Part I-Final Report, Tasks 1 and 2

FEASIBILITY STUDY OF AN INTEGRATED PROGRAM FOR AEROSPACE VEHICLE DESIGN (IPAD)

Volume V: Catalog of IPAD Technical Program Elements

D6-60181-5

September 21, 1973

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16. Abstract

Volume V of the Boeing report on the IPAD feasibility study contains the catalog of Technical Program Elements which are required to support the design activities for a subsonic and supersonic commercial transport. Information for each Element consists of usage and storage information, ownership, status and an abstract describing the purpose of the Element.

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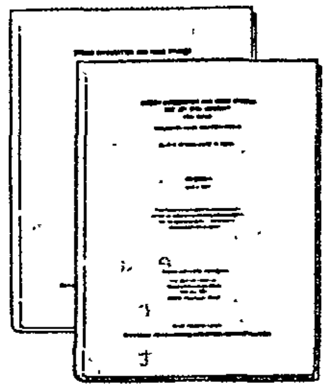

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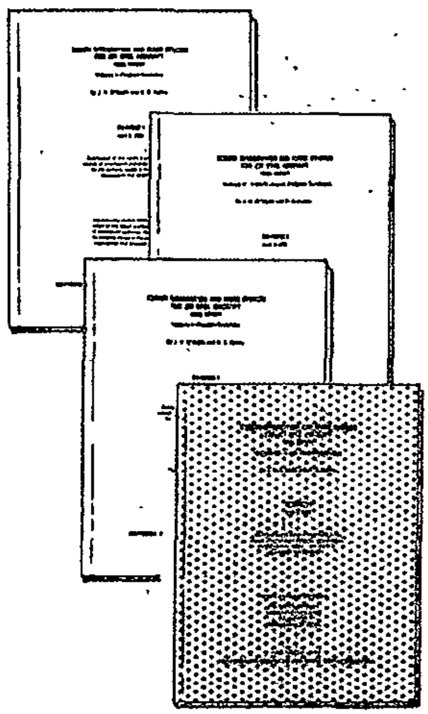

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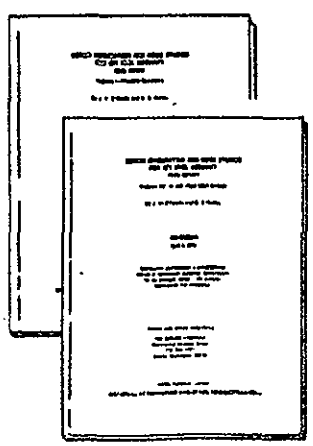

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Catalog of IPAD Technical Program Elements

1.0 INTRODUCTION

The design processes, for example aero-space projects, were examined and used to characterize the design environment. Two projects were studied in sufficient depth to establish the entire spectrum of activities, from research through design to product support while in service, with the goal of bringing as many of these activities as possible into the man-machine environment. Then, the technical code required to support this man-machine environment was documented. This Catalog is the collection of the code identified during the IPAD feasibility study.

The two projects represented in this Catalog are a subsonic commercial transport and a supersonic commercial transport. The technical code is denoted as Technical Program Elements, and represents all of the twenty technical disciplines identified during the process of characterizing the design process. These technical disciplines and the three-character code used for identification purposes are presented in Table 1.1.

Section 2 of this volume gives the status of the code for each technical discipline, and provides a cross-reference indicating the usage of each Element in the design sequence shown in Volume II. The status is given in one of three categories: Category 1 (operational) indicates that the TPE is in current use or has been used. Category 2 (in development) indicates that a TPE is being developed but is not yet operational. Category 3 (not programmed) indicates that a TPE is required for IPAD but is not currently being developed.

Section 3 presents the Catalog of the Technical Program Elements (TPE). For each TPE, a measure of the size is given in terms of boxes of source code where one box equals 2,000 cards. This information was used to estimate the cost for incorporating 64 of the 304 Technical Program Elements into IPAD. The cost information is presented in Volume VI.

CODE	Technical Discipline
ARO	Aerodynamics
DCA	Design, configuration arrangement
DGL	Design, geometry loft
DSA	Design, structural airframe
FCS	Flight controls
FNC	Finance
MIS	Management information
MKT	Marketing
MTH	Mathematics
PNZ	Propulsion, noise
PRF	Performance
PRO	Propulsion, design
REL	Product assurance, reliability
S&C	Stability and Control
SDL	Structures, dynamic loads
SFL	Structures, flutter
SLO	Structures, static loads
STM	Systems
STR	Structures, stress
WTS	Weights

Table 1.1. Technical Disciplines for Project 1 and Project 2

2.0 STATUS AND USAGE

Each of the Technical Program Elements has the status of the code indicated. There are three situations. The code can be operational, in development, or not started. It is possible for an Element to be in more than one state. For instance, an operational program may need further development to fulfill its requirements in IPAD, and would be indicated both as operational and not started.

Table 2.1 measures the status of the code for each technical discipline in each of these three categories. The measurement is in terms of boxes of source code, and is counted in the lowest indicated status. For example, an Elment listed as both operational and under development would be included in the "under development" column, Status 2.

Table 2.1 also indicates the percentage of activities that can be brought into the man-machine environment. These numbers cannot be measured, and are consequently based on opinion. This matter is discussed more fully in Section 6 of Volume II.

Following Table 2.1 is a series of tables (not numbered) that give the status and usage in the design networks, for each Technical Program Element. The tables are arranged alphabetically by the codes of Table 1.1. The reference to the design networks gives the network block numbers used in Section 4 of Volume II to explain the design activity of Project 1 and Project 2.

Technical Discipline	Project 1				Project 2			
	Status (Boxes)			% Codable	Status (Boxes)			% Codable
	1	2	3		1	2	3	
ARO - Aerodynamics	47	0	48	80	45	0	46	90
DCA - Configuration design	5	0	9	90	5	0	9	90
DGL - Geometry Loft	65	0	65	90	65	0	65	90
DSA - Structural design	0	0	18	70	0	0	18	70
FCS - Flight controls	30	8	45	80	30	8	45	80
FNC - Finance	5	2	7	90	5	2	7	90
MIS - Management Information	0	0	9	100	0	0	9	100
MKT - Marketing	3	0	6	90	3	0	6	90
MTH - Mathematics	N.A.	N.A.	N.A.	100	N.A.	N.A.	N.A.	100
PNZ - Noise	4	0	4	70	4	0	4	60
PRF - Performance	3	5	10	90	3	5	10	90
PRO - Propulsion	7	2	12	80	6	2	12	70
REL - Reliability	68	0	68	90	68	0	68	90
S&C - Stability & control	12	15	32	70	6	0	28	60
SDL - Dynamic loads	10	0	15	70	10	0	15	70
SFL - Flutter	20	10	30	60	32	12	46	50
SLO - Static loads	35	0	46	70	29	0	40	70
STM - Systems	19	3	44	80	19	3	44	80
STR - Stress	127	3	130	80	84	13	98	80
WTS - Weights	84	2	234	80	80	1	231	70

Table 2.1 Status and Extent of Technical Program Elements - Boeing Survey

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

AERODYNAMICS

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
ARO-1	Subsonic Wing-Body Design and Analysis	X			IV-2 V-3,11 VI-3	
ARO-2	Subsonic Wing-Body Design Process			X	IV-2 V-3,11 VI-3	
ARO-3	Potential Flow About Arbitrary Configurations	X			V-3,10,11 VI-2,3	
ARO-4	Calculation of Aerodynamic Influence Coefficients Matrix	X			V-11 VI-3 EM-3	V-10 VI-3 EM-3
ARO-5	Analysis & Design of Wing-Body Combinations	X			V-11 VI-3 EM-3	III-3,14,29 IV-19,26,53,65 V-3,10 EM-3
ARO-6	Calculation of Slender Body Effects for A/C Matrix Formulation	X			V-11 VI-3 EM-3	III-3,29 IV-19,66 V-10 VI-3 EM-3
ARO-7	Subsonic Cruise Drag Module For Transport Configurations	X			II-5 III-3,24 IV-56	II-5 III-3,7,19,29 IV-66
ARO-8	Low Speed Lift & Drag Module - Transport Configurations	X			II-5 III-9,24 IV-56	II-5 III-9,29 IV-66
ARO-9	Wave Drag and Supersonic Area Rule	X				II-5 III-3,32 IV-19,66 V-3,10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS
AERODYNAMICS (CONTINUED)

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS : PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
ARO-10	Calculation of Supersonic Drag Due to Lift & Wing Nacelle Interference Drag	X				III-3,32 IV-19,66 V-10 VI-3
ARO-11	Supersonic Drag and Pressure Distribution on Bodies of Revolution	X				III-3 IV-19,66 V-3,10 VI-3
ARO-12	Supersonic Skin Friction Prediction	X				II-5 III-3 IV-19,66 V-10 VI-3
ARO-13	Influence of Non-Smooth Geometries on Sonic Boom	X				III-32 IX-66 V-10 VI-3
ARO-14	Propagation Characteristics of Sonic Booms in Non-Homogeneous Atmosphere	X				III-28 IV-66 V-10 VI-3
ARO-15	Supersonic Loading Optimization (NASA Carlson-Middleton Method)	X				V-3,10 VI-3
ARO-16	Supersonic Camber Surface Design	X				V-3,10 VI-3
ARO-17	Calculation of Lift & Induced Drag	X			VI-3	II-5 V-10 VI-3
ARO-18	Supersonic Camber Shape Generation - Extended Grant-Tucker Method	X				V-3,10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

AERODYNAMICS (CONTINUED)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
ARO-19	Combination of Supersonic Loadings to Generate Wing Camber	X				V-3,10 VI-3
ARO-20	Minimum Supersonic Lift Dependent Drag & Camber Shape-Grant Tucker Method	X				V-3,10 VI-3
ARO-21	Parametric Estimate of Supersonic Drag of Complete Configurations			X		II-5

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

DESIGN, CONFIGURATION ARRANGEMENT

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
DCA-1	Airplane Geometry Control	X			III-2	III-2
DCA-2	Airplane Geometry Parameters			X	II-5	II-5
DCA-3	Computerized Space Arrangement Mockup			X	III-2 V-11	III-2 V-10
DCA-4	Level III Configuration Sizing Driver			X	III-10	III-10

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

DESIGN, GEOMETRY LOFT

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
DGL-1	Airplane Exterior Geometry Loft (Shape)	X			III-2 IV-2	III-2
DGL-2	Mathematically Splined Wing Loft (Geometry Control System -GCS)	X			V-3,4,10,11	V-3,4,10
DGL-3	Mathematically Splined Body Loft (Geometry Control System -GCS)	X			V-3,4,10,11	V-3,4,10
DGL-4	Master Dimensions Definition & Extraction (MD)	X			VI-1,2,3	VI-1,2,3
DGL-5	Mathematical Definition of Airplane Wing	X			VI-1,2,3	VI-1,2,3
DGL-6	Flat Pattern Development	X			VI-1,2,3	VI-1,2,3
DGL-7	Aircraft Design & Extraction Language (ADEL)	X			IV-24a V-10,11	IV-312 V-10
DGL-8	Applied Interactive Data Extration (AIDE)	X			V-10,11	IV-31a V-10
DGL-9	Perspective Projections of 3-D Data (PERSPE)	X			III-2,12 IV-24a V-11	III-12 V-10
DGL-10	Control Cabin Design Evaluation	X			V-11	V-10

STATUS: (1) OPERATIONAL (2) IN DEVELOPMENT (3) NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

DESIGN, STRUCTURAL AIRFRAME

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
DSA-1	Wing Structural Arrangement Definition			X	III-12 IV-24	III-12 IV-31 V-10
DSA-2	Body Structural Arrangement Definition			X	III-12 IV-24	III-12 IV-31a V-10
DSA-3	Empennage Structural Arrangement Definition			X	III-12 IV-24	III-12 IV-31a V-10
DSA-4	Landing Gear Structural Arrangement Definition			X	III-12 IV-24	III-8,12 IV-31a V-10
DSA-5	Interactive Design-Structural			X	IV-24 V-11 VI-3	IV-31a V-10 VI-3
DSA-6	Frame Design Program			X	V-11 VI-3	V-10 VI-3
DSA-7	Floor Beam Design Program			X	V-11 VI-3	V-10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

FLIGHT CONTROLS

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
FCS-1	Control System Analyses QR Program	X			IV-6,12,29,53 V-6,11 VI-2,3 VIII-2	IV-5,6,36,63 V-6,10,11 VI-2,3 VIII-2
FCS-2	Control System Analyses MDELTA Program	X			IV-6,29,53 V-11 VI-3 VIII-2 IX-4	IV-5,36,63 V-10 VI-2,3 VIII-2
FCS-3	Control System Optimization-LORPS Program	X			IV-12,29,53 V-11 VI-3	IV-5,36,63 VI-3
FCS-4	Control System Optimization -Generalized Inverse	X			IV-12,29,53 V-11 VI-3	IV-5,36,63 VI-3
FCS-5	Control System Optimization-Gain Scheduling	X	X		IV-12,29,53 V-11 VI-3	IV-5,36,63 VI-3
FCS-6	Control System Optimization-Modal Program	X			IV-12,29,53 V-11 VI-3	IV-5,36,63 VI-3
FCS-7	Control System Optimization-Decoupling	X	X		IV-12,29,53 V-11 VI-3	IV-5,36,63 VI-3
FCS-8	Digital Simulation - GD Program	X	X		V-11 VI-2,3 VII-2 IX-4	V-10 VI-2,3 VIII-2
FCS-9	Digital Simulation NONSIM Program	X			V-11 VI-2,3 VII-2 IX-4	V-10 VI-2,3 VIII-2

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

FLIGHT CONTROLS (CONTINUED)

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS: PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
FCS-10	Digital Simulation - MIMIC Program	X			V-11 VI-2,3 VII-2 IX-4	V-10 VI-2,3 VIII-2
FCS-11	Rigid Body Equations of Motion with Static Aeroelastic Corrections (QSE)	X	X		IV-12 V-11 VI-3 VIII-2 IX-4	IV-5 V-10 VI-3
FCS-12	Flight Control System Hardware Sizing			X	IV-12,17,35,53 V-11	IV-5,22,42,63
FCS-13	Actuator Transfer Functions			X	EM-9,11	EM-9
FCS-14	Preliminary Flight Control System Synthesis			X	IV-9	III-6
FCS-15	Actuator Sizing			X	IV-9,17 V-11	IV-22
FCS-16	Flight Control System Definition			X	IV-17 V-11	
FCS-17	Flight Control System Reliability and Redundancy Analysis			X	IV-10,17	IV-12,14,22

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

FINANCE

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS: PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
FNC-1	Preliminary Design Cost Model (Manhours and $ Model)	x			II-6 III-11,24	II-6 III-11,33 IV-66
FNC-2	Production Cost Estimate (COSIMOD)	x			IF-56 V-12	IV-66 V-16
FNC-3	Estimate of Overtime Production Costs (COSIMOD B)		x		IV-56 V-12	IV-66 V-16
FNC-4	Risk Analysis Model	x			IV-56 V-12	IV-66 V-16

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

MANAGEMENT INFORMATION

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
MIS-1	Configuration Management			x	III-24 IV-55,56 V-13 VI-5	III-33 IV-65,66 V-13 VI-5
MIS-2	Operations Management			x	VI-5 VII-1,3	VI-5 VII-1,3
MIS-3	Program Management			x	VI-5 VII-3	VI-5 VII-3 VIII-4

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

MARKETING

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
MKT-1	Open Market Model	x			II-2	II-2
MKT-2	Market Environment Disciplines			x	II-2	II-2
MKT-3	Mission Requirements and Market Potential Assessment			x	II-3	II-3
MKT-4	Airplane Economic Analysis Model	x			II-6 III-11,24 IV-56	II-6 III-11,33 IV-66
MKT-5	Route System Economic Analysis Model	x			II-6 III-11,24 IV-56	II-6 III-11,33 IV-66
MKT-6	Market Suitability and Sales Potential Forecast			x	II-7 III-11,24 IV-56	II-7 III-11,33 IV-66

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

MATHEMATICS

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS: PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
MTH-1	Programmed Arithmetic	X			As Needed	As Needed
MTH-2	Elementary Functions	X			As Needed	As Needed
MTH-3	Polynomials and Special Functions	X			As Needed	As Needed
MTH-4	Ordinary Differential Equations	X			As Needed	As Needed
MTH-5	Interpolation, Approximation, Quadrature, Etc.	X			As Needed	As Needed
MTH-6	Linear Algebra	X			As Needed	As Needed
MTH-7	Probability & Statistics	X			As Needed	As Needed
MTH-8	Nonlinear Equations	X			As Needed	As Needed

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PROPULSION NOISE

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS : PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
PNZ-1	Noise Prediction	x			III-9,23 IV-15a,56	III-9,32 IV-17a,66

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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PRF

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PERFORMANCE

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
PRF-1	Airplane Performance Calculation for Market Analysis			x	II-5	II-5
PRF-2	Calculation of Flight Performance	x			III-3,24 IF-56 V-6,11 VI-3	III-3 IV-19,66 V-6,10
PRF-3	Takeoff and Climbout Performance		x		III-9,24 IV-56 V-6,11 VI-3	III-9 IV-66 V-6,10
PRF-4	Landing Performance		x		III-9,24 IV-56 V-6,11 VI-3	III-9 IV-66 V-6,10
PRF-5	Performance Summary			x	III-24 IV-56 V-11 VI-3	III-33 IV-66 V-10

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PROPULSION, DESIGN

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
PRO-1	Nacelle Design	x			III-2 IV-15a	IV-17a
PRO-2	Nacelle Design			x	III-2 IV-15a	III-2 IV-17a
PRO-3	Engine Performance (Cycle Matching)	x			II-5 III-3,9,24 IV-15a,56	II-5 III-3,9,29 IV-17a,19,66
PRO-4	Engine Performance (Cycle Matching) GSA	x			II-5 III-3,9,24 IV-15a,56	II-5 III-3,9,29 IV-17a,19,66
PRO-5	Engine Performance (Table Lookup)	x			II-5 III-3,9,24 IV-15a,56	II-5 III-3,9,29 IV-17a,19,66
PRO-6	Engine Installation			x	II-5 III-3,9,24 IV-15a,56	II-5 III-3,9,29 IV-17a,19,66

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PRODUCT ASSURANCE, RELIABILITY

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS: PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
REL-1	Utilization, Maintenance and Reliability Capability Analysis	x			II-5,6 III-24 IV-56 V-11,13 VI-3	II-5 III-33 IV-14,29,66 VI-3
REL-2	Automatic Reliability Mathematical Model	x			IV-10,17 V-11 VI-3	IV-14,22 V-10 VI-3
REL-3	Computerized Boolean Reliability Analysis	x			IV-10,17 V-11 VI-3	IV-14,22 V-10 VI-3
REL-4	SST Operations and Maintenance Simulation Model	x			II-5,6 III-24 IV-56 V-11,13 VI-3	II-5,6 III-33 IV-17,66 VI-3
REL-5	Fault Tree Simulation With Importance Sampling	x			IV-10,17 V-11 VI-3	IV-14,22 V-10 VI-3
REL-6	Maintenance Event Analysis Data System	x			II-5,6 III-24 IV-10,17,56 V-11 VI-3,5 VIII-1,2,3 IX-1,3,4	II-5,6 III-33 IV-14,66 V-10 VI-3,5,17 VIII-1,2,3 IX-1,3,4
REL-7	Reliability Computations (KRONOS)	x			As above	As above
REL-8	Aircraft Time and Departure System (ATD)	x			As above	As above
REL-9	Aircraft Component Identification System (ACIOS)	x			As above	As above

