF DEVICE OPTIONS: 0.X FRACTION OF LOCAL TRAP. WING CHORD XX.X DISTANCE	INCHES
1506	0.0	CHORDWISE DISTANCE FROM WING LE TO LE OF FIXED WING STRUCT-INBD EDGE OF DEVICE OPTIONS: 0.X FRACTION OF LOCAL TRAP. WING CHORD. XX.X DISTANCE	INCHES

1507	0.0	CHORDWISE DISTANCE FROM WING LE TO LE OF FIXED WING STRUCT-OUTED EDGE OF DEVICE OPTIONS: 0.X FRACTION OF LOCAL TRAP. WING CHORD XX.X DISTANCE	INCHES
1508		UNIT WT. FOR DEVICE. OPTIONS: 0.0 W/S IS GENERATED BY PROGRAM FROM STAT. DATA X.X INPUT W/S	LBS/SQ FT
1509	1.0	FACTOR FOR DEVICE NO. 1 WEIGHT	
		* D(1510) THRU D(1519) AND D(1520) THRU D(1529) BOTH HAVE THE EXACT SAME INPUT FORMATS AND OPTIONS AS D(1500) THRU D(1509)	
1510-1519	0.0	INPUT DATA FOR LE DEVICE NO. TWO-SEE INPUT OPTIONS FOR D(1500) THRU D(1509)	
1520-1529	0.0	INPUT DATA FOR LE DEVICE NO. THREE-SEE INPUT OPTIONS FOR D(1500) THRU D(1509)	
1530	1.0	CONSTANT DATA-LE DEVICE-SLAT	
1531	0.145	-SLAT	
1532	1.0	-SLAT	
1533	0.551	-SLAT	
1534	0.32	-SLAT	
1535	1.0	-SLAT	
1536	0.80	-SLAT	
1537	0.25	-SLAT	
1538	0.10	-SLAT	
1539	0.25	-SLAT	
1540	0.10	-SLAT	
1541	0.01	-SLAT	
1542	1.0	-SLAT	
1543	0.125	-SLAT	
1544	1.0	-SLAT	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1545	1.0	CONSTANT DATA-LE DEVICE-KRUGER
1546	1.5	-KRUGER
1547	1.0	-KRUGER
1548	0.413	-KRUGER
1549	0.32	-KRUGER
1550	0.667	-KRUGER
1551	0.80	-KRUGER
1552	0.2[illegible]	-KRUGER
1553	0.10	-KRUGER
1554	0.25	-KRUGER
1555	0.10	-KRUGER
1556	0.0[illegible]	-KRUGER
1557	0.75	-KRUGER
1558	0.125	-KRUGER
1559	1.0	-KRUGER
1560	1.0	CONSTANT DATA LE DEVICE-DROOP NOSE
1561	5.0	-DROOP NOSE
1562	1.725	-DROOP NOSE
1563	0.00077	-DROOP NOSE
1564	0.80	-DROOP NOSE
1565	0.330	-DROOP NOSE
1566	0.80	-DROOP NOSE
1567	0.25	-DROOP NOSE
1568	0.10	-DROOP NOSE
1569	0.25	-DROOP NOSE
1570	0.10	-DROOP NOSE
1571	0.01	-DROOP NOSE
1572	0.50	-DROOP NOSE
1573	0.125	-DROOP NOSE
1574	1.0	-DROOP NOSE
1575	0.830	-DROOP NOSE
1576-1577		NOT USED

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1580    0.0    NO. OF SEGMENTS-SPOILER NO. ONE
                  OPTIONS: 0.0 NO SPOILER
                           X.0 NO. OF SEGMENTS-VALUE
                                CAN VARY FROM 1 TO 3.
1581    0.0    SPANWISE LOC. FOR INBD EDGE OF SPOILER
                  OPTIONS: 0.X FRACTION OF SEMISPAN
                           XX.X BUTTOCK PLANE              INCHES
1582    0.0    SPANWISE LOC. FOR OUTBD EDGE OF SPOILER
                  OPTIONS:  0.X FRACTION OF SEMISPAN
                           XX.X BUTTOCK PLANE              INCHES
1583    0.0    CHORDWISE DISTANCE FROM WING LE TO FWD
                EDGE OF SPOILER-INBD EDGE OF SPOILER
                  OPTIONS: <2.0 FRACTION OF LOCAL TRAP.
                                WING CHORD.
                           >2.0 DISTANCE                   INCHES
1584    0.0    CHORDWISE DISTANCE FROM WING LE TO FWD
                EDGE OF SPOILER.OUTBD EDGE OF SPOILER
                  OPTIONS: <2.0 FRACTION OF LOCAL TRAP.
                                WING CHORD.
                           >2.0 DISTANCE                   INCHES
1585    0.0    CHORDWISE DISTANCE FROM WING LE TO AFT
                EDGE OF SPOILER-INBD EDGE OF SPOILER
                  OPTIONS: <2.0 FRACTION OF LOCAL TRAP.
                                WING CHORD.
                           >2.0 DISTANCE                   INCHES
1586    0.0    CHORDWISE DISTANCE FROM WING LE TO AFT
                EDGE OF SPOILER-OUTBD EDGE OF SPOILER
                  OPTIONS: <2.0 FRACTION OF LOCAL TRAP.
                                WING CHORD.
                           >2.0 DISTANCE                   INCHES

1587    0.0    UNIT WT. FOR SPOILER NO. 1
                  OPTIONS: 0.0 W/S IS GENERATED BY
                               PROGRAM FROM STAT. DATA
                           X.X INPUT W/S                LBS/SQ FT
1588    1.0    FACTOR FOR SPOILER NO.1 WEIGHT
1589    0.0    FACTOR FOR FIXED TE DELTA WEIGHT
```

1590- 1594		NOT USED
		* D(1595) THRU D(1604) SPOILER NO. 2 INPUT DATA HAS THE SAME FORMATS AND OPTIONS AS D(1580) THRU D(1589)-
1595- 1604	0.0	INPUT DATA FOR SPOILER NO. TWO-SEE INPUT OPTIONS FOR D(1580) THRU D(1589)
1605- 1609		NOT USED
		* WING,H.TAIL AND V.TAIL TE DEVICE WTS. ARE DETERMINED FROM INPUTS TO D(1610) THRU D(1729). INPUT LOCATIONS ARE AVAILABLE FOR 6 TE DEVICES. THE FIRST FOUR ARE USED BY THE WING, THE FIFTH BY THE H.TAIL AND THE SIXTH BY THE V.TAIL. DEVICES 1-3 WING TE FLAPS DEVICE 4 WING TE FLAP OR AILERON DEVICE 5 H.TAIL ELEVATOR DEVICE 6 V.TAIL RUDDER INPUT DATA D(1630) THRU D(1729) FOR DEVICES 2-6 REQUIRES THE SAME INPUT DATA AND OPTIONS AS D(1610) THRU D(1629). SEE FIGURE 49 FOR A PICTURIAL DESCRIPTION OF THE TE DEVICE INPUTS.
1610	0.0	ID TE DEVICE NO. ONE OPTIONS: 0.0 SIMPLE FLAP 1.0 SINGLE SLOTTED FLAP 2.0 DOUBLE SLOTTED FLAP

```
                              3.0 TRIPLE SLOTTED FLAP

1611    0.0    NO. OF SEGMENTS-TE DEVICE NO. ONE
                   OPTIONS: 0.0 NO DEVICE
                            X.0 NO. OF SEGMENTS-VALUE
                                CAN VARY

             * SEE FIGURE 49  FOR A PICTORIAL DESCRIPTION
               OF THE TE DEVICE INPUTS.

1612    0.0    SPANWISE LOC. FOR INBD EDGE OF DEVICE NO. ONE
                   OPTIONS:  0.X FRACTION OF SEMISPAN
                            XX.X BUTTOCK PLANE            INCHES
1613    0.0    SPANWISE LOC. FOR OUTBD EDGE OF DEVICE NO. ONE
                   OPTIONS:  0.X FRACTION OF SEMISPAN
                            XX.X BUTTOCK PLANE            INCHES

             * THE FOLLOWING OPTIONS ARE APPLICABLE
               TO INPUT LOCATIONS D(1614) THRU D(1627)-
                   OPTIONS: <2.0 FRACTION OF LOCAL TRAP.
                                 WING CHORD.
                            >2.0 DISTANCE IN INCHES
1614    0.0    CHORDWISE DISTANCE FROM WING LE TO FWD
                EDGE OF FIRST FLAP PANEL ON INBD BUTTOCK
                PLANE-SEE OPTIONS ABOVE
1615    0.0    SAME AS D(1614) EXCEPT ON OUTBD BUTTOCK
                PLANE

1616    0.0    CHORDWISE DISTANCE FROM WING LE TO AFT
                EDGE OF FIRST FLAP PANEL ON INBD BUTTOCK
                PLANE-SEE ABOVE OPTIONS
1617    0.0    SAME INPUT AS D(1616) EXCEPT FOR OUTBD
                BUTTOCK PLANE

1618    0.0    CHORDWISE DISTANCE FROM WING LE TO FWD
                EDGE OF SECOND FLAP PANEL ON INBD BUTTOCK
                PLANE-SEE ABOVE OPTIONS
```

1619	0.0	SAME INPUT AS D(1618) EXCEPT FOR INBD BUTTOCK PLANE
1620	0.0	CHORDWISE DISTANCE FROM WING LE TO AFT EDGE OF SECOND FLAP PANEL ON INBD BUTTOCK PLANE-SEE ABOVE OPTIONS
1621	0.0	SAME INPUT AS D(1620) EXCEPT FOR OUTBD BUTTOCK PLANE
1622	0.0	CHORDWISE DISTANCE FROM WING LE TO FWD EDGE OF THIRD FLAP PANEL ON INBD BUTTOCK PLANE-SEE ABOVE OPTIONS
1623	0.0	SAME INPUT AS D(1622) EXCEPT FOR OUTBD BUTTOCK PLANE
1624	0.0	CHORDWISE DISTANCE FROM WING LE TO TE OF FIXED WING UPPER SURFACE STRUCTURE ON INBD BUTTOCK PLANE-SEE ABOVE OPTIONS
1625	0.0	SAME INPUT AS D(1624) EXCEPT FOR OUTBD BUTTOCK PLANE
1626	0.0	CHORDWISE DISTANCE FROM WING LE TO TE OF FIXED WING LOWER SURFACE STRUCTURE ON INBD BUTTOCK PLANE-SEE ABOVE OPTIONS
1627	0.0	SAME INPUT AS D(1626) EXCEPT FOR OUTBD BUTTOCK PLANE
1628	0.0	UNIT WT. FOR DEVICE NO. ONE OPTIONS: 0.0 W/S CALC BY PROGRAM FROM STAT. DATA. X.X INPUT W/S — LBS/SQ FT
1629	1.0	FACTOR FOR DEVICE WEIGHT
1630-1649	0.0	WING TE DEVICE NO. TWO-SEE D(1610) THRU D(1629) FOR INPUT DESCRIPTIONS.

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1650-1669	0.0	WING TE DEVICE NO. THREE-SEE D(1610) THRU D(1629) FOR INPUT DESCRIPTIONS.
1670	0.0	ID TE DEVICE NO. FOUR OPTIONS: 0.0 SIMPLE FLAP 1.0 SINGLE SLOTTED FLAP 2.0 DOUBLE SLOTTED FLAP 3.0 TRIPLE SLOTTED FLAP 4.0 AILERON
1671-1689	0.0	DEVICE NO. FOUR INPUT DATA-SEE D(1611) THRU D(1629) FOR INPUT DESCRIPTIONS.
1690-	0.0	ID TE DEVICE NO. FIVE-INPUT 5 IN D(1690) FOR H.TAIL ELEVATOR
1691-1709	0.0	DEVICE NO. FIVE INPUT DATA-SEE D(1611) THRU D(1629) FOR INPUT DESCRIPTIONS.
1710	0.0	ID TE DEVICE NO. SIX- INPUT 6 IN D(1710) FOR V.TAIL RUDDER.
1711-1729	0.0	DEVICE NO. SIX INPUT DATA-SEE D(1611) THRU D(1629) FOR INPUT DESCRIPTIONS.
1730	0.0	CONSTANT DATA TE-SPOILER
1731	1.0	-SPOILER
1732	0.008	-SPOILER
1733	0.8	-SPOILER
1734	1.95	-SPOILER
1735	0.10	-SPOILER
1736	0.25	-SPOILER
1737	0.10	-SPOILER
1738	0.01	-SPOILER
1739	1.0	-SPOILER
1740	0.125	-SPOILER
1741	1.0	-SPOILER
1742	0.45	-SPOILER
1743	0.15	-SPOILER
1744		NOT USED

1745	0.001	CONSTANT DATA TE-FLAP
1746	0.09	-FLAP
1747	14.40	-FLAP
1748	0.25	-FLAP
1749	0.0	-FLAP
1750	1.0	-FLAP
1751	1.25	-FLAP
1752	1.50	-FLAP
1753	1.75	-FLAP
1754	0.10	-FLAP
1755	0.25	-FLAP
1756	0.10	-FLAP
1757	0.01	-FLAP
1758	0.25	-FLAP
1759	0.125	-FLAP
1760	1.0	-FLAP
1761	0.25	-FLAP
1762	0.125	-FLAP
1763-1764		NOT USED
1765	0.0	CONSTANT DATA TE-AILERON
1766	1.0	-AILERON
1767	0.01625	-AILERON
1768	0.35	-AILERON
1769	1.55	-AILERON
1770	0.50	-AILERON
1771	0.25	-AILERON
1772	0.10	-AILERON
1773	0.25	-AILERON
1774	0.10	-AILERON
1775	0.01	-AILERON
1776	0.10	-AILERON
1777	0.125	-AILERON
1778	1.0	-AILERON
1779	0.10	-AILERON

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1780	0.05	-AILERON
1781-1784		NOT USED
1785	1.40	CONSTANT DATA-ELEVATOR
1786	0.773	-ELEVATOR
1787	0.35	-ELEVATOR
1788	0.3069	-ELEVATOR
1789	0.0	-ELEVATOR
1790	1.50	CONSTANT DATA-RUDDER
1791	0.03442	-RUDDER
1792	0.35	-RUDDER
1793	1.36027	-RUDDER
1794	0.0	-RUDDER
1795	0.10	CONSTANT DATA-K SUPTS TYPE-SIMPLE
1796	0.28	-S. S.
1797	0.40	-D. S.
1798	0.55	-T. S.
1799	0.10	-AIL
1800	0.10	-ELE
1801	0.10	-RUD
1802	0.10	CONSTANT DATA-KXA AFT-SIMPLE
1803	0.15	-S. S.
1804	0.20	-D. S.
1805	0.20	-T. S.
1806	0.10	-AIL
1807	0.10	-ELE
1808	0.10	-RUD
1809	0.475	CONSTANT DATA-TAPER SUPT WT.-SIMPLE
1810	0.40	-S. S.
1811	0.30	-D. S.
1812	0.25	-T. S.
1813	0.475	-AIL

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1814	0.475	-ELF	
1815	0.475	-RUD	
1816-1819		NOT USED	
* 1820	0.0	WEIGHT TO BE DISTRIBUTED OVER THE TORQUE BOX AREA-USED IN CALC. DEAD WEIGHT DISTRIBUTION OF WING AND CONTENTS -- IF D(1820)=0.0, PORTION OF EQUIPMENT WT. -- WILL BE TRANSFER'D FROM G.D. IF YOU HEVE NO WT. TO BE DISTRIBUTED OVER TORQUE BOX, SUGGEST AN INPUT VALUE OF D(1820)=1.0	LBS/SIDE
* 1821	0.0	WEIGHT OF WING CONTENT TO BE DISTRIBUTED ALONG SECTION OF WING ON A LINE DEFINED BY INPUT IN D(1822)-D(1828) -- IF D(1820)=0.0, SURFACE CONTROLS WT. FROM G.D. IS TRANSFER'D. IF ONLY ONE LINE OF DISTRIBUTED WEIGHT TO BE INPUT THEN USE 1821-1828.	LBS/SIDE
* 1822	0.0	SPANWISE LOCATION OF INBD. POINT OPTIONS: 0.X FRACTION OF SEMISPAN X.X BUTTOCK PLANE -- IF D(1823)=0.0, TRANSFER DATA --	 INCHES
* 1823	0.0	SPANWISE LOCATION OF OUTBD. POINT OPTIONS: 0.0 D(1823) SET=1.0 AND LINE DIST. DATA BLOCK(1822-1827) WILL BE TRANSFERRED. 0.X FRACTION OF SEMISPAN X.X BUTTOCK PLANE	 INCHES
* 1824	0.0	CHORDWISE LOC. OF INBD. POINT OPTIONS: 0.X FRACTION OF LOCAL CHORD XX.X FUSELAGE STATION -- IF D(1823)=0.0, TRANSFER DATA --	 INCHES

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

* 1825	0.0	CHORDWISE LOC. OF OUTBD. POINT OPTIONS: 0.X FRACTION OF LOCAL CHORD XX.X FUSELAGE STATION	INCHES	
		-- IF D(1823)=0.0, TRANSFER DATA --		
* 1826	0.0	SPANWISE LOCATION OF INTERMEDIATE PT. ALONG LINE. OPTIONS: 0.X FRACTION OF LOCAL CHORD XX.X BUTTOCK PLANE	INCHES	
		-- IF D(1823)=0.0, TRANSFER DATA --		
* 1827	0.0	TAPER RATIO OF WT. DISTRIBUTION FROM INBD PT. TO MID. PT.		
		-- IF D(1823)=0.0, TRANSFER DATA --		
1828	0.0	TAPER RATIO OF WT. DISTRIBUTION FROM MID PT. TO OUTBD. PT.		
		* IF YOU WISH TO USE ONE TAPER RATIO FOR THE TOTAL LENGHT THEN SET D(1826) AND D(1828) TO ZERO.		
1829	0.0	WEIGHT OF WING CONTENT TO BE DISTRIBUTED ALONG AFT SECTION OF WING ON A LINE DEFINED BY INPUT IN D(1830)-D(1836)	LBS/SIDE	
1830-1836	0.0	INPUT DATA TO DEFINE LINE FOR DISTRIBUTION OF D(1829) WEIGHT-SAME INPUT REQUIREMENTS AS D(1822)-D(1828)		
1837	0.0	CONC. DEAD WT. NO. 1-USED AS PART OF WING CONTENTS FOR DEAD WEIGHT DIST.	LBS/SIDE	
1838	0.0	SPANWISE LOCATION OF CONC. WT. NO. 1 OPTIONS: 0.X FRACTION OF SEMISPAN XX.X BUTTOCK PLANE	INCHES	
1839	0.0	CHORDWISE LOCATION OF CONC. WT. NO. 1 OPTIONS: 0.X FRACTION OF LOCAL WING CHORD FROM LE XX.X FUSELAGE STATION	INCHES	
		* D(1840) THRU D(1854), INPUT LOC. FOR		

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		CONC. WTS. 2-6, WILL REQUIRE THE SAME INPUT DATA AS D(1837)-D(1839)	
1940	0.0	CONC. WT. NO. 2	LBS/SIDE
1941	0.0	BUTTOCK PLANE	INCHES
1942	0.0	FUS. STATION	INCHES
1943	0.0	CONC. WT. NO. 3	LBS/SIDE
1944	0.0	BUTTOCK PLANE	INCHES
1945	0.0	FUS. STATION	INCHES
1946	0.0	CONC. WT. NO. 4	LBS/SIDE
1947	0.0	BUTTOCK PLANE	INCHES
1948	0.0	FUS. STATION	INCHES
1949	0.0	CONC. WT. NO. 5	LBS/SIDE
1950	0.0	BUTTOCK PLANE	INCHES
1951	0.0	FUS. STATION	INCHES
1952	0.0	CONC. WT. NO. 6	LBS/SIDE
1953	0.0	BUTTOCK PLANE	INCHES
1954	0.0	FUS. STATION	INCHES

* D(1855) THRU D(1935) ARE USED TO INPUT UP TO SEVEN EXTERNALLY MOUNTED CONC. WTS. CDL 1 AND 2 ARE USED FOR WT. ITEMS WHICH ARE REMOVED FOR CERTAIN DESIGN CONDITIONS SUCH AS EXTERNAL FUEL AND MISSILES. CDL 3 AND 4 MUST BE USED AS MOUNTS FOR CDL 1 AND 2 WHEN 1 & 2 ARE REMOVED FOR SOME DESIGN CONDITION. CDL 5-7 ARE USED FOR FIXED EXTERNAL STORE WTS.

-- NOTES FOR DATA TRANSFER --
WING PYLON AND EXT. TANK DATA WILL BE TRANSFERRED INTO CDL NO.1,2,3 AND 4 IF DATA TRANSFER REQUIRED-

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                        WING MOUNTED NACELLE(S) DATA ARE TRANSFERRED
                        TO COL NO.5 AND 6 IF TRANSFER REQUIRED-
                        LG DATA IS TRANSFERRED TO COL NO.7 IF
                        TRANSFER REQUIRED-

* 1855     0.0         WT. COL NO.1-
                          OPTIONS:  0.0 NO CONC. WT.
                                   XX.X WEIGHT                     LBS/SIDE
                                  -XX.X WEIGHT-IF MINUS
                                        SIGN USED ONLY THE
                                        WING HARDPOINT WT. IS
                                        USED IN DIFFERENT
                                        DESIGN CONDITIONS.         LBS/SIDE
                     -- IF D(1855)&D(1856)=0.0 THEN WT. --
                        TRANSFERRED FROM DM.

* 1856                 SPANWISE LOC. FOR COL NO.1-
                          OPTIONS: 0.X FRACTION OF SEMISPAN
                                  XX.X BUTTOCK PLANE                  INCHES
                     -- IF D(1856)=0.0 THEN COL AC.1 DATA BLOCK --
                        LOC. WILL BE TESTED FOR TRANSFER. ONLY
                        THE WT., X, Y, AND Z CG'S WILL BE TESTED
                        FOR TRANSFER.

* 1857     0.0         CHORDWISE LOC. FOR COL NO. 1
                          OPTIONS: 0<2 FRACTION OF LOCAL WING
                                       CHORD-DIST. AFT OF LE
                                    >2 DIST. AFT OF LE                INCHES
                                 0>-2 FRACTION OF LOCAL WING
                                       CHORD-DIST. FWD OF LE
                                   <-2 DIST. FWD OF LE                INCHES
                     -- IF D(1856)&D(1857)=0.0 THEN X CG TRANSFERRED --
                        FROM DM.

* 1858     0.0         VERTICAL DIST. TO COL 1 FROM WRP.
                          OPTIONS: -X.X DIST. BELOW WRP               INCHES
                                    X.X DIST. ABOVE WRP               INCHES
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

```
                  -- IF D(1856)&D(1858)=0.0 THEN Z CG TRANSFERRED --
                     FROM DM.