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PRODUCT ASSURANCE, RELIABILITY (Cont'd)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
REL-10	Maintenance Manhour Study for STOL Support (MMHS)	x			II-5,6 III-24 IV-10,17,56 V-11 VI-3,5 VIII-1,2,3 IX-1,3,4	II-5,6 III-33 IV-14,66 V-10 VI-3,5,17 VIII-1,2,3 IX-1,3,4
REL-11	American Airlines Field Maintenance Reliability Report Processing (AA FM)	x			As above	As above
REL-12	United Airlines Maintenance (UALN)	x			As above	As above
REL-13	Schedule Interruption Data System (SID)	x			As above	As above
REL-14	Reliability Computations CTS (CTS)	x			II-5 IV-10,17 V-11 VI-3	II-5 IV-22 V-10 VI-3
REL-15	NAV-001 Record Count Program	x			II-5,6 III-24 IV-10,17,56 V-11,13 VI-3,5 IX-1,3,4	II-5,6 III-33 IV-14,22,66 V-10,17 VI-3,5 IX-1,3,4
REL-16	NAV-200/201 Monthly Counts by Card Type Program	x			As above	As above
REL-17	NAMASEP PROGRAM	x			As above	As above
REL-18	NAV 003 Aircraft Inventory Program	x			As above	As above

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PRODUCT ASSURANCE, RELIABILITY (cont'd.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
REL-19	NAV 004 Flight Time and Type Flight Program	x			II-5,6 III-24 IV-10,17,56 V-11,13 VI-3,5 IX-1,3,4	II-5,6 III-33 IV-14,22,66 V-10,17 VI-3,5 IX-1,3,4
REL-20	NAV-005 Not Operational Ready (NOR) Status	x			As above	As above
REL-21	NAV 600/601/602 Unscheduled Maintenance NOR Priority Program	x			As above	As above
REL-22	NAV 007 Maintainability Final Program	x			As above	As above
REL-23	NAV-008 Reliability Final Program	x			As above	As above
REL-24	NAV 900/901/902 Abort Programs	x			As above	As above
REL-25	NAV-010 Organizational Adonis Program	x			As above	As above
REL-26	NAV-011 Intermediate Adonis Program	x			As above	As above
REL-27	NAV-012/013 Priority By Aircraft System Program	x			As above	As above
REL-28	Program #1, Tape Copy Program	x			As above	As above
REL-29	Program #2	X			As above	As above

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

PRODUCT ASSURANCE, RELIABILITY (cont'd.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
REL-30	Program #2A USA vs SEA Purify	x			II-5,6 III-24 IV-10,17,56 V-11,13 VI-3,5 IX-1,3,4	II-5,6 III-33 IV-14,22,66 V-10,17 VI-3,5 IX-1,3,4
REL-31	Program #3	x			As above	As above
REL-32	Program #4 Manhours by Aircraft System	x			As above	As above
REL-33	Priority Program	x			As above	As above
REL-34	Abort Program	x			As above	As above
REL-35	Adonis Program	x			As above	As above
REL-36	Maintainability Final Program	x			As above	As above
REL-37	Reliability Final Program	x			As above	As above
REL-38	Special Study Program	x			As above	As above
REL-39	Bit and Piece Program	x			As above	As above
REL-40	Depot Programs	x			As above	As above
REL-41	Computerized Reliability Assessment Model	x			II-5 IV-10,17 V-11 VI-3	IV-14,22 V-10 VI-3
REL-42	Dispatch (Schedule) Reliability Analysis	x			IV-10	IV-14

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STABILITY AND CONTROL

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS:	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
S&C -1	Preliminary Airplane Balance and Tail Sizing Program	x	x		III-6	
S&C -2	Maneuver Margin Increment Due to SAS			x	III-6	
S&C -3	Longitudinal Stability and Control Program	x	x		IV-4 V-6,11 VI-3 VIII-2	
S&C -4	Lateral Rate Derivatives	x			IV-4 V-6,11 VI-3 VIII-2	
S&C -5	Airplane Sideslip Static Derivatives	x			IV-4	
S&C -6	Airplane Dynamic Stability Characteristics	x			IV-4 V-6,11 VI-3	
S&C -7	Take Off Rotation Analysis	x			IV-4 V-11 VI-3 VIII-2	IV-6 V-6,10
S&C -8	Landing Flare Analysis	x			As above	IV-6 V-6,10
S&C -9	Minimum Control Speed (Ground)	x			As above	IV-6 V-6,10
S&C -10	Minimum Control Speed AIR)	x			As above	IV-6 V-6,10

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STABILITY AND CONTROL (cont'd.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS:	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
S&C -11	Roll Response	x			IV-4 V-11 VI-3 VIII-2	
S&C -12	Longitudinal Stability & Control Analysis (Elastic Airplane)	x			IV-4 V-6,11 VI-3 VIII-2	
S&C -13	Lateral-Directional Control from Wind Tunnel Data	x			IV-4 V-11 VI-3 VIII-2	
S&C -14	Lateral-Directional Stability Analysis	x			IV-4 V-6,11 VI-3 VIII-2	
S&C -15	Horizontal Tail Hinge Moment Analysis	x			IV-9 V-11 VI-3 VIII-2	IV-12
S&C -16	Lateral & Directional Control Hinge Moment Analysis	x			IV-9 V-11 VI-3 VIII-2 EM-4	IV-12 EM-4
S&C -17	Stability Characteristics of Flexible Configurations (Flexstab)	x			IV-4 V-6,11 VI-3 VIII-2	IV-4 V-6,11 VI-3 VIII-2
S&C -18	Automatic Handling Qualities Estimator	x			IV-4 V-6,11 VI-3 VIII-2	IV-7 V-6

STATUS: (1) OPERATIONAL (2) IN DEVELOPMENT (3) NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STABILITY AND CONTROL (cont'd.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
S&C -19	Handling Qualities Simulation	x	x		V-6,11 VI-2,3 VIII-2	IV-7 V-6,10 VI-2,3 VIII-2
S&C -20	SST Preliminary Airplane Balance, Tail Sizing, Gear Location and Lateral Control Check			x		III-6,18
S&C -21	Longitudinal S&C Program, Calculation of Static Coefficients			x		IV-4 V-10 VI-3
S&C -22	Longitudinal S&C Program, Calculation of Dynamic Derivatives			x		IV-4 V-10 VI-3
S&C -23	Lateral & Directional S&C Program, Calculations of Static Coefficients			x		IV-4 V-10 VI-3
S&C -24	Lateral & Directional S&C Program, Calculations of Dynamic Derivatives			x		IV-4 V-10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, DYNAMIC LOADS

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
SDL-1	Natural Vibration Modes	x			EM-5	EM-5
SDL-2	Force Matrices, Quasi-Steady Equations of Motion			x	IV-41 V-11 VI-3 EM-11	IV-48 V-10 VI-3 EM-10,11
SDL-3	Dynamic Loads & Ride Quality Evaluation	x			IV-42 V-11 VI-3	IV-49 V-10 VI-3
SDL-4	Dynamic Loads & Ride Quality Evaluation	x			IV-42 V-11 VI-3	IV-49 V-10 VI-3
SDL-5	Dynamic Loads & Ride Quality Evaluation	x			IV-42 V-4 VI-3	IV-49 V-10 VI-3
SDL-6	Dynamic Loads & Ride Quality Evaluation	x			IV-42 V-11 VI-3	IV-49 V-10 VI-3
SDL-7	Dynamic Loads & Ride Quality Evaluation	x			IV-42 V-11 VI-3	IV-49 V-10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, FLUTTER

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
SFL-1	Beam Modal Interpolation	X			V-11 VI-3 EM-7	
SFL-2	Subsonic Lifting Line Theory Unsteady Airloads	X			V-11 VI-3 EM-8	
SFL-3	Subsonic Lifting Surface Theory Unsteady Airloads For Main Surface With or Without Trailing Edge Control Surfaces	X			V-11 VI-3 EM-8	V-10 VI-3 EM-8
SFL-4	Subsonic Unsteady Airloads For Single Rigid Cowl		X		V-11 VI-3 EM-8	V-10 VI-3 EM-8
SFL-5	Subsonic Unsteady Aerodynamics Using Double-Latrice Method	X			V-11 VI-3 EM-8	V-10 VI-3 EM-8
SFL-6	Subsonic Lifting Surface Unsteady Interaction Airloads		X		V-11 VI-3 EM-8	V-10 VI-3 EM-8
SFL-7	Subsonic Unsteady Airloads For Lifting Surface With L.E., T.E., Control Surfaces and Tab		X		V-11 VI-3 EM-8	V-10 VI-3 EM-8
SFL-8	Generalized Forces Matrices Summation	X			V-11 VI-3 EM-8	V-10 VI-3 EM-8
SFL-9	Generalized Forces Matrices Interpolation	X			V-11 VI-3 EM-8	V-10 VI-3 EM-8

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, FLUTTER (CONT.)

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS: PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
SFL-10	Flutter Matrices Formulation and Solution	X			III-22 IV-31 V-11 VI-3 VIII-2 EM-9	III-24 IV-38 V-10 VI-3 VIII-2 EM-9
SFL-11	Flutter Matrices Formulation and Solution	X			III-22 IV-31 V-11 VI-3 VIII-2 EM-9	III-24 IV-38 V-10 VI-3 VIII-2 EM-9
SFL-12	Automation Flutter Solution		X		III-21,22 IV-30,31 V-11 VI-3 VIII-2 EM-9	III-24 IV-38 V-10 VI-3 VIII-2 EM-9
SFL-13	Energy Loops	X			IV-30 V-11 VI-3 VIII-2	III-26,37 IV-37 V-10 VI-3 VIII-2
SFL-14	Interpolation by Surface Splines	X				V-10 VI-3 EM-7
SFL-15	Surface Interpolation Using Beam Splines	X				V-10 VI-3 EM-7
SFL-16	Unsteady Aerodynamic Loadings in Supersonic Flow, Box Method	X				V-10 EM-8

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, FLUTTER (CONT.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
SFL-17	Unsteady Aerodynamic Loadings in Supersonic Flow, Kernel Function-Assumed Pressure Mode Method	X				V-10 EM-8
SFL-18	Unsteady Aerodynamic Loadings in Supersonic Flow, Consistent Finite Elements Approach	X				V-10 EM-8
SFL-19	Supersonic Unsteady Aerodynamics For Multiple Lifting Surfaces-Body Configurations		X			V-10 EM-8
SFL-20	Piston Theory Unsteady Aerodynamics	X				V-10 EM-8
SFL-21	Scale-Merge-Reduce Operation for Substructure Stiffness Matrices	X				III-23,26 IV-35,37 V-10 VI-3
SFL-22	Flat Plate Panel Flutter	X				V-10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, LOADS

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
SLO-1	Rigid Wing Aerodynamics	X			III-14 IV-20,45 V-11 VI-3	
SLO-2	Aeroelastic Wing Loads Distribution	X			III-14 IV-20,45 V-11 VI-3	
SLO-3	Body & Empennage Loads Distribution	X			III-14 IV-20,45 V-11 VI-3	
SLO-4	Supersonic Load Distributions	X				III-14 IV-26,53
SLO-5 -8	Wing Aerodynamics From Wind Tunnel Data	X			V-11 VI-3	V-10 VI-3
SLO-8 -11	Wing Aerodynamics From Wind Tunnel Data			X	V-11 VI-3	V-10 VI-3
SLO-12	Body Aerodynamics For Wing Analysis			X	V-11 VI-3	V-10 VI-3
SLO-13	Nacelle Aerodynamics			X	V-11 VI-3	V-10 VI-3
SLO-14	Power-On Analysis	X			V-11 VI-3	V-10 VI-3
SLO-15	Horizontal Tail Aerodynamics			X	V-11 VI-3	V-10 VI-3
SLO-16	Horizontal Tail & Fin Reversal Characteristics	X			V-11 VI-3	V-10 VI-3
SLO-17	Vertical Fin Aerodynamics			X	V-11 VI-3	V-10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, LOADS (cont'd.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
SLO-18 -20 -23 -24 -25	Wing Loads	X			V-11 VI-3	V-10 VI-3
SLO-21 -22	Wing Loads			X	V-11 VI-3	V-10 VI-3
SLO-26	Upset Analysis	X			V-11 VI-3	V-10 VI-3
SLO-27	Total Horizontal Tail Loads	X				
SLO-28	Horizontal Tail & Fin Load Distributions	X			V-11 VI-3	V-10 VI-3
SLO-29	Total Fin Loads	X			V-11 VI-3	V-10 VI-3
SLO-30 -34	Fuselage Load Distributions	X			V-11 VI-3	V-10 VI-3
SLO-35 -36	Gear Loads	X			V-11 VI-3	V-10 VI-3
SLO-37 -40	Selection of Critical Conditions	X			V-11 VI-3	V-10 VI-3
SLO-41	Select Critical Con-ditions			X	V-11 VI-3	V-10 VI-3

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

SYSTEMS

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
STM-1	Systems Requirements Analysis			X	III-2	III-2
STM-2	Hydraulic Fluid Flow Determination			X	IV-17	IV-22
STM-3	Preliminary Hydraulic System Component Sizing			X	IV-17	IV-22
STM-4	Preliminary Hydraulic Cooling Requirements			X	IV-17	IV-22
STM-5	Hydraulic System Dynamic Analysis	X			V-11	V-10
STM-6	Hydraulic Line Sizing Optimization	X			V-11	V-10
STM-7	Refined Hydraulic System Thermal Analysis	X			V-11	V-10
STM-8	Determine APU Power Requirements			X	IV-17	IV-22
STM-9	APU Installation Location			X	V-11	V-10
STM-10	ECS Design Criteria and System Requirements			X	IV-17	IV-22
STM-11	ECS System Trades		X	X	IV-17	IV-22
STM-12	ECS System Selection and Integration			X	IV-17	IV-22
STM-13	Avionics Requirements			X	IV-17	IV-22
STM-14	Brake Sizing			X	IV-17	IV-22

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

SYSTEMS (CONT.)

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS : PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
STM-15	Landing Gear Flotation Analysis			X	IV-17	IV-22
STM-16	Brake Sizing	X			V-11	V-10
STM-17	Landing Gear Flotation Analysis	X			V-11	V-10
STM-18	Steering System Sizing			X	IV-17	IV-22
STM-19	Steering and Ground Handling Simulation	X			V-11	V-10
STM-20	Electrical Power Load Analysis	X			IV-17	IV-22
STM-21	Electrical System Performance	X			IV-17 V-11	IV-22 V-10
STM-22	Wire Release System	X			V-11 VI-3 VII-1,3 VIII-3 IX-1	V-10 VI-3 VII-1,3 VIII-3 IX-1
STM-23	Fuel Tank Arrangement			X	III-2	III-2
STM-24	Wing Fuel Tank End Locations			X	III-2	III-2
STM-25	Body Auxiliary Fuel Tank Sizing and Locations			X	III-2	III-2
STM-26	Refuel System Design			X	IV-17	IV-22
STM-27	Fuel Vent System Design			X	IV-17	IV-22

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

SYSTEMS (cont'd.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS:	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
STM-28	Fuel Vent Surge Tank Design			X	IV-17	IV-22
STM-29	Engine Fuel Feed System Design			X	IV-17	IV-22
STM-30	Fuel Quantity Measurement System Design			X	IV-17	IV-22
STM-31	Steady-State Performance of Aircraft Fuel Systems	X			IV-17	IV-22
STM-32	Volume and C.G. Characteristics of Fuel Tanks		X		IV-17	IV-22
STM-33	Gauge Design and Error as a Function of Fuel Level and Tank Attitude	X			IV-17	IV-22
STM-34	Fuel Gauge Error as a Function of Fuel Level and Tank Attitude		X		IV-17	IV-22

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

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USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, STRESS

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
STR-1	Preliminary Wing Gross Stress Analysis and Sizing	X			III-15 V-11	
STR-2	Preliminary Body and Empennage Stress Analysis and Sizing	X			III-15 V-11	
STR-3	Detail Stress Analysis and Sizing - Wing and Empennage	X			IV-21,37,43,46 V-11	III-16 IV-28,31a,51,55 V-10
STR-4	Detail Stress Analysis and Sizing - Body	X			IV-21,37,43,46 V-11	III-16 IV-28,3-a,51,55 V-10
STR-5	Fatigue Analysis and Design		X		III-15 IV-21,43,46 V-11	III-16 IV-28,31a,51,55 V-10
STR-6	Integrated Struct. Analysis and Design (Finite Elem.)-ATLAS	X			EM-2	III-14,16 IV-26,28,51, 53,55 V-10 VI-3 EM-2
STR-7	Finite Element Structural Analysis-SAMECS	X			V-11 VI-3	
STR-8	Finite Element Structural Analysis-SAMECS Automated Plotting Program (SAPP)	X			V-11 VI-3	
STR-9	Finite Element Structural Analysis-SAMECS Data Checker Program (SAMCHK)	X			V-11 VI-3	

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

STRUCTURES, STRESS (CONT.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
STR-10	Finite Element Structural Analysis - SAMECS Loads Transformation Program (LOADS)	X			V-11 VI-3	
STR-11	Finite Element Structural Analysis-SAMECS Merge Program (MERMAT)	X			V-11 VI-3	
STR-12	Finite Element Structural Analysis-SAMECS Superposition Program (SUPERPO)	X			V-11 VI-3	
STR-13	Finite Element Structural Analysis-SAMECS Deflections Back Substitution Program (DEFPU)	X			V-11 VI-3	
STR-14	Finite Element Structural Analysis-ASTRA (Advanced Structural Analyzer)	X			V-11 VI-3	
STR-15	Aerodynamic Heating		X			IV-27,54
STR-16	Aerodynamic Heating-Preliminary Estimate			X		III-15

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

WEIGHTS

NO.	TITLE	STATUS 1	STATUS 2	STATUS 3	APPEARS IN DESIGN NETWORK BLOCK NUMBERS: PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
WTS-1	Class 0 Weight Estimation			X	II-5	II-5
WTS-2	Level I Weight and Balance System (Type A Weights)	X			II-5 III-5,7	II-5 III-5,7
WTS-3	(GEMPAK) Wing Geometry and Dead Weight Generating and Distribution	X			III-13	
WTS-4	Body/Empennage Design System	X			III-13	
WTS-5	Wing Primary Structure (Type B Weights)	X			III-17	
WTS-6	Body/Empennage Primary Structure (Type B Weights)	X			III-17	
WTS-7	Wing Secondary Structure (Type B Weights)	X			III-17 IV-5,23,38,48	III-19,31 IV-8,19,30,45, 57
WTS-8	Body/Empennage Structure (Type B & C Weights)	X			III-17 IV-5,23,33,48	III-19,31 IV-8,19,30,45,57
WTS-9	Landing Gear (Type D Weights)	X			III-17 IV-18 V--1	III-19 IV-19,23 V-10
WTS-10	Propulsion and Fixed Equipment	X			III-17 IV-5,18	III-19 IV-8,19 V-23
WTS-11	Fuel Distribution	X			III-17 IV-18,25,38,48	III-19,31 IV-19,23, 32, 45,57 V-10

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

WEIGHTS (CONT.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
WTS-12	Mass Properties	X			III-17 IV-11,18,25,38, 48	III-19,31 IV-19,23,32, 45,57 V-10
WTS-13	Weight Statement	X			III-17 IV-5,18,23,25, 38,48 V-11	III-19,31 IV-8,19,23,30, 32,45,57 V-10
WTS-14	Airplane Mass Distribution	X			III-17 IV-18,25,38,48 V-11	III-19,31 IV-19,23,32,45, 57 V-10
WTS-15	Weights Update Control			X	III-17 IV-5,18,23,25, 38,48 V-11	III-19,31 IV-8,19,23,30, 32,45,57 V-10
WTS-16	Wing Primary Structure			X	IV-23,38,48	
WTS-17	Body/Empennage Primary Structure (Type B Weights)			X	IV-23,38,48	
WTS-18	Wing Secondary Structure (Type C Weights)			X	IV-23,38,48 V-11	IV-30,45,57 V-10
WTS-19	Body/Empennage Secondary Structure (Type C Weights)			X	IV-23,38,48 V-11	IV-30,45,57 V-10
WTS-20	Mass Matrix Formation			X	EM-1	EM-1
WTS-21	Finite Element Mass Module (Type B & C Weights)	X			V-11	III-19,31 IV-30,45,57 V-10

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

USAGE & STATUS OF TECHNICAL PROGRAM ELEMENTS

WEIGHTS (CONT.)

NO.	TITLE	STATUS			APPEARS IN DESIGN NETWORK BLOCK NUMBERS :	
		1	2	3	PROJECT 1 SUBSONIC TRANSPORT	PROJECT 2 SUPERSONIC TRANSPORT
WTS-22	Standardized Weight Record System	X			VI-1,3 VII-3 VIII-4	VI-1,3 VII-3 VIII-4
WTS-23	Propulsion and Fixed Equipment			X	V-11	V-10
WTS-24	Parametric/Statistic Weight Estimating (Type A Weights)		X			II-5 III-5 IV-7
WTS-25	Wing, Body, Empennage Paneling and Weight Distributions			X		III-13
WTS-26	Fuel Management Requirements			X		III-19 IV-19

STATUS: ① OPERATIONAL ② IN DEVELOPMENT ③ NOT PROGRAMMED

3.0 CATALOG

The individual Technical Program Elements are compiled in this Section. The form used gives the technical discipline, the title, computing specifications, status, references, ownership, and an abstract for the Element. The arrangement of the forms is alphabetical by the codes of Table 2.1. These codes are on an upper corner of the form, for ease in finding the section for a particular technical discipline.

The characterization of the design process that produced this Catalog was done by technology representatives of the Boeing Commercial Airplane Company, and it will be noted that the Elements in this Catalog are either in the public domain or are Boeing-owned. Furthermore, the forms for reporting the Elements were completed by many representatives, with a resulting variety of style in the abstract of each form. In order to preserve the writer's intent, the editors have not attempted to organize these abstracts into a consistent form.

Many of the abstracts refer to CPDS. This stands for Computerized Preliminary Design System, which is a Boeing integrated design system.

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NO. ARO-1

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Wing-Body Design and Analysis

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 600 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Wing-Body Design or Analysis - 400 Singularities

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Coord. Sheet AMEP-M-174A, "TEA-236, Subsonic Wing Design and Analysis Including External Interference Effects", D. C. Bailey - Program User's Guide.

OWNERSHIP: Public ___, Private X, Owner ___

ABSTRACT

This program is used to design or analyze wing-body geometries. The solution is valid until local Mach numbers exceed unity. The theoretical basis is planar small perturbation theory using sources and vortices in the wing plane and sources on the fuselage surface. The following design or analysis capabilities are currently available:

1) Calculate pressures, given geometry and twist.
2) Design twist, given geometry and span load.
3) Design wing sections and twist, given desired upper and lower pressures.

NO. ARO-2

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Wing-Body Design Process

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE --- HOST MACHINE ---

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Est. to Drive 5 Calls of ARO-1 to Produce a Wing-Body Design

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE "The Advanced Transport Program Method for Subsonic and Transonic Wing-Body Design", W. B. Gillette (D6-40104, Unreleased).

OWNERSHIP: Public___, Private X, Owner___

ABSTRACT

This process is at present done manually. It would be easily adapted to an automated one, using a suitable geometry module and an interactive graphics terminal. The design and analysis would be done with Technical Program Element ARO-1. The result of this design would be a wing contour suitable for wind tunnel testing.

*Estimated.

NO. ARO-3

TECHNICAL PROGRAM ELEMENT

TITLE Potential Flow About Arbitrary Configurations (TEA 230)

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 20 (Boxes of Source Cards)

TIMING 2500 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical wing-body-nacelle geometry having 900 panels. The time for this solution could be reduced to 1/5 with program changes.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-15047, "A General Method for Determining the Aerodynamic Characteristics of Fan-in-Wing Configurations", P. E. Rubbert, et al.

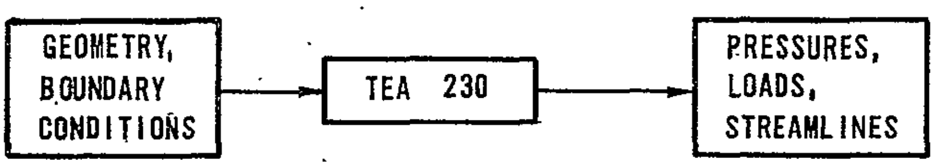
OWNERSHIP: Public X, Private ___, Owner ___

ABSTRACT

This method solves for the potential flow pressure of an arbitrary geometry. Limitations are: 1) No locally supersonic flow and 2) No boundary layer effects.

The program calculates

1) Pressures.
2) Loads.
3) Streamlines on or off the geometry.



NO. ARO-4

TECHNICAL PROGRAM ELEMENT

TITLE Calculation of Aerodynamic Influence Coefficients (AIC) Matrix

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 800 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 300 panels on the geometry, to 1) find AIC matrix, 2) find area and Cp matrix and 3) reduce the AIC matrix for loads.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE 1) Boeing Coord. Sheet 2707-AERO-1906, "Aerodynamic Influence Matrices for Aeroelastic Calculations".

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Program "SHRINK" was developed during the SST activities to 1) calculate a well-paneled (in the aerodynamic sense) AIC matrix, then 2) shrink it to a more manageable size for loads analyses.

The range of application is $M = 0$ to $M \approx 5$, with a continuous solution thru $M \approx 1$. However, the true pressures at subsonic Mach numbers where mixed flow exists are not calculated. The load distribution is still usable. The loads are calculated by the method of ARO-5.

TECHNICAL PROGRAM ELEMENT

TITLE Analysis and Design of Supersonic Wing-Body Combinations, Including Flow Properties in the Near Field

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 12 (Boxes of Source Cards)

TIMING 400 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Wing-body with 200 panels, one Mach number.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE NASA CR-73106, "Analysis and Design of Supersonic Wing-Body Combinations, Including Flow Properties in the Near Field", F. A. Woodward, E. N. Tinoco, J. W. Larsen

OWNERSHIP: Public X, Private ___, Owner NASA

ABSTRACT

An AIC matrix is formed by a linearized solution to the potential flow equations. Linearized boundary conditions are satisfied in the plane of the wing and on the surface of the body. The solution applied from M = 0 continuously thru M = 1 to M = 5 or more. Wings, bodies and nacelles may be modeled. The surface pressures and local lift are determined.

NO. ARO-6

TECHNICAL PROGRAM ELEMENT

TITLE Calculation of Slender Body Effects for AIC Matrix Formulation

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Eight angles of attack, 100 body panels.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Coord. Sheet AMEP-M-246, "Usage Notes for Program TEA 245, A Non-Linear Aerodynamic Method for the Analysis of Flexible Airplanes - On the CDC 6600."

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The program uses linear theory with empirical corrections for the flexible geometry. Thickness effects are not included. The modeling is restricted to 100 panels.

This program should allow more panels and an easier paneling scheme, if implemented into IPAD.

NO. ARO-7

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Cruise Drag Module - Transport Configurations

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Calculation of drag polars of 10 points each for 5 Mach numbers.

STATUS: Operational X , Programming In Development __, Not Programmed __

REFERENCE 1) Boeing Document D6-24229, "Drag Prediction Methods for Subsonic Airplanes", 2) Boeing Document D6-40065, "EDRAG - A CPDS Module for Drag Estimation of Subsonic Transport Airplanes".

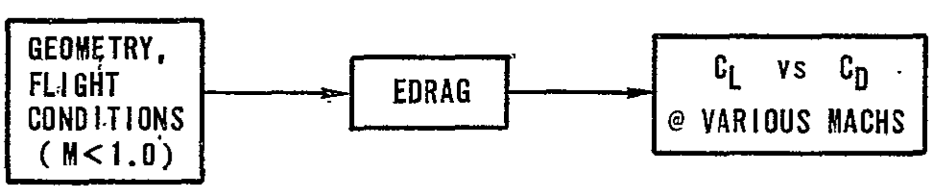
OWNERSHIP: Public __, Private X , Owner The Boeing Company

ABSTRACT

The method relies heavily on statistical information to calculate cruise drag. The drag is prepared as three main factors - parasite drag, vortex drag, and compressibility drag.

Typical prediction error and 90 percent confidence band:

Airplane M L/D at Cruise:	-2 percent	$\pm$ 10 percent
Horiz. Tail Parasite Drag:	-4 percent	$\pm$ 32 percent
Nacelle Parasite Drag:	+1 percent	$\pm$ 11.4 percent



NO. ARO-8

TECHNICAL PROGRAM ELEMENT

TITLE Low Speed Lift and Drag Module - Transport Configurations

FORM PREPARED BY W. B. Gillette DATE 7/13/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 10 angles of attack, one flap setting.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-26011TN, "Low Speed Aerodynamic Prediction Method", M. Grainger (LØWLAM).

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The module provides

- Maximum lift, trimmed and untrimmed.
- Flap effect on pitching moment.
- Drag polar as a function of flap setting.
- Lift curve as a function of flap setting.
- All of the above for elastic A/P (statistical), in ground effect, with conventional thrust effects.

Typical prediction error and 90 percent band:

L/D_{max}, takeoff: -5 percent $\pm$ 10 percent
L/D_{max}, landing: -1.5 percent $\pm$ 10 percent

$C_{L_{max}}$, takeoff: -1 percent $\pm$ 3 percent
$C_{L_{max}}$, landing: - 4 percent $\pm$ 12 percent

NO. ARO-9

TECHNICAL PROGRAM ELEMENT

TITLE: Wave Drag and Supersonic Area Rule

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One geometry.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-6507

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program is based on a slender-body far-field solution for supersonic area rule. It can predict the zero-lift wave drag of a complete configuration. It can also do design in that a body can be constrained to satisfy the cross-sectional area at several points (crew station, etc.), then the program will design the remainder of the body to reduce the wing-body wave drag. It will also predict the lift-dependent pressure drag.

NO. ARO-10

TECHNICAL PROGRAM ELEMENT

TITLE Calculation of Supersonic Drag Due to Lift and Wing-Nacelle Interference Drag

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 300 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical M = 2.7 case.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE 1) Boeing Coord. Sheet AMEP-M-080

2) Journal of Aircraft, Vol. 2, No. 4, 1965

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Program results include:

- Nacelle pressure distribution on the wing.
- Camber and flat plate pressures.
- C_D, C_L, C_M due to camber, flat plate, nacelle acting on wing, wing acting on nacelle.
- Drag polars for wing with and without nacelles.

The program method uses the Middleton-Carleson method for the wing, with the nacelle pressure effects being calculated by Whitham's method.

NO. ARO-11

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Drag and Pressure Distribution on Bodies of Revolution

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each mach number.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Coord. Sheet AMEP-G-054A, "Aerodynamics Program TEA-210, Pressures on Bodies of Revolution at Supersonic Speeds", Byron, T. S. October 24, 1968.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

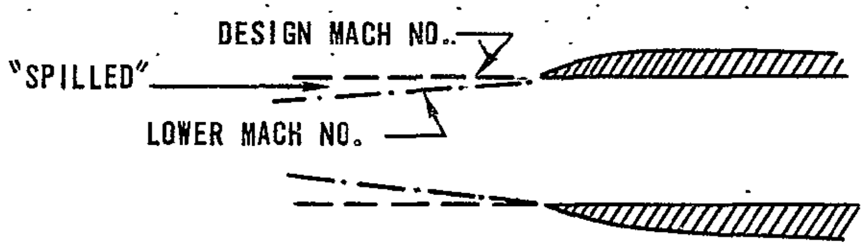
ABSTRACT

The method is the Lighthill approach modified for discontinuities by using compression corner or Prandtl-Meyer expansions.

Input
  Geometry of nacelle or body and Mach numbers.

Output
  Wave drag and pressure distribution.

For nacelles, the program should be modified to predict the spillage drag and pressure:



NO. ARO-12

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Skin Friction Prediction

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Skin friction calculation for a typical set of flight conditions.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE 1) Boeing Document D6-29792TN - Sommer and Short Method,
2) Boeing Document D6A11281-TN - Spalding and Chi Method.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The program uses either the Sommer and Short or the Spalding and Chi methods of calculating supersonic flat plate skin friction drag.

Inputs

Flight conditions and component geometry.

Output

Wetted areas, D/Q, skin friction coefficients.

NO. ARO-13

TECHNICAL PROGRAM ELEMENT

TITLE Influence of Nonsmooth Geometries on Sonic Boom

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 flight condition

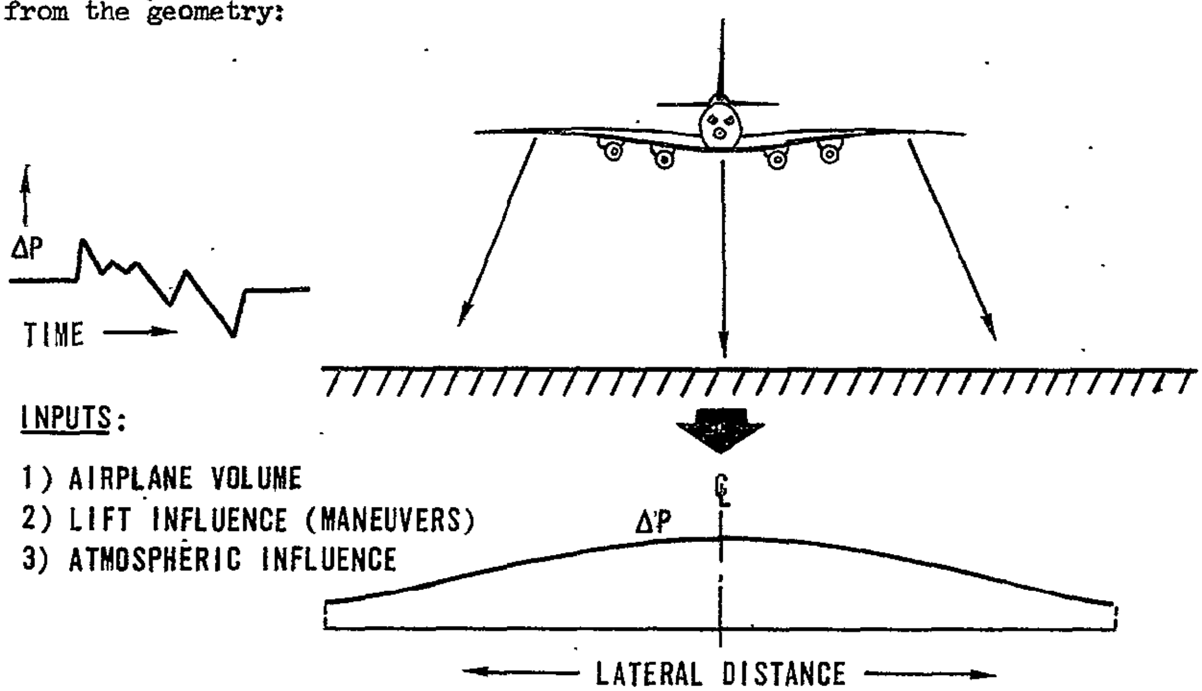
STATUS: Operational x, Programming In Development___, Not Programmed___

REFERENCE Boeing Coord. Sheet AMEP-M-078

OWNERSHIP: Public X, Private___, Owner___

ABSTRACT

The program finds the pressure signatures at any distance of azimuth angle from the geometry:



NO. ARO-14

TECHNICAL PROGRAM ELEMENT

TITLE Propagation Characteristics of Sonic Booms in Non-Homogeneous Atmospheres

FORM PREPARED BY W. B. Gillette DATE 8/16/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 200 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Prepare all constants required by ARO-13 for one atmospheric model.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE NASA CR-1299

OWNERSHIP: Public X, Private ___, Owner ___

ABSTRACT

This program converts a defined atmosphere into scaling factors and age constants. One run provides all the information required by ARO-13. Subsequent runs are required only when the atmosphere model is changed.

NO. ARO-15

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Loading Optimization (NASA Carlson-Middleton Method)

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical design case.

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing Coord. Sheet AMEP-M-082

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The program combines NASA P916.15 which optimizes three loadings (uniform, linear chordwise and linear spanwise) for least drag with NASA 916.AF which calculates the lifting pressures on a flat plate.

Inputs

- Wing grid, flat wing characteristics, planform geometry.

Outputs

- Flat wing force coefficients.
- Wing streamwise and spanwise lift distribution.
- Force coefficients for the uniform, linear chordwise and linear spanwise loadings.
- Force coefficients of component and interference loadings.
- Drag-due-to-lift factor and $C_{MO}/C_{L_{DES}}$ for various loadings.
- Parameters for input to ARO-16.

NO. ARO-16

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Camber Surface Design

FORM PREPARED BY W. B. Gillette DATE 8/15/72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 90 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical wing design.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Coord. Sheet AMEP-M-085

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This is a version of NASA Program P916.5 that defines the camber surface for a given pressure distribution on a given arbitrary planform.

Inputs
- Geometry of wing planform.
- C_L for uniform, linear chordwise and linear spanwise loadings.
- Parameters defining leading edge C_P and dC_P/d_X.
- Optional nacelle pressure distribution.

Outputs
- Table of leading edge C_P and dC_P/d_X.
- Camber shape.

NO. ARO-17

TECHNICAL PROGRAM ELEMENT

TITLE Calculation of Lift and Induced Drag

FORM PREPARED BY W. B. Gillette DATE 8/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 1/2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-40274TN

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The program fits the span load distribution with a spline curve. Lift and induced drag are predicted.

NO. ARO-18

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Camber Shape Generation - Extended Grant-Tucker Method

FORM PREPARED BY W. B. Gillette DATE 8/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 200 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program TEA 075

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The Boeing extension to the Grant-Tucker method uses numerical integration of cubic chains, rather than the direct analytical approach of the original Grant-Tucker method. Whereas, the extended method is slower and less accurate, it allows arbitrary planforms to be input, as well as arbitrary loadings.

NO. ARO-19

TECHNICAL PROGRAM ELEMENT

TITLE Combination of Supersonic Loadings to Generate Wing Camber

FORM PREPARED BY W. B. Gillette DATE 8/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 90 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program TEA 054/U

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This program takes a series of loadings and combines them to find the camber shape corresponding to a restricted minimum.