                  -- NOTE FOR DATA TRANSFER: THE INERTIA AND --
                     SHAPE FACTOR LOCATIONS (1860-1865) WILL
                     NOT HAVE TRANSFER DATA FOR ANY OF THE
                     FIRST FOUR COL ITEMS. COL NO.5 6 WILL
                     HAVE ALL LOCATED TESTED IF THEIR BLOCK
                     TRANSFER ID'S ARE ZERO. COL NO.7 WILL
                     ONLY HAVE THE WT,X,Y AND Z CG'S TESTED
                     IF ITS BLK. DATA ID IS ZERO.

 1859     0.0        INERTIA ID FOR COL 1-
                        OPTIONS: 0.0 INPUT IX,IY,&IZ IN
                                     D(1860)-D(1862)
                                 1.0 ID-CIRCULAR/ELLIPTICAL
                                     SHAPE
                                 2.0 ID-RECTANGULAR SHAPE
                                 3.0 NOT USED
                                 4.0 ASSUME SHAPE & K

*1860     0.0        PITCH INERTIA.IY FOR COL 1.
                        OPTIONS: IF D(1859)=0 INPUT IY       LB-IN-SQ
                                 IF D(1859)>0 D(1860)
                                    REPRESENTS SCALE FACTOR
                                    FOR CALC. IY.

*1861     0.0        ROLL INERTIA IX FOR COL 1-
                        OPTIONS: IF D(1859)=0 INPUT IX       LB-IN-SQ
                                 IF D(1859)>0 D(1860)
                                    REPRESENTS SCALE FACTOR
                                    FOR CALC. IX.