NO. ARO-20

TECHNICAL PROGRAM ELEMENT

TITLE Minimum Supersonic Lift-Dependent Drag and Camber Shape - Grant-Tucker Method

FORM PREPARED BY W. B. Gillette DATE 8/23/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 120 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program TEA 054

OWNERSHIP: Public X, Private ___, Owner ___

ABSTRACT

This solution is analytic and is applicable to wings with subsonic leading edges and supersonic trailing edges. The camber shape for minimum drag is produced. The planform capability could be extended to straked planforms by inclusion of terms developed by Beverly Beane of M.I.T.

NO. ARO-21

TECHNICAL PROGRAM ELEMENT

TITLE Parametric Estimate of Supersonic Drag of Complete Configurations

FORM PREPARED BY W. B. Gillette DATE 8/23/72

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 drag polar

STATUS: Operational ___, Programming In Development ___, Not Programmed x

REFERENCE ____

OWNERSHIP: Public ___, Private ___, Owner ____

ABSTRACT

Parametric supersonic drag estimates for a complete configuration could be calculated very rapidly by the following components:

1) Flat plate drag - Difference due to L.E. suction times a factor for fuselage effects.
2) Wing wave drag due to thickness by Pluckett's method.
3) Body drag by "transfer rule".
4) Nacelle drag by empirical rules.
5) Empennage drag by Pluckett's method.
6) Simple skin friction estimate.

All components could be represented by parameterized equations.

*Estimate.

NO. DCA-1

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Geometry Control

FORM PREPARED BY J. W. Southall DATE 8/24/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 4 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Time to design one airplane geometry including time to call SHAPE II (DCL-1) and nacelle design (PRO-1 or PRO-2).

STATUS: Operational x , Programming In Development___, Not Programmed___

REFERENCE CPDS Program "DESIGN II" - undocumented.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This program calculates airplane geometry including body, wing, empennage, power plant, landing gear, passenger seating arrangements and cargo arrangements. Capabilities include subsonic, transonic and supersonic commercial jet transports. When used in an integrated computer design/analysis system, this module will revise the airplane to meet the mission requirements and criteria for performance, balance, loadability, stability and control.

Input consists of sizing criteria such as payload, body cross section, wing and empennage parameters and the number and placement of engines. Many variables have been assigned default values based on statistics, current practice or design studies. This reduces the input required to develop a configuration, however, all default values are identified and may be altered.

Output consists of complete definition of the airplane geometry including major structural elements.

TECHNICAL PROGRAM ELEMENT NO. DCA-1 (Continued)

Program Deficiency:

The capability to calculate a geometry description for the control surfaces should be added. This information is required for the low speed performance calculation ARO-8 and the stability and control analysis S&C-3, 4, 5, 6, 21, 22, 23 and 24. Initial sizing will be input. This module will be required to revise the control surfaces to meet the stability and control check S&C-1, 2, and 20 and the stability and control analysis S&C-3, 4, 5, 6, 21, 22, 23 and 24.

The capability to locate fuel tanks and major items of fixed equipment should be added.

The capability to locate pivot points for variable sweep wings should be added.

The capability to identify one additional lifting surface should be added. The capability to identify vertical fins on the wing should be added.

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Geometry Parameters

FORM PREPARED BY J. W. Southall DATE 7/27/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING ________ (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10—— (Words)

OUTPUT VOLUME 10—— (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Calculation of geometry parameters for a 49-point airplane family.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE None

OWNERSHIP: Public___, Private___, Owner________

ABSTRACT

This module will calculate the geometry parameters required for the performance calculations (APF-1) supporting the market analysis.

Input will consist of range, payload, Mach number, wing loading grid, thrust loading grid and technology base. Equations will relate the body length to payload, the fuel volume to wing area and the cruise speed to wing and empennage planform characteristics.

NO. DCA-3

TECHNICAL PROGRAM ELEMENT

TITLE Computerized Space Arrangement Mockup

FORM PREPARED BY J. W. Southall DATE 10/24/72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Locate one item in the structure and check for conflicts.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This module will identify and locate internal volumes reserved within the geometric definition representing the external shape of an airplane. The internal volumes will be represented by combinations of the following shapes:

Shape	Input Variables
1. Sphere	4
2. Cylinder	7
3. General Cone	13
4. Parallelopiped	24
5. General pyramid	24
6. Any shape	As Required

*Estimate.

NO. DCA-4

TECHNICAL PROGRAM ELEMENT

TITLE Level III Configuration Sizing Driver

FORM PREPARED BY W. B. Gillette DATE 10/3/72

LANGUAGE ________ HOST MACHINE ________

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1/2 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 resizing loop

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ________

OWNERSHIP: Public____, Private____, Owner________

ABSTRACT

This module will control the iteration to achieve a sized configuration. The inputs will be the controlling variables, the constraints, and the rules controlling sizing changes.

The module will receive information from the analysis activities and will respond by producing changes to the controlling variables.

*Estimate.

NO. DGL-1

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Exterior Geometry Loft (SHAPE)

FORM PREPARED BY J. W. Southall DATE 7/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 4 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Generate one airplane geometry (wing, body, empennage) cut spars in wing and empennage, cut deck in body.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D183-10139-1, "Airplane Geometry Computer Program 'SHAPE' (TEA-268) - User's Manual", W. B. Gillette, P. L. LeRoy (Unreleased).

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

SHAPE generates wing-like surfaces from input cross-section and planform parameters. The program uses a simplified analytic mapping transformation to develop cross-sections from descriptive parameters and uses linear span-wise interpolation between the parameters of the input cross-sections to develop an entire surface. Body-like surfaces are generated from input crown, keel, and maximum halfbreadth contours using the same mapping function. Results from SHAPE are sufficiently accurate for parametric analysis and early preliminary design studies.

Program Deficiency:

The cross-section capability of the body module should be increased to handle bodies defined as double lobe and triple lobe and should also handle bodies with local or continuous flat sides.

The capability to add pods and fairings for landing gear stowage should also be added.

NO. DGL-2

TECHNICAL PROGRAM ELEMENT

TITLE Mathematically Splined Wing Loft (Geometry Control System - GCS)

FORM PREPARED BY W. B. Gillette DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 14 (Boxes of Source Cards)

TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 wing loft

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-24200 TN, "Wing/Empennage Geometry Control System".

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program provides a mathematically defined wing loft. The process fits a spline (cubic) to the input points, and optional smoothing is accomplished by reduction in the strain energy of the spline.

The inputs are point-wise definitions of wing sections, and the spanlines can be constrained to have cylindrical curvature or straight segments. Point and slope information for control of N.C. machine movements is provided.

This program provides a rapid means of lofting a wind tunnel model wing and providing for N.C. manufacture of the wing.

NO. DGL-3

TECHNICAL PROGRAM ELEMENT

TITLE Mathematically Splined Body Loft (Geometry Control System - GCS)

FORM PREPARED BY W. B. Gillette DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 9 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 body loft

STATUS: Operational ___, Programming In Development X, Not Programmed ___

REFERENCE None

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program provides a mathematically defined body loft. The description is otherwise the same as DGL-2.

NO. DGL-4

TECHNICAL PROGRAM ELEMENT

TITLE Master Dimensions (MD) Definition and Extraction

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 10 (Boxes of Source Cards)

TIMING 60 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Basic extraction program - one pass.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29951 (TX 95) * Userfile 135K Octal Max.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

A Master Dimensions definition is a mathematical means of developing and precisely controlling dimensions, curves and compound geometrical shapes through the use of the computer. This system provides the capability of creating the definitions, extracting data in any geometrical plane that intersects such a definition, and outputting the data as tabulated printout and/or numerical data on magnetic tape for use on a numerically controlled drafting machine or for future input into this program or an APT program.

NO. DGL-5

TECHNICAL PROGRAM ELEMENT

TITLE Mathematical Definition of Airplane Wing

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 8 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT **

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29931 (TX 90)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This provides the capability of creating definitions of airplane wings, extracting data in any geometrical plane that intersects such a definition, and outputting the data as tabulated printout and/or numerical data on magnetic tape for use on a numerically controlled drafting machine or for future input into this program or an APT program.

*Estimate.

**Use DGL-4 for new airplanes. This program is maintained as the reference source for data on the 727, 737 and 747 wings.

NO. DGL-6

TECHNICAL PROGRAM ELEMENT

TITLE Flat Pattern Development

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 60 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10 2/5 (Words)

OUTPUT VOLUME 10 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average program

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-24694 TN - *Userfile 135K Octal Max.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The Flat Pattern Development Program computes the flat pattern development of a wing or body-like structure. The system converts stringers and ribs which are given as input in the form of lines and/or points into a two-dimensional grid system and extracts a surface point from a Master Dimension Definition (MDD) program to form a three-dimensional representation of the skin panel. The flat pattern of this panel is then developed and output representing the flat pattern of the skin panel is given as tabular form and/or graphical form for analysis by the user.

*Estimate.

NO. DGL-7

TECHNICAL PROGRAM ELEMENT

TITLE Aircraft Design and Extraction Language (ADEL)

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 10 (Boxes of Source Cards)

TIMING 60 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{5} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average program

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29924

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

ADEL provides the capability to Tool Design to plot MD data in conjunction with standard tool symbols, using a simplified language. Reduction in flow time and manhours is the result.

*Estimate.

NO. DGL-8

TECHNICAL PROGRAM ELEMENT

TITLE Applied Interactive Data Extraction (AIDE) Program

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Sets up program for batch processing.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29574 TN

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

AIDE provides a capability that allows personnel untrained in the creation of CDC 6600 job control statements or the use of Master Dimensions TX-95 system to extract data from Master Dimensions Definition (MDD). The user can build a file containing DGL-4 data extraction directives interactively at a remote terminal. The output from AIDE may be printed, executed or punched in the batch stream on the CDC 6600.

*Estimate.

NO. DGL-9

TECHNICAL PROGRAM ELEMENT

TITLE Perspective Projections of 3-D Data - PERSPE

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{5} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average program

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-24605

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

PERSPE is a program that provides the capability to produce a perspective view of a three-dimensional object. The minimum input requirement is the set of three-dimensional input points describing the defining lines of the object. The standard output is a perspective view of the object centered and contained within a standard frame. Rotation and frame size are optional.

NO. DGL-10

TECHNICAL PROGRAM ELEMENT

TITLE Control Cabin Design Evaluation

FORM PREPARED BY R. K. Robinson - H. Crowell DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 75 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average program

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29906-1

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This set of computer programs is used to analyze geometry, arrangement efficiency and vision capability for use in flight deck certification. It was used on the 737 for evaluating panel arrangements, procedures, and placement of controls and indicators within the cabin. The normal application is to compare the proposed configuration with an existing baseline.

NO. DSA-1

TECHNICAL PROGRAM ELEMENT

TITLE Wing Structural Arrangement Definition

FORM PREPARED BY R. K. Robinson DATE 7/28/72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

The wing box primary structural arrangement is synthesized with the geometry defined in DCA-1.

All inspar box structure is defined as to location, material and structural concept. Skin panels, ribs, access cut outs, control surface and landing gear support structure and any other structure required for structural analysis in later programs, are also defined.

This task is to be coordinated with DSA-2.

*Estimate.

NO. DSA-2

TECHNICAL PROGRAM ELEMENT

TITLE Body Structural Arrangement Definition

FORM PREPARED BY R. K. Robinson DATE 7/28/72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public ___, Private ___, Owner ______

ABSTRACT

The body primary structural arrangement is synthesized with the geometry defined in DCA-1.

All major body structural elements, skin panels, frames, bulkheads, floor structure wheel well and keel beam and any other structure required for structural analysis in later programs are defined as to location, material and structural concept.

This task is to be coordinated with DSA-1 and -3.

*Estimate.

NO. DSA-3

TECHNICAL PROGRAM ELEMENT

TITLE Empennage Structural Arrangement Definition

FORM PREPARED BY R. K. Robinson DATE 7/28/72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

The empennage primary structural arrangement is synthesized with the geometry defined in DCA-1.

All major structural elements, skin panels, frames, bulkheads, spars and any other structure required for structural analysis in later programs are defined as to location, material and structural concept.

This task is to be coordinated with DSA-2.

*Estimate.

NO. DSA-4

TECHNICAL PROGRAM ELEMENT

TITLE Landing Gear Structural Arrangement Definition

FORM PREPARED BY R. K. Robinson DATE 9/5/72

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE ____

OWNERSHIP: Public___, Private___, Owner____

ABSTRACT

The landing gear structural arrangement is synthesized with the geometry defined in DCA-1.

All major structural elements, wheels, trucks, main posts, trunions, drag links and struts are defined as to location material and structural concept.

This task is to be coordinated with DSA-1 and -2.

*Estimate.

NO. DSA-5

TECHNICAL PROGRAM ELEMENT

TITLE Interactive Design - Structural

FORM PREPARED BY R. K. Robinson DATE 8/31/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 5 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE "Light Pen Input to a Design Package".

OWNERSHIP: Public ___, Private X, Owner McDonnel Douglas - Lockheed

ABSTRACT

This tool would provide a man/machine interface to the computer for use on both analytical and graphics oriented design problems. Many Cathode Ray Tube display, light pen, keyboard equipped terminals would connect the designers to a data blank, a computational module and an automated micro-film hardcopy reproduction service.

The user, mominally a structural design engineer, could determine material allowables, load conditions and all other design criteria from data stored by staff experts utilizing their own computer analytical and test programs. The user then could proceed to develop his design using staff approved analytical modules and the graphics capabilities of the ADEL program with GCS and MD loft definition data from the memory bank. The CRT display would provide all pictures and calculations required to completely define the design. Upon completion of the design definition, all data would be stored on the memory bank. This data then would be reviewed by the appropriate staff personnel and management. Such review could be accomplished interactively or by inspection of hardcopy drawings, documents or other type of display. Upon approval the data would be released

*Estimate

into a secured data storage bank for access by manufacturing, quality control, engineering or any other authorized party. It is intended that this stored data would be accessed directly for control of N.C. machining operations.

NO. DSA-6

TECHNICAL PROGRAM ELEMENT

TITLE Frame Design Program

FORM PREPARED BY G. N. Roe DATE 9/12/72

LANGUAGE ______ HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This program would be used with the interactive design tool (DSA-5) and the graphics program, ADEL (DGL-7) by the design engineer to develop sizes for body frame detail parts. For any body frame on the aircraft, at any point on that body frame, input data would be called from the data bank and would include frame depth, body radius of curvature, ground and flight loads, body pressure loads, minimum material thicknesses, body skin thickness, frame stability requirements, and material allowables. Input is from DSA-2, DCA-1, DGL-3 or DGL-4 and STR 3, 4, and 5.

The designer then sizes the various elements of the body frame using the frame design program. First the design program would optimize the sizes of skin pads, inner and outer chords and shear webs using the input data and display the results including a weight for the frame segment for review by the designer and store the results for later comparison. Next the designer reviews the results and revises the sizes using his knowledge of optimum fastener location, stringer/frame interface criteria, load path continuity requirements, and producibility. These changes and

*Estimate

reasons for them are stored in the data bank as historical background for later analysis and widely applicable design innovations may be retrieved for inclusion in revisions to IPAD software.

After the designer has reviewed the results the frame design program would optimize the sizes not revised by the designer using the revised sizes as fixed dimensions.

Output parameters from the final run of the frame design program would include all frame detail sizes. ADEL (DGL-7) would be used to draw any required cross sections and details of the frame for structural concept studies.

All output data including detail sizes and section properties would be stored in the memory bank for review and approval of the appropriate staff personnel and management. After approval the data would be stored in a secure data bank and made available for use in preparation of engineering drawings (VI) and in design detail analysis (VI).

NO. DSA-7

TECHNICAL PROGRAM ELEMENT

TITLE Floor Beam Design Program

FORM PREPARED BY G. N. Roe DATE 9/12/72

LANGUAGE ______ HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 design case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This program would be used with the interactive design tool (DSA-5) and the graphics program, ADEL, (DGL-7) by the design engineer to develop sizes for floor beam detail parts. For any floor beam, at any point on the beam, input data would be called from the data bank and would include maximum beam depth, floor beam length and pitch, seat and floor panel loads, minimum material thicknesses, end fixity conditions and supports (i.e., stanchions, seat tracks), minimum beam stiffness requirements, and material allowables. Input from DSA-2, DCA-1, DGL-3 or DGL-4 and STR 3, 4, and 5.

The designer then sizes the various floor beam elements using the floor beam design program. First, the program would optimize the sizes for the chords, beam depth, the shear web, web stiffening (if any), and end fittings using the input data. The results of this operation including a beam weight are displayed for review by the designer and stored for later use. Next, the designer reviews the results and revises the sizes using his knowledge of optimum fastener location, load path continuity

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*Estimate

requirements and producibility. These changes and the reasons for them are stored in the data bank as historical background for later analysis and widely applicable design innovations may be retrieved for inclusion in revisions to IPAD software. After the designer has reviewed the results the floor beam design program would optimize the sizes not revised by the designer as fixed dimensions.

Output parameters from the final run of the floor beam design program would include all beam detail sizes. ADEL (DGL-7) would be used to draw any required cross sections or details of the frame for structural concept studies.

All output data including detail sizes and section properties would be stored in the memory bank for review and approval of the appropriate staff personnel and management. After approval the data would be stored in a secure data bank and made available for use in preparation of engineering drawings (VI) and in design detail analysis (VI).

NO. FCS-1

TECHNICAL PROGRAM ELEMENT

TITLE Control System Analyses - QR Program

FORM PREPARED BY T. M. Richardson DATE 7/11/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 60 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 flight condition with 10 degrees of freedom, 1 root locus, 1 frequency response and 1 time response.

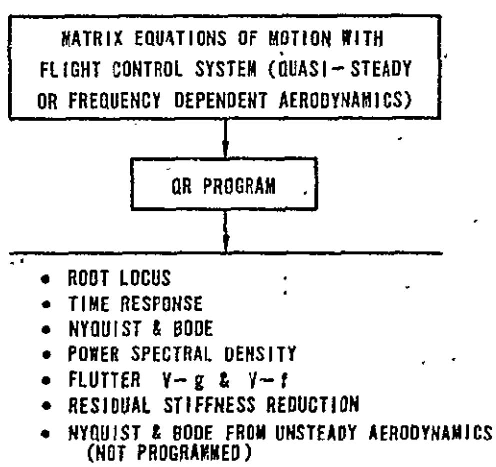
STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6A11656-1TN, "QR User's Guide", T. M. Richardson, July 1969.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

Classical control systems analysis and synthesis techniques (root locus, time response, and frequency response) can be performed using this program. Laplace transformed differential equations form the basic input data.



NO. FCS-2

TECHNICAL PROGRAM ELEMENT

TITLE Control System Analyses - MDELTA Program

FORM PREPARED BY T. M. Richardson DATE 7/18/72

LANGUAGE Fortran IV HOST MACHINE IBM-360

PROGRAM SIZE 15 (Boxes of Source Cards)

TIMING 120 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 flight condition with 10 degrees of freedom, 1 root locus, 1 frequency response, and 1 time response.