*1862     0.0        YAW INERTIA IZ FOR COL 1.
                        OPTIONS: IF D(1859)=0 INPUT IZ       LB-IN-SQ
                                 IF D(1859)>0 D(1860)
                                    REPRESENTS SCALE FACTOR
```

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		FOR CALC. IZ.	
*1863	0.0	LENGTH OF SHAPE IN D(1859) OPTIONS: IF D(1859)=0 THEN SET D(1863)=0 IF D(1859)>0 INPUT LENGTH OF SHAPE IN D(1863)	INCHES
*1864	0.0	WIDTH OF SHAPE IN D(1859) OPTIONS: IF D(1859)=0 THEN SET D(1863)=0 IF D(1859)>0 INPUT WIDTH OF SHAPE IN D(1863)	INCHES
*1865	0.0	DEPTH OF SHAPE IN D(1859) OPTIONS: IF D(1859)=0 THEN SET D(1863)=0 IF D(1859)>0 INPUT WIDTH OF SHAPE IN D(1863)	INCHES
1866	0.0	ID FOR PROCESSING DATA IN VF PROGRAM. OPTIONS: 0.0 VF PROG. WILL USE ONLY CDL #3OR#4 DATA SUBSETS. 1.0 CDL #1&#3 ARE PROCESSED TOGETHER AS ONE ADD-ON MASS AND CDL #2&#4 ARE PROCESSED AS ONE ADD-ON MASS.	
		* D(1867) THRU D(1938), INPUT LOC. FOR CDL WTS. 2-7, WILL HAVE THE SAME INPUT FORMATS AND OPTIONS AS CDL #1 DATA LOC. D(1855)-D(1866).	
* 1867-1878	0.0	CDL NO. 2 INPUT DATA-SEE D(1855)-D(1866) FOR DATA DESCRIPTIONS.	
		-- IF D(1868)=0.0 TEST CDL #2 DATA BLOCK -- LOCATIONS 1867-1870 FOR TRANSFER DATA	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

* 1879-1890	0.0	COL NO. 3 INPUT DATA-SEE D(1855)-D(1866) FOR DATA DESCRIPTIONS. * NOTE: IF BOTH COL 1&3 ARE USED THEN D(1856) & D(1880) MUST BE EQUAL -- IF D(1880)=0.0 TEST COL #3 DATA BLOCK -- LOCATIONS 1879-1882 FOR TRANSFER DATA
* 1891-1902	0.0	COL NO. 4 INPUT DATA-SEE D(1855)-D(1866) FOR DATA DESCRIPTIONS. * NOTE: IF BOTH COL 2&4 ARE USED THEN D(1868) & D(1892) MUST BE EQUAL -- IF D(1892)=0.0 TEST COL #4 DATA BLOCK -- LOCATIONS 1891-1894 FOR TRANSFER DATA
		* IF NACELLE DATA IS INPUT IN COL #1 AND #3 THEN 1904 AND 1916 MUST BE SET GREATER THAN ZERO OR NACELLE DATA FROM G.D. WILL BE TRANSFER'D.
* 1903-1914	0.0	COL NO. 5 INPUT DATA-SEE D(1855)-D(1866) FOR DATA DESCRIPTIONS. -- IF D(1904)=0.0 COL #5 DATA BLK. WILL BE -- TESTED FOR TRANSFER OF INBOARD NACELLE DATA FROM DM.
* 1915-1926	0.0	COL NO. 6 INPUT DATA-SEE D(1855)-D(1866) FOR DATA DESCRIPTIONS. -- IF D(1916)=0.0 COL #6 DATA BLK. WILL BE -- TESTED FOR TRANSFER OF OUTBOARD NACELLE DATA FROM DM.
		* IF LANDING GEAR IS INPUT IN EITHER COL #1 OR #3 THEN 1928 MUST BE SET GREATER THAN ZERO

		OR LANDING GEAR DATA FROM G.D. WILL BE TRANSFER'D.
* 1927-1936	0.0	CDL NO. 7 INPUT DATA-SEE D(1855)-D(1866) FOR DATA DESCRIPTIONS. — IF D(1928)=0.0 CDL #7 DATA BLK. LOCATIONS — 1927-1930 WILL BE TESTED FOR TRANSFER OF THE LANDING GEAR DATA FROM DM.
1939	0.75	CONSTANT DATA-CDL
1940	0.75	-CDL
1941	0.75	-CDL
1942	1.0	-CDL
1943	0.75	-CDL
1944	1.0	-CDL
1945	1.0	-CDL
1946	1.0	-CDL
1947	1.0	-CDL
1948	0.5	-CDL
1949	1000.0	-CDL
1950	3.0	-CDL
1951	2.5	-CDL
1952	1.5	-CDL
1953	1.25	-CDL
1954		NOT USED
1955	0.0	CONSTANT DATA-TIP
1956	1.0	-TIP
1957	0.00077	-TIP
1958	0.80	-TIP
1959	0.830	-TIP
1960	0.5	-TIP
1961	0.0	-TIP
1962	0.10	-TIP
1963	0.25	-TIP
1964	0.10	-TIP

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

1965-1969		NOT USED
1970	0.1155	CONSTANT DATA-K D SQ TERM-BOX
1971	0.0533	-LE
1972	0.0533	-TE
1973	0.0687	-TIP
1974	0.0533	-FUEL
1975	0.0500	-DIST. MISC.
1976	0.0400	-LINE MISC.
1977	0.0500	-CONC. MISC.
1978	0.75	% MAX DEPTH-FS
1979	0.80	-RS
1980	0.45	-LE
1981	0.80	-BOX MISC
1982-1984		NOT USED
		* D(1985) THRU D(2007) IS USED TO DEFINE THE COORDINATES OF BLENDED LEADING EDGE. THE LE IS DEFINED BY INPUTING BUTTOCK LOC. IN D(1985)-D(1995) AND THEIR CORRESPONDING CHORDWISE POSITIONS IN D(1997)-D(2007). THE LE SHAPE IS FORMED BY THE STRAIGHT LINE SEGMENTS WHICH CONNECT CONSECUTIVE POINTS. YOU CAN INPUT FROM ONE TO ELEVEN PTS.
1985-1995	0.0	BUTTOCK LOC. FOR BLENDED LE- OPTIONS: 0.X FRACTION OF SEMISPAN; XX.X BUTTOCK PLANE — INCHES
1996	0.0	ID INPUT DATA OPTIONS: 0.0 CHORDWISE DISTANCE IN INCHES IN D(1997)-D(2007); 2.0 FRACTION OF LOCAL TRAP.

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONT)

		CHORD IN D(1997)-D(2007) 1.0 INPUT FUS. STATION IN D(1997)-D(2007)	
1997-2007	0.C	CHORDWISE LOC. FOR BLENDED LE- OPTIONS: IF D(1996)=0 INPUT DIST. FROM TRAP. LE TO BLENDED LE.	INCHES
		IF D(1996)=1 INPUT FRACTION OF LOCAL CHORD FROM TRAP. LE TO BLENDED LE	
		IF D(1996)=2 INPUT FUS. STA. OF LE POINT	INCHES
		* D(2008) THRU D(2030) ARE USED TO DEFINE THE COORDINATES FOR A CRANKED TE. THE TE IS DEFINED BY INPUTING BUTTOCK LOC. IN D(2008)-D(2018) AND THEIR RESPECTIVE CHORDWISE POSITIONS IN D(2020)-D(2030). THE TE SHAPE IS FORMED BY THE STRAIGHT LINE SEGMENTS WHICH CONNECT CONSECUTIVE POINTS. YOU CAN INPUT FROM ONE TO ELEVEN POINTS.	
2008-2018	0.0	SPANWISE LOCATION FOR TE POINTS- OPTIONS 0.X FRACTION OF SEMISPAN XX.X BUTTOCK PLANE	INCHES
2019	0.C	FORMAT ID-INPUTDATA OPTIONS: 0.0 CHORDWISE DIST. IN INCHES FOR D(2020)-D(2030) 2.0 FRACTION OF LOCAL TRAP. CHORD IN D(2020)-D(2030) 1.0 INPUT FUS.STATION IN D(2020) THRU D(2030)	
2020-	0.0	CHORDWISE LOC. FOR CRANKED TE POINTS-	

TABLE 12. WING (HORIZONTAL, VERTICAL TAIL) DATA LIST (CONCL)

2030		OPTIONS: IF D(2019)=0 DIST. FROM TRAP. TE TO CRANKED TE	INCHES
		IF D(2019)=1 FRACTION OF LOCAL CHORD-TRAP. TE TO CRANKED TE.	
		IF D(2019)=2 FUS. STATION OF TE POINTS	INCHES
		* D(2031) THRU D(2052) ARE USED TO DEFINE THE BLENDED WING SPANWISE THICKNESS RATIOS. THE WING THICKNESS IS DEFINED BY INPUTING BUTTOCK LOC. IN D(2031)-D(2041) AND THEIR RESPECTIVE T/C VALUES IN D(2042) THRU D(2052). THERE IS A LINEAR VARIATION FOR THE DEPTHS BETWEEN CONSECUTIVE CALC DEPTHS AT THE CONTROL POINTS. YOU CAN INPUT FROM ONE TO ELEVEN CONTROL VALUES.	
2031-2041	0.C	SPANWISE LOCATION FOR T/C VALUES. OPTIONS: 0.X FRACTION OF SEMISPAN	
		XX.X BUTTOCK PLANE	INCHES
2042-2052	0.0	T/C VALUES-BASED ON TOTAL AERO CHORD	

***** END *****

Section VII

FUSELAGE DATA

INTRODUCTION

The fuselage module, level (11,0) and (12,0) overlays, of SWEEP develops the weight synthesis of the fuselage structure. Fuselage data, fuselage loads data, and inertia data are required by the module to determine fuselage structure weights. The inertia data are usually developed in the data management module; discussions of this data array are presented in Section X. Fuselage loads data, developed in the airloads module, are discussed in Section IX. The following paragraphs discuss the fuselage data array, user options, and program rationale necessary for the execution of this module.

GENERAL DESCRIPTION

The fuselage module develops a shell weight synthesis and integration between as many as 19 user-selected cuts. The programmed procedure is a combination of analytical, empirical, and statistical methods that provides estimates at the detail weight level. The primary structure synthesis approach is based on the evaluation of applied loads and design criteria for a multistation three-dimensional approximation. It accounts for geometry, construction, material properties, temperature, loads, pressure, acoustic fatigue, local panel flutter, cutouts, and stiffness requirements. The secondary structure estimating procedure is principally statistical in nature, and is dependent on specific components.

The external geometry is input at 10 discrete points along the fuselage. This input is in the form of longitudinal and vertical coordinates, depth, width, and perimeter or perimeter correction factor. The sectional geometry is generated as a family of shapes that may be defined by straight lines and circular arcs. The program is structured to evaluate the shell at a maximum of 19 synthesis cuts. The geometry at the synthesis cuts is determined by linear interpolation between the input geometry points.

Local cross-sectional geometrics may be further defined by specifications for locating internal horizontal decks and shrouds. Computed geometry data from these descriptions are used in the statistical weight estimation equations for these items. Horizontal deck and local cutout information are also used to derive geometry data describing local shell and bulkhead characteristics. These are used in (1) computations of estimated shell torsional properties and (2) evaluations of fuel pressure or cabin pressurization requirements.

Net design loads are calculated by combining the fuselage loads data and inertia data with the structural geometry. The external surface inertia and airloads are combined to determine net reactions at the major support frames. Nacelle and landing gear reactions are also calculated and located. Should the external surface supports provide moment continuity, cross-ship moments are also determined for each of the affected major frames. The fuselage airload and the wing carry-over lift are distributed longitudinally according to center of pressure and nose and wing locations. The module integrates the effect of the external loads and distributed inertia data to develop net longitudinal shear and bending moment diagrams. Net loads are developed at each of the synthesis cuts for a maximum of 24 design load conditions. The program is currently limited to the evaluation of symmetrical vertical loads. The only exception is the introduction of vertical tail loads, which are used in the synthesis of support frames.

The shell structure may be synthesized for longeron or skin-stringer-type construction. Fixed panel geometry or optimizing search options may be selected. In the case of the optimizing search routine for stringer spacing, the starting value is the predetermined minimum. Stringer spacing is increased in search of a right-hand optimum (Figure 52), while a left-hand optimum abbreviates the search at the starting value. The same type of searching procedure is carried out for variable frame spacing. If both stringer spacing and frame spacing searches are specified, the stringer search occurs within the frame search loop. Cover milling, frame depth, and fabrication minimums are other user input options.

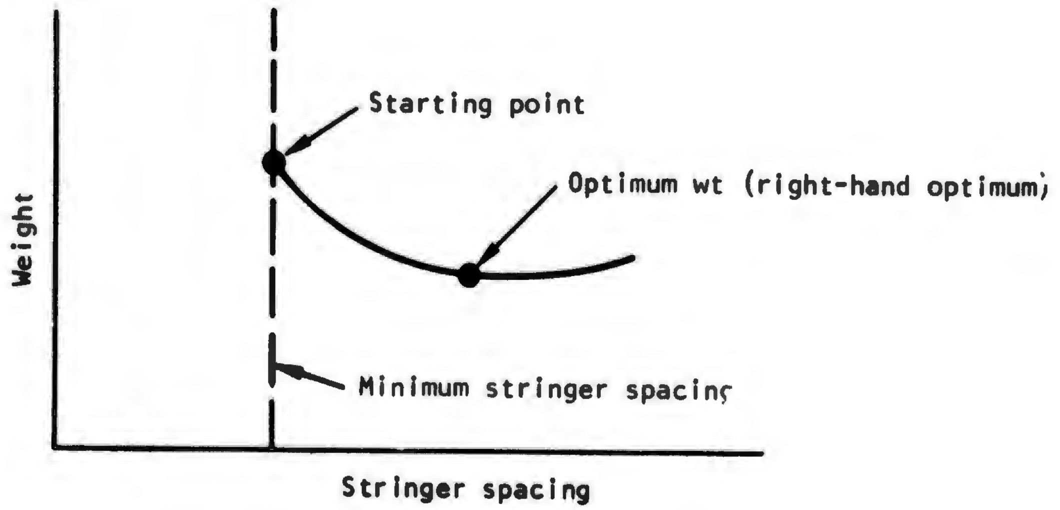


Figure 52. Stringer spacing search.

The effect of fuel or cabin pressurization is evaluated as part of the panel synthesis approach. Cover synthesis is based on a generalized least resistance path assumption. This method checks hoop tension effect versus bending and diaphragming action between supports. Pressure bulkheads are estimated as webs with stiffening members. Cabin pressure or fuel vent pressure is input at the synthesis cuts. A negative value for pressure is used to designate human environment for which the design factor of safety is 2. Fuel hydraulic head pressure is defined by input of fuel density. A negative value for density indicates the location of fuel below the deck; conversely, a positive value indicates fuel above the deck or within the entire fuselage section. Hydraulic head is determined at the top and bottom of the tank by using the internal shell geometry definition and the maximum positive and negative load factors at the synthesis cut.

Local panel flutter prevention requirements are evaluated for supersonic flight. The program scans the speed-altitude profile data for the critical flutter point. If the fuselage module is executed in the stand-alone mode, the critical flutter data (mach number and altitude) may be input, either through the FUSELAGE or the INERTIA data blocks.

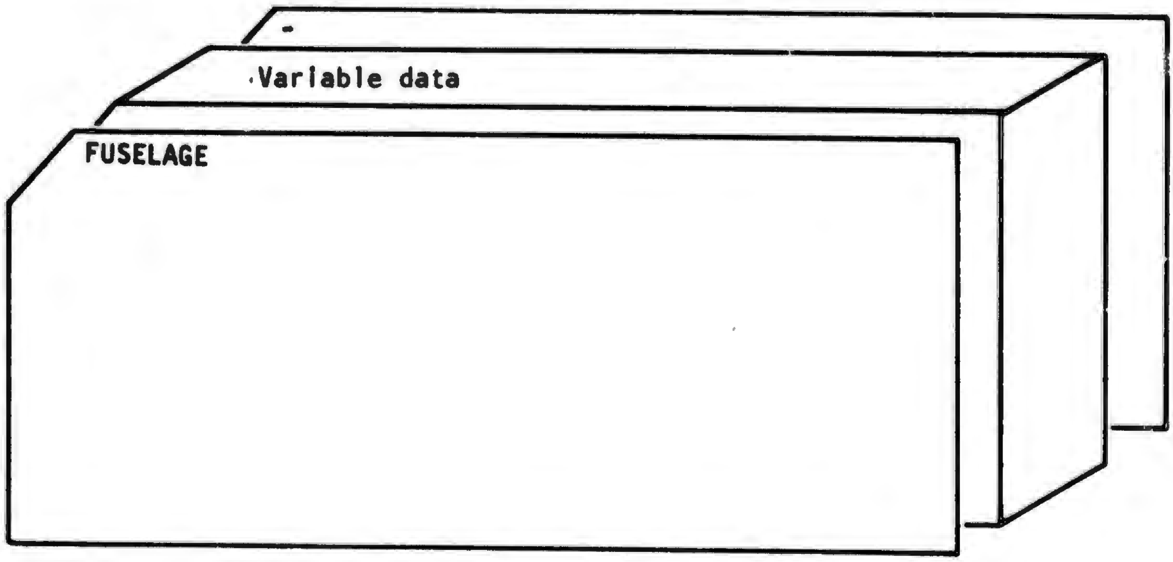
Acoustic fatigue and stiffness requirements are not automatically generated in this program. However, these requirements can be described by data in the FUSELAGE deck for evaluation by the fuselage module.

The fuselage shell weight analysis routines use the synthesis results to compute the individual component weights of the shell, internal panels, and secondary structure items; when combined, they represent the total fuselage structural weight. Cover and longeron weights are based on a linear taper of thickness and area between station cuts. Minor frame weights are based on a weighted average within each section. Major frame weights are based on peripheral sizing data computed at 60 rings analysis points. The synthesis approach to shell weight estimating presents a qualitative solution dependent on the input design parameters and constraints. However, this solution still leaves a gap between the synthesized structure and the actual hardware weight The indexing factors are used to compute final estimated weights. These factors should be developed by operation of the program on known hardware systems. The design limitations of the programmed approach should be considered when values for indexing factors are derived.

The secondary structure weight estimating procedure consists of three different approaches. During the initial vehicle conceptual phase when detail geometric descriptions are not available, a checklist approach may be used. The checklist approach uses rule-of-thumb estimates for certain secondary structure components. A second approach requires geometric description such as individual door size. The third approach is to override program computations with input component weights. This method should be used when detail component weights are available. All three methods may be used in any single computer run. If nose and/or tail radomes are specified as secondary structure, the synthesized nose and/or tail cone segments are deleted from the primary shell weight estimates.

INPUT DESCRIPTION

A complete description of input fuselage data is presented in Table 13. All of the variables are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card "FUSELAGE". The last data card must have a minus sign in column 1. The FUSELAGE deck setup is as follows:



Expanded explanations for those variables which may be subject to misinterpretation are:

- Locations 242 and 361 through 379 specify the number and locations of the shell synthesis cuts. The selection of these synthesis cuts is left to the discretion of the user. The first and last cuts must not be at the extremities, since structural segments are defined to exist forward and aft of these cuts. Should radomes exist, these cuts are used to define the radome attach locations. The priority in the selection of synthesis cuts is as follows:

- Locate cuts at sharp discontinuities in geometry. Should this situation exist, the cuts are taken immediately forward and aft of the discontinuity. The distance between such cuts should be no greater than 2 inches. The 2-inch segment is a program key that designates a sharp step in fuselage wetted surface. The location of cuts must be compatible with the geometry described in locations 291 through 300.

- Locate cuts immediately forward and aft of major load introduction points such as wing front and rear spars, and landing gear support frames. This allows the program to reflect proper design values of loads on panels forward and aft of these load introduction points.

- Locate cuts at the forward and aft ends of major cutouts such as weapons bay doors, engine removal doors, and wing carry-through structure. Do not describe cutouts that are not bounded by synthesis cuts. Smaller cutouts such as those due to entrance doors generally should not be input. The program shell synthesis routines account for the weight effect due to cutouts, and the secondary structure routines estimate the weight of the door and associated mechanisms.

- Locate synthesis cuts at fuel or cabin pressure bulkheads and the forward and aft ends of cargo and weapons bays.

- Locate cuts to reduce segment lengths. This will improve sensitivity to longitudinal loads and geometry.

- <u>Locations 246 through 249</u> specify the material identification number for the covers, longerons, major frames, and minor frames. These material codes are used to order material property data from the SWEEP permanent data bank. Required data for the evaluation of the structural components are then computed. The computed data describe the temperature properties of the selected material for each design load condition.

- <u>Locations 291 through 300</u> specify the geometry description cuts. Sharp geometric changes, such as occur at the start of duct inlets, should be described by double cuts immediately forward and aft of the change.

- <u>Locations 301 through 340</u> describe the cross-sectional shape of the fuselage at each of the geometry cuts (Figure 53). Geometry data for the fuselage synthesis cuts (361-379) are derived by interpolation of geometry cut data. The perimeter of the fuselage section at each geometry station, locations 331 through 340, may be specified in terms of actual dimensions or as functions of the local cross-section shapes.

The type of input data is indicated by the control code value in location 243. A code value of 2.0 requires input of perimeter correction factors, (K_c) determined for the cross-section shape at each geometry station. The curves in Figure 54 should be used to derive the appropriate perimeter correction values.

- Locations 381 through 399 specify the frame spacing at the synthesis cuts. Data in these locations take precedence over data in location 257. The spacing at each synthesis cut is independently derived. Therefore, the user may specify fixed spacing at one cut and frame spacing search at another. If any of these locations are left blank, search control for that cut reverts back to the type specified in location 257.

- Locations 401 through 420 specify the major frame depth if it differs from the general frame depth in location 256. This depth is used for the analysis of major support frames specified at the cut or within the segment immediately forward of the cut. If the required, major frames occur in the segment aft of the last synthesis cut, the frame depth must be input in the corresponding location.

- Locations 441 through 459 specify the vertical location of horizontal decks or the vertical locations of the centers of curvature of the shrouds. Data in locations 521 through 539 define the shroud radius. Geometrical representation of the program application is shown in Figure 55. It is necessary that either a deck or a shroud be defined at each synthesis cut where a cutout is specified.

- Locations 1001 through 1038 specify the location of external components relative to the fuselage. Data for these locations are depicted in Figures 56 through 60. If a major frame is common for two or three load points, such as rear spar attachment and gear attachment, input the attach points at identical stations. Locations 1022 through 1025 are useful only when the fuselage module is operated in the stand-alone mode, since there is no provision for accommodating external fuselage stores in the integrated program.

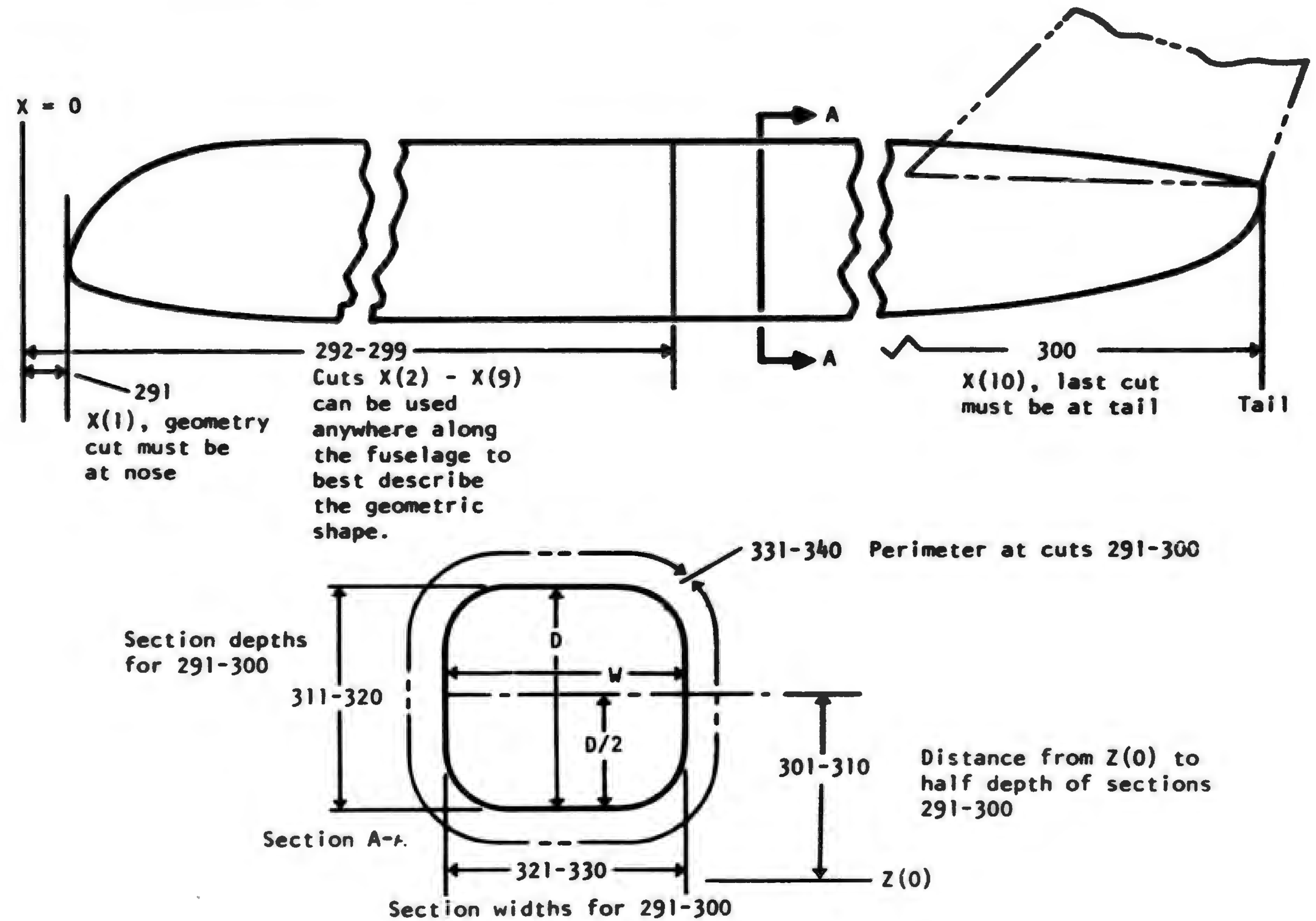


Figure 53. Fuselage geometry.

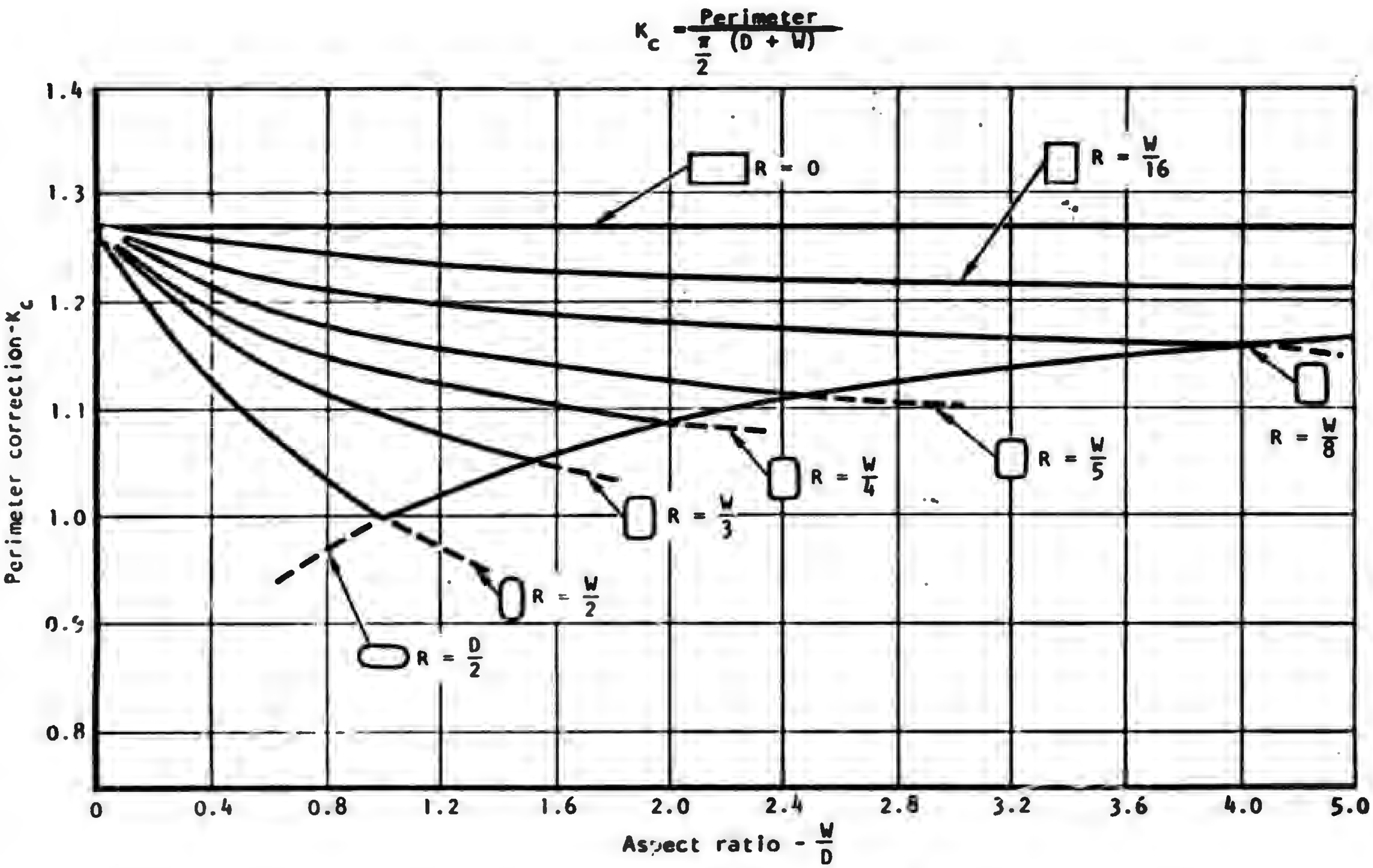
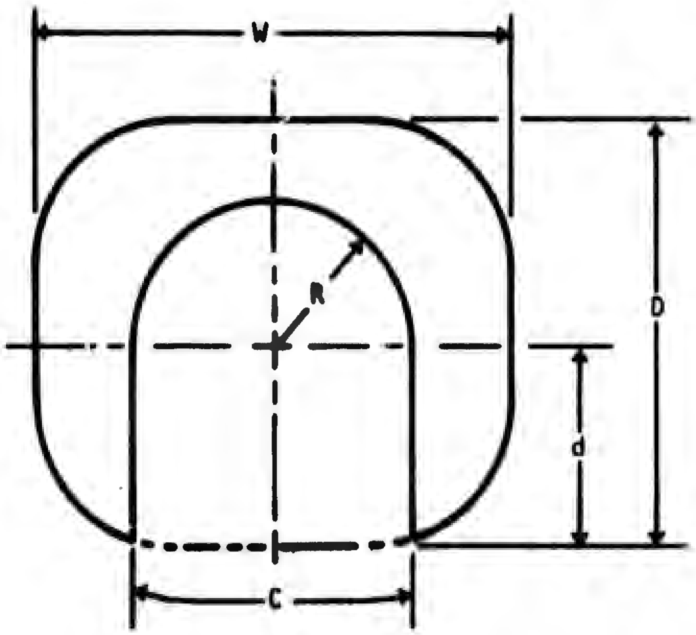
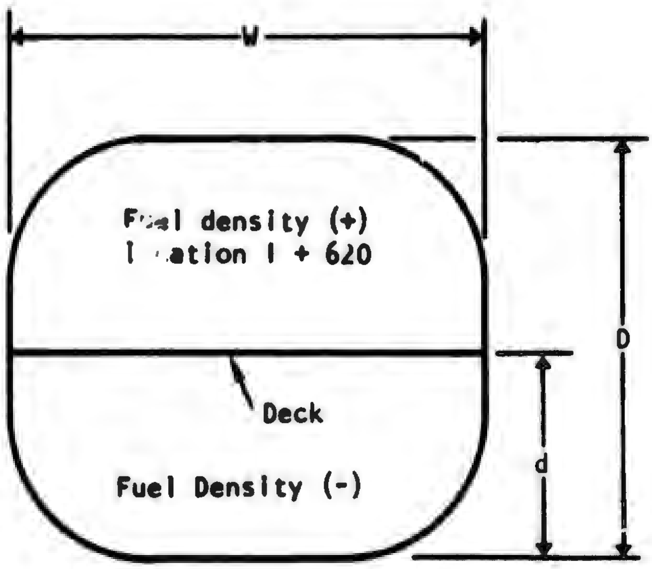


Figure 54. Programmed shapes and correction factors.



I = synthesis cut number (1-19)

	Location
d/D	I + 440
R	I + 520
C	I + 480
1.0	254



	Location
d/D	I + 440
0.0	I + 520

Figure 55. Synthesis cut geometry - FUSELAGE data.

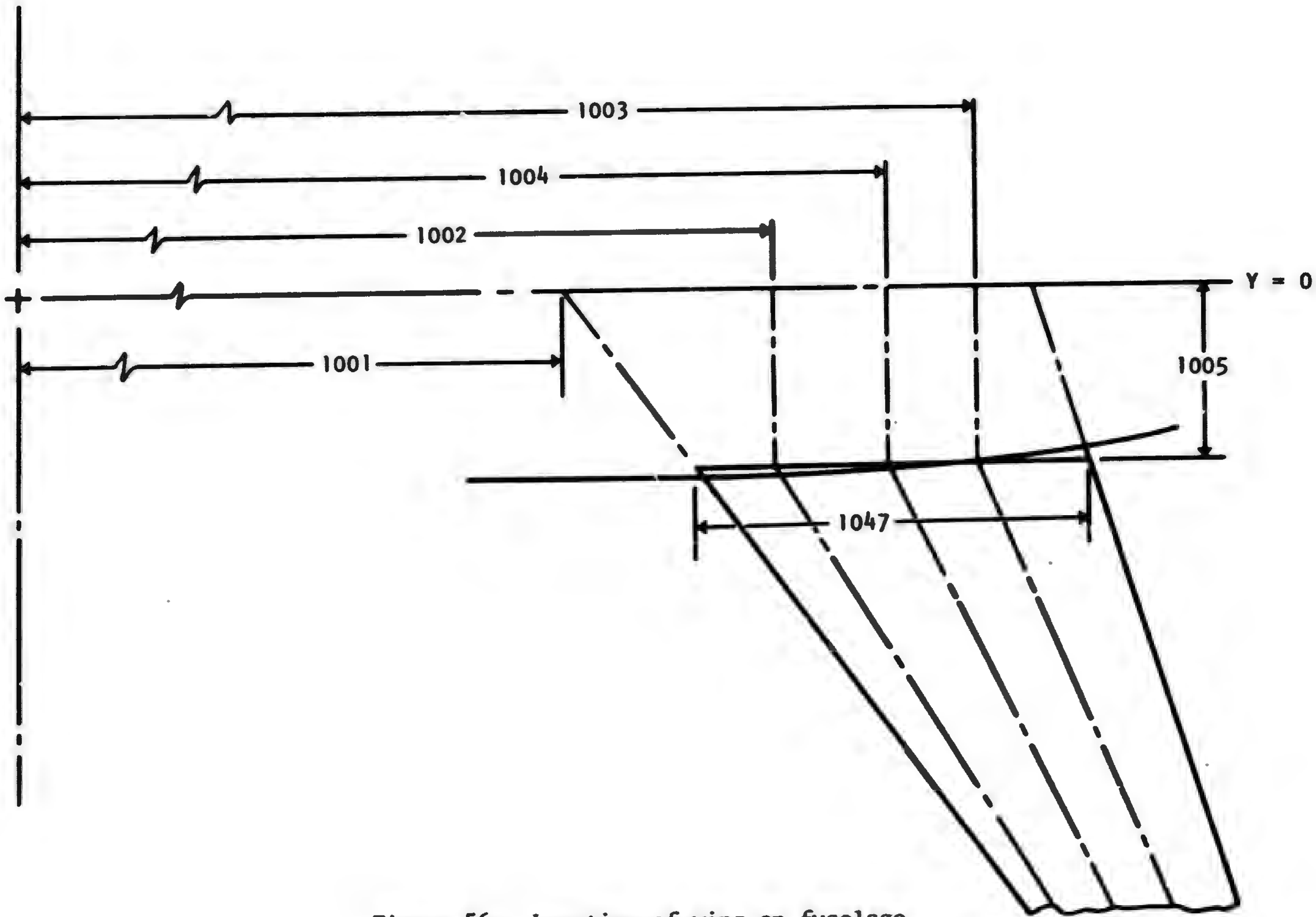


Figure 56. Location of wing on fuselage.

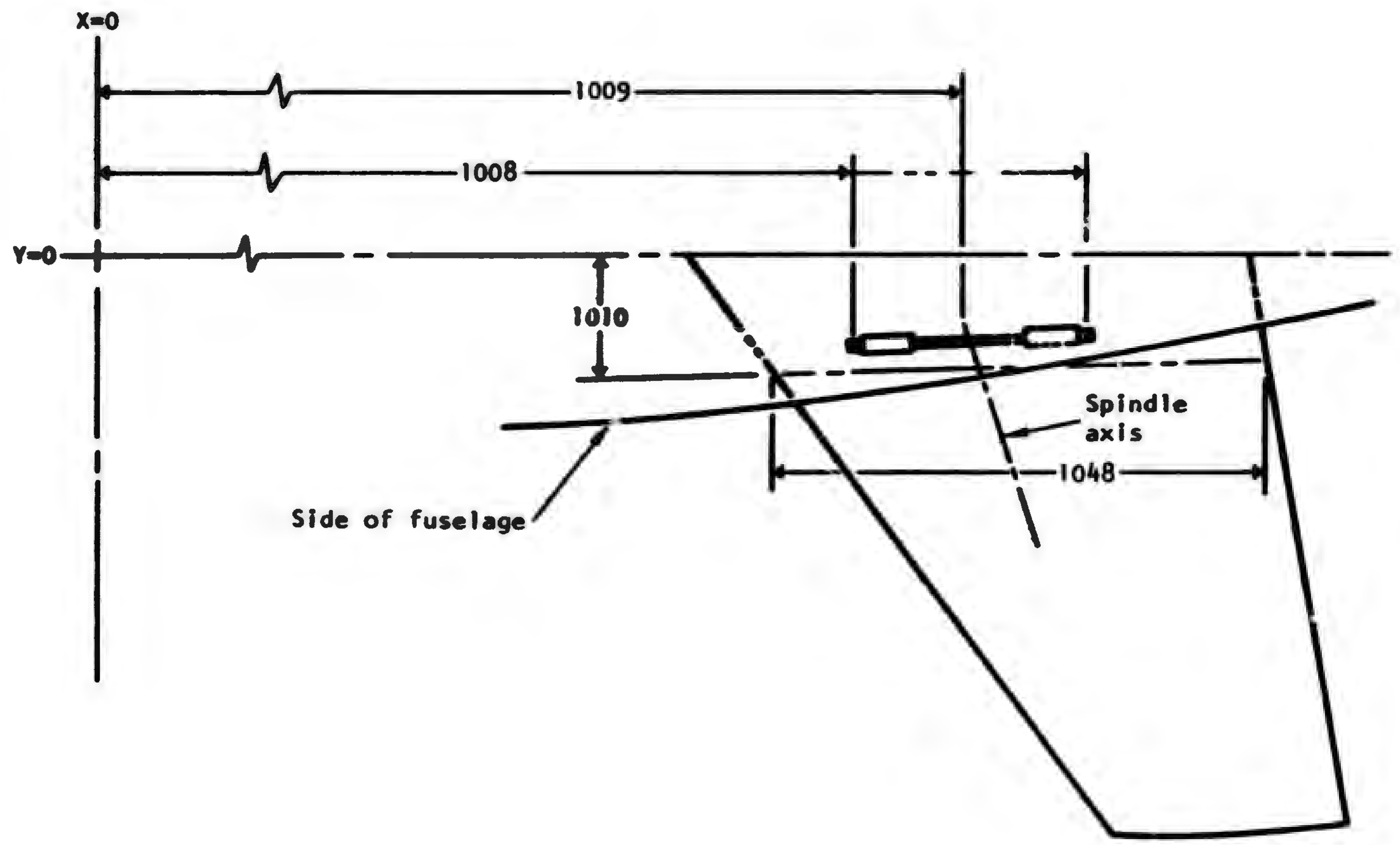


Figure 57. Horizontal tail location on fuselage.

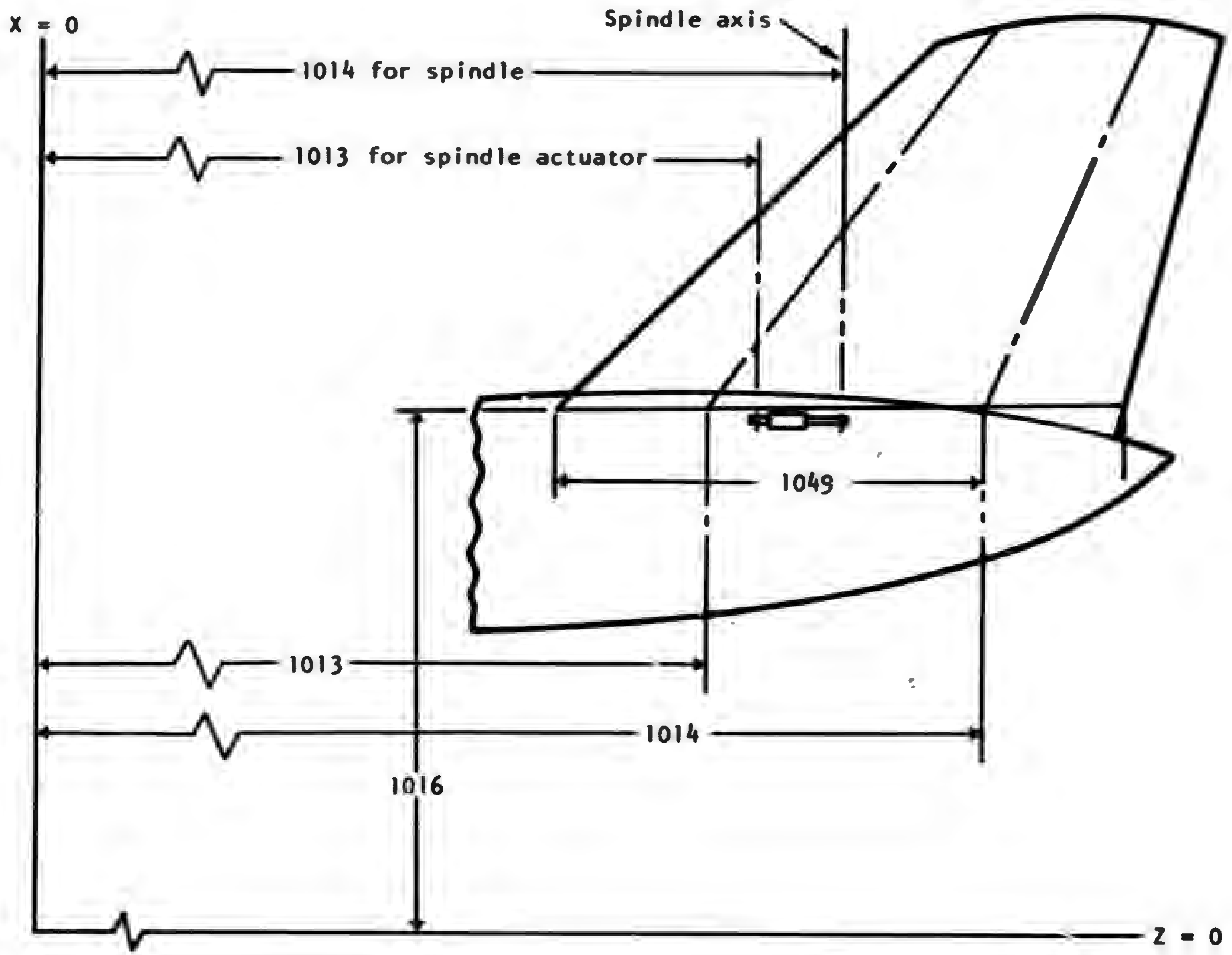


Figure 58. Vertical tail location on fuselage.

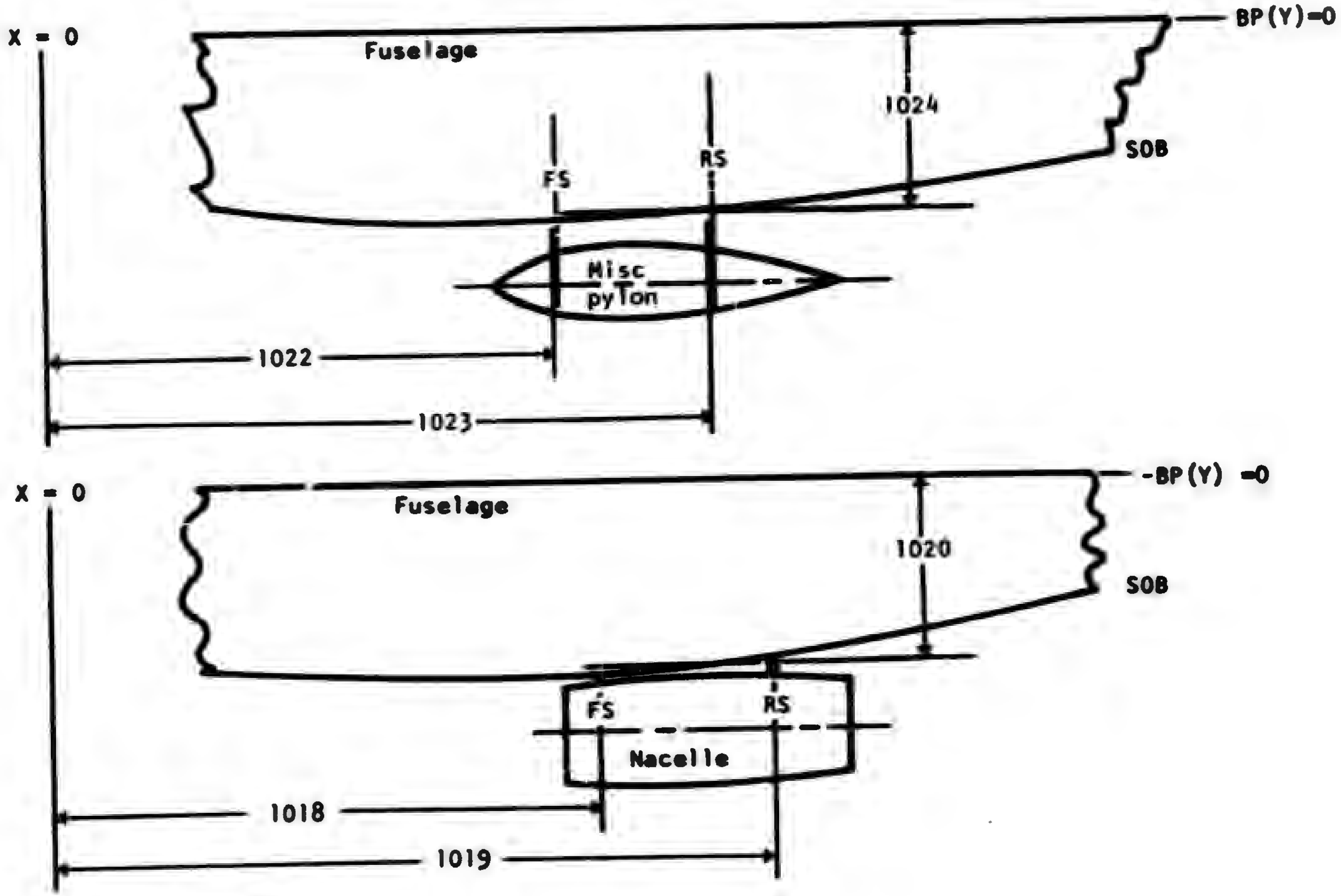
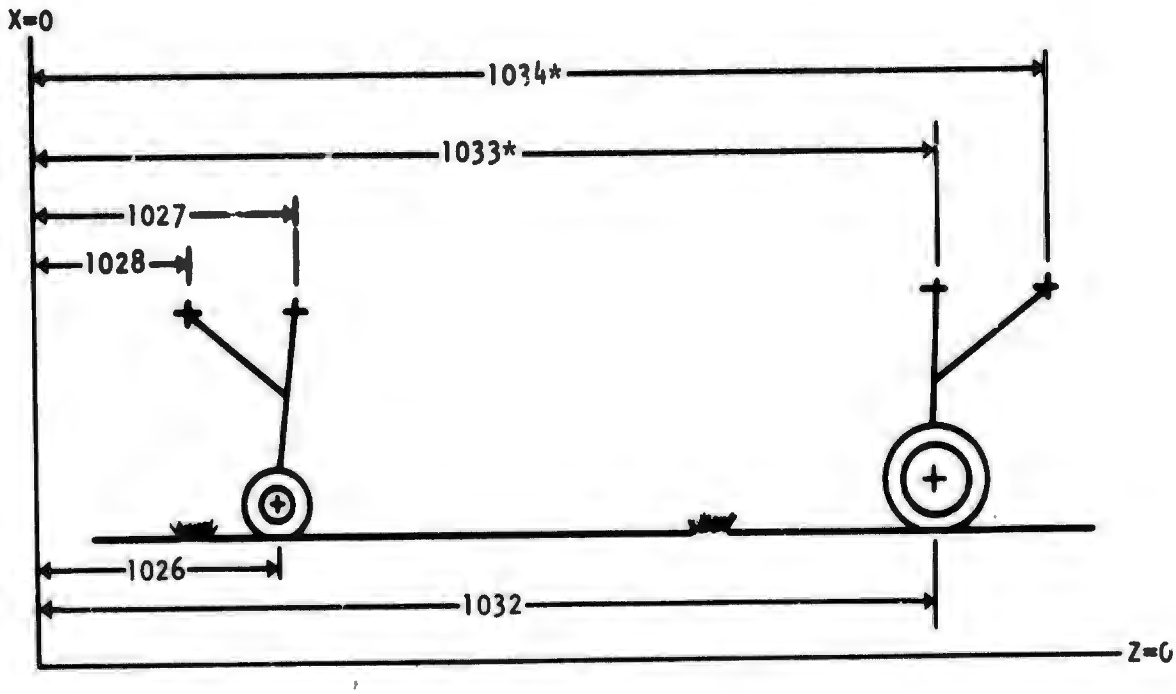


Figure 59. Miscellaneous pylon and nacelle location on fuselage.



*For wing-mounted gear enter 0.0

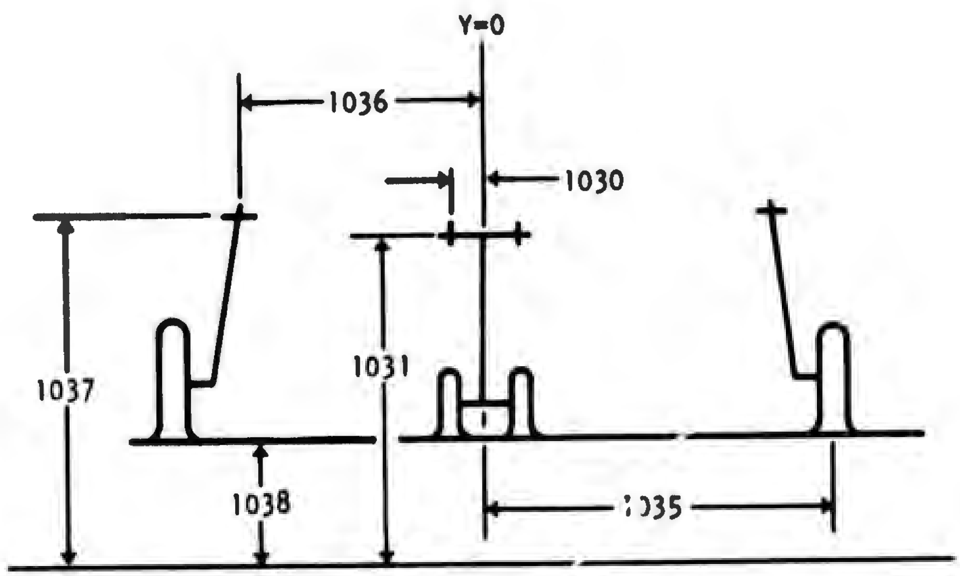


Figure 60. Location of landing gear on fuselage.

TABLE 13 FUSELAGE DATA LIST

```
**************************************************************
*     CONSTANT DATA AREA LOCATIONS 1-240.                    *
*     CONSTANTS IN THESE LOCATIONS ARE STORED ON PERMANENT FILE. *
*     INPUT MAY BE USED TO OVERRIDE THESE CONSTANTS.         *
**************************************************************
```

LOCATIONS	DESCRIPTIONS
1	CONSTANT = 1.0
2	CONSTANT = 2.0
3	CONSTANT = 3.0
4	CONSTANT = 4.0
5	CONSTANT = 5.0
6	CONSTANT = 6.0
7	CONSTANT = 7.0
8	CONSTANT = 8.0
9	CONSTANT = 9.0
10	CONSTANT = 10.0
11	CONSTANT = 11.0
12	CONSTANT = 12.0
13	CONSTANT = 20.0
14	CONSTANT = 1000.0
15	CONSTANT = 3.1415927 (PI)
16	CONSTANT = 0.01745329 (PI/180)
17	CONSTANT = 144.0
18	CONSTANT = 24.0
19	CONSTANT = 0.5
20	CONSTANT = 1.5
21	CONSTANT = 0.33333333 (1/3)
22	CONSTANT = 0.95
23	CONSTANT = 0.25
24	CONSTANT = 0.0
25	CONSTANT = 1.414213562 SQUARE ROOT OF TWO
26	CONSTANT = 32.174049 GRAVITATIONAL ACCELERATION
27	CONSTANT = 180.0
28	CONSTANT = 1.732051 SQUARE ROOT OF THREE
29	2.5 LAND TO COVER RATIO - MAXIMUM
30	1.333333 ADDITIONAL FACTOR OF SAFETY - HUMAN ENVIRONMENT

TABLE 13 FUSELAGE DATA LIST (CONT)

31	NOT USED		
32	NOT USED		
33	0.5	STRINGER SPACING SEARCH INCREMENT	IN
34	0.5	FRAME SPACING SEARCH INCREMENT	IN
35	0.25	MAXIMUM FRAME SPACING - FRACTION OF DIAMETER	
36	4.0	MINIMUM NUMBER OF STRINGERS	
37	4.0	MINIMUM STRINGER SPACING	IN
38	1.5	STANDARD FACTOR OF SAFETY	
39	NOT USED		
40	0.0000625	FRAME STABILITY COEFFICIENT	
41	5.0	NUMBER OF FRAME CUTS PER QUADRANT - MAXIMUM = 15	
42	0.426	FLANGE CRIPPLING COEFFICIENT - ONE EDGE FREE	
43	4.0	FLANGE CRIPPLING COEFFICIENT - EDGES FIXED	
44	7.5	SHEAR CRIPPLING COEFFICIENT	
45	NOT USED		
46	0.9	REDUCTION FACTOR - FRAME FCY	
47	0.75	RIVET FACTOR - COVER	
48	0.005	ONE GAGE FOR FRAME STIFFENERS	IN
49	2.0	LAND WIDTH - FRAME ATTACHMENT	IN
50	2.0	LAND WIDTH - LONGERON ATTACHMENT	IN
51	0.050	MINIMUM GAGE - LAND FOR COVER	IN
52	0.032	MINIMUM GAGE - COVER	IN
53	0.145	MINIMUM AREA - LONGERON	SQ IN
54	0.050	MINIMUM GAGE - FRAME CAP (MAJOR FRAME)	IN
55	0.032	MINIMUM GAGE - FRAME WEB (MAJOR FRAME)	IN
56	1.0	MINIMUM WIDTH - FRAME CAP	IN
57	0.050	MINIMUM GAGE - MINOR FRAME CAP	IN
58	0.025	MINIMUM GAGE - MINOR FRAME WEB	IN
59	1.0	MINIMUM WIDTH - MINOR FRAME CAP	IN
60	0.9	REDUCTION FACTOR - LONGERON FCY	
61	0.875	MINIMUM WIDTH - STRINGER WEB	IN
62	0.3263434	RATIO - STRINGER WEB/STRINGER FLANGE	
63	0.050	MINIMUM GAGE - BULKHEAD	IN
64-75		NOT USED	

D(75)-D(80) ACOUSTIC FATIGUE DESIGN PARAMETERS

TABLE13. FUSELAGE DATA LIST (CONT)

76	1.25	FACTOR-FRAME CAP THICKNESS
77	1.0794	CURVATURE CORRELATION EQUATION-CONSTANT
78	0.000143	-CONSTANT
79	0.076475	-CONSTANT
80	0.29969	-CONSTANT
		D(81)-D(88) SPEED PROFILE PARAMETERS
81	1479.757	CALC. OF DYNAMIC PRESSURE-CONSTANT
82	52.187	-CONSTANT
83	0.619858	-CONSTANT
84	1465.175	-CONSTANT
85	50.76695	-CONSTANT
86	0.6434412	-CONSTANT
87	0.002907194	-CONSTANT
88	199.659	-CONSTANT
		D(89)-D(95) MACH NUMBER PARAMETERS
89	0.4651674	CALC. OF FLUTTER PARAMETER-CONSTANT
90	1.166456	-CONSTANT
91	0.488412	-CONSTANT
92	0.4037203	-CONSTANT
93	1.4	-CONSTANT
94	0.6	-CONSTANT
95	0.4849271	-CONSTANT
		D(96)-D(99) FLUTTER PARAMETERS
96	0.5551841	CALC. OF COVER THICKNESS PARAMETER-CONSTANT
97	0.1666944	-CONSTANT
98	0.02169992	-CONSTANT
99	0.000693694	-CONSTANT
		D(100)-D(102) SHEAR MODULUS PARAMETERS

TABLE 13 FUSELAGE DATA LIST (CONT)

100	0.115	APPROX. OF SHEAR CRIPPLING COEF.-EXPONENT	
101	9.0	-CONSTANT	
102	0.522	-EXPONENT	
		D(103)-D(106) ACOUSTIC PARAMETERS	
103	2.9X10(-9)	ACOUSTIC PRESSURE REFERENCE CONSTANT	PSI
104	2.6108	THICKNESS CORRELATION FOR FATIGUE-COVER	
105	5.229	-FRAME	
106	0.600	COVER FIELD T TO LAND T RATIO-T(C)/T(L)	
		D(107)-D(114) PRESSURE PANEL PARAMETERS	
107	1.646	THICKNESS EQ. FOR PRESSURE LOADING-PANEL EDGE	
108	0.894	-PANEL EDGE	
109	0.394	-PANEL EDGE	
110	1.288	-PANEL EDGE	
111	1.3769	-MIDSPAN	
112	2.484	-MIDSPAN	
113	1.984	-MIDSPAN	
114	4.467	-MIDSPAN	
		D(115)-D(127) FORCED CRIPPLING PARAMETERS	
115	0.1443	FIRST APPROX. OF TENSION FIELD ANGLE-CONSTANT	
116	0.175622	-CONSTANT	
117	0.013411	-CONSTANT	
118	1.2	MAX TO AVERAGE INDUCED STRESS RATIO -CONSTANT	
119	1.0	-CONSTANT	
120	0.78	-CONSTANT	
121	0.650	-CONSTANT	
122	151.580	CURVATURE LIMIT FOR CALC. OF CRIPPLING ALLOWABLE	
123	0.18695	CALC. OF FORCED CRIPPLING ALLOWABLE-CONSTANT	
124	5.88	-CONSTANT	
125	0.002	-CONSTANT	
126	0.00075238	-CONSTANT	
127		NOT USED	

TABLE 13 FUSELAGE DATA LIST (CONT)

		D(128)-D(130) CURVED PANEL COMPRESSION CRIPPLING PARAMETERS
128	0.16	CONSTANT FOR CALC. OF COVER CRIPPLING STRESS
129	0.85	CONSTANT FOR EFFECTIVE POST BUCKLED COVER WIDTH
130	761.182	CONVERSION FACTOR-MACH NUMBER TO MPH
		D(131)-D(140) BULKHEAD PARAMETERS
131	0.125	MAX STIFFENER BENDING MOMENT CONSTANT
132	0.312	FLANGE CRIP. COEFF. OF STIFFENER-ONE EDGE FREE
133	0.44444	STIFFENER THICKNESS CALCULATION-EXPONENT
134	224.0	-CONSTANT
135	0.6667	-EXPONENT
136	2.0	STIFFENER SPACING FOR BULKHEAD SIZING-MIN INCHES
137	12.0	-MAX INCHES
138	1.1	LAND WIDTH TO STIFF. CAP WIDTH RATIO
139	1.0	MIN STIFFENER CAP WIDTH INCHES
140	10.0	MAX STIFFENER HEIGHT INCHES
		D(141)-D(146) CANOPY WEIGHT PARAMETERS
141	215.0	PILOTS CANOPY WT.-RULE OF THUMB LBS
142	215.0	NAVIGATORS CANOPY WT.-RULE OF THUMB LBS
143	1.69	CANOPY WEIGHT CALC.-CONSTANT
144	0.0026	-CONSTANT
145	2.158	-CONSTANT
146	1460.0	-CONSTANT
		D(147)-D(156) WINDSHIELD,WINDOWS AND PORTS FOR COCKPIT
147	10500.0	ULT. TENSILE STRENGTH OF WINDSHIELD MAT'L PSI
148	0.23	WINDSHIELD THICKNESS FOR BIRD STRIKE-CONSTANT
149	0.346	-CONSTANT
150	0.102587	DENSITY & FRAMING FACTOR FOR WINDSHIELD&WINDOWS

TABLE 13 FUSELAGE DATA LIST (CONT)

151	0.0525	WINDSHIELD/WINDOW MAX BENDING MOMENT-CONSTANT	
152	0.0025	-CONSTANT	
153	157.4	WINDSHIELD THICKNESS FOR BIRD STRIKE-CONSTANT	
154	0.250	MIN WINDSHIELD PANEL THICKNESS	INCHES
155	60.0	WINDSHIELD RULE OF THUMB WT.-FIGHTER,ATTACK	LBS
156	640.0	-BOMBR TRANSPORT	LBS
157	250.0	-TRANSPORT,PERSL	LBS
158	125.0	-PERSONNEL	LBS
		D(159)-D(160) CABIN WINDOW AND PORT PARAMETERS	
159	0.175	DENSITY AND FRAMING FACTOR FOR CABIN WINDOWS	
160	10.0	CABIN WINDOW WT./WINDOW-RULE OF THUMB	LBS
		D(161)-D(165) FLIGHT DECK FLOORING PARAMETERS	
161	14.0	FLOORING WT./CREW FOR FIGHTER-RULE OF THUMB	
162	2.21	WT. CREW FLOORING AND SUPPORTS-RULE OF THUMB	PSF
163	6.0	WT. ESTIMATE ON TRANSPORTS & BOMBERS-CONSTANT	
164	1.5	-CONSTANT	
165	24.0	-CONSTANT	
		D(166)-D(169) STAIRWAY AND LADDERS PARAMETERS	
166	6.0	STAIRWAY AND LADDER WT.-RULE OF THUMB,FGHTR.	LBS
167	8.0	WT. ESTIMATE ON TRANSPORTS AND BOMBERS-CONSTANT	
168	9.0	-CONSTANT	
169	11.45	-CONSTANT	
		D(170)-D(172) RADOME PARAMETERS	
170	2.76	UNIT WT.-NOSE RADOME-SUPERSONIC VEH.	PSF
171	2.76	-TAIL RADOME-SUPERSONIC VEH.	PSF
172	1.75	-RADOMES ON SUBSONIC VEHICLES	PSF
		D(173)-D(176) SPEED BRAKE PARAMETERS	
173	2.35	SPEED BRAKE UNIT WT. PARAMETER-CONSTANT	
174	0.00[illegible]	-CONSTANT	

TABLE 13 FUSELAGE DATA LIST (CONT)

175	1.3	SPEED BRAKE SUPT. STRUCTURE FACTOR	
176	0.8	APPROX. SPEED BRAKE PANEL ASPECT RATIO	
177	5.3	UNIT WT.-MAIN GEAR DOOR	PSF
178	5.0	-NOSE GEAR DOOR	PSF
179	2.9	-AFT CARGO DOOR	PSF
180	9.5	-SIDE CARGO DOOR	PSF
181	NOT USED		
182	12.21	UNIT WT.-RAMP	PSF
183	0.933	CONSTANT - F(RAMP GEOMETRY)	
184	4.0	UNIT WT.-RAMP TOE	PSF
185	5.5	CONSTANT - PRESSURE DOOR	
186	2.5	CONSTANT - PRESSURE DOOR	
		D(187)-D(191) BOMB BAY DOOR PARAMETERS	
187	1.55	UNIT WT. PARAMETER-BASIC WEAPONS DOOR-CONSTANT	
188	0.0369	-CONSTANT	
189	1.3	SLIDING WEAPONS BAY DOOR WEIGHT FACTOR	
190	1.7	SINGLE HINGED WEAPONS BAY DOOR WT. FACTOR	
191	1.9	DOUBLE HINGED WEAPONS BAY DOOR WT. FACTOR	
192	15.0	CONSTANT-GUN DOOR	LB/GUN
193	0.020	-AMMO DOOR	LB/RND
194	170.0	-ESCAPE COCKPIT	LB
195	19.5	-ESCAPE COCKPIT	PSF
196	19.5	-ESCAPE TYPE 1	PSF
197	10.0	-ESCAPE TYPE 2	PSF
198	48.0	-TYPE 1	LB
199	24.0	-TYPE 2	LB
200	NOT USED		
201	230.0	CONSTANT-PARATROOP DOORS	LB
202	11.0	-PARATROOP DOORS	PSF

TABLE 13 FUSELAGE DATA LIST (CONT)

203	10.0	-SPOILER DEFLECTORS-PARATROOP DOOR	LB
204	120.0	-ENTRANCE DOORS	LB
205	10.0	-ENTRANCE DOORS	PSF
206	794.495	-MISC. ACCESS DOORS-FIGHTERS-BOMBERS	
207	2067.32	-MISC. ACCESS DOORS-FIGHTERS-BOMBERS	
208	10.45	-MISC. ACCESS DOORS-TRANSPORTS	
209	0.28	-MISC. ACCESS DOORS-TRANSPORTS	
210	10.0	-IN FLIGHT REFUELING	LB
211	100.0	-IN FLIGHT REFUELING	LB
212	25.0	-RAM AIR TURBINE	LB
213	5.0	-RAM AIR TURBINE	PSF
214	2.93	UNIT WT.-ENGINE REMOVAL DOORS	PSF
215	5.0	CLEARANCE-ENGINE REMOVAL DOORS	IN
216	2.5	UNIT WT.-ACCESSORY ACCESS	PSF
217	2.5	-THERMAL PROTECTION	PSF
218	2.2	-MAIN LANDING GEAR POD	PSF
219	1.5	-MISC. FAIRING	PSF
220	0.5	-MISC. FAIRING	LB/IN
221	0.1	CONSTANT-WALKWAYS.STEPS AND GRIPS	LB/IN
222	0.035	-ANTI SKID PROTECTION	LB/IN
223	0.026	-EXTERIOR FINISH	PSF
224	0.050	-INTERIOR FINISH	PSF

D(225)-D(229) CARGO FLOORING AND SUPPORT FRAME PARAMETERS

225	0.66	EXPONENT FOR CARGO FLOOR WIDTH PARAMETER	
226	4.8	UNIT WT. PARAMETER-WHEELED VEHICLE	PSF
227	3.3	-BULK CARGO FLOOR	PSF
228	2.27	-PASSENGER FLOOR	PSF
229	14.16		

D(230)-D(232) FITTING WEIGHT PARAMETERS

230	141.3125	FITTING WEIGHT CALC. - CONSTANT
231	78.20	- CONSTANT
232	0.000025	- CONSTANT

TABLE 13 FUSELAGE DATA LIST (CONT)

```
                    D(233)-D(237) MISC. CONSTANTS

233       0.00038      CONSTANT-ENGINE DRAG BEAM                          LB/LB
234       20.0                  -EJECTION FRAME PER MAN                    LB
235       0.2                   -PARTITIONS
236       0.1                   -J.S.F.
237       0.77                  -RAMP BULKHEAD                             LB/IN

238-240   NOT USED

   ...................................................................
   .      VARIABLE DATA BEGIN LOCATIONS 241-1070.                    .
   ...................................................................
          ****************************************************
            *** NOTE THOSE INPUT DATA LOCATIONS PRECEDED BY
            ASTERISKS (*) ARE INPUT INTO GENERAL DATA.  THESE
            ASTERISKS SIGNIFY THAT THESE SPECIFIC INPUTS ARE NOT
            REQUIRED WHEN THE GENERAL DATA ARRAY IS PART OF
            THE CASE DATA SET. ***
          ****************************************************

*241      VEHICLE CLASS.
           ELEVEN        (11.0)=FIGHTERS AND ATTACK (FIGHTER-BOMBER).
           TWENTY-ONE    (21.0)=BOMBERS.
           THIRTY-ONE    (31.0)=TRANSPORTS FOR WHEELED VEHICLES >100K .
           THIRTY-TWO    (32.0)=                                0-100K.
           THIRTY-THREE  (33.0)=TRANSPORTS FOR BULK CARGO       >100K .
           THIRTY-FOUR   (34.0)=                                0-100K.
           THIRTY-FIVE   (35.0)=TRANSPORTS FOR PERSONNEL        >100K .
           THIRTY-SIX    (36.0)=                                0-100K.