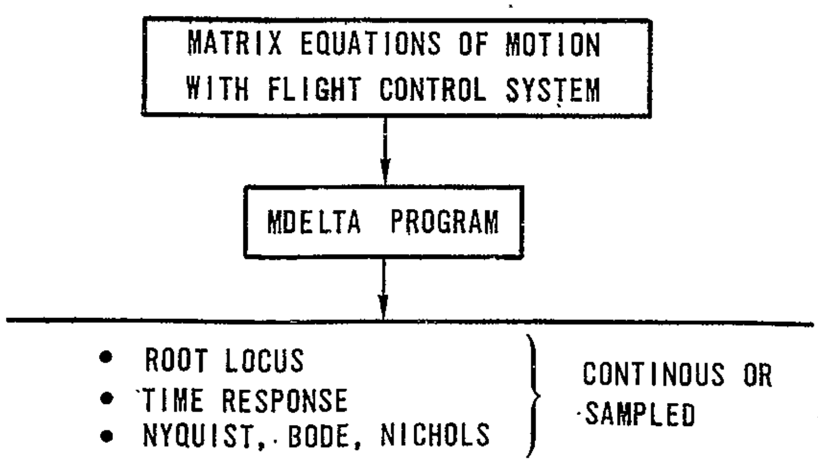
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. AS 2384, "MDELTA User's Manual". B. H. Anstiss, July 1968.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The MDELTA program provides frequency response, root locus, time response, and gain boundary analyses for continuous systems defined by matrix polynomial equations.



NO. FCS-3

TECHNICAL PROGRAM ELEMENT

TITLE Control System Optimization - LORPS Program

FORM PREPARED BY T. M. Richardson DATE 7/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 6 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per case of 4th through 13th order system.

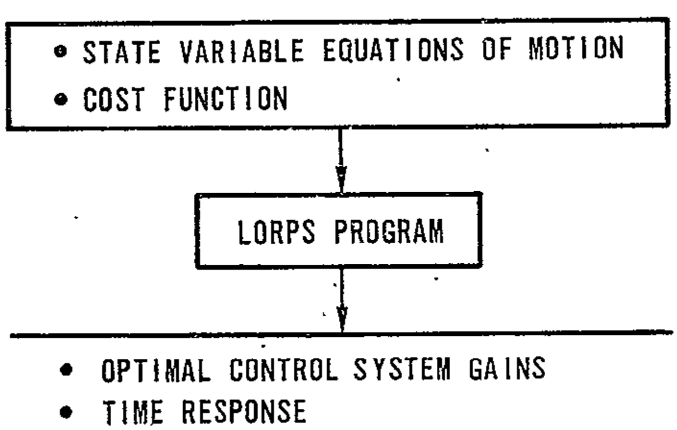
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6-29949TN, "LORPS: A Digital Computer Program for Optimizing Multi-Input Output Linear Control Systems", R. H. Fulton, April 1970.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This is a computer program for optimizing multi-input/output linear control systems via the modified eigenvector technique. Systems designed with the program are optimal for a quadratic index of performance. the program can compute the optimal feedback for the state-regulator, tracking-regulator, and implicit-model-following systems. An additional feature of the program is its ability to compute and display the closed-loop time responses and eigenvalue sensitivities in tabulated or graphical form.



NO. FCS-4

TECHNICAL PROGRAM ELEMENT

TITLE Control System Optimization - Generalized Inverse

FORM PREPARED BY T. M. Richardson DATE 7/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case with 5 unknowns.

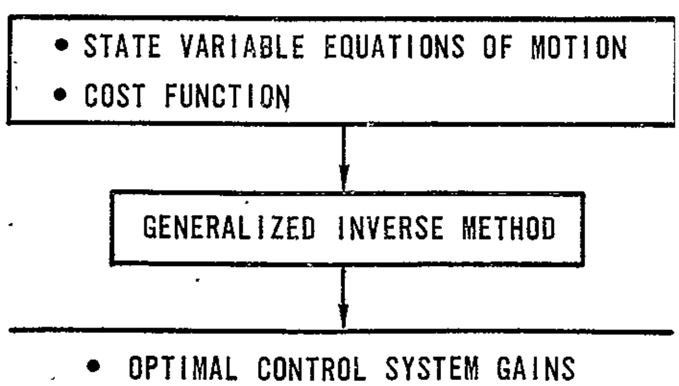
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6A11130-1, "Techniques for Optimal and Suboptimal Stability Augmentation System Design", C. A. Markland, January 1969.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The reference describes several optimization techniques. The only important one not found in the LORPS program (FCS-3) is the generalized inverse method. The reference contains Fortran code for implementing the technique.



NO. FCS-5

TECHNICAL PROGRAM ELEMENT

TITLE Control System Optimization - Gain Scheduling

FORM PREPARED BY T. M. Richardson DATE 7/18/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case with 20 samples and 5 unknowns.

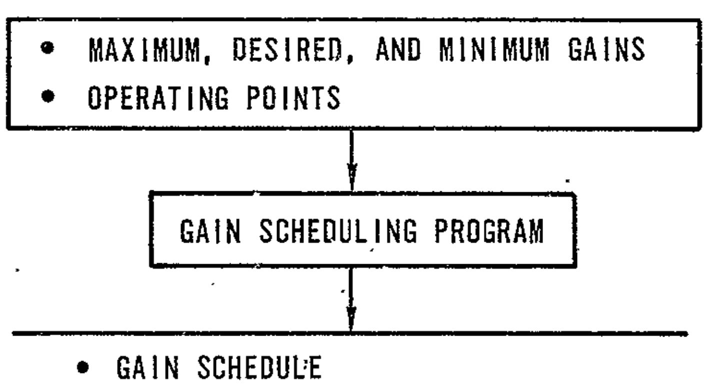
STATUS: Operational X, Programming In Development X, Not Programmed ____

REFERENCE Not documented.

OWNERSHIP: Public ____, Private X, Owner The Boeing Company

ABSTRACT

A program is available for constructing a control system gain schedule for all points on the operating envelope. The user specifies maximum, desired and minimum gains for each Mach number and altitude. The number of operating points is arbitrary.



NO. FCS-6

TECHNICAL PROGRAM ELEMENT

TITLE Control System Optimization - Modal Program

FORM PREPARED BY T. M. Richardson DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case with 5 unknowns.

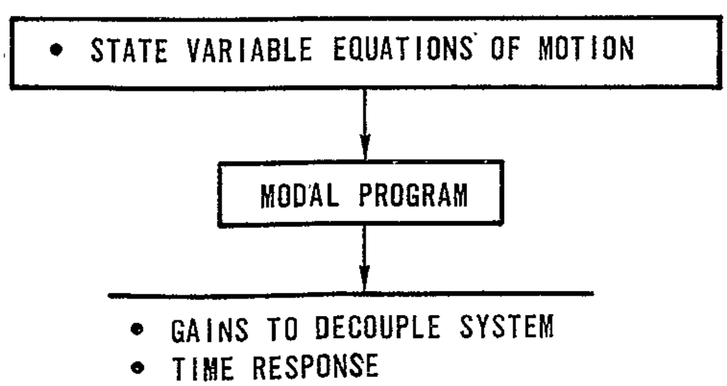
STATUS: Operational X , Programming In Development___, Not Programmed___

REFERENCE Boeing Document No. D6-24712TN, "Modal: A Digital Computer Program for Decoupling Multi-Variable Control Systems (TED-038)", R. H. Fulton, August 1970.

OWNERSHIP: Public___, Private X , Owner The Boeing Company

ABSTRACT

This is a computer program for decoupling a multi-variable linear control system into its dominant modes. It computes the decoupling-feedback-matrix which minimizes the effects of cross coupling between modes even for the non-ideal observation and control cases. Additional features of the program include time response data display of the closed loop decoupled system in tabulated or graphical form and conversational mode processing via an iteractive system.



NO. FCS-7

TECHNICAL PROGRAM ELEMENT

TITLE Control System Optimization - Decoupling

FORM PREPARED BY T. M. Richardson DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case with 5 unknowns.

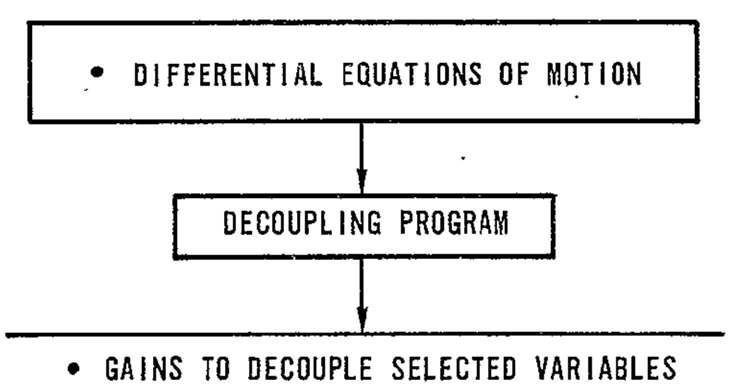
STATUS: Operational X, Programming in Development X, Not Programmed ____

REFERENCE Boeing Document No. D6A11132-1, "Analytical Synthesis of a Decoupled Lateral-Directional Stability Augmentation System", Keith Mitchell, December 1967.

OWNERSHIP: Public ____, Private X, Owner ____

ABSTRACT

This is a method of representing a multi-variable system such that the coupling present between output and input variables is observable by inspection. This representation was used to synthesize a Stability Augmentation System for the 2707 Supersonic Transport.



NO. FCS-8

TECHNICAL PROGRAM ELEMENT

TITLE Digital Simulation - GD Program

FORM PREPARED BY T. M. Richardson DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE IBM 360/CDC 6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per 1 second real time for a 6 degree of freedom simulation.

STATUS: Operational X, Programming In Development __, Not Programmed __

REFERENCE Boeing Document D2-125231-1, "Generalized Six Degree of Freedom Simulation, Engineering Description", John T. Patha, Not released.
Boeing Document D2-125232-1, "Generalized Six Degree of Freedom Simulation (AS 2808) Computing and Analysis Usage Manual", M. Vardell Lines, August 1968.

OWNERSHIP: Public __, Private X, Owner The Boeing Company

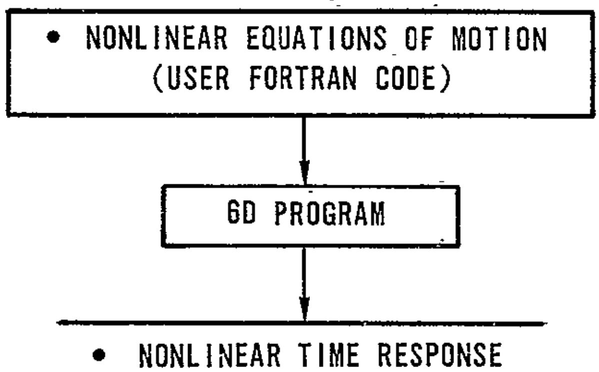
ABSTRACT

The General Six Degree of Freedom Simulation program was written to provide a flexible tool for studying rigid body motions of vehicles using varying degrees of analysis complexity. Due to the wide variety of applications and simulation complexity the program was written as a framework which can easily be built upon to form complete programs for the various applications. The module construction of the program allows the user to include only those items which are applicable to his problem. It further allows the user to simulate the hardware to the detail he desires.

Previous applications of the program include the following:

High g boosters
Large multistage boosters
Re-entry vehicles
Roll-to-steer, lifting body vehicles

TECHNICAL PROGRAM ELEMENT NO. FCS-8 (Continued)



NO. FCS-9

TECHNICAL PROGRAM ELEMENT

TITLE Digital Simulation - NONSIM Program

FORM PREPARED BY T. M. Richardson DATE 7/19/72

LANGUAGE Fortran IV HOST MACHINE IBM 360

PROGRAM SIZE 6 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per 1 second real time for a 6 degree of freedom simulation.

STATUS: Operational X, Programming In Development __, Not Programmed __

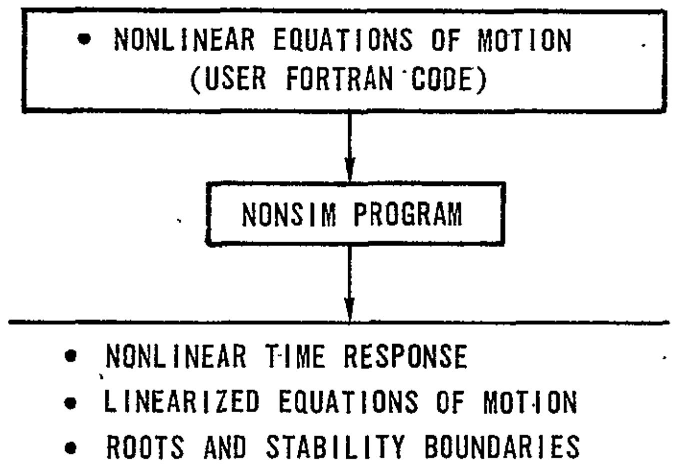
REFERENCE Boeing Document No. D2-133063-2, "A Graphic Digital Dynamic Analysis Facility", J. D. Burroughs, May 1971.

OWNERSHIP: Public __, Private X, Owner The Boeing Company

ABSTRACT

This is a digital computer program that provides a facility for nonlinear simulation and dynamic analysis. To utilize this facility the user provides a digital subroutine that contains the nonlinear equations of motion describing the system to be studied. The user chooses whatever means of integration he wishes to use from numerous available integration routines. The program described in this document then provides a convenient means of data display, storage, retrieval, and comparison. In addition to time history generation, linear analyses, stability bounds, and a variety of functional relationships can be obtained from the given nonlinear model. An interactive graphic console is used to present nonlinear and linear analysis information concerning the dynamic system as it is being studied. This broad analytical capability makes it possible to bring several techniques of dynamics analysis to bear on the problem during a single graphic computer session. A complete record of all changes made to the system model and the results of all analyses are automatically made by the computer line printer.

TECHNICAL PROGRAM ELEMENT NO. FCS-9 (Continued)



NO. FCS-10

TECHNICAL PROGRAM ELEMENT

TITLE Digital Simulation - MIMIC Program

FORM PREPARED BY T. M. Richardson DATE 7/20/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per 1 second real time for a 6 degree of freedom simulation.

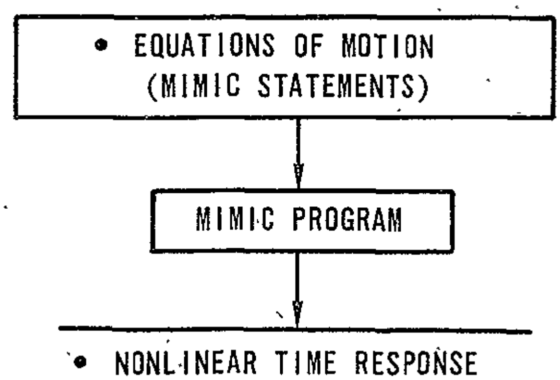
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6-24652, "MIMIC User's Guide", T. G. Baker, May 1970.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

MIMIC is a digital computer program used to solve systems of differential equations that may have non-linearities. A set of MIMIC statements may be taken from a block diagram or a mathematical description of a problem. The set of instructions available in MIMIC is closely correlated with common engineering analog terminology. The program's output consists of time histories of user-specified variables.



NO. FCS-11

TECHNICAL PROGRAM ELEMENT

TITLE Rigid Body Equations of Motion with Static Aeroelastic Corrections (QSE)

FORM PREPARED BY T. M. Richardson DATE 7/20/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per flight condition

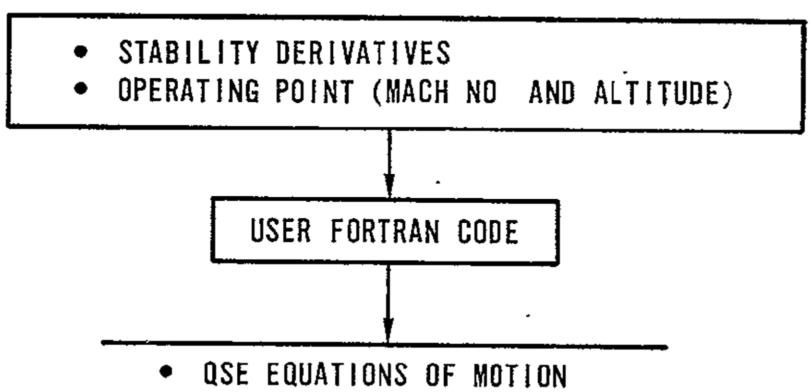
STATUS: Operational X, Programming In Development X, Not Programmed ____

REFERENCE Boeing Doc. D6A11451-1TN, "An MDELTA Computer Program Adaptation to Airplane Small Perturbation Equations of Motion", J.H.Scott, P.M.Condit, Feb. ~~1969. Boeing Doc. D2-2459, "Airplane Equations of Motion", Carl~~ Hendrickson, 1958.

OWNERSHIP: Public ____, Private X, Owner The Boeing Company

ABSTRACT

The quasi-static elastic (QSE) equations of motion describe the rigid body airplane degrees of freedom. However, the stability derivatives are corrected to account for static aeroelasticity. Input data consists of stability derivatives and operating point (Mach number and altitude). User furnished Fortran code converts those data to equations of motion.



NO. FCS-12

TECHNICAL PROGRAM ELEMENT

TITLE Flight Control System Hardware Sizing

FORM PREPARED BY T. M. Richardson DATE 7/27/72

LANGUAGE Fortran IV HOST MACHINE ____

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per flight control system

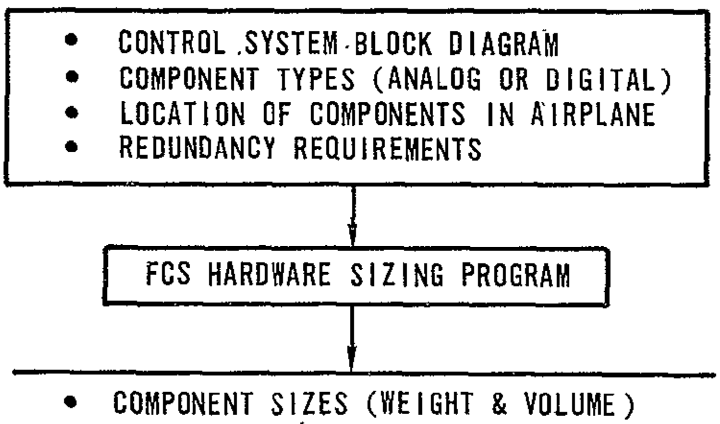
STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ____

OWNERSHIP: Public____, Private____, Owner____

ABSTRACT

This computer program would count the elements of the flight control system electronics and would predict electronic component weights.



*Estimate.

NO. FCS-13

TECHNICAL PROGRAM ELEMENT

TITLE Actuator Transfer Functions

FORM PREPARED BY T. M. Richardson DATE 7/27/72

LANGUAGE Fortran IV HOST MACHINE

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per actuator

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

This computer program will develop the transfer functions of torque as a function of input signal and actuator displacement.

$$Q_A = \frac{(N_{GA})\ X_{IN} - (N_{HA})\ \delta_A}{(D_{HA})}$$

where:

Q_A - actuator torque

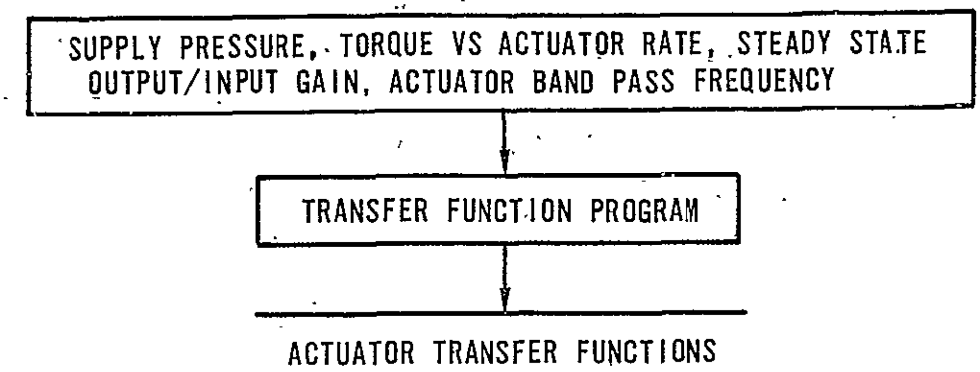
X_{IN} - input to actuator

δ_A - actuator rotation

N_{GA}, N_{HA}, and D_{HA} - polynomials in the Laplace operator, S.