*242      NUMBER OF CUTS FOR SHELL SYNTHESIS - 19 CUTS MAXIMUM.
           MUST AGREE WITH DATA INPUT IN LOCATIONS 361-379.

*243      PERIMETER CODE - MUST AGREE WITH DATA IN LOCATIONS 331-340.
           ONE (1.0)=PERIMETER IS INPUT
```

TABLE 13 FUSELAGE DATA LIST (CONT)

```
            TWO (2.0)=PERIMETER CORRECTION FACTOR IS INPUT - USE
            CURVES IN FIGURE 54 FOR INPUT IN LOCATIONS 331-340

244      CONSTRUCTION TYPE INDICATOR
          ONE (1.0)=LONGERON
          TWO (2.0)=STRINGER
245      COVER MILLING INDICATOR
          ZERO (0.0)=COVER NOT MILLED
          ONE  (1.0)=COVER MILLED(LANDS AT FRAMES AND LONGERONS).
246      MATERIAL NUMBER-COVER
247                     -LONGERON
248                     -MAJOR FRAME
249                     -MINOR FRAME AND BULKHEADS
250      NOT AVAILABLE (USED INTERNALLY FOR PRINT CONTROL)
251      NUMBER OF PRIMARY LONGERONS **LOAD FOUR (4.0) IF 244=1.0**
252      NUMBER OF SECONDARY LONGERONS USE FOUR (4.0) OR MULTIPLES OF
         FOUR (4.0) IE. 8,12,16,20.
         THIS APPROXIMATION IS USED TO ACCOUNT FOR SECONDARY
         LONGITUDINAL MEMBERS THAT EXIST ON VEHICLES WITH LONGERON
         CONSTRUCTION IE, FIGHTERS AND BOMBERS.  THESE SECONDARY
         LONGITUDINAL MEMBERS EXIST AT THE INTERSECTION OF VERTICAL
         PANELS (INTERCOSTALS) AND HORIZONTAL PANELS (DECKS).  IT IS
         RECOMMENDED THAT ZERO (0.0) BE USED FOR STRINGER TYPE
         CONSTRUCTION (LOCATION 244 = 2.0).
253      GENERAL LONGERON LOCATION FOR ALL SYNTHESIS STATIONS.
             POSITIVE VALUE INDICATES DISTANCE BETWEEN UPPER AND
                 LOWER LONGERONS AS A DECIMAL FRACTION OF TOTAL
                 FUSELAGE DEPTH.             TYPICAL VALUE = .7
             NEGATIVE VALUE INDICATES ANGLE BETWEEN THE VEHICLE
                 VERTICAL CENTER LINE AND A RADIUS TO THE LONGERON.
                 ANGLE IS IN RADIANS         TYPICAL VALUE = -.785
             LOCAL VARIATIONS MAY BE OBTAINED BY USING LOC. 421-439.

254      SHROUD RADII INDICATOR              ZERO OR BLANK OR
                                             ONE (1.0)=SINGLE SHROUD.
                                             TWO (2.0)=DOUBLE SHROUD.
                                             *AS ON TWO BURIED FUSELAGE
```

TABLE 13 FUSELAGE DATA LIST (CONT)

```
                          ENGINES*
           LOCATIONS 521-539 DEFINE THE RADII AT 19 CUTS(361-379).
           LOCATIONS 441-459 DEFINE VERTICAL LOC'S OF RADII CENTER.

 255     STRINGER SPACING INDICATOR **MUST BE LOADED IF 244=2.0**
              ZERO (0.0)=SEARCH STARTING WITH FOUR INCH SPACING.
              POSITIVE VALUE=DESIRED SPACING.
              TYPICAL VALUE = 0.0
 256     GENERAL FRAME DEPTH FOR BOTH MAJOR AND MINOR FRAMES-INCHES.
          *MAJOR FRAME DEPTH MAY BE ALTERED BY USING AREA 401-419*
          TYPICAL VALUE = 5.0

 257     GENERAL FRAME SPACING-INCHES.
         **INPUT INITIAL FRAME SPACING IF SEARCH IS REQUIRED.
          TYPICAL VALUE = 0.0
         ADD 1000 TO FRAME SPACING IF NO SEARCH IS REQUIRED OR IF
         SPACING IS PREDETERMINED BY OTHER REQUIREMENTS. EXAMPLE 1020
         DESIGNATES FIXED FRAME SPACING AT 20 INCHES.
         LOCAL VARIATIONS MAY BE OBTAINED BY INPUT IN AREA 361-399.
 258-260 NOT USED

     LOCATIONS 261-265 ARE USED BY THE PROGRAM TO STORE THE CRITICAL
     LOCAL PANEL FLUTTER DATA DUE TO SUPERSONIC FLIGHT.  IF THE
     FUSELAGE IS RUN WITH INPUT LOADS, THESE LOCATIONS MAY BE USED
     TO INPUT THE CRITICAL LOCAL FLUTTER PARAMETERS.  LOCATIONS
     261 AND 262 OR LOCATIONS 261 AND 263  ARE SUFFICIENT TO DESCRIBE
     THE LOCAL PANEL FLUTTER CRITERIA.
*261     MACH NUMBER FOR CRITICAL PANEL FLUTTER.
*262     ALTITUDE THAT CORRESPONDS WITH CRITICAL MACH NUMBER.    FEET
*263     DYNAMIC PRESSURE (Q) POUNDS/SQUARE FOOT AT CRITICAL LOCAL
         PANEL FLUTTER POINT.
         THIS POINT IS ON THE M(L) DIAGRAM AND DOES NOT INCLUDE
         ANY FLUTTER MARGIN.
*264     COVER MODULUS OF ELASTICITY - POUNDS/SQUARE INCH.
         IF NOT INPUT, PROGRAM WILL USE VALUE CORRESPONDING WITH
         FIRST LOAD CASE OPERATING TEMPERATURE.
*265     NO INPUT REQUIRED.  PROGRAM GENERATES VALUE - FUNCTION OF
```

TABLE 13 FUSELAGE DATA LIST (CONT)

```
          MACH NUMBER (BETA).

        LOCATIONS 266-267 ARE USED BY THE PROGRAM TO STORE CERTAIN
        MAXIMUM DESIGN VALUES.  THESE VALUES ARE USED FOR ESTIMATING
        SECONDARY STRUCTURE COMPONENTS.  IF FUSELAGE LOADS DATA IS
        INPUT, AND THE DESIGN POINTS CORRESPOND WITH THESE MAXIMUMS, NO
        INPUT IS REQUIRED IN THESE LOCATIONS.
*266      MAXIMUM SEA LEVEL SPEED - MACH NUMBER AT M(L).
*267      MAXIMUM DYNAMIC PRESSURE (Q) POUNDS/SQUARE FOOT.
 268      NO INPUT REQUIRED.  PROGRAM SCANS LOCAL PRESSURE DATA,
          LOCATIONS 601-619, FOR MAXIMUM PRESSURE.
 269      FLUTTER CORRECTION FACTOR FOR BOUNDARY LAYER EFFECT.
           THE DATA IN THIS LOCATION IS AN APPROXIMATION.
                                               LOADED VALUE = 0.663265
 270      NOT USED
 271      INDEX-COVERS                           *LOADED VALUE=ONE (1.0)
 272           -LONGERON                                     =ONE (1.0)
 273           -JOINTS, SPLICES AND FASTENERS                =ONE (1.0)
 274           -MINOR FRAMES                                 =ONE (1.0)
 275           -MAJOR FRAMES                                 =ONE (1.0)
 276           -BULKHEADS                                    =ONE (1.0)
 277-290  NOT USED
```

```
        LOCATIONS 291-340 DEFINE THE FUSELAGE GEOMETRY AND COORDINATES.
          ALL OF THESE LOCATIONS MUST BE ENTERED (ALL 10 CUTS).

*291      FIRST CUT - AT NOSE TIP                     STATION (X) INCHES.
*292-299  INTERMEDIATE CUTS (8)                       STATION (X) INCHES.
*300      LAST CUT - AT TAIL TIP                      STATION (X) INCHES.
*301-31   DISTANCE FROM ZERO WATER LINE REFERENCE TO FUSELAGE HALF
           DEPTH AT FUSELAGE CUTS.                  WATER LINE (Z) INCHES.
*311-320  FUSELAGE DEPTH AT FUSELAGE CUTS                         INCHES.
*321-330  FUSELAGE WIDTH AT FUSELAGE CUTS                         INCHES.
*331-340  FUSELAGE PERIMETER AT FUSELAGE CUTS IF  243=1.0         INCHES.
          FUSELAGE PERIMETER CORRECTION FACTOR IF 243=2.0
```

TABLE 13 FUSELAGE DATA LIST (CONT)

```
341-360 NOT USED

*361-379 FUSELAGE SYNTHESIS CUTS **MUST ENTER FROM 1 TO 19 STATIONS**
           NUMBER OF CUTS USED MUST BE ENTERED IN LOCATION 242.
           FIRST CUT MUST BE AFT OF NOSE REFERENCE LOC. 291
           LAST CUT MUST BE FORWARD OF TAIL REFERENCE LOC. 300
380      NOT AVAILABLE.
381-399 FRAME SPACING,ENTER ONLY FOR THOSE SYNTHESIS CUTS WHERE
           SPACING IS DIFFERENT FROM THAT SPECIFIED IN LOC. 257.
400      NOT USED

401-420 MAJOR FRAME DEPTH, ENTER ONLY FOR THOSE SYNTHESIS CUTS WHERE
           DEPTH IS DIFFERENT FROM THAT SPECIFIED IN LOC. 256.
421-439 LONGERON HEIGHT RATIO-HEIGHT BETWEEN LONGERONS/FUSELAGE
        HEIGHT, ONLY IF DIFFERENT FROM LOCATION 253
        **RATIO ENTRIES MUST AGREE WITH STATIONS LISTED IN 361-379**

440      NOT USED
441-459 DECK HEIGHT RATIO-HEIGHT OF DECK FROM BOTTOM/FUSELAGE HEIGHT
        INPUT ONLY WHEN DECK OR ENGINE SHROUD EXISTS.
        REFERENCE LOCATION 254.
        **RATIO ENTRIES MUST AGREE WITH STATIONS LISTED IN 361-379**
460      NOT USED

461-479 CUTOUT WIDTH-UPPER
        CUTOUTS MUST BE BOUNDED FORE AND AFT BY SYNTHESIS CUTS.
         MINUS (-)        =FORWARD EDGE OF CUTOUT.
         ONE (1.0)        =ENTIRE UPPER PANEL CUTOUT.
         OVER ONE (1.0+)=CUTOUT WIDTH IN INCHES.
         *CUTOUT ENTRIES MUST AGREE WITH STATIONS LISTED IN 361-379*
480      NOT USED

481-499 CUTOUT WIDTH-LOWER
        SEE DESCRIPTION FOR LOCATION 461-479.
        **CUTOUT ENTRIES MUST AGREE WITH STATIONS LISTED IN 361-379*
500      NOT USED
501-519 CUTOUT WIDTH-SIDE - INCHES.
```

TABLE 13 FUSELAGE DATA LIST (CONT)

```
        **CUTOUT ENTRIES MUST AGREE WITH STATIONS LISTED IN 361-379*
520     NOT USED
521-539 SHROUD RADIUS IN INCHES AT STATIONS LISTED IN AREA 361-379.
         NEGATIVE VALUE USED TO DESIGNATE FORWARD END OF SHROUD.
         INDICATOR IN LOCATION 254 USED TO DESIGNATE NO. OF SHROUDS.
         IN LOCATION **254**
540     NOT USED
541-559 NOT USED
560     NOT USED

561-579 BULKHEAD LOCATION INDICATOR FOR PRESSURE BULKHEADS
         ONLY.  ANY POSITIVE VALUE.  PROGRAM WILL PROVIDE BULKHEAD
         AT CUT(S) INDICATED.
580-600 NOT USED

601-619 MAXIMUM CABIN PRESSURE DIFFERENTIAL OR FUEL VENT PRESSURE
         (FOR FUEL TANKS).  MINUS (-) INDICATES HUMAN ENVIRONMENT.
         PSI LIMIT
620     NOT USED
621-639 FUEL DENSITY **POUNDS/CUBIC INCH**.
            MINUS (-) INDICATES FUEL BELOW DECK
            PLUS  (+) INDICATES FUEL ABOVE DECK.

640     NOT USED
641-659 OVERALL ACOUSTIC LEVEL **DECIBELS**.
660     NOT USED
661-679 REQUIRED VERTICAL BENDING STIFFNESS **POUND-INCHES SQUARED**
680     NOT USED
681-699 REQUIRED LATERAL BENDING STIFFNESS **POUND-INCHES SQUARED**.
700     NOT USED
701-719 REQUIRED TORSIONAL STIFFNESS **POUND-INCHES SQUARED**.
720-760 NOT USED

761-820 NOT AVAILABLE.
```

TABLE 13 FUSELAGE DATA LIST (CONT)

SECONDARY STRUCTURE (821 THRU 863), RELATED INPUTS ARE REFERENCED

ZERO(0.0) OR BLANK = ITEM NOT REQUIRED, NO OTHER INPUT.

ONE (1.0) = CALCULATE WEIGHT OF THIS ITEM,
OPTIONAL INPUTS WILL IMPROVE WT. IF AVAIL.

GREATER THAN ONE (>1.0) = WEIGHT OF ITEM,
REQUIRES C.G. INPUT,
IGNORE OTHER INPUT REQUIREMENTS.

		REQUIRED LOC'S. C.G.	REQUIRED LOC'S. OTHER	OPTIONAL
821	PILOT CANOPY	871		921
822	NAVIGATORS CANOPY	872		922
823	WINDSHIELD (FRONT PANELS SUBJECT TO BIRD IMPACT)	873		923–926
824	COCKPIT WINDOWS AND PORTS	874	927– 929	
825	CABIN WINDOWS AND PORTS	875	933	931–932
826	COCKPIT FLOORING AND SUPPORT	876		935
827	STAIRWAY AND LADDER	877		
828	NOSE RADOME	878		936
829	AFT RADOME	879		937

TABLE 13 FUSELAGE DATA LIST (CONT)

SECONDARY STRUCTURE (CONT.)	/	REQUIRED LOC'S. C.G.	/ OTHER	OPTIONAL
830	MISCELLANEOUS RADOMES	880		938
831	SPEED BRAKES	881	941 AND/OR 939-940	
832	WEIGHT UNLISTED ELSEWHERE	882		
833	MAIN LANDING GEAR DOOR	883	943	
834	NOSE LANDING GEAR DOOR	884	944	
835	CARGO DOOR-AFT	885	945	
836	CARGO DOOR-SIDE	886	946	
837	RAMP-FORWARD	887	947	948
838	RAMP TOE-FORWARD	888	949	
839	RAMP-AFT	889	950	951
840	RAMP TOE-AFT	890	952	
841	PRESSURE DOOR-INTERNAL	891	953	954-955
842	BOMB BAY DOOR	892	957	956
843	GUN ACCESS DOOR	893	958	
844	AMMO ACCESS DOOR	894	959	
845	EMERGENCY EXIT-FLIGHT	895		960-961

TABLE 13 FUSELAGE DATA LIST (CONT)

SECONDARY STRUCTURE (CONT.) /		REQUIRED LOC'S. C.G.	/ OTHER	OPTIONAL
846	EMERGENCY EXIT-GROUND	896		962-963
847	PARATROOP DOOR	897		964-965
848	.SPOILER DEFLECTORS	898		
849	ENTRANCE DOOR	899		966-967
850	MISCELLANEOUS ACCESS DOORS	900		
851	IN FLIGHT REFUELING	901		968
852	RAM AIR TURBINE	902		969
853	ENGINE REMOVAL DOOR	903		970
854	ACCESSORY ACCESS DOOR	904		971
855	THERMAL PROTECTION	905	972	
856	MAIN LANDING GEAR POD	906	973	
857	MISCELLANEOUS FAIRING	907		974
858	DORSAL	908	975	
859	WALKWAYS, STEPS AND GRIPS	909	976	977
860	ANTI-SKID PROTECTION	910	976	977
861	EXTERIOR FINISH	911		
862	INTERIOR FINISH	912		

TABLE 13 FUSELAGE DATA LIST (CONT)

863	FLOORING AND SUPPORTS-CABIN	913	976
864-870	NOT USED		

TABLE 13 FUSELAGE DATA LIST (CONT)

```
***********************************************************************

                      LOCATIONS 871 THRU 913
  CENTER OF GRAVITY STATIONS FOR SECONDARY STRUCTURE -(X) INCHES.