*Estimate

TECHNICAL PROGRAM ELEMENT NO. FCS-13 (Continued)



NO. FCS-14

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Flight Control System Synthesis

FORM PREPARED BY T. M. Richardson DATE 8/15/72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per flight condition

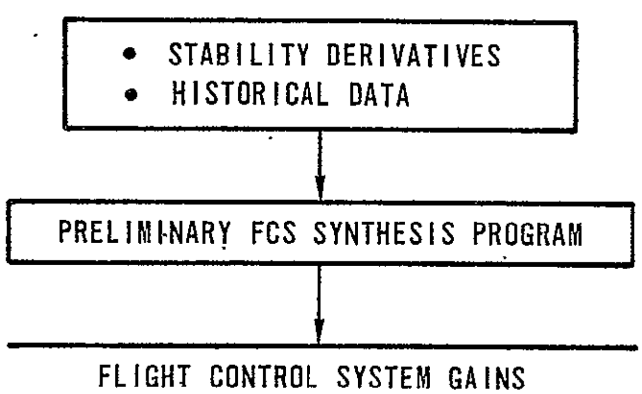
STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This computer program will perform a preliminary flight control system synthesis. Input data are sparse. Hence, estimated and historical data are required to complement the known information. Only control system gains are produced. Filter characteristics are anticipated to the extent the filter break frequencies will limit the feedback gains.



*Estimate.

NO. FCS-15

TECHNICAL PROGRAM ELEMENT

TITLE Actuator Sizing

FORM PREPARED BY A. D. Tweeddale DATE 8/29/72

LANGUAGE Fortran HOST MACHINE

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT per actuator

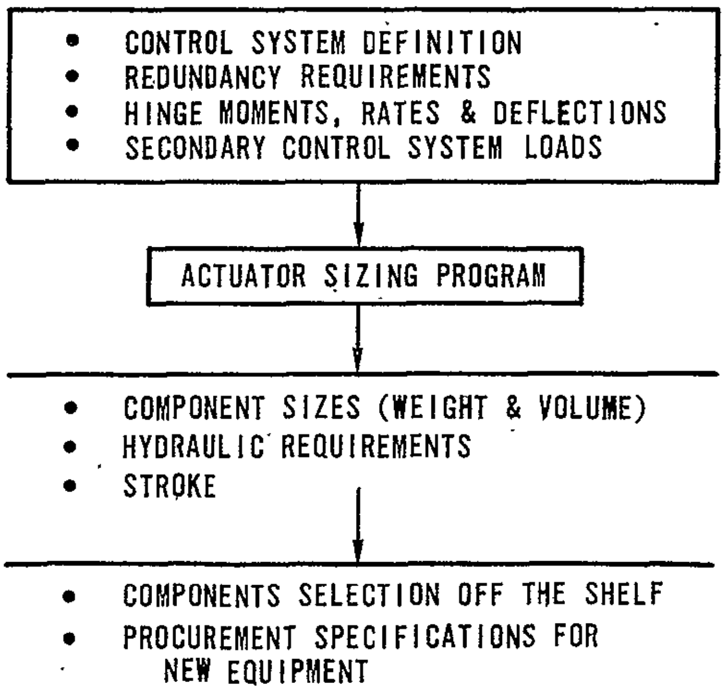
STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

This computer program would size the primary and secondary control system actuators. Output would be actuator size, stroke and weight.



*Estimate

NO. FCS-16

TECHNICAL PROGRAM ELEMENT

TITLE Flight Control System Definition

FORM PREPARED BY A. D. Tweeddale DATE 8/30/72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 set of schematics

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public ___, Private ___, Owner ______

ABSTRACT

Requirements are determined from FCS-12, 15 and 17, STM-2, 3 and 4 tasks. This information is converted to system schematics. From the schematic design of critical mechanical elements is started.

*Estimate.

NO. FCS-17

TECHNICAL PROGRAM ELEMENT

TITLE FCS Reliability and Redundancy Analysis

FORM PREPARED BY A. D. Tweeddale DATE 9/1/72

LANGUAGE Fortran HOST MACHINE ______

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING .50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT each control path, primary and secondary

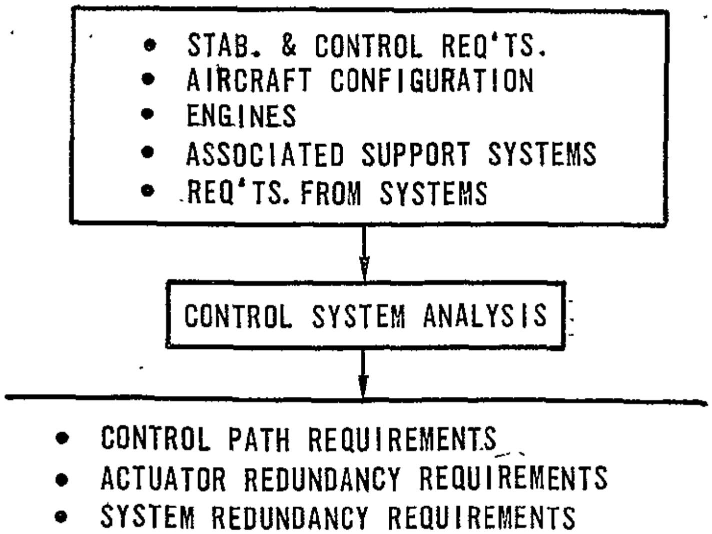
STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This module defines the redundancy concept for each primary and secondary control path. It relies heavily on past experience, aircraft configuration and system concepts.



*Estimate.

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NO. FNC-1

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Design Cost Model (Manhours and Dollar Model)

FORM PREPARED BY J. H. Ward DATE 8/3/72

LANGUAGE Fortran HOST MACHINE IBM 360

PROGRAM SIZE 80 Records

TIMING 10 sec. CPU

INPUT VOLUME 20-30 words (min)

OUTPUT VOLUME 100 words (min) 1200 words max)

BASIS FOR TIMING, INPUT, AND OUTPUT Current experience.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Program needs periodic updating for labor and overhead rates and adjustment to base data to reflect technology (composites, titanium).

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

A flexible computer program which calculates and prints out program cost summaries for non-recurring and recurring cost for three airplane quantities by 10 major airplane components. Output options are hours and material dollars by cost element (engineering, developmental labor, production labor, purchased equipment and production material), total dollars, and Project Cost Report which contains hours and total dollars. Output is in constant year dollars.

Inputs are limited to group weight statements. Engine cost is a direct input.

Note: Data Base is proprietary.

NO. FNC-2

TECHNICAL PROGRAM ELEMENT

TITLE Production Cost Estimate (COSIMOD)

FORM PREPARED BY J. H. Ward DATE 8/3/72

LANGUAGE COSI* HOST MACHINE IBM 360

PROGRAM SIZE 800 records

TIMING 60 sec. CPU

INPUT VOLUME 100 words

OUTPUT VOLUME 200 words (variable)

BASIS FOR TIMING, INPUT, AND OUTPUT Current experience.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Operational in current form.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

*Being programmed in Fortran

A detailed cost estimate for a production quantity. Output as a minimum is Project Cost Report summary of hours and dollars. Options are detailed cost elements by sections and components of the airplane.

Inputs are weight, part cards, labor and overhead rates, flight test hours (certification and follow-on Airborne Special Test Equipment (ASTE), test options, and mockup options.

Note: Data is proprietary.

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NO. FNC-3

TECHNICAL PROGRAM ELEMENT

TITLE Estimate of Overtime Production Costs
(COSIMOD Phase B)

FORM PREPARED BY J. H. Ward DATE 8/3/72

LANGUAGE COSI HOST MACHINE IBM 360

PROGRAM SIZE 550 records

TIMING 40 sec CPU

INPUT VOLUME 100 words (variable)

OUTPUT VOLUME Variable

BASIS FOR TIMING, INPUT, AND OUTPUT Similar to earlier version.

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

An extension of the Cosimod model which provides production cost overtime.

This program has the capability of changing the Manufacturing schedule, customer type and introduction schedule, assess impact of changes, and derivative of base model.

Note: Data is proprietary.

NO. FNC-4

TECHNICAL PROGRAM ELEMENT

TITLE. Risk Analysis Model

FORM PREPARED BY J. H. Ward DATE 8/3/72

LANGUAGE Fortran HOST MACHINE IBM 360

PROGRAM SIZE 70 records

TIMING 10 sec. CPU

INPUT VOLUME 70 min. (Words)

OUTPUT VOLUME 100 min. (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Current experience

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program determines the return on investment and cash flow by year. It has the capability of escalating costs and sales price.

Inputs are delivery schedule, ordering schedule, non-recurring expenditures, and advance payment schedule.

NO. MIS-1

TECHNICAL PROGRAM ELEMENT

TITLE MANAGEMENT INFORMATION SYSTEM - CONFIGURATION MANAGEMENT

FORM PREPARED BY J. W. Southall DATE 10-20-72

LANGUAGE ______ HOST MACHINE ______

* PROGRAM SIZE 3 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^5 (Words)

* OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 complete format set.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This module will use the capability of the data base manager to extract and display configuration information in the formats required to support the management decision process.

* estimate

NO. MIS-2

TECHNICAL PROGRAM ELEMENT

TITLE MANAGEMENT INFORMATION SYSTEM - OPERATIONS MANAGEMENT INTERFACE

FORM PREPARED BY J. W. Southall DATE 10-20-72

LANGUAGE ____ HOST MACHINE ____

* PROGRAM SIZE 3 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^5 (Words)

* OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 complete format set.

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ____

OWNERSHIP: Public ___, Private ___, Owner ____

ABSTRACT

This module will use the capability of the data base manager to extract and display operations information in the formats required to support the management decision process.

* estimate

NO. MIS-3

TECHNICAL PROGRAM ELEMENT

TITLE MANAGEMENT INFORMATION SYSTEM-PROGRAM MANAGEMENT INTERFACE

FORM PREPARED BY J. W. Southall DATE 10-20-72

LANGUAGE ________ HOST MACHINE ________

*PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^5 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 set of formats

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ________

OWNERSHIP: Public___, Private___, Owner________

ABSTRACT

This module will use the capability of the data base manager to extract and display program information in the formats required to support the management decision process.

* estimate

NO. MKT-1

TECHNICAL PROGRAM ELEMENT

TITLE OPEN MARKET MODEL

FORM PREPARED BY Mark S. Lee DATE 7-27-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One year, one airline, and one market assumption.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE None

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Develops forecasts of total number of airplanes required by the world's airlines as a function of airplane capacity, range and operating cost.

NO. MKT-2

TECHNICAL PROGRAM ELEMENT

TITLE MARKET ENVIRONMENT DISCIPLINES

FORM PREPARED BY Mark S. Lee DATE 7-27-72

LANGUAGE FORTRAN HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^4 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One airline, one year, one market assumption

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE none

OWNERSHIP: Public ___, Private ___, Owner ___

ABSTRACT

Processes market data computations and source data for market environment factors such as market category limitations, competitive factors of market shares, growth and traffic trends and probabilities (with time periods), wind, temperature and airfield effects, etc.

* estimate

NO. MKT-3

TECHNICAL PROGRAM ELEMENT

TITLE MISSION REQUIREMENTS AND MARKET POTENTIAL ASSESSMENT

FORM PREPARED BY Mark S. Lee DATE 7-27-72

LANGUAGE FORTRAN HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One airplane route system

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE none

OWNERSHIP: Public____, Private____, Owner____

ABSTRACT

Analyzes market requirements and determines design mission requirements that need to be met. Evaluates the potential traffic needed for input to MKT-6.

* estimate

NO. MKT-4

TECHNICAL PROGRAM ELEMENT

TITLE AIRPLANE ECONOMIC ANALYSIS MODEL

FORM PREPARED BY Mark S. Lee DATE 7-27-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One airplane, one set of ranges.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE none

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Detailed analysis of operating costs and return on investment of subject airplane for specified mission load factors and ranges.

NO. MKT-5

TECHNICAL PROGRAM ELEMENT

TITLE ROUTE SYSTEM ECONOMIC ANALYSIS MODEL

FORM PREPARED BY Mark S. Lee DATE 7-27-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 120 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One airplane route system

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE none

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Detailed analysis of operating costs and return on investment over a specified route system with representative frequencies and load factors by segment.

NO. MKT-6

TECHNICAL PROGRAM ELEMENT

TITLE MARKET SUITABILITY AND SALES POTENTIAL FORECAST

FORM PREPARED BY Mark S. Lee DATE 7-27-72

LANGUAGE FORTRAN HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 120 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^4 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One airline traffic system, one year.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE none

OWNERSHIP: Public___, Private___, Owner___

ABSTRACT

Required to provide output of probable market with time, effect of cost/price variations, trades, etc., as required in context with the input options, analysis constraints and probabilities.

* estimate

NO. MTH-1

TECHNICAL PROGRAM ELEMENT

TITLE PROGRAMMED ARITHMETIC

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME $10^{N.A.}$ (Words)

OUTPUT VOLUME $10^{N.A.}$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This is a collection of subroutines that perform arithmetical operations in the fixed point, floating point, interval arithmetic and rational arithmetic modes.

NO. MTH-2

TECHNICAL PROGRAM ELEMENT

TITLE ELEMENTARY FUNCTIONS

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME $10^{N.A.}$ (Words)

OUTPUT VOLUME $10^{N.A.}$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This collection of subroutines provides the elementary functions, namely trigonometric, hyperbolic, exponential, logarithmic, and roots and powers.

NO. MTH-3

TECHNICAL PROGRAM ELEMENT

TITLE POLYNOMIALS AND SPECIAL FUNCTIONS

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME $10^{N.A.}$ (Words)

OUTPUT VOLUME $10^{N.A.}$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This set of subroutines provides for the algebraic manipulation of non-zero polynomials and for the calculation of the following special functions:

- Bessel functions
- Elliptic integrals
- Error function
- Gamma function and natural log
- Hankel function
- Sine and Cosine integrals
- Spherical Bessel functions

NO. MTH-4

TECHNICAL PROGRAM ELEMENT

TITLE ORDINARY DIFFERENTIAL EQUATIONS

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10 N.A. (Words)

OUTPUT VOLUME 10 N.A. (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This set of subroutines provides for the solution to ordinary differential equations.

NO. MTH-5

TECHNICAL PROGRAM ELEMENT

TITLE INTERPOLATION, APPROXIMATION, QUADRATURE, ETC.

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME ~~10~~ N.A. (Words)

OUTPUT VOLUME ~~10~~ N.A. (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This set of subroutines provides a general curve-fitting capability.

NO. MTH-6

TECHNICAL PROGRAM ELEMENT

TITLE LINEAR ALGEBRA

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME $10^{\text{N.A.}}$ (Words)

OUTPUT VOLUME $10^{\text{N.A.}}$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

These programs will provide the capability to deal with equation-solving in the exactly and overdetermined cases, matrix inversion, eigenvalue and lambda-matrix problems.

NO. MTH-7

TECHNICAL PROGRAM ELEMENT

TITLE PROBABILITY AND STATISTICS

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10 ~~N.A.~~ (Words)

OUTPUT VOLUME 10 ~~N.A.~~ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This set of programs will provide for calculations in the fields of probability and statistics.

NO. MTH-8

TECHNICAL PROGRAM ELEMENT

TITLE NONLINEAR EQUATIONS

FORM PREPARED BY W. Gillette DATE 1/12/73

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE N.A. (Boxes of Source Cards)

TIMING N.A. (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME $10^{N.A.}$ (Words)

OUTPUT VOLUME $10^{N.A.}$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT N.A.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document D6-29720

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This provides for the solving of non-linear equations in the following subdivisions:

Zeros of Polynomials

Zeros of an Arbitrary Nonlinear Function in One Variable

Solutions of Nonlinear Systems of Equations

NO. PNZ-1

TECHNICAL PROGRAM ELEMENT

TITLE NOISE PREDICTION

FORM PREPARED BY R. B. French DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 3 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Predict maximum perceived noise at one point on the ground.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Coordination Sheet ANS-RES-280 (Program TEE-187)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program contains the latest noise prediction techniques for estimating maximum fly-by noise of a given aircraft using turbojet or turbofan engines. It will predict the maximum perceived noise at a single point on the ground, or with a simple driver, will generate entire noise footprints. The program considers the combined effect of noise from various sources (jet noise, turbomachinery noise, etc.).

NO. PRF-1

TECHNICAL PROGRAM ELEMENT

TITLE AIRPLANE PERFORMANCE CALCULATION FOR MARKET ANALYSIS

FORM PREPARED BY W. B. Gillette DATE 7-17-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Calculation of performance characteristics of a 49-point airplane family

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE None

OWNERSHIP: Public____, Private____, Owner______

ABSTRACT

This module will calculate field and cruise performance using simplified expressions. For instance, the takeoff field length might be given by

$$T.O.F.L. = (TOFL)_0 + \frac{\partial FL}{\partial K_{TO}} * K_{TO} + \frac{\partial FL}{\partial C_D} (C_{D_G} - \mu \rho_L)$$

$$K_{TO} = \frac{(GW)^2}{T * C_{L_{LO}} * S * \sigma}$$

Similar equations will be used for all the field and cruise performance. The cruise drag will come from Module ARO-7, the low speed drag from ARO-8, and the engine performance from PRO-3, 4, or 5.

* estimate

NO. PRF-2

TECHNICAL PROGRAM ELEMENT

TITLE CALCULATION OF FLIGHT PERFORMANCE

FORM PREPARED BY W. B. Gillette DATE 7-19-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 15 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical 15-segment cruise mission.

STATUS: Operational X , Programming In Development __, Not Programmed __

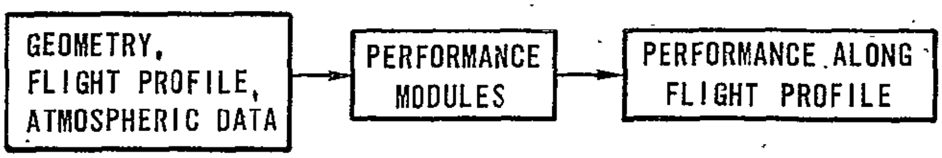
REFERENCE Boeing document, "TEA 238 Description", P. G. Osterbeck (unreleased)

OWNERSHIP: Public __, Private X , Owner The Boeing Company

ABSTRACT

The simplified equations of motion (the same as used for flight certification) are integrated stepwise for acceleration, climb, descent and cruise. Capabilities in this program allow for the calculation of all current airplane operation practices, plus variations that are not yet certified. Restrictions are primarily 1) small flight path angle 2) thrust vector aligned with body axis 3) no thrust-lift interaction.

The calculation is supported by the cruise drag module ARO-7, by the thrust module PRO-3, 4, or 5, and by tables of atmospheric data.