          REQUIRED FOR ALL NON-ZERO ITEMS FROM 821 THRU 863

***********************************************************************
   871      PILOT CANOPY
   872      NAVIGATOR CANOPY
   873      WINDSHIELD
   874      COCKPIT WINDOWS AND PORTS
   875      CABIN WINDOWS AND PORTS

   876      COCKPIT FLOORING AND SUPPORT
   877      STAIRWAY AND LADDER
   878      NOSE RADOME
   879      AFT RADOME
   880      MISCELLANEOUS RADOMES

   881      SPEED BRAKES
   882      WEIGHT UNLISTED ELSEWHERE
   883      MAIN LANDING GEAR DOOR
   884      NOSE LANDING GEAR DOOR
   885      CARGO DOOR-AFT

   886      CARGO DOOR-SIDE
   887      RAMP-FORWARD
   888      RAMP TIE-FORWARD
   889      RAMP-AFT
   890      RAMP TIE-AFT

   891      PRESSURE DOOR-INTERNAL
   892      BOMB BAY DOOR
   893      GUN ACCESS DOOR
   894      AMMO ACCESS DOOR
```

TABLE 13 FUSELAGE DATA LIST (CONT)

895	EMERGENCY EXIT-FLIGHT
896	EMERGENCY EXIT-GROUND
897	PARATROOP DOOR
898	SPOILER DEFLECTORS
899	ENTRANCE DOOR
900	MISC. ACCESS DOORS(RECOMMENDED ESTIMATE=46% FUSELAGE LENGTH)
901	IN FLIGHT REFUELING
902	RAM AIR TURBINE
903	ENGINE REMOVAL DOOR
904	ACCESSORY ACCESS DOOR
905	THERMAL PROTECTION (AREA SUBJECT TO INTENSE THERMAL ENVIRONMENT)
906	MAIN LANDING GEAR POD
907	MISCELLANEOUS FAIRING
908	DORSAL
909	WALKWAYS, STEPS AND GRIPS
910	ANTI SKID PROTECTION
911	EXTERIOR FINISH (RECOMMENDED ESTIMATE=43% FUSELAGE LENGTH)
912	INTERIOR FINISH (RECOMMENDED ESTIMATE=43% FUSELAGE LENGTH)
913	FLOORING AND SUPPORTS-CABIN
914-920	NOT USED

TABLE 13 FUSELAGE DATA LIST (CONT)

****

MISCELLANEOUS INPUT FOR SECONDARY STRUCTURE CALCULATION

SEE INSTRUCTIONS FOR ITEMS IN LOC'S. 821 THRU 863
TO DETERMINE IF DATA IS REQUIRED OR IS OPTIONAL.

****

921	LENGTH OF PILOT'S CANOPY-INCHES. REFERENCE LOCATION	821,871
922	LENGTH OF NAVIGATOR'S CANOPY-INCHES.	822,872
923	LENGTH OF WINDSHIELD-INCHES PER PANE.	823,873
924	WIDTH OF WINDSHIELD-INCHES PER PANE.	823,873
925	NUMBER OF PANES-WINDSHIELD.	823,873
926	ANGLE OF INCIDENCE, BIRD IMPACT-DEG. FROM VERTICAL. IF THIS LOCATION IS NOT INPUT, PROGRAM DESIGNS WINDSHIELD FOR PRESSURE.	823,873
927	LENGTH OF COCKPIT WINDOW-INCHES PER WINDOW.	824,874
928	WIDTH OF COCKPIT WINDOW-INCHES PER WINDOW.	824,874
929	NUMBER OF PANES-COCKPIT WINDOWS	824,874
930	NOT USED	
931	LENGTH OF CABIN WINDOW-INCHES PER WINDOW.	825,875
932	WIDTH OF CABIN WINDOW-INCHES PER WINDOW.	825,875
933	NUMBER OF CABIN WINDOWS. REFERENCE LOCATION	825,875
934	NOT USED	
935	AREA-CREW FLOORING-SQUARE FEET.	826,876
936	SURFACE AREA-NOSE RADOME -SQUARE FEET.	828,878
937	SURFACE AREA-TAIL RADOME -SQUARE FEET.	829,879
938	SURFACE AREA-MISC. RADOMES-SQUARE FEET.	831,881
939	LENGTH-SPEED BRAKE-INCHES.	831,881
940	WIDTH -SPEED BRAKE-INCHES.	831,881

TABLE 13. FUSELAGE DATA LIST (CONT)

941	AREA -SPEED BRAKE-SQUARE FEET. REFERENCE LOCATION	831,881
942	NOT USED	
943	AREA -MAIN GEAR DOOR -SQUARE FEET	833,883
944	AREA -NOSE GEAR DOOR -SQUARE FEET.	834,884
945	AREA -CARGO DOOR-AFT -SQUARE FEET.	835,885
946	AREA -CARGO DOOR-SIDE-SQUARE FEET.	836,886
947	AREA -FORWARD RAMP -SQUARE FEET.	837,887
948	LENGTH-FORWARD RAMP -INCHES.	837,887
949	AREA -FORWARD RAMP TOE-SQUARE FEET.	838,888
950	AREA -AFT RAMP -SQUARE FEET.	839,889
951	LENGTH-AFT RAMP -INCHES. REFERENCE LOCATION	839,889
952	AREA -AFT RAMP TOE -SQUARE FEET.	840,890
953	AREA -PRESSURE DOOR -SQUARE FEET.	841,891
954	LENGTH-PRESSURE DOOR -INCHES.	841,891
955	WIDTH -PRESSURE DOOR -INCHES.	841,891
956	TYPE OF BOMB BAY DOOR ZERO (0.0), BLANK ( ) OR ONE (1.0)=SLIDING. TWO (2.0) =SINGLE HINGED. THREE (3.0) =DOUBLE HINGED.	842,892
957	AREA-BOMB BAY DOORS-SQUARE FEET.	842,892
958	NUMBER OF GUNS.	843,893
959	NUMBER OF ROUNDS OF AMMO.	844,894
960	AREA -FLIGHT EMERGENCY EXIT/EACH-SQUARE FEET.	845,895
961	NUMBER-FLIGHT EMERGENCY EXITS. REFERENCE LOCATION	845,895
962	AREA -GROUND EMERGENCY EXIT/EACH-SQUARE FEET.	846,896
963	NUMBER-GROUND EMERGENCY EXITS.	846,896
964	AREA -PARATROOP DOOR/EACH-SQUARE FEET.	847,896
965	NUMBER-PARATROOP DOORS.	847,896
966	AREA -ENTRANCE DOOR/EACH-SQUARE FEET.	849,899
967	NUMBER-ENTRANCE DOORS.	849,899
968	TYPE OF IN FLIGHT REFUELING PROVISIONS.	851,901

TABLE 13 FUSELAGE DATA LIST (CONT)

```
          ZERO (0.0), BLANK ( ) OR TWO (2.0)=BOOM.
          ONE   (1.0)                        =PROBE
          THREE (3.0)                        =BOTH

 969     AREA-RAM AIR TURBINE  DOOR-SQUARE FEET/VEHICLE.        852,902
 970     AREA-ENGINE REMOVAL   DOOR-SQUARE FEET/VEHICLE.        853,903

 971     AREA-ACCESSORY ACCESS DOOR-SQUARE FEET/VEHICLE.
                                           REFERENCE LOCATION  854,904
 972     AREA-THERMAL PROTECTION       -SQUARE FEET/VEHICLE.  855,905
          (AREA SUBJECTED TO INTENSE THERMAL ENVIRONMENT)
 973     AREA-MAIN LANDING GEAR POD    -SQUARE FEET/VEHICLE.  856,906
 974     AREA-MISCELLANEOUS FAIRING    -SQUARE FEET/VEHICLE.  857,907
 975     WETTED AREA-DORSAL FIN        -SQUARE FEET/VEHICLE.  858,908

 976     LENGTH-CARGO BAY-INCHES.                          859-60,909-10
 977     NUMBER OF WALKWAYS-CARGO BAY.                     859-60,909-10
 978     FLOOR AREA-CARGO BAY-SQUARE FEET.                 859-60,909-10
 979-    NOT
1000     USED
```

TABLE 13 FUSELAGE DATA LIST (CONT)

```
***********************************************************************

          VARIOUS INPUT LOCATIONS.          **MUST BE LOADED**
***********************************************************************

*1001     INTERSECTION OF WING LEADING EDGE AND FUSELAGE CENTER LINE-
                                          STATION (X)-INCHES.
 1002     INTERSECTION OF WING FRONT SPAR AND REF. BUTT LINE(LOC 1005)
                                          STATION (X)-INCHES.
 1003     INTERSECTION OF WING REAR SPAR AND REF. BUTT LINE (LOC 1005)
                                          STATION (X)-INCHES.
 1004     INTERSECTION OF WING INTERMEDIATE SPAR AND REFERENCE BUTT
              LINE (LOC. 1005)            STATION (X)-INCHES.
*1005     INTERSECTION OF WING AND SIDE OF FUSELAGE-(REF. BUTT LINE)
                                          BUTT LINE (Y)-INCHES.
*1006     INTERSECTION OF WING REFERENCE PLANE AND SIDE OF FUSELAGE-
                                          WATER LINE (Z)-INCHES.
*1007     WING CARRY-THRU INDICATOR.
           ZERO (0.0) OR BLANK ( )=  SHEAR TIE.
           ONE (1.0)              =  SHEAR AND MOMENT TIE.

 1008     INTERSECTION OF HORIZONTAL TAIL FRONT SPAR AND BUTT LINE IN
              LOCATION 1010               STATION (X)-INCHES.
 1009     INTERSECTION OF HORIZONTAL TAIL REAR SPAR AND BUTT LINE IN
              LOCATION 1010               STATION (X)-INCHES.
*1010     INTERSECTION OF HORIZONTAL TAIL AND SIDE OF FUSELAGE-
                                            BUTT LINE  (Y) INCHES.
*1011     INTERSECTION OF HORIZONTAL TAIL REFERENCE PLANE AND SIDE OF
          FUSELAGE-                         WATER LINE (Z) INCHES.
*1012     HORIZONTAL TAIL INDICATOR.
           ZERO (0.0) OR BLANK ( )=  SHEAR TIE.
           ONE (1.0)              =  SHEAR AND MOMENT TIE.
           TWO (2.0)              =  SPINDLE.

 1013     INTERSECTION OF VERTICAL TAIL FRONT SPAR AND FUSELAGE MOLD
          LINE-                             STATION (X) INCHES.
```

TABLE 13 FUSELAGE DATA LIST (CONT)

1014	INTERSECTION OF VERTICAL TAIL REAR SPAR AND FUSELAGE MOLD LINE- STATION (X) INCHES.
*1015	INTERSECTION OF VERTICAL TAIL REFERENCE PLANE AND FUSELAGE MOLD LINE- BUTT LINE (Y) INCHES.
*1016	INTERSECTION OF VERTICAL TAIL AND FUSELAGE MOLD LINE- WATER LINE (Z) INCHES.
*1017	VERTICAL TAIL INDICATOR. ZERO (0.0) OR BLANK ( )= SHEAR TIE. ONE (1.0) = SHEAR AND MOMENT TIE. TWO (2.0) = SPINDLE.
1018	INTERSECTION OF ENGINE NACELLE PYLON FRONT SPAR WITH SIDE OF FUSELAGE- STATION (X) INCHES.
1019	INTERSECTION OF ENGINE NACELLE PYLON REAR SPAR WITH SIDE OF FUSELAGE- STATION (X) INCHES.
1020	INTERSECTION OF PYLON REFERENCE PLANE WITH SIDE OF FUSELAGE- BUTT LINE (Y) INCHES.
1021	INTERSECTION OF PYLON REFERENCE PLANE WITH SIDE OF FUSELAGE- WATER LINE (Z) INCHES.
1022	INTERSECTION OF MISCELLANEOUS PYLON OR STRUT FRONT SPAR WITH FUSELAGE MOLD LINE- STATION (X) INCHES.
1023	INTERSECTION OF MISCELLANEOUS PYLON OR STRUT REAR SPAR WITH FUSELAGE MOLD LINE- STATION (X) INCHES.
1024	INTERSECTION OF MISCELLANEOUS PYLON OR STRUT REFERENCE PLANE WITH FUSELAGE MOLD LINE- BUTT LINE (Y) INCHES.
1025	INTERSECTION OF MISCELLANEOUS PYLON OR STRUT REFERENCE PLANE WITH FUSELAGE MOLD LINE- WATER LINE (Z) INCHES.
*1026	INTERSECTION OF VERTICAL PLANE THRU AXLE OF NOSE LANDING GEAR AND GROUND PLANE- STATION (X) INCHES.
1027	INTERSECTION OF TRUNNION CENTER LINE AND FUSELAGE STATION- NOSE GEAR- STATION (X) INCHES.
1028	INTERSECTION OF DRAG STRUT FUSELAGE TRUNNION AND FUSELAGE STATION-NOSE GEAR- STATION (X) INCHES.
1029	NOT USED.
1030	INTERSECTION OF NOSE GEAR TRUNNION CENTER LINE AND TRUNNION

TABLE 13 FUSELAGE DATA LIST (CONT)

	SPINDLE CENTER LINE-	BUTT LINE (Y) INCHES.
1031	INTERSECTION OF NOSE GEAR TRUNNION SPINDLE CENTER LINE AND FUSELAGE STATION-	WATER LINE (Z) INCHES.
*1032	INTERSECTION OF VERTICAL PLANE THRU AXLE OF MAIN LANDING GEAR AND GROUND PLANE-	STATION (X) INCHES.
1033	INTERSECTION OF TRUNNION CENTER LINE AND FUSELAGE STATION-MAIN LANDING GEAR-	STATION (X) INCHES.
	FOR WING MOUNTED MAIN GEAR ENTER ZERO (0.0)	
1034	INTERSECTION OF DRAG STRUT FUSELAGE TRUNNION AND FUSELAGE STATION-MAIN LANDING GEAR-	STATION (X) INCHES.
*1035	INTERSECTION OF CENTER LINE OF MAIN LANDING GEAR AND GROUND PLANE-	BUTT LINE (Y) INCHES.
1036	INTERSECTION OF MAIN LANDING GEAR TRUNNION SPINDLE CENTER LINE AND FUSELAGE STATION-	BUTT LINE (Y) INCHES.
1037	INTERSECTION OF MAIN LANDING GEAR TRUNNION SPINDLE CENTER LINE AND FUSELAGE BUTT PLANE-	WATER LINE (Z) INCHES.
*1038	GROUND LINE AT MAIN GEAR-	WATER LINE (Z) INCHES.
1039	NOT USED	
1040	NOT USED	
*1041	CREW MEMBERS-NUMBER.	
*1042	-C.G. STATION (X).	INCHES
*1043	ENGINES-NUMBER.	
*1044	-DIAMETER.	INCHES
*1045	-FRONT FACE STATION (X).	INCHES
*1046	-LENGTH.	INCHES
*1047	WING CHORD AT SIDE OF FUSELAGE-INCHES.	
*1048	HORIZONTAL TAIL CHORD AT SIDE OF FUSELAGE-INCHES.	
*1049	VERTICAL TAIL CHORD AT INTERSECTION OF FUSELAGE-INCHES.	
*1050	THICKNESS/CHORD (T/C)-WING AT SIDE OF FUSELAGE.	DECIMAL
*1051	THRUST/ENGINE-POUNDS.	
1052-1070	NOT USED.	
1071-1100	NOT AVAILABLE - USED INTERNALLY FOR SPEED ALTITUDE PROFILE DATA.	

TABLE 13 FUSELAGE DATA LIST (CONCL)

```
1101-1300   NOT AVAILABLE - USED FOR FUSELAGE LOADS DATA BLOCK.
1301-1590   NOT USED.
1591-2000   NOT AVAILABLE - USED FOR PROGRAM COMPUTATIONS.
-------------------------------- END --------------------------------
```

Section VIII

WHV LOADS DATA

GENERAL DESCRIPTION

The WHV LOADS data block is a special variable data block used to input wing and empennage limit design airloads to be used during airloads module execution. Data in this block will be used in lieu of calculated surface shears and moments only if the airloads module is instructed not to compute wing and/or empennage loads. This allows the user to input discrete sets of airload data for any or all surfaces and, during airloads module execution, evaluate all required design conditions for output of fuselage design loads.

This data block consists of component limit airload shear and bending moment along the elastic axis (swept loads). The loads data must be compatible with the structural synthesis cuts, and are ordered from the tip cut to the root.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 14. All of the variables are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card, "WHV LOADS." The last data card must have a minus sign in column 1. The WHV LOADS deck setup is as follows:

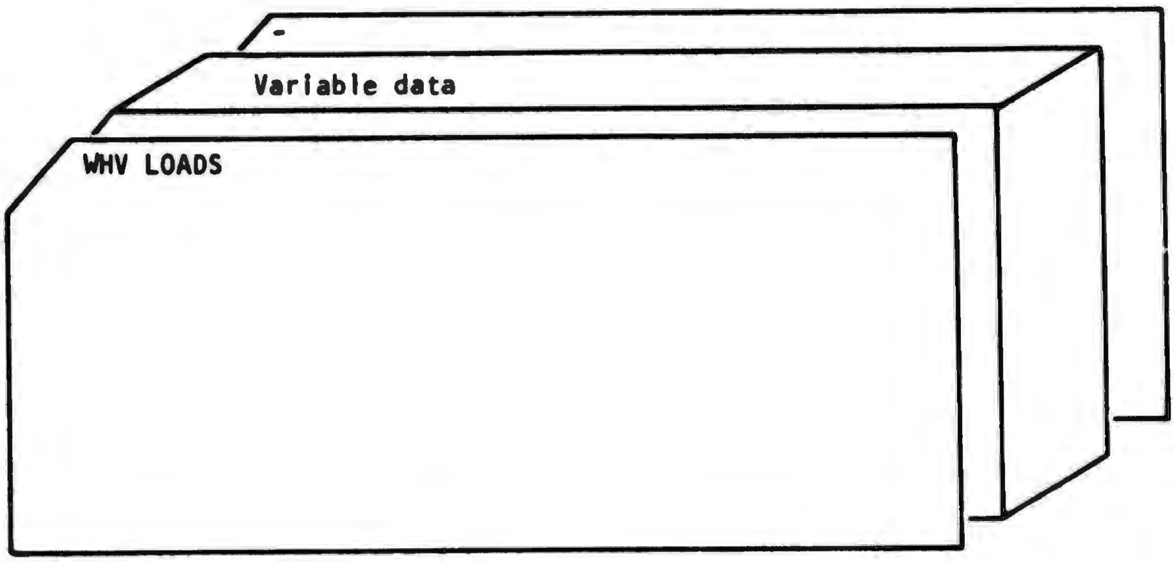


TABLE 14. WHV LOADS INPUT LIST

WING, HORIZONTAL, VERTICAL INPUT LOADS
LOADS ARE INPUT FROM TIP TO ROOT AT SYNTHESIS CUTS.

LOCATIONS	DESCRIPTIONS
1-11	POSITIVE WING AIRLOAD SHEAR (+V) AT SYNTHESIS CUTS.
12-22	NEGATIVE WING AIRLOAD SHEAR (-V) AT SYNTHESIS CUTS.
23-33	POSITIVE WING AIRLOAD BENDING MOMENT (+BM) NORMAL TO THE ELASTIC AXIS AT SYNTHESIS CUTS.
34-44	NEGATIVE WING AIRLOAD BENDING MOMENT (-BM) NORMAL TO THE ELASTIC AXIS AT SYNTHESIS CUTS.
45-55	POSITIVE HORIZONTAL TAIL AIRLOAD SHEAR (+V) AT SYNTHESIS CUTS.
56-66	NEGATIVE HORIZONTAL TAIL AIRLOAD SHEAR (-V) AT SYNTHESIS CUTS.
67-77	POSITIVE HORIZONTAL TAIL AIRLOAD BENDING MOMENT (+BM) NORMAL TO THE ELASTIC AXIS AT SYNTHESIS CUTS
78-88	NEGATIVE HORIZONTAL TAIL AIRLOAD BENDING MOMENT (-BM) NORMAL TO THE ELASTIC AXIS AT SYNTHESIS CUTS
89-99	POSITIVE VERTICAL TAIL AIRLOAD SHEAR (+V) AT SYNTHESIS CUTS.
100-110	NEGATIVE VERTICAL TAIL AIRLOAD SHEAR (-V) AT SYNTHESIS CUTS.
111-121	POSITIVE VERTICAL TAIL AIRLOAD BENDING MOMENT (+BM) NORMAL TO THE ELASTIC AXIS AT SYNTHESIS CUTS
122-132	NEGATIVE VERTICAL TAIL AIRLOAD BENDING MOMENT (-BM) NORMAL TO THE ELASTIC AXIS AT SYNTHESIS CUTS
133-143	WING AIRLOAD TORQUE AT POSITIVE BENDING MOMENT CONDITION, AT SYNTHESIS CUTS.
144-154	WING AIRLOAD TORQUE AT NEGATIVE BENDING MOMENT CONDITION, AT SYNTHESIS CUTS.
155-165	HORIZONTAL TAIL AIRLOAD TORQUE AT POSITIVE BENDING MOMENT CONDITION, AT SYNTHESIS CUTS.
166-176	HORIZONTAL TAIL AIRLOAD TORQUE AT NEGATIVE BENDING MOMENT CONDITION, AT SYNTHESIS CUTS.

TABLE 14. WHV LOADS INPUT LIST (CONCL)

```
177-187 VERTICAL TAIL AIRLOAD TORQUE AT POSITIVE BENDING MOMENT
         CONDITION, AT SYNTHESIS CUTS.
188-198 VERTICAL TAIL AIRLOAD TORQUE AT NEGATIVE BENDING MOMENT
         CONDITION, AT SYNTHESIS CUTS.