NO. PRF-3

TECHNICAL PROGRAM ELEMENT

TITLE TAKEOFF AND CLIMBOUT PERFORMANCE

FORM PREPARED BY W. B. Gillette DATE 7-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 takeoff and climbout calculation

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE Documentation incomplete on program "ATØ2"

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

Takeoff and climbout are calculated for the balanced field situation, if it can be achieved. The module iterates to find the largest flap setting that will meet the F.A.A. minimum climb gradient. The effect of thrust cutback on observer station noise is estimated. Engine thrust, engine angle, airspeed and altitude along the takeoff profile are provided for subsequent noise footprint determination.

Limitations 1) small flight path angles, 2) No radial acceleration 3) Thrust angle aligned with body axis 4) No thrust-lift interaction. The low speed drag module ARO-3 and thrust modules PRO-3 to 6 support the calculation.

NO. PRF-4

TECHNICAL PROGRAM ELEMENT

TITLE LANDING PERFORMANCE

FORM PREPARED BY W. B. Gillette DATE 7-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 6 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Landing performance calculation.

STATUS: Operational___, Programming In Development X , Not Programmed___

REFERENCE Documentation incomplete on module "ALAND 2"

OWNERSHIP: Public___; Private X , Owner The Boeing Company

ABSTRACT

The landing calculation iterates to find the minimum flap angle that will meet the FAR 25 climbout requirements. The landing distance is then found. Thrust and engine angle, airplane speed and altitude are provided so that noise footprints may be calculated.

Limitations 1) small flight path angle 2) no thrust-lift interaction 3) Thrust axis aligned with body axis.

Low speed drag is provided by module ARO-8 and thrust data is provided by modules PRO-3 to 6.

NO. PRF-5

TECHNICAL PROGRAM ELEMENT

TITLE PERFORMANCE SUMMARY

FORM PREPARED BY W. Gillette DATE 10-3-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Summarize performance for 1 configuration.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

The purpose of this module is to summarize the performance of a configuration, by using information generated during the design/analysis process and retained in the data bank. The logic would be a data collector and driver for PRF-2, 3, 4.

* estimate

NO. PRO-1

TECHNICAL PROGRAM ELEMENT

TITLE NACELLE DESIGN

FORM PREPARED BY R. B. French DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 4-5 cases

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE This is part of the computerized preliminary design system (CPDS) - program modules PDESIGN/PDESIGN2

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This is a module for determining nacelle geometry for a given engine and nacelle type. Major dimensions (Maximum diameter, bare engine length, etc.) can be input or statistically calculated as a function of certain engine parameters (total airflow, bypass ratio, etc.) and year of delivery.

The program will fit cowl and afterbody fairings to the major dimension and nacelle type requirements. Likewise, bare engine weight can be input or statistically calculated.

A scaling procedure will scale weight and dimensions as a function of engine size by simple exponent or by a scaling table.

This is for both subsonic and transonic nacelles.

NO. PRO-2

TECHNICAL PROGRAM ELEMENT

TITLE NACELLE DESIGN

FORM PREPARED BY R. B. French DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10—2— (Words)

*OUTPUT VOLUME 10—3— (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 2-3 cases

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

The nacelle design module would be similar to PRO-1, except that it could also do supersonic cases. Unlike PRO-1, the subsonic/transonic capability would be contained in one module. It would also be compatible with the Engine Installation Module (PRO-6).

* estimate

NO. PRO-3

TECHNICAL PROGRAM ELEMENT

TITLE ENGINE PERFORMANCE (CYCLE MATCHING)

FORM PREPARED BY R. B. French DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 13-15 Off-design cases for a mixed, augmented turbofan.

STATUS: Operational X, Programming In Development X, Not Programmed ____

REFERENCE Boeing document D6-22794 (TEM237) and Coordination Sheet ME-RES-1134 (TEM237, Version A)

OWNERSHIP: Public ____, Private X, Owner The Boeing Co.

ABSTRACT

This is a thermodynamic analysis program that calculates steady state engine performance, design or off-design. It is not a true component matching program in that it does not use RPM-dependent component maps, however, this capability will be added in the near future. Its primary features are small size, high speed and flexibility of input/output. Basically, it is configured to do a front to back analysis of a mixed, augmented turbofan, and simpler configurations are handled by omitting inputs for various components.

NO. PRO-4

TECHNICAL PROGRAM ELEMENT

TITLE ENGINE PERFORMANCE (CYCLE MATCHING) - GSA

FORM PREPARED BY R. B. French DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1-2 off design cases for a mixed, augmented turbofan.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29697, User's Guide for the General Engine Performance Program (TEM191)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

GSA (General Simulator-Analyzer) is a general purpose, thermodynamic, component matching program that calculates steady state or dynamic engine performance, either design or off-design. All components are treated as separate modules that can be connected in any desired order, making it possible to analyze unconventional as well as conventional engines. For off-design calculations, compressor and turbine performance must be represented by full component maps. An extensive library of GSA component maps is maintained by the Boeing Propulsion Research Staff.

NO. PRO-5

TECHNICAL PROGRAM ELEMENT

TITLE ENGINE PERFORMANCE (TABLE LOOK-up) - MARK10/MARK11

FORM PREPARED BY R. B. French DATE 28 July 72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 200-300 Cases

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing programs MARK10/MARK 11

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This is a modular package that provides engine thrust and/or fuel consumption for a given flight condition. The table can contain either installed or uninstalled engine data, and can scale engine airbleed and horsepower extraction. It can handle up to 10 altitudes and 30 Mach numbers.

NO. PRO-6

TECHNICAL PROGRAM ELEMENT

TITLE ENGINE INSTALLATION

FORM PREPARED BY R. B. French DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate losses for one configuration at one flight condition.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public___, Private___, Owner___

ABSTRACT

The engine installation module would estimate all losses for a given engine/nacelle configuration at a particular flight condition, and represent the loss as a thrust increment. It would include such losses as exhaust scrubbing drag, pressure drag, acoustic treatment effects and skin friction drag. Supersonic effects could also be estimated. The module would run in close conjunction with the engine performance module (PRO-3, PRO-4 or PRO-5).

* estimate

NO. REL-1

TECHNICAL PROGRAM ELEMENT

TITLE Utilization, Maintenance, and Reliability Capability Analysis

FORM PREPARED BY J. P. Armer DATE 8/8/72

LANGUAGE GPS 360 HOST MACHINE GPS 360

PROGRAM SIZE 1/4 (Boxes of Source Cards)

TIMING 1 min GPSS360 (Central Processor Decimal Seconds of GPSS 360)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Problem dependent simulation model

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-40747, STOL Simulation Model - Product Assurance DPDD 65, 66

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This simulation model evaluates interactions, major influences, controlling parameters, special features and characteristics affecting utilization, dispatch reliability, maintenance and logistics facilities and costs. The simulation model outputs are dispatch reliability, utilization, and maintenance manhours per flight hour. Variables such as fleet size, route structure, schedules, flight time, and ground time are altered to assess each change in configuration/design and to evaluate strengths and weaknesses of each airplane in operational environments. Optimum competitive conditions can be identified and used in management decisions on new or derivative commercial airplanes.

NO. REL-2

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Systems Analysis - Reliability
(Automatic Reliability Mathematical Model)

FORM PREPARED BY J. P. Armer DATE 8/8/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING * Problem ~~Dependent~~ (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME ~~10~~ (Words) Problem Dependent

OUTPUT VOLUME ~~10~~ (Words) Problem Dependent

BASIS FOR TIMING, INPUT, AND OUTPUT Problem Dependent

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6A10500-1, An Automatic Reliability Mathematical Model

OWNERSHIP: Public ___, Private X, Owner North American Aviation
(Boeing cannot sell or give away)

ABSTRACT

A CDC-6600 computer program which derives a system reliability mathematical model and calculates system reliability by integrating component failure density functions. The program uses a sequential method of analysis, based on application of conditional probability. The program is capable of handling such component relationships as interdependencies, mutually exclusive failure modes, and standby redundancy. The program is intended for general use, and for application to the reliability analysis of systems having complex relationships.

*REV. A D6A10500-1
Pg. 121 - 10,000 combinations 128 sec.
390,000 combinations 1116 sec.

NO. REL-3

TECHNICAL PROGRAM ELEMENT

TITLE AIRPLANES SYSTEMS ANALYSIS - RELIABILITY
(Computerized Boolean Reliability Analysis)

FORM PREPARED BY J. P. Armer DATE 8-8-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600 or CTS/GPS 360

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING Problem Dependent (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Users guide & experience

STATUS: Operational X, Programming In Development __, Not Programmed __

REFERENCE D162-10117-1, Computerized Boolean Reliability Analysis (COBRA) Program - Users Manual

OWNERSHIP: Public __, Private X, Owner The Boeing Company

ABSTRACT

Cobra is a CDC 6600 computer program which will transform Boolean expressions describing a system into an equation for the reliability of a system and evaluate the derived equation to compute system reliability. A Boolean reduction technique is used to convert Boolean expressions of system success into mutually exclusive form. Program inputs required include a list of success paths in Boolean form, component failure rates and mission duration. The program is intended for general use, and for application to the reliability analysis of systems having complex component relationships. The program may be used directly in the CTS/360 as well as the CDC 6600.

NO. REL-4

TECHNICAL PROGRAM ELEMENT

TITLE OVERALL AIRPLANE SYSTEM MAINTAINABILITY REQUIREMENTS EVALUATION (SST Operations and Maintenance Simulation Model)

FORM PREPARED BY J. P. Armer DATE 8-8-72

LANGUAGE GPSS III, 360II HOST MACHINE IBM 360

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING Problem Dependent (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Problem Dependent - varies depending on job size.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6A10266-1, SST Operations and Maintenance Simulation Model

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The operations and maintenance simulation model assists in accomplishing overall system maintainability requirements evaluations. Specifically, it determines system sensitivity; predicts maintenance facilities, ground support equipment, personnel, and spares requirements; studies future operations and maintenance concepts; and predicts operational performance.

* estimate

NO. REL-5

TECHNICAL PROGRAM ELEMENT

TITLE AIRPLANE SYSTEM ANALYSIS RELIABILITY/SAFETY

FORM PREPARED BY J. P. Armer DATE 8-8-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING *Problem Dependent (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10 3 (Cards) ~~(Words)~~

*OUTPUT VOLUME 10 3 (Words).

BASIS FOR TIMING, INPUT, AND OUTPUT Not sized by normal, manner but by size and complexity of problem to be solved.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-24691 Fault Tree Simulation with Importance Sampling (FTS15)

OWNERSHIP: Public ___, Private X , Owner Logic Simulations of Computer ~~Graphics Inc.~~ (All rights sold by Boeing to Logic Simulations)

ABSTRACT

A Monte Carlo simulation technique incorporating importance sampling is presented for the calculation of fault tree probabilities. The Fault Tree Simulation with Importance Sampling is used to calculate fault tree probabilities and to discover the critical fault paths of a fault tree. A fault tree is a logic diagram representing the combinations of events which may cause a specific failure of a complex system. A fault path is a set of inputs, coexistence of which will cause the event represented by the fault tree. Critical fault paths are those paths which make a significant contribution to the probability of the event represented by the fault tree.

Small tree 20 sec.

Large tree 10-15 min.

* estimate

NO. REL-6

TECHNICAL PROGRAM ELEMENT

TITLE MAINTENANCE EVENT ANALYSIS DATA SYSTEM (MEAD)

FORM PREPARED BY. J. P. Armer/C. Henry DATE 8-8-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 9 (Boxes of Source Cards)

TIMING 180 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Schedule

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE CWA # DKCS 61

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The MEAD system is utilized solely as the DAS input facility for those data which will be utilized by SIDS (Schedule Interruption Data System, REL-13)

* estimate

NO. REL 7

TECHNICAL PROGRAM ELEMENT

TITLE RELIABILITY COMPUTATIONS - KRONOS (RCKS)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-8-72

LANGUAGE FORTRAN HOST MACHINE 6600

PROGRAM SIZE Varies (Boxes of Source Cards)

TIMING < 1 min. (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE BTNS 62

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The RCKS is used by Reliability/Maintainability engineers to solve complex mathematical problems which can be solved economically only by the computer. This is complementary to CTS. It is utilized in those instances when specific data on tapes can be extracted onto cards, those data are input directly to the 6600 computer and are processed by FORTRAN programs prepared by the user or drawn from the library.

* estimate

NO. REL-8

TECHNICAL PROGRAM ELEMENT

TITLE AIRCRAFT TIME AND DEPARTURE SYSTEM (ATD)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-8-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 35

INPUT VOLUME 6.5×10^4 (Words)

OUTPUT VOLUME 6×10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE DPD S 61

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

Aircraft time and departure system computer program accepts and processes aircraft life, time and landings, maintains historical data records, keeps track of aircraft status such as sales, leases, etc. and reports jet fleet statistics.

NO. REL 9

TECHNICAL PROGRAM ELEMENT

TITLE AIRCRAFT COMPONENT IDENTIFICATION DATA SYSTEM (ACIDS)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-8-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 95

INPUT VOLUME $2x10^4$ (Words)

OUTPUT VOLUME $1.5x10^6$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The ACID system supplies support to the input and output to all the other computer systems used by the Design Support Experience Retention Group. There are three basic code sub elements within this system.

1. Hardware identification codes
2. Logic codes
3. Conversion tables

NO. REL-10

TECHNICAL PROGRAM ELEMENT

TITLE MAINTENANCE MANHOUR STUDY FOR STOL SUPPORT (MMHS)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-9-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 400 360-370 CRU's

INPUT VOLUME 12.5×10^5 (Words)

OUTPUT VOLUME 7.3×10^5 (Words)

BASIS FOR TIMING. INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE DPD D63

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The system provides United Air Lines Maintenance time data as it is related to variations in flight time, available ground time, stations, manning and other variables. These data will support studies related to design configuration trade studies.

This program was developed for STOL, but is useable on any type utilization.

NO. REL-11

TECHNICAL PROGRAM ELEMENT

TITLE AMERICAN AIRLINES FIELD MAINTENANCE RELIABILITY REPORT PROCESSING (AA FM)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-9-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 420

TIMING 95 360/370 CRU's

INPUT VOLUME $3.2x10^6$ (Words)

OUTPUT VOLUME $2.8x10^5$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE DPD D70

OWNERSHIP: Public___, Private X, Owner American Airlines/The Boeing Co.

ABSTRACT

This program provides up to date DC-10, 747 and 727 data on American Airline field maintenance reliability experience to design project and new business proposal teams.

NO. REL-12

TECHNICAL PROGRAM ELEMENT

TITLE UNITED AIRLINES MAINTENANCE (UALN)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-9-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 250 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 2.6×10^5 (Words)

OUTPUT VOLUME 2.7×10^7 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE DPD D71

OWNERSHIP: Public ___, Private X, Owner United Air Lines/The Boeing Co.

ABSTRACT

This program provides up-to-date DC-10 and 747 United Airlines Non-routine Line Maintenance Data.

NO. REL-13

TECHNICAL PROGRAM ELEMENT

TITLE SCHEDULE INTERRUPTION DATA SYSTEM (SID)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-9-72

LANGUAGE COBAL HOST MACHINE 360-370

PROGRAM SIZE 8 (Boxes of Source Cards)

TIMING 50

INPUT VOLUME $7x10^4$ (Words)

OUTPUT VOLUME $10.5x10^5$ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE DRMS 61

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The SID system is a set of batch processing programs which provide standardized methods for receiving, storing, retrieving and reporting of all schedule interruption event data. These data are statistical in nature. They are originated whenever a revenue flight is interrupted due to a mechanical deficiency.

NO. REL-14

TECHNICAL PROGRAM ELEMENT

TITLE RELIABILITY COMPUTATIONS (CTS)

FORM PREPARED BY J. P. Armer/C. Henry DATE 8-9-72

LANGUAGE FORTRAN HOST MACHINE 360

*PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1 Min. (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE BTNS 61

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The Reliability Computations (CTS) is used for two basic functions:

A. Data processing by Reliability and Experience Retention engineers to produce special reports or statistical compilations which:

1. Cannot be economically provided in standard computer program outputs.

2. Require a quick turnaround time.

B. Solve complex reliability mathematical problems which are impossible to solve by means other than a computer.

* estimate

TECHNICAL PROGRAM ELEMENT

TITLE NAV 001 RECORD COUNT PROGRAM

FORM PREPARED BY J. P. Armer DATE 8-14-72

LANGUAGE COBOL HOST MACHINE

PROGRAM SIZE 1/2 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

*estimate

ABSTRACT

Boeing program NAV001 is the initial program for processing Navy (3M) data. Eight preparatory steps are required to separate the data for follow-on processing, since there is no consistent order to the raw data received on any single tape from the Navy.

The data for each aircraft model is divided onto separate tapes. A single type/model aircraft can then be examined without searching all the data. During this diversion process, checking and re-write on each record is accomplished. Reject listings of bogus card types are printed for visual examination. Any new card types introduced thus become apparent. If the data (year or day) is erroneous the record is printed on the reject listing. As records are rewritten, the type aircraft and Julian date are relocated. This relocation provides a constant field for aircraft type and data for easier recall in all succeeding programs.

The number of records read, rejected, filed and accepted are printed and are then compared with those provided by NATSF to verify that all records have been examined.

Inputs are Navy 3M Data Tapes.

NO. REL-16

TECHNICAL PROGRAM ELEMENT

TITLE NAV 200/201 MONTHLY COUNTS BY CARD TYPE PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds.

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2 TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 200/201 program is the most critical step in the reduction of data as it creates the card type files for all ensuing programs. Any file or combination of files can then be selected, depending on program requirements.

The printout shows by month for each file generated; the number of records, items processed (units produced) and total manhours expended. With this information a check of each month can be made to determine if all data have been received, and a representative time period selected for documentation. If a month is short of data, steps can be taken to determine the cause and accomplish a rerun.

INPUT: NAV001 data.

* estimate

NO. REL-17

TECHNICAL PROGRAM ELEMENT

TITLE NAMASEP PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE D6-57166 - 2 TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The NAMASEP program further reduces the data by separating each card type file into Navy or Marine data. Due to variances in operation on some aircraft, the Navy data are also reduced by operating command (normally Navy Atlantic; and Navy Pacific) which provides a selective data sample. The data is separated by the first digit of the organization code. A printout is not provided for this program.

INPUT NAV 200/201

* estimate

NO. REL-18

TECHNICAL PROGRAM ELEMENT

TITLE NAV 003 AIRCRAFT INVENTORY PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/3 (Boxes of Source Cards)

TIMING .25 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57116-2TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program uses the 76 card file (Equipment Statistical Data) to determine the average number of aircraft assigned to each theater of operation by finding the highest and lowest Julian data on an records for a single airplane tail number and computing the number of airplane days between the two dates. The theater of operation is determined by the first digit of the organizational code. The printout provides additional information necessary to select a representative data sample.

INPUT: NAMASEP

* estimate

NO. REL-19

TECHNICAL PROGRAM ELEMENT

TITLE NAV 004 FLIGHT TIME AND TYPE FLIGHT PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .25 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE D6-57166-2TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 004 program uses the 76 Card File (Equipment Statistical Data)(ESD) to produce a printout which shows for each sortie type, the number of flights, land flight time, ship flight time and total flight time for each month. An average flight time per sortie is also provided by month. The second part of the printout shows the monthly number of landings by type, total and average flight time per landing.

INPUT: NAMASEP

* estimate

NO. REL-20

TECHNICAL PROGRAM ELEMENT

TITLE NAV 005 NOT OPERATIONAL READY (NOR) STATUS PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .25 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2TN

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The NAV005, Not Operational Ready Program, uses the NOR transaction cards (Card type 71 file) to produce by the month the percentages for various NOL operational Ready conditions and the Operational Ready rate. For each NOR category, an Awaiting Maintenance percentage is also calculated.

* estimate

NO. REL 21

TECHNICAL PROGRAM ELEMENT

TITLE NAV 600/601/602 UNSCHEDULED MAINTENANCE NOR PRIORITY, PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 4 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 600/601/602, Unscheduled Maintenance Not Operational Ready Priority program shows the frequency with which a Work Unit Code is associated with an unscheduled maintenance NOR condition. The printout can be used to measure the frequency with which any item degrades readiness, either by itself or in conjunction with one or two other items; or to identify the number of times a Work Unit Code appeared as a primary, secondary or tertiary degrading cause.

INPUT: NAMASEP

*estimate

NO. REL-22

TECHNICAL PROGRAM ELEMENT

TITLE NAV 007 MAINTAINABILITY FINAL PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The NAV 007 program produces the standard Maintainability Final printout for insertion directly into the detailed volumes of the field experience document. The printout summarizes maintenance manhour rates for all work unit codes at the system, subsystem and component levels. It provides maintenance task rates and average manhours per task for specific jobs such as "Remove and Replace" or "Bench Check and Repair". Percent of manhours expended and percent of removals for each "How Malfunction" mode is also shown. This program provides the statistics normally required to identify maintenance problem areas and to establish a baseline from which maintainability predictions can be established for new design application. The "Manhour Frequency" tabulations are produced as a part of the NAV 007 Maintainability Final program and portrays the cumulative percent of maintenance tasks versus the manhour interval to permit graphic presentation of maintenance task distributions.

INPUT: NAMESEP

* estimate

NO. REL 23

TECHNICAL PROGRAM ELEMENT

TITLE NAV 008 RELIABILITY FINAL PROGRAM

FORM PREPARED BY J. P. Armer/R. Reed DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1-1/2 (Boxes of Source Cards)

TIMING .7 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-5-7166-2IN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 008 Reliability Final Program provides the standard reliability printout for insertion directly into the detailed volumes of the field experience document. The printout provides failure, abort, beyond capability of maintenance (BCM) and condemmed rates for each component, subsystem and system on the airplane. Also provided is the rate for that portion of the failures corrected by repair of attaching parts, the phase of operation in which the failures were discovered and the percent of failures by specific failure mode. The printout permits reliability specialists to relate failure rates to defined types of failures and as data base.

INPUT: NAMASEP

* estimate

NO. REL-24

TECHNICAL PROGRAM ELEMENT

TITLE NAV 900/901/902 ABORT PROGRAMS

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .7 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2TN Boeing Navy Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 900 series abort programs provide two printouts - Aborts by Aircraft Tail number and Aborts by Aircraft System. Correlation of airplane tail number and date of occurrence with such factors as airplane Flight Time and Action Taken code permits a refined analysis of aircraft aborts. Duplicate and multiple records for a single abort are deleted prior to executing the Aborts by Aircraft System program. The printout is helpful in determining in-flight reliability, aircraft downtime, and potential safety of flight failures.

INPUT: NAMASEP

* estimate

NO. REL-25

TECHNICAL PROGRAM ELEMENT

TITLE NAV 010 ORGANIZATIONAL ADONIS PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6 57166-2TN, Boeing Navy Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The NAV 010, Organizational ADONIS (Aircraft Data Ordered Numerically In Sequence) program provides a detailed report for Organizational Maintenance Data. The printout lists each line entry and all data recorded on the individual keypunch cards. The data is grouped by work unit code within each system and subsystem and summarized statistically all codes for "Action Taken", "When Discovered", "Type Maintenance", and "Work Center". The printout provides detailed verification of data and furnishes answers that can not be obtained from the standard Maintainability and Reliability print-outs.

INPUT: NAMASEP

* estimate

NO. REL-26

TECHNICAL PROGRAM ELEMENT

TITLE NAV 011 INTERMEDIATE ADONIS PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1-1/2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-2TN, Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 011, Intermediate ADONIS, program contains the same features and provides the same type printout (NAV 010 Organizational ADONIS). The difference between the two is NAV 010, derived from organizational (Flight Line) maintenance and NAV 011 is derived from Intermediate (Shop) Maintenance.

INPUT: NAMASEP

* estimate

NO. REL-27

TECHNICAL PROGRAM ELEMENT

TITLE NAV 012/013 PRIORITY BY AIRCRAFT SYSTEM PROGRAMS

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE D6-57166 2TN Boeing Navy 3M Electronic Data Processing Programs

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The NAV 012/013, Priority by Aircraft System, combining organizational and intermediate maintenance data, is arranged by aircraft system and for each Work Unit Code shows a tabulated summary of Removals, Failures, Aborts, Maintenance manhours, Elapsed Maintenance Time, and Trouble-shooting manhours. The last three categories reflect both total hours and Intermediate hours to quickly determine where the majority of maintenance is expended. The codes are printed in descending order to permit a graphic presentation as well as statistical correlation of the potential maintenance and reliability problems.

INPUT: NAMASEP

* estimate

NO. REL-28

TECHNICAL PROGRAM ELEMENT

TITLE PROGRAM #1, TAPE COPY PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

*PROGRAM SIZE 1/2 (Boxes of Source Cards)

*TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN, Boeing AFM 66-1 Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Boeing Program #1 copies the AFLC raw data tape, printing every 5000th line record. In addition, Program #1 prints all operational data including flight times, number of aircraft and number of landings for each model aircraft.

INPUT: AFLC raw data tape.

* estimate

NO. REL-29

TECHNICAL PROGRAM ELEMENT

TITLE PROGRAM #2

FORM PREPARED BY j. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN, Boeing AFM 66-1 Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

Program #2 separates the data by each model aircraft for application to the remaining programs. No printout is accomplished.

INPUT: Program #1

* estimate

NO. REL-30

TECHNICAL PROGRAM ELEMENT

TITLE PROGRAM #2A USA VERSUS SEA PURIFY

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING .5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN, Boeing AFM66-1 Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Program #2A (USA versus SEA Purify, separates Continental US(CONUS) records and Southeast Asia (SEA) records and provides a printout showing every 5000th CONUS record and a card count of SEA records by base for a given aircraft model.

INPUT: PROGRAM #2

* estimate

NO. REL-31

TECHNICAL PROGRAM ELEMENT

TITLE PROGRAM #3

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/3 (Boxes of Source Cards)

TIMING .25 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ______

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE D6-57166-1TN, Boeing AFM 66-1 Electronic Data Processing Programs

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The Program #3 separates the data for an aircraft model by on-equipment, shop, bit and piece, TOTO, AGE and other tasks, and prints the number of records and manhours within each of the categories. The printout identifies the extent of the records by month within each category.

INPUT: Program #2A

* estimate

NO. REL 32

TECHNICAL PROGRAM ELEMENT

TITLE PROGRAM 34 (MANHOURS BY AIRCRAFT SYSTEM)

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .25 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Program #4 (Manhours by Aircraft System) provides two printouts, on-equipment and shop, which tabulate total monthly manhours for each airplane system (Work Unit Codes 11 through 97). These, when related to total flight time, give manhour rates for the aircraft and its systems.

INPUT: Program #3

* estimate

NO. REL-33

TECHNICAL PROGRAM ELEMENT

TITLE PRIORITY PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .25 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN Boeing AFM 66-1 Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The priority program merges On-Equipment and Shop data and is normally referred to as the "Priority" run. The printout is arranged by airplane system and for each work unit code shows a tabulated summary of Removals, Failures, Manhours, Troubleshooting manhours and Aborts. The two manhour categories reflect both total manhours and shop manhours to quickly determine where the majority of maintenance is expended. The codes are printed in descending order beginning with the highest number to permit a graphic presentation as well as statistical ocrrelation of the potential maintenance and reliability problems.

INPUT: Program #3

* estimate

NO. REL-34

TECHNICAL PROGRAM ELEMENT

TITLE ABORT PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1/2 (Boxes of Source Cards)

*TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1 TN, Boeing AFM 66-1 Electronic Data Processing System

OWNERSHIP: Public ___, Private ___, Owner The Boeing Company

ABSTRACT

The Abort Program provides two printouts - Aborts by Tail Number and Aborts by System. Correlation of aircraft tail number and date of occurrence with such factors as Airplane Flight Time and Action Taken code permits a refined analysis of aircraft aborts. Duplicate and Multiple records for a single abort are deleted prior to executing the aborts by system program. This printout is helpful in determining in-flight reliability and aircraft downtime.

INPUT: Program #3

* estimate

NO. REL-35

TECHNICAL PROGRAM ELEMENT

TITLE ADONIS PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN, Boeing AFM 66-1 Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The ADONIS (Aircraft Data Ordered Numerically in Sequency) program provides detailed reports for On-Equipment and Shop data. The printouts list each line entry and all data recorded on the base keypunch cards. The data is grouped by work unit code within each system and summarizes statistically all codes for "Action Taken", "When Discovered", "Types of Maintenance" and "Work Center". An "Action Taken - How Malfunction" matrix is also provided. The report provides detailed verification of data and provides answers that cannot be obtained from Maintenance and Reliability Final printouts.

INPUT: Program #3

* estimate

NO. REL-36

TECHNICAL PROGRAM ELEMENT

TITLE MAINTAINABILITY FINAL PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN, Boeing AFM66-1 Electronic Data Processing Programs

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The Maintainability Final program provides the standard maintainability printout for insertion directly into the detailed volumes of the field experience document. The printout summarizes maintenance manhour rates for all work unit codes at the system, subsystem and component levels. It provides maintenance task rates and average manhours per task for specific jobs such as "Remove and Replace" or "Bench Check and Repair". Percent of manhours expended and percent of removals for each "How Malfunctioned" code is also shown. This printout provides the statistics normally required to identify maintenance problem areas and to establish a baseline from which maintainability predictions can be established for new design applications. The "Manhour Frequency" tabulation is produced as a part of the Maintainability Final program and portrays the cumulative percent of maintenance tasks versus the manhour interval to permit graphic presentation of maintenance tasks versus manhour curves.

INPUT: Program #3

* estimate

NO. REL 37

TECHNICAL PROGRAM ELEMENT

TITLE RELIABILITY FINAL PROGRAMS

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1-1/2 (Boxes of Source Cards)

TIMING .7 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1TN, Boeing AFM 66-1 Electronic Data Processing Program

OWNERSHIP: Public ____, Private X, Owner The Boeing Company

ABSTRACT

The "Reliability Final" Program provides the standard reliability printout for insertion directly into the detailed volumes of the field experience document. The printout provides failure, abort, NRTS (Not Repairable This Station) and condemned rates for each component, (subsystem and system on the airplane). Also provided is the rate for that portion of the failures corrected by repair of attaching parts, the phase of operation in which the failures were discovered and the percent of failures by specific failure mode. The printout permits reliability specialists to relate failure rates to defined types of failures for baseline reference use.

INPUT: Program #3

* estimate

NO. REL 38

TECHNICAL PROGRAM ELEMENT

TITLE SPECIAL STUDY PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1-1/2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-ITN, Boeing AFM 66-1 Electronics Data Processing Program

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The "Special Study" program provides the ability to select records with specific data codes to pinpoint certain types of failures/malfunctions or conditions within an airplane model. THe special studies printout shown is an example of bearing failures. The special studies program is also used to provide the depot tail number listing.

INPUT: PROGRAM #3

* estimate

NO. REL 39

TECHNICAL PROGRAM ELEMENT

TITLE BIT AND PIECE PROGRAM

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1-1/2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-ITN, Boeing AFM 66-1 Electronic Data Processing Program

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The Bit and Piece program provides a report which lists and summarizes by Work Unit Code, the parts replaced during shop repair of components. It assists in identification of the specific failed parts causing component malfunctions.

INPUT: PROGRAM #3

* estimate

NO. REL-40

TECHNICAL PROGRAM ELEMENT

TITLE DEPOT PROGRAMS

FORM PREPARED BY J. P. Armer/R. Reel DATE 8-14-72

LANGUAGE COBOL HOST MACHINE 360-165

PROGRAM SIZE 1-1/2 (Boxes of Source Cards)

TIMING 1.0 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-57166-1 TN, Boeing AFM 66-1 Electronic Data Processing Program

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Depot data is processed through three programs previously discussed: ADONIS, Priority, and Special Studies. The single difference is the prior selection of Depot records which are separated in Program #3. The special Studies program provides the Depot Tail Number Listing which allows determination of airplane flow time through Iran, and extent of Iran maintenance by individual tail number.

INPUT: PROGRAM #3
Adonis
Special Studies
Priority

* estimate

NO. REL-41

TECHNICAL PROGRAM ELEMENT

TITLE CRAM-COMPUTERIZED RELIABILITY ASSESSMENT MODEL

FORM PREPARED BY G. A. McKnight/J. P. Armer DATE 8-16-72

LANGUAGE Fortran IV HOST MACHINE CTS

PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Coordination Sheet R69-3, dated 1-6-69

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The program computes the reliability of complex systems (involving redundancy) using inputs obtained directly from the reliability block diagram. Component failure rates are assumed to be exponential. For additional information see C/S R69-3.

* estimate

NO. REL 42

TECHNICAL PROGRAM ELEMENT

TITLE Dispatch (Schedule) Reliability Analyses

FORM PREPARED BY G. A. McKnight/J. P. Armer DATE 8-15-72

LANGUAGE FORTRAN IV HOST MACHINE CTS

PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE None (See D6-13026-1 for typical usage of program)

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The program calculates the schedule reliability of the airplane based on component by component comparison with baseline airplane. Baseline data (schedule interruption rates) and comparison factors must be input. Schedule interruption rates may be obtainable (on cards) directly from the BOE 004 series reports.

* estimate

NO. S&C-1

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Airplane Balance and Tail Sizing Program

FORM PREPARED BY R. Middleton DATE 7/21/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational X , Programming In Development X , Not Programmed X *

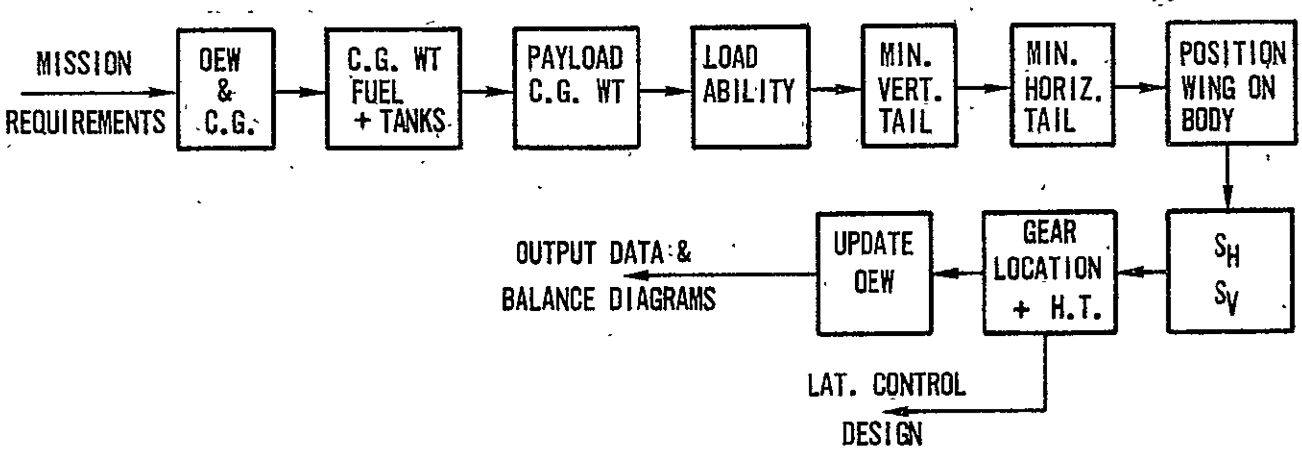
REFERENCE Boeing Document No. D6-26049, "Stability and Control Design Characteristics for CPDS Level I", P. Smutny, 1972.

OWNERSHIP: Public ____, Private X , Owner The Boeing Company

ABSTRACT

The balance module is a digital computer program obtained from the Level I weights and balance Computerized Preliminary Design System (CPDS).

Use of loading and aerodynamic design criteria positions the wing along the body, sizes the empennage, positions the main landing gear and determines the required length of the main gear strut. Finally, the balance diagrams are plotted to illustrate the balance characteristics of said configuration. An additional subroutine (not available) will provide lateral control design.



NO. S&C-2

TECHNICAL PROGRAM ELEMENT

TITLE Maneuver Margin Increment Due to SAS

FORM PREPARED BY T. M. Richardson DATE 7/21/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ______

STATUS: Operational___, Programming In Development___, Not Programmed X

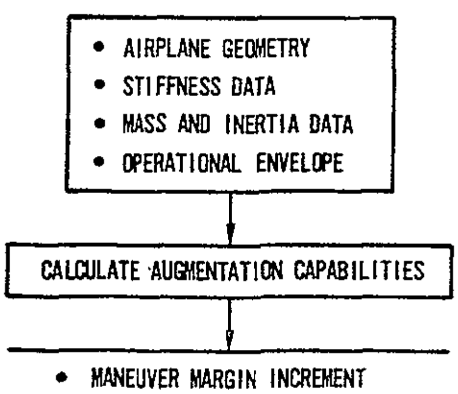
REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Statistical data could be used to estimate the increment of maneuver margin which could be provided by a stability augmentation system (SAS). Little data of this type exists at present. This information would represent input data for a program such as CPDS. The configuration development would continue as presently performed by CPDS. However, a wider discretion of the c.g. travel would permit a more efficient design.

The statistics used to estimate the maneuver margin may be biased by the airplane geometry and mass. Typically, the airplane's fuselage bending modes may be estimated to permit imposition of an upper limit of SAS gain.



*Estimate.

NO. S&C-3

TECHNICAL PROGRAM ELEMENT

TITLE Longitudinal Stability and Control Program

FORM PREPARED BY R. Middleton DATE 7/21/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational X, Programming In Development __, Not Programmed __

REFERENCE Undocumented

OWNERSHIP: Public __, Private X, Owner The Boeing Company

ABSTRACT

This program computes longitudinal stability and control characteristics and stability derivatives.

S_W, $\bar{C}_W$, b_W, Λ_W, AR_W, AR_H, S_H, $\bar{V}_H$, Λ_H, α_{LH}, $\alpha_{n_{Z_H}}$, λ_H, cg, W, M, h, V_e, V_0, L_E/L_R w, $C_{M_{C_L}}$, $C_{L_{n_Z}}$, $C_{M_{n_Z}}$, L_E/L_R H, $M_E/M_R\ \delta_E$, $L_E/L_R\ \delta_E$, $C_{L_{\alpha_W}}$, $C_{M_{C_L}}$ WB, $1-\epsilon_d$, $C_{L_{\alpha_H}}$, $C_{M_{\delta_E}}$

↓

LONGITUDINAL STABILITY & CONTROL PROGRAM

↓

N.P., M.P., $\delta e/g$, C_{L_α}, C_{M_α}, $C_{L_{\hat{\dot