        *****  END  *****
```

Section IX

FUSELAGE LOADS DATA

GENERAL DESCRIPTION

During execution of the fuselage module, structural design loads are computed from inertia and airloads data stored in separate data blocks. These blocks are set up during execution of the data processing and design data evaluation modules of SWEEP. A data processing feature of SWEEP provides the user with two options for transmitting airloads data to the fuselage module:

1. Execute airloads module with instruction to create the airloads data block (control card 2, columns 9 through 12)

2. Input "FUS LOADS" data block as part of the case data deck

Should both options be exercised in a given case run, data created by the airloads module overrides the input "FUS LOADS" data block. However, airloads data created by the airloads module may be partially or completely revised by input of "FUS LOADS" in a subsequent case run. Control card 2 for the subsequent case must contain (0) punch in column 80 to indicate that mass storage file status resulting from the previous case is to be updated only with input data.

This data block consists of component airloads and centers of pressure, and vehicle load factor and pitch acceleration. Loads data sets are provided for different flight and ground design conditions. A description of each of the load conditions is shown in Table 15. Although the load condition number has a specific significance during the operation of the airloads module, the only user concern is the compatibility among the input load set, design weight, and wing sweep position.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 16. All of the variables are in the form to be read by subrouting DECRD. This data block must be preceded by a deck identification card "FUS LOADS." The last data card must have a minus sign in column 1. THE FUS LOADS deck setup is as follows:

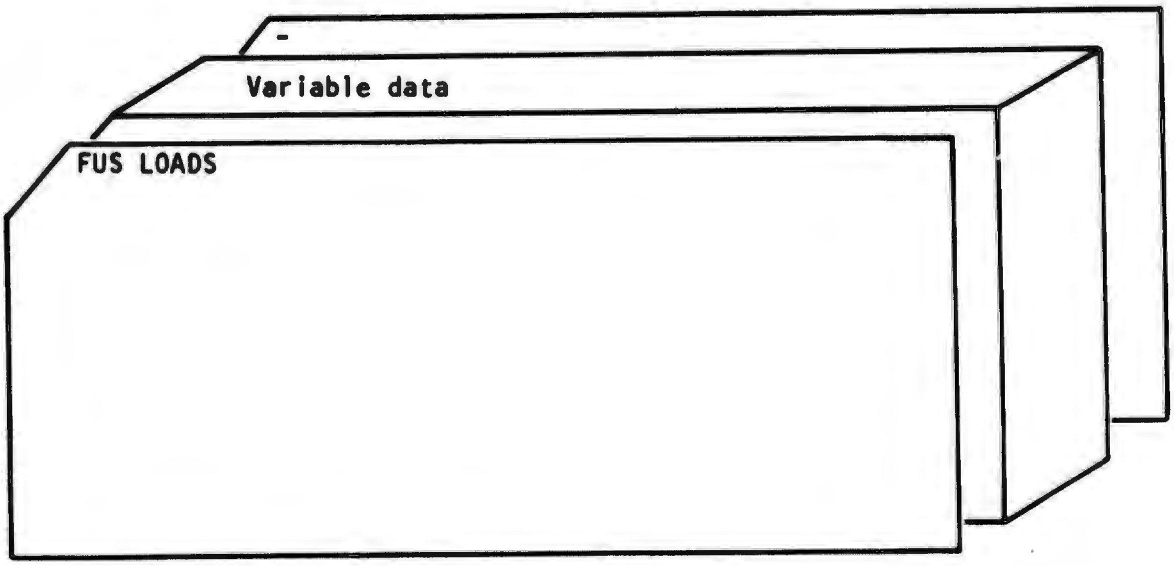


TABLE 15. DESIGN LOAD CONDITIONS AND CONSTRAINTS

Load Cond No.	Type of Load Cond	A/V Type	Vehicle Weight	Wing Sweep AW	Speed-Altitude Profile (Fig. 17) Point[a]	Mach No.	Alt	Additional Design Constraints
1	$+N_Z$	F, A, B, C	BFDW	Fix - aft	1	M_L	SL	
2	$+N_Z$	F, A, B, C	BFDW	Fix - aft	2	M_L	Int	Only if M_L at 2 ≥ M_L at 3
3	$+N_Z$	F, A, B, C	BFDW	Fix - aft	3	M_L	Min at max M_H	Only if M_L at 3 ≥ M_L at 2
4	$+N_Z$	F, A	BFDW	Fix - aft	7	0.9	SL	Only if M_L at 1 ≥ 1.0
5	$+N_Z$	F, A, B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
6	$-N_Z$	F, A, B, C	BFDW	Fix - aft	4	M_H	SL	
7	$-N_Z$	F, A, B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
8	Man flap	F, A, B, C	MDW	Fix - fwd	8	1.5 V_{SO}	SL	
9	1 g trim	F, A, B, C	LDW	Fix - fwd	9	1.2 V_{SL}	SL	
10	+ Vert gust	B, C	BFDW	Fix - aft	4	M_H	SL	
11	+ Vert gust	B, C	BFDW	Fix - aft	5	M_H	Int	
12	+ Vert gust	B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
13	+ Vert gust	B, C	BFDW	Fwd	11	M_H	Int	Variable sweep wing only
14	- Vert gust	F, A, B, C	BFDW	Fix - aft	4	M_H	SL	
15	- Vert gust	F, A, B, C	BFDW	Fix - aft	5	M_H	Int	
16	- Vert gust	B, C	BFDW	Fwd	10	M_H	SL	Variable sweep wing only
17	- Vert gust	B, C	BFDW	Fwd	11	M_H	SL	Variable sweep wing only
18	Lat gust	F, A, B, C	BFDW	Fix - aft	4	M_H	SL	
19	Lat gust	F, A, B, C	BFDW	Fix - aft	5	M_H	Int	

[a]Identified by hexagonal points in Figure 17.

TABLE 15. DESIGN LOAD CONDITIONS AND CONSTRAINTS (CONCL)

Load Cond No.	Type of Load Cond	A/V Type	Vehicle Weight	Wing Sweep ΛW	Speed-Altitude Profile (Fig. 17)			Additional Design Constraints
					Point[a]	Mach No.	Alt	
20	Pitch acc	F, A, B, C	BFDW	Fix - aft	1	M_L	SL	
21	Pitch acc	F, A, B, C	BFDW	Fix - aft	3	M_L	Min at max M_H	
22	Yaw acc	F, A, B, C	BFDW	Fix - aft	1	M_L	SL	
23	Yaw acc	F, A, B, C	BFDW	Fix - aft	3	M_L	Min at max M_H	
24	2g taxi	F, A, B, C	MDW	Fix - fwd	-	-	-	

[a]Identified by hexagonal points in Figure 17.

TABLE 16. FUSELAGE LOADS DATA LIST

****

THE FUSELAGE LOADS DATA IS TO BE COMPATIBLE WITH THE INERTIA DATA. THE TABLE BELOW SHOWS THE INERTIA DATA USED WITH EACH OF THE FUSELAGE LOADS BLOCKS. FOR FIXED WING AIRCRAFT, THE WING POSITION IS NOT PERTINENT, AND THE INERTIA DATA IN LOCATIONS 1-90 WOULD BE IDENTICAL TO THE DATA IN LOCATIONS 91-180.

CONDITION NUMBER	FUS LOADS LOCATIONS	VEHICLE WEIGHT	WING POSITION VARIABLE SWEEP	INERTIA DATA LOCATIONS
1	1- 28	BFDW	AFT	1- 90
2	29- 56	BFDW	AFT	1- 90
3	57- 84	BFDW	AFT	1- 90
4	85-112	BFDW	AFT	1- 90
5	113-140	BFDW	FWD	91-180
6	141-168	BFDW	AFT	1- 90
7	169-196	BFDW	FWD	91-180
8	197-224	MDW	FWD	181-270
9	225-252	LDW	FWD	271-360
10	253-280	BFDW	AFT	1- 90
11	281-308	BFDW	AFT	1- 90
12	309-336	BFDW	FWD	91-180
13	337-364	BFDW	FWD	91-180
14	365-392	BFDW	AFT	1- 90
15	393-420	BFDW	AFT	1- 90
16	421-448	BFDW	FWD	91-180
17	449-476	BFDW	FWD	91-180
18	477-504	BFDW	AFT	1- 90
19	505-532	BFDW	AFT	1- 90
20	533-560	BFDW	AFT	1- 90
21	561-588	BFDW	AFT	1- 90
22	589-616	BFDW	AFT	1- 90
23	617-644	BFDW	AFT	1- 90
24	645-672	MDW	FWD	361-450

****

TABLE 16. FUSELAGE LOADS DATA LIST (CONT)

```
LOCATIONS                         DESCRIPTIONS
---------                         ------------

      LOCATIONS 1-28 ARE FOR LOAD CONDITION NUMBER 1.
  1       LOAD CONDITION INPUT DATA INDICATOR.  ENTER 2.0 IF
           THIS CONDITION IS TO BE INVESTIGATED.

  2       LOAD CONDITION TYPE INDICATOR.
           ONE    (1.0)=BALANCED FLIGHT-FLAPS UP.
           TWO    (2.0)                 -FLAPS DOWN.
           THREE  (3.0)=TWO WHEEL LANDING.
           FOUR   (4.0)=VERTICAL GUST.
           FIVE   (5.0)=LATERAL  GUST.
           SIX    (6.0)=PITCHING ACCELERATION.
           SEVEN  (7.0)=YAWING   ACCELERATION.
           EIGHT  (8.0)=TWO G TAXI.

  3       LOAD CONDITION COUNTER              ** DO NOT LOAD **
  4       NUMBER OF CONDITIONS.               ** DO NOT LOAD **
  5       TEMPERATURE-                        DEGREES FAHRENHEIT.
  6       FACTOR TO CONVERT LIMIT LOAD TO ULTIMATE LOAD.
  7       VERTICAL LOAD FACTOR - NZ
  8       NOT AVAILABLE - USED FOR LATERAL LOAD FACTOR - NY.
  9       WING APEX AT CENTERLINE OF FUSELAGE - STATION (X)      INCHES
 10       PITCHING ACCELERATION                         RADIANS/SECOND SQ.
 11       NOT AVAILABLE - USED FOR PITCHING VELOCITY.
 12       SINKING SPEED, REQUIRED WHEN LOC. 2 = 3.0         FEET/SECOND
 13       LANDING GEAR STROKE, REQUIRED WHEN LOC. 2 = 3.0        INCHES
 14       VELOCITY                           -MACH NUMBER.
 15       ALTITUDE OF MACH NUMBER            -FEET.
 16       FOREBODY LIMIT LIFT                -POUNDS.
 17       CENTER OF PRESSURE OF FOREBODY LIFT-STATION (X) INCHES.
 18       WING CARRY OVER LIMIT LIFT         -POUNDS.
 19       CENTER OF PRESSURE OF BODY LIFT-    STATION (X) INCHES.
 20       WING OUTER PANEL LIMIT LIFT        -POUNDS.
 21       CENTER OF PRESSURE OF WING LIFT-    STATION (X) INCHES.
 22       CENTER OF PRESSURE OF WING LIFT-  BUTT LINE (Y) INCHES.
```

TABLE 16. FUSELAGE LOADS DATA LIST (CONT)

```
23     HORIZONTAL TAIL LIMIT LIFT               -POUNDS.
24     CENTER OF PRESSURE OF HORIZONTAL TAIL LIFT-
                                          STATION (X) INCHES.
25                                       BUTT LINE (Y) INCHES.
26     VERTICAL TAIL LIMIT LOAD                 -POUNDS.
27     CENTER OF PRESSURE VERTICAL TAIL-STATION     (X) INCHES.
28                                          -WATER LINE (Z) INCHES.

   LOCATIONS 29-56 ARE FOR LOAD CONDITION NUMBER 2.
29     LOAD CONDITION INPUT DATA INDICATOR.  ENTER 2.0 IF
        THIS CONDITION IS TO BE INVESTIGATED.
30     LOAD CONDITION TYPE INDICATOR.
        ONE    (1.0)=BALANCED FLIGHT-FLAPS UP.
        TWO    (2.0)                -FLAPS DOWN.
        THREE  (3.0)=TWO WHEEL LANDING.
        FOUR   (4.0)=VERTICAL GUST.
        FIVE   (5.0)=LATERAL  GUST.
        SIX    (6.0)=PITCHING ACCELERATION.
        SEVEN  (7.0)=YAWING   ACCELERATION.
        EIGHT  (8.0)=TWO G TAXI.
31     LOAD CONDITION COUNTER                  ** DO NOT LOAD **
32     NUMBER OF CONDITIONS.                   ** DO NOT LOAD **
33     TEMPERATURE-                            DEGREES FAHRENHEIT.
34     FACTOR TO CONVERT LIMIT LOAD TO ULTIMATE LOAD.
35     VERTICAL LOAD FACTOR - NZ
36     NOT AVAILABLE - USED FOR LATERAL LOAD FACTOR - NY.
37     WING APEX AT CENTERLINE OF FUSELAGE - STATION (X)      INCHES
38     PITCHING ACCELERATION                      RADIANS/SECOND SQ.
39     NOT AVAILABLE - USED FOR PITCHING VELOCITY.
40     SINKING SPEED, REQUIRED WHEN LOC. 30 = 3.0      FEET/SECOND
41     LANDING GEAR STROKE, REQUIRED WHEN LOC. 30 = 3.0      INCHES
42     VELOCITY                                 -MACH NUMBER.
43     ALTITUDE OF MACH NUMBER                  -FEET.
44     FOREBODY LIMIT LIFT                      -POUNDS.
45     CENTER OF PRESSURE OF FOREBODY LIFT-STATION (X) INCHES.
46     WING CARRY OVER LIMIT LIFT               -POUNDS.
47     CENTER OF PRESSURE OF BODY LIFT-     STATION (X) INCHES.
```

TABLE 16. FUSELAGE LOADS DATA LIST (CONT)

48	WING OUTER PANEL LIMIT LIFT	-POUNDS.
49	CENTER OF PRESSURE OF WING LIFT-	STATION (X) INCHES.
50	CENTER OF PRESSURE OF WING LIFT-	BUTT LINE (Y) INCHES.
51	HORIZONTAL TAIL LIMIT LIFT	-POUNDS.
52	CENTER OF PRESSURE OF HORIZONTAL TAIL LIFT-	STATION (X) INCHES.
53		BUTT LINE (Y) INCHES.
54	VERTICAL TAIL LIMIT LOAD	-POUNDS.
55	CENTER OF PRESSURE VERTICAL TAIL-STATION	(X) INCHES.
56		-WATER LINE (Z) INCHES.
57-84	LOADS DATA FOR CONDITION NUMBER 3. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
85-112	LOADS DATA FOR CONDITION NUMBER 4. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
113-140	LOADS DATA FOR CONDITION NUMBER 5. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
141-168	LOADS DATA FOR CONDITION NUMBER 6. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
169-196	LOADS DATA FOR CONDITION NUMBER 7. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
197-224	LOADS DATA FOR CONDITION NUMBER 8. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
225-252	LOADS DATA FOR CONDITION NUMBER 9. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
253-280	LOADS DATA FOR CONDITION NUMBER 10. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	
281-308	LOADS DATA FOR CONDITION NUMBER 11. FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.	

TABLE 16. FUSELAGE LOADS DATA LIST (CONT)

```
309-336 LOADS DATA FOR CONDITION NUMBER 12.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

337-364 LOADS DATA FOR CONDITION NUMBER 13.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

365-392 LOADS DATA FOR CONDITION NUMBER 14.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

393-420 LOADS DATA FOR CONDITION NUMBER 15.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

421-448 LOADS DATA FOR CONDITION NUMBER 16.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

449-476 LOADS DATA FOR CONDITION NUMBER 17.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

477-504 LOADS DATA FOR CONDITION NUMBER 18.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

505-532 LOADS DATA FOR CONDITION NUMBER 19.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

533-560 LOADS DATA FOR CONDITION NUMBER 20.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

561-588 LOADS DATA FOR CONDITION NUMBER 21.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

589-616 LOADS DATA FOR CONDITION NUMBER 22.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

617-644 LOADS DATA FOR CONDITION NUMBER 23.
          FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.
```

TABLE 16. FUSELAGE LOADS DATA LIST (CONCL)

```
645-672 LOADS DATA FOR CONDITION NUMBER 24.
        FOR DESCRIPTION OF DATA SEE LOCATIONS 1-28.

        ***      END      ***
```

Section X

INERTIA DATA

INTRODUCTION

During execution of the fuselage module, structural design loads are computed from inertia and airloads data stored in separate data blocks. These blocks are set up during execution of the data processing and design data evaluation modules of SWEEP. A data processing feature of SWEEP provides the user with two options for transmitting inertia data to the fuselage module:

1. Input "INERTIA" data block as part of the case data deck.

2. Input "GENERAL" data block as part of the case data deck.

The "INERTIA" data block is stored in the mass storage file by the data processing module for use by the fuselage module.

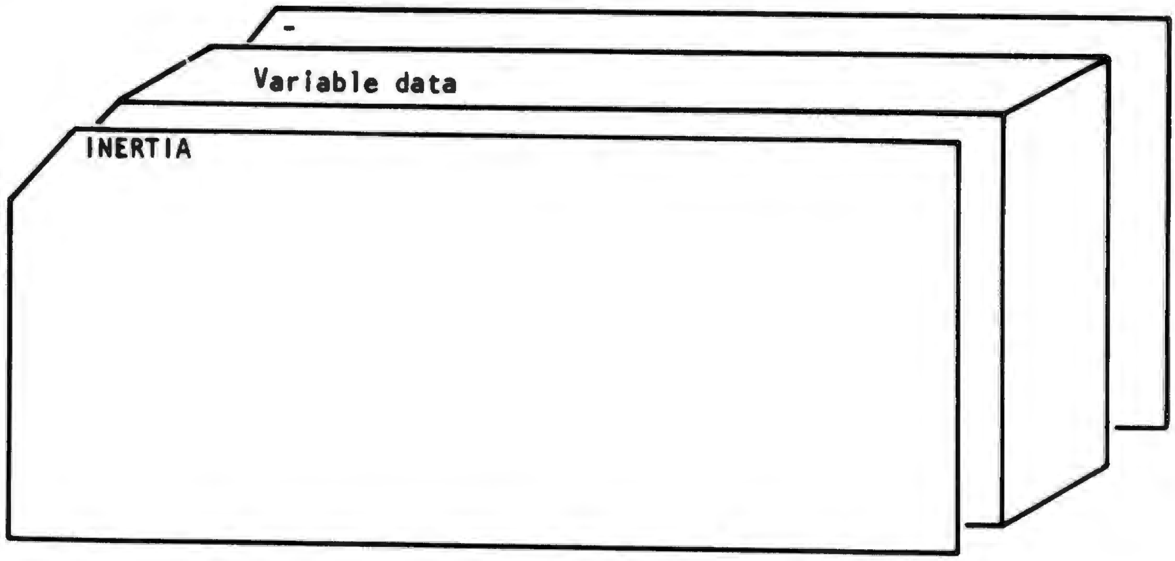
GENERAL DESCRIPTION

This data block consists of deadweight distributions of the fuselage and contents, and the weight, balance, and inertia of external components. Weight data sets are provided for the different flight and ground design conditions. External surface load reactions are calculated by combining the inertia and load factor data with the appropriate airloads. Integration of these external reactions and the fuselage weight distributions determine the net longitudinal shear and bending moment diagrams. Speed profile data for local panel flutter design is also part of this input set.

SWEEP executes the data management module in each case when the "GENERAL" data block is included in the case variable data set. Part of the operation in the data management module consists of calculation and organization of the required inertia data. If the "INERTIA" and "GENERAL" data blocks are both included for any case, data computed by the data management module override the input "INERTIA" data. For fuselage analysis problems where predetermined inertia data are to be used, the "GENERAL" data block must not be used and the input data blocks for analysis of any other components must be adjusted to account for required data generally inputted with the "GENERAL" data block. An alternate method which can be used would be to execute the problem with two cases. In the first case, the setup should include the necessary "GENERAL" data block and control instructions to execute all modules except the structural weight analysis modules. The second case setup then should include only the "INERTIA" data block plus control instructions to execute the required structural weight analysis modules. With this tandem case setup, the required design data will be computed and stored in the mass storage file during execution of the first case. These data will then be available during execution of the structural weight analysis modules in the second case. Control card 2 for the second case must contain a zero (0) punch in column 80 to indicate that mass storage file status resulting from the previous case is to be updated only with input data.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 17. All of the variables are in the form to be read by subroutine DECRD. This data block must be preceded by a deck identification card "INERTIA." The last data card must have a minus sign in column 1. The INERTIA deck setup is as follows:



It is mandatory that the weight and inertia data are in agreement with the fuselage loads data. Table 16 presents the relationship between the loads and weight arrays. Expanded explanations for those variables which may be subject to misinterpretation are:

- Locations 1 through 6 define the vehicle weight balance and inertia characteristics. The data are not required since the data in locations 8 through 90 sufficiently define the vehicle.

- Locations 451 through 480 specify the limit vehicle speed-altitude profile. These data are not required for subsonic vehicles or if the fuselage loads data include the critical local panel flutter speed-altitude point.

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA

LOCATIONS	DESCRIPTIONS		
	LOCATIONS 1 THRU 50 ARE FOR BASIC FLIGHT DESIGN WEIGHT FOR WINGS AFT CP FOR FIXED WINGS.		
01	VEHICLE WEIGHT		POUNDS
02	VEHICLE CENTER OF GRAVITY-	STATION (X)	INCHES.
03		BUTT LINE (Y)	INCHES.
04		WATER LINE (Z)	INCHES.
05	NOT USED		
06	VEHICLE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
07	NOT USED		
08	WEIGHT OF WING PLUS CONTENTS		POUNDS
09	WING CENTER OF GRAVITY	STATION (X)	INCHES.
10		BUTT LINE (Y)	INCHES.
11		WATER LINE (Z)	INCHES.
12	NOT USED		
13	WING INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
14	NOT USED		
15	WEIGHT OF HORIZONTAL TAIL PLUS CONTENTS		POUNDS
16	HORIZONTAL TAIL CENTER OF GRAVITY-STATION	(X)	INCHES.
17		-BUTT LINE (Y)	INCHES.
18		-WATER LINE (Z)	INCHES.
19	NOT USED		
20	HORIZONTAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
21	NOT USED		
22	WEIGHT OF VERTICAL TAIL PLUS CONTENTS		
23	VERTICAL TAIL CENTER OF GRAVITY	STATION (X)	INCHES.
24		BUTT LINE (Y)	INCHES.
25		WATER LINE (Z)	INCHES.
26	NOT USED		
27	VERTICAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
28	NOT USED		

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

```
 29      WEIGHT OF NACELLE PLUS CONTENTS                                 POUNDS
 30      NACELLE CENTER OF GRAVITY-          STATION    (X) INCHES.
 31                                          BUTT LINE  (Y) INCHES.
 32                                          WATER LINE (Z) INCHES.
 33      NOT USED
 34      NACELLE INERTIA-PITCH (IYY)                    POUND-INCHES SQUARED
 35      NOT USED

 36      WEIGHT OF STORE PLUS CONTENTS                                   POUNDS
 37      STORE CENTER OF GRAVITY-            STATION    (X) INCHES.
 38                                          BUTT LINE  (Y) INCHES.
 39                                          WATER LINE (Z) INCHES.
 40      NOT USED
 41      STORE INERTIA-PITCH (IYY)                      POUND-INCHES SQUARED
 42      NOT USED

 43- 50 NOT USED

NOTE-----FUSELAGE SECTIONS ARE FORWARD OF THE CORRESPONDING SYNTHESIS
           CUTS EXCEPT THE LAST SECTION, WHICH IS AFT OF THE LAST
           CUT.  (FOR 19 CUTS THERE ARE 20 SECTIONS)
           FUSELAGE SYNTHESIS CUTS ARE FUSELAGE DATA LOC. 361-379

 51- 70 WEIGHT OF FUSELAGE CONTENTS FOR EACH SECTION.                    POUNDS
 71- 90 WEIGHT OF FUSELAGE FOR EACH SECTION.                             POUNDS

        ..............................................................
        . LOCATIONS 91 THRU 180 ARE FOR BASIC FLIGHT DESIGN WEIGHT    .
        .                      FOR WINGS FORWARD.                     .
        ..............................................................
 91      VEHICLE WEIGHT                                                 POUNDS
092      VEHICLE CENTER OF GRAVITY-          STATION    (X) INCHES.
093                                          BUTT LINE  (Y) INCHES.
094                                          WATER LINE (Z) INCHES.
095      NOT USED
096      VEHICLE INERTIA-PITCH (IYY)                    POUND-INCHES SQUARED
```

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

097	NOT USED		
098	WEIGHT OF WING PLUS CONTENTS		POUNDS
099	WING CENTER OF GRAVITY	STATION (X)	INCHES.
100		BUTT LINE (Y)	INCHES.
101		WATER LINE (Z)	INCHES.
102	NOT USED		
103	WING INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
104	NOT USED		
105	WEIGHT OF HORIZONTAL TAIL PLUS CONTENTS		POUNDS
106	HORIZONTAL TAIL CENTER OF GRAVITY-STATION	(X)	INCHES.
107		-BUTT LINE (Y)	INCHES.
108		-WATER LINE (Z)	INCHES.
109	NOT USED		
110	HORIZONTAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
111	NOT USED		
112	WEIGHT OF VERTICAL TAIL PLUS CONTENTS		
113	VERTICAL TAIL CENTER OF GRAVITY	STATION (X)	INCHES.
114		BUTT LINE (Y)	INCHES.
115		WATER LINE (Z)	INCHES.
116	NOT USED		
117	VERTICAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
118	NOT USED		
119	WEIGHT OF NACELLE PLUS CONTENTS		POUNDS
120	NACELLE CENTER OF GRAVITY-	STATION (X)	INCHES.
121		BUTT LINE (Y)	INCHES.
122		WATER LINE (Z)	INCHES.
123	NOT USED		
124	NACELLE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
125	NOT USED		
126	WEIGHT OF STORE PLUS CONTENTS		POUNDS
127	STORE CENTER OF GRAVITY-	STATION (X)	INCHES.
128		BUTT LINE (Y)	INCHES.

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

129		WATER LINE (Z)	INCHES.
130	NOT USED		
131	STORE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
132	NOT USED		
133-140	NOT USED		

NOTE-----FUSELAGE SECTIONS ARE FORWARD OF THE CORRESPONDING SYNTHESIS CUTS EXCEPT THE LAST SECTION, WHICH IS AFT OF THE LAST CUT. (FOR 19 CUTS THERE ARE 20 SECTIONS)
FUSELAGE SYNTHESIS CUTS ARE FUSELAGE DATA LOC. 361-379

141-160	WEIGHT OF FUSELAGE CONTENTS FOR EACH SECTION.		POUNDS
161-180	WEIGHT OF FUSELAGE FOR EACH SECTION.		POUNDS

LOCATIONS 181 THRU 270 ARE FOR MAXIMUM DESIGN WEIGHT FOR WINGS FORWARD.

181	VEHICLE WEIGHT		POUNDS
182	VEHICLE CENTER OF GRAVITY-	STATION (X)	INCHES.
183		BUTT LINE (Y)	INCHES.
184		WATER LINE (Z)	INCHES.
185	NOT USED		
186	VEHICLE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
187	NOT USED		
188	WEIGHT OF WING PLUS CONTENTS		POUNDS
189	WING CENTER OF GRAVITY	STATION (X)	INCHES.
190		BUTT LINE (Y)	INCHES.
191		WATER LINE (Z)	INCHES.
192	NOT USED		
193	WING INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
194	NOT USED		
195	WEIGHT OF HORIZONTAL TAIL PLUS CONTENTS		POUNDS
196	HORIZONTAL TAIL CENTER OF GRAVITY-STATION	(X)	INCHES.

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

197		-BUTT LINE (Y)	INCHES.
198		-WATER LINE (Z)	INCHES.
199	NOT USED		
200	HORIZONTAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
201	NOT USED		
202	WEIGHT OF VERTICAL TAIL PLUS CONTENTS		
203	VERTICAL TAIL CENTER OF GRAVITY	STATION (X)	INCHES.
204		BUTT LINE (Y)	INCHES.
205		WATER LINE (Z)	INCHES.
206	NOT USED		
207	VERTICAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
208	NOT USED		
209	WEIGHT OF NACELLE PLUS CONTENTS		POUNDS
210	NACELLE CENTER OF GRAVITY-	STATION (X)	INCHES.
211		BUTT LINE (Y)	INCHES.
212		WATER LINE (Z)	INCHES.
213	NOT USED		
214	NACELLE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
215	NOT USED		
216	WEIGHT OF STORE PLUS CONTENTS		POUNDS
217	STORE CENTER OF GRAVITY-	STATION (X)	INCHES.
218		BUTT LINE (Y)	INCHES.
219		WATER LINE (Z)	INCHES.
220	NOT USED		
221	STORE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
222	NOT USED		
223-230	NOT USED		

NOTE-----FUSELAGE SECTIONS ARE FORWARD OF THE CORRESPONDING SYNTHESIS CUTS EXCEPT THE LAST SECTION, WHICH IS AFT OF THE LAST CUT. (FOR 19 CUTS THERE ARE 20 SECTIONS)
FUSELAGE SYNTHESIS CUTS ARE FUSELAGE DATA LOC. 361-379

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

231-250	WEIGHT OF FUSELAGE CONTENTS FOR EACH SECTION.			POUNDS
251-270	WEIGHT OF FUSELAGE FOR EACH SECTION.			POUNDS

```
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
• LOCATIONS 271 THRU 360 ARE FOR LANDING DESIGN WEIGHT   •
•                  FOR WINGS FORWARD.                     •
•                                                          
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
```

271	VEHICLE WEIGHT			POUNDS
272	VEHICLE CENTER OF GRAVITY-	STATION	(X)	INCHES.
273		BUTT LINE	(Y)	INCHES.
274		WATER LINE	(Z)	INCHES.
275	NOT USED			
276	VEHICLE INERTIA-PITCH (IYY)			POUND-INCHES SQUARED
277	NOT USED			
278	WEIGHT OF WING PLUS CONTENTS			POUNDS
279	WING CENTER OF GRAVITY	STATION	(X)	INCHES.
280		BUTT LINE	(Y)	INCHES.
281		WATER LINE	(Z)	INCHES.
282	NOT USED			
283	WING INERTIA-PITCH (IYY)			POUND-INCHES SQUARED
284	NOT USED			
285	WEIGHT OF HORIZONTAL TAIL PLUS CONTENTS			POUNDS
286	HORIZONTAL TAIL CENTER OF GRAVITY-	STATION	(X)	INCHES.
287		-BUTT LINE	(Y)	INCHES.
288		-WATER LINE	(Z)	INCHES.
289	NOT USED			
290	HORIZONTAL TAIL INERTIA-PITCH (IYY)			POUND-INCHES SQUARED
291	NOT USED			
292	WEIGHT OF VERTICAL TAIL PLUS CONTENTS			
293	VERTICAL TAIL CENTER OF GRAVITY	STATION	(X)	INCHES.
294		BUTT LINE	(Y)	INCHES.
295		WATER LINE	(Z)	INCHES.
296	NOT USED			

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

```
297      VERTICAL TAIL INERTIA-PITCH (IYY)          POUND-INCHES SQUARED
298      NOT USED

299      WEIGHT OF NACELLE PLUS CONTENTS                          POUNDS
300      NACELLE CENTER OF GRAVITY-       STATION    (X) INCHES.
301                                       BUTT LINE  (Y) INCHES.
302                                       WATER LINE (Z) INCHES.
303      NOT USED
304      NACELLE INERTIA-PITCH (IYY)                POUND-INCHES SQUARED
305      NOT USED

306      WEIGHT OF STORE PLUS CONTENTS                            POUNDS
307      STORE CENTER OF GRAVITY-         STATION    (X) INCHES.
308                                       BUTT LINE  (Y) INCHES.
309                                       WATER LINE (Z) INCHES.
310      NOT USED
311      STORE INERTIA-PITCH (IYY)                  POUND-INCHES SQUARED
312      NOT USED

313-320 NOT USED

NOTE-----FUSELAGE SECTIONS ARE FORWARD OF THE CORRESPONDING SYNTHESIS
           CUTS EXCEPT THE LAST SECTION, WHICH IS AFT OF THE LAST
           CUT.  (FOR 19 CUTS THERE ARE 20 SECTIONS)
           FUSELAGE SYNTHESIS CUTS ARE FUSELAGE DATA LOC. 361-379

321-340 WEIGHT OF FUSELAGE CONTENTS FOR EACH SECTION.           POUNDS
341-360 WEIGHT OF FUSELAGE FOR EACH SECTION.                    POUNDS

        ..............................................................
        . LOCATIONS 361 THRU 450 ARE FOR MAXIMUM DESIGN WEIGHT       .
        .                       FOR WINGS FORWARD.                   .
        ..............................................................
361      VEHICLE WEIGHT                                          POUNDS
362      VEHICLE CENTER OF GRAVITY-       STATION    (X) INCHES.
363                                       BUTT LINE  (Y) INCHES.
364                                       WATER LINE (Z) INCHES.
```

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONT)

365	NOT USED		
366	VEHICLE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
367	NOT USED		
368	WEIGHT OF WING PLUS CONTENTS		POUNDS
369	WING CENTER OF GRAVITY	STATION (X) INCHES.	
370		BUTT LINE (Y) INCHES.	
371		WATER LINE (Z) INCHES.	
372	NOT USED		
373	WING INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
374	NOT USED		
375	WEIGHT OF HORIZONTAL TAIL PLUS CONTENTS		POUNDS
376	HORIZONTAL TAIL CENTER OF GRAVITY-STATION	(X) INCHES.	
377		-BUTT LINE (Y) INCHES.	
378		-WATER LINE (Z) INCHES.	
379	NOT USED		
380	HORIZONTAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
381	NOT USED		
382	WEIGHT OF VERTICAL TAIL PLUS CONTENTS		
383	VERTICAL TAIL CENTER OF GRAVITY	STATION (X) INCHES.	
384		BUTT LINE (Y) INCHES.	
385		WATER LINE (Z) INCHES.	
386	NOT USED		
387	VERTICAL TAIL INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
388	NOT USED		
389	WEIGHT OF NACELLE PLUS CONTENTS		POUNDS
390	NACELLE CENTER OF GRAVITY-	STATION (X) INCHES.	
391		BUTT LINE (Y) INCHES.	
392		WATER LINE (Z) INCHES.	
393	NOT USED		
394	NACELLE INERTIA-PITCH (IYY)		POUND-INCHES SQUARED
395	NOT USED		
396	WEIGHT OF STORE PLUS CONTENTS		POUNDS

TABLE 17. INERTIA AND WEIGHT DISTRIBUTION DATA (CONCL)

```
397      STORE CENTER OF GRAVITY-          STATION    (X) INCHES.
398                                        BUTT LINE  (Y) INCHES.
399                                        WATER LINE (Z) INCHES.
400      NOT USED
401      STORE INERTIA-PITCH (IYY)               POUND-INCHES SQUARED
402      NOT USED

403-410 NOT USED

NOTE-----FUSELAGE SECTIONS ARE FORWARD OF THE CORRESPONDING SYNTHESIS
            CUTS EXCEPT THE LAST SECTION, WHICH IS AFT OF THE LAST
            CUT.  (FOR 19 CUTS THERE ARE 20 SECTIONS)
            FUSELAGE SYNTHESIS CUTS ARE FUSELAGE DATA LOC. 361-379

411-430 WEIGHT OF FUSELAGE CONTENTS FOR EACH SECTION.           POUNDS
431-450 WEIGHT OF FUSELAGE FOR EACH SECTION.                    POUNDS

--------- LOCATIONS 451 THRU 480 MUST BE COMPATIBLE DATA SETS. ------
           THESE LOCATIONS DEFINE 9 POINTS ON THE SPEED ALTITUDE
           PROFILE.

451-460 ALTITUDES                                                 FEET
461-470 MACH NUMBERS
471-480 DYNAMIC PRESSURES                         POUNDS/SQUARE FOOT

-------------------------------END OF INERTIA DATA-------------------
```

Section XI

MATERIAL PROPERTY DATA

INTRODUCTION

The structural synthesis procedures of an analytical weight-estimating program is not only dependent upon the modeling of general structural geometries, design loads, and requirements, but also on the modeling of the physical and mechanical properties of the materials selected for the analysis. These material properties are permanent records in SWEEP which are used by the wing and empennage, fuselage, and air induction system modules. The fatigue, and flutter and temperature modules also require material property data. SWEEP is structured to maintain a library of 20 different materials. The materials and identification numbers of the current library are presented in Table 18. Although the library is part of the permanent data in SWEEP, the user, in the course of configuration selection, might find it inadequate. The following paragraphs present data descriptions required to update or add to this material library. Refer to Section I for procedures to revise the SWEEP permanent data bank. Suggested program deck setup is presented in Figure 16.

GENERAL DESCRIPTION

The data for each material are organized such that the mechanical properties may be defined for up to six different temperatures. The weight modules enter the library with the design temperature, and interpolate library data for physical properties at temperature. When data for only one temperature set are available, the program will use that set. If specified design temperatures exceed the limits in the library, the material properties are determined by extrapolation. The material stress-strain curve fit is based on a least squares fit with a straight line plus exponential curve, using three points on the stress-strain curve - the proportional limits, the yield point, and one intermediate point.

INPUT DESCRIPTION

A complete description of input data locations is presented in Table 19. All of the variables are in the form to be read by subroutine DECRD. The data must be preceded by two comment cards which describe the material. These comments are printed by the user modules. The data for each material starts

TABLE 18. MATERIAL LIBRARY DATA

Material ID No.	Material Description	Density (lb/in^3)	Basis (Note 1)	Thickness (in.)	Temperature Range (° F)	Room Temp Properties (psi)	
						F_{CY}	F_{SU}
1	2024-T81 Al clad sheet	0.100	S	0.063-0.250	80	57,000	39,000
2	2024-T851 Al bare plate	0.100	S(2)	0.500-1.000	80-300	58,500	38,000
3	2024-T851 Al bare plate	0.100	S(3)	1.000-3.000	80-350	54,500	37,500
4	7075-T6 Al clad sheet	0.101	B	0.040-0.062	80	65,000	44,000
5	7075-T6 Al bare plate	0.101	B	0.250-0.500	80	71,000	47,000
6	7075-T6511 Al extrusion	0.101	A	3.000-4.000	80	66,000	45,000
7	7075-T7351 Al bare plate	0.101	S	0.250-0.500	80	56,000	39,000
8	7050-T7351 Al bare plate	0.102	Est	- -	80	66,000	42,200
9	2219-T851 Al bare sheet/plate	0.102	Est	0.250-2.000	80	48,000	36,000
10	7178-T6 Al clad sheet	0.102	B	0.045-0.249	80	75,000	48,000
11	7178-T6 Al bare sheet	0.102	B(4)	0.045-0.249	80-280	75,000	49,000
12	7079-T651 Al bare plate	0.099	A	0.250-1.500	80	63,000	42,000
13	6Al-4V Ti annealed sheet/plate	0.160	B(2)	-0.250	80-500	138,000	81,000
14	6Al-4V Ti annealed plate	0.160	S	0.187-4.000	80-350	126,000	76,000
15	9Ni-4CO-.2C steel sheet/plate	0.283	Est	- -	80	188,000	118,000
16	17-4PH (H900)	0.282	Est	- -	80	165,000	120,000
17	Rene 41 plate	0.298	B	0.187-	80-1600	113,000	118,000

NOTE

1. The basis A, B, and S are as defined in MIL-HDBK-5A.
2. After exposure to 290° F for 120 hours.
3. After exposure to 265° F for 390 hours.
4. After exposure to 280° F for 120 hours.

in location 1. Expanded explanations for those variables which may be subject to misinterpretation are:

- Location 1 specifies the material number. The number in this location is determined by the sequence of data in the material property deck; i.e., if this is the third set of material data, the set describes material number three.

- Location 5 specifies the reduction of area. This parameter is used to define the fatigue characteristics of the material as a function of strain. The data for this location is defined by the following equation:

$$RA = 1 - \frac{AF}{AO}$$

  where

  AF = The material cross-section area at fracture of a tensile specimen

  AO = The initial material cross-section area

- Location 130 specifies the material endurance limit as a fraction of the ultimate tensile strength. This value is for a fully reversing loading on an unnotched specimen. It is used by the fuselage module to determine acoustic fatigue requirements. The value in this location is replaced by computed data from the fatigue module.

- Location 132 specifies an estimated material allowable under pressure cycling as a fraction of the ultimate tensile strength. These data are used by the fuselage module to determine the cover fatigue allowable. The value in this location is replaced by computed data from the fatigue module.

- Locations 133 and 134 specify an estimated material allowable under cyclic loading as a fraction of the tensile yield strength. Data in location 133 define the design allowable at the wing root and are not currently in use. Data in location 134 define the design allowable at the second wing synthesis cut and are used by the wing module to determine the lower cover fatigue allowable. Values in these locations are replaced by input in wing data or by computed data from the fatigue module. Input of fatigue allowable in wing data takes precedence over data developed by the fatigue module.

TABLE 19. MATERIAL LIBRARY INPUT

MATERIAL PROPERTIES LIBRARY

TITLE CARD ONE 1-80 FOR COMMENTS. **MUST BE USED**
TWO 1-80 FOR COMMENTS. **MUST BE USED**

LOCATIONS	DESCRIPTIONS	
1	MATERIAL NUMBER-CHECK PROGRAM LIBRARY FOR NEXT NUMBER.	
2	MATERIAL DENSITY.	POUNDS/CUBIC INCH
3	YOUNG'S MODULUS AT 80 DEG. FAHRENHEIT	
4	SHEAR MODULUS AT 80 DEG. FAHRENHEIT	
5	REDUCTION IN AREA. FATIGUE PARAMETER.	
6	MATERIAL CRIPPLING COEFFICIENT -FOR FLAT SHEET SIMPLY SUPPORTED AT TWO EDGES	
7	-FOR FLAT SHEET SIMPLY SUPPORTED AT ONE EDGE ONLY	
8-109	NOT USED	
110	TEMPERATURE OF MATERIAL FOR DATA IN LOCATIONS 111 THRU 134 *** TEMPERATURES IN DEGREES FAHRENHEIT ***	
111	MU - POISSON'S RATIO	
112	EC1 COMPRESSION STRAIN AT PROPORTIONAL LIMIT	INCH/INCH
113	EC5 COMPRESSION STRAIN AT YIELD POINT	INCH/INCH
114	FC1 COMPRESSION STRESS AT PROPORTIONAL LIMIT	PSI
115	FC2 COMPRESSION STRESS AT EC1 + (EC5 - EC1) * .25	PSI
116	FC3 COMPRESSION STRESS AT EC1 + (EC5 - EC1) * .50	PSI
117	FC4 COMPRESSION STRESS AT EC1 + (EC5 - EC1) * .75	PSI
118	FC5 COMPRESSION STRESS AT YIELD POINT	PSI
119	ET1 TENSION STRAIN AT PROPORTIONAL LIMIT	INCH/INCH
120	ET5 TENSION STRAIN AT YIELD POINT	INCH/INCH
121	FT1 TENSION STRESS AT PROPORTIONAL LIMIT	PSI
122	FT2 TENSION STRESS AT ET1 + (ET5 - ET1) * .25	PSI
123	FT3 TENSION STRESS AT ET1 + (ET5 - ET1) * .50	PSI
124	FT4 TENSION STRESS AT ET1 + (ET5 - ET1) * .75	PSI
125	FT5 TENSION STRESS AT YIELD POINT	PSI
126	FTU ULTIMATE TENSION STRESS	PSI
127	FSU ULTIMATE SHEAR STRESS	PSI
128	FBRU ULTIMATE BEARING STRESS	PSI

TABLE 19. MATERIAL LIBRARY INPUT (CONT)

```
129    NOT USED
130    KFTU  FATIGUE FACTOR - ENDURANCE LIMIT, KT=1, R=-1
131                         - FUSELAGE SHELL BENDING
132                         - FUSELAGE PRESSURE CYCLES, R=0
133                         - WING AT SIDE OF FUSELAGE (SOF)
134                         - WING OUTER PANEL STATION (WOS)

       **INPUT FOR SECOND TEMPERATURE**   **OPTIONAL**
135    TEMPERATURE, MUST BE HIGHER THAN TEMPERATURE IN LOCATION 110
136    MU.
137    EC1  STRAIN AT P.L.
138    EC5  STRAIN AT YIELD
139    FC1
140    FC2
141    FC3
142    FC4
143    FC5
144    FT1  STRAIN AT P.L.
145    FT5  STRAIN AT YIELD
146    FT1
147    FT2
148    FT3
149    FT4
150    FT5
151    FTU
152    FSU
153    FBRU
154    NOT USED
155    KFTU  - ENDURANCE LIMIT
156          - FUS. SHELL
157          - FUS. PRESSURE
158          - SOF
159          - WOS

       **INPUT FOR THIRD TEMPERATURE**   **OPTIONAL**
160    TEMPERATURE, MUST BE HIGHER THAN TEMPERATURE IN LOCATION 135
161    MU.
```

TABLE 19. MATERIAL LIBRARY INPUT (CONT)

162	EC1	STRAIN AT P.L.
163	EC5	STRAIN AT YIELD
164	FC1	
165	FC2	
166	FC3	
167	FC4	
168	FC5	
169	ET1	STRAIN AT P.L.
170	ET5	STRAIN AT YIELD
171	FT1	
172	FT2	
173	FT3	
174	FT4	
175	FT5	
176	FTU	
177	FSU	
178	FBRU	
179	NOT USED	
180	KFTU	- ENDURANCE LIMIT
181		- FUS. SHELL
182		- FUS. PRESSURE
183		- SCF
184		- MOS
	INPUT FOR FOURTH TEMPERATURE **OPTIONAL**	
185	TEMPERATURE, MUST BE HIGHER THAN TEMPERATURE IN LOCATION 160	
186	MU.	
187	EC1	STRAIN AT P.L.
188	EC5	STRAIN AT YIELD
189	FC1	
190	FC2	
191	FC3	
192	FC4	
193	FC5	
194	ET1	STRAIN AT P.L.
195	ET5	STRAIN AT YIELD
196	FT1	

TABLE 19. MATERIAL LIBRARY INPUT (CONT)

```
197     FT2
198     FT3
199     FT4
200     FT5
201     FTU
202     FSU
203     FERU
204     NOT USED
205     KFTU   - ENDURANCE LIMIT
206            - FUS. SHELL
207            - FUS. PRESSURE
208            - SLF
209            - WOS

        **INPUT FOR FIFTH TEMPERATURE**     **OPTIONAL**
210     TEMPERATURE, MUST BE HIGHER THAN TEMPERATURE IN LOCATION 185
211     MU.
212     EC1  STRAIN AT P.L.
213     EC5  STRAIN AT YIELD
214     FC1
215     FC2
216     FC3
217     FC4
218     FC5
219     ET1  STRAIN AT P.L.
220     ET5  STRAIN AT YIELD
221     FT1
222     FT2
223     FT3
224     FT4
225     FT5
226     FTU
227     FSU
228     FERU
229     NOT USED
230     KFTU   - ENDURANCE LIMIT
231            - FUS. SHELL
```

TABLE 19. MATERIAL LIBRARY INPUT (CONCL)

```
232          - FUS. PRESSURE
233          - SOF
234          - WOS

        **INPUT FOR SIXTH TEMPERATURE**     **OPTIONAL**
235     TEMPERATURE, MUST BE HIGHER THAN TEMPERATURE IN LOCATION 210
236     NU.
237     EC1  STRAIN AT P.L.
238     EC5  STRAIN AT YIELD
239     FC1
240     FC2
241     FC3
242     FC4
243     FC5
244     ET1  STRAIN AT P.L.
245     ET5  STRAIN AT YIELD
246     FT1
247     FT2
248     FT3
249     FT4
250     FT5
251     FTU
252     FSU
253     FBRU
254     NOT USED
255     KFTU  - ENDURANCE LIMIT
256           - FUS. SHELL
257           - FUS. PRESSURE
258           - SOF
259           - WOS

*** LAST CARD FOR EACH MATERIAL MUST HAVE A MINUS (-) IN COLUMN ONE(1)

*** LAST MATERIAL MUST BE A DUMMY
       WITH 2 TITLE CARDS AND A 3RD CARD WITH MINUS IN COLUMN 1
                               AND ZERO (0.0) IN LOCATION 1
```

REFERENCES

1. Military Specification MIL-A-008860A(USAF), "Airplane Strength and Rigidity, General Specification for," 31 March 1971

2. Military Specification MIL-A-8861(ASG), "Airplane Strength and Rigidity Reliability Requirements, Repeated Loads, and Fatigue," 18 May 1960

3. Military Specification MIL-A-008861A(USAF), "Airplane Strength and Rigidity Flight Loads, " 31 March 1971

4. Military Specification MIL-A-008862A(USAF), "Airplane Strength and Rigidity, Landing and Ground Handling Loads," 31 March 1971

5. Military Specification MIL-A-008866A(USAF), "Airplane Strength and Rigidity Reliability Requirements, Repeated Loads, and Fatigue," 31 March 1971

6. Military Standardization Handbook MIL-HDBK-5B, "Metallic Materials and Elements for Aerospace Vehicle Structures," 1 September 1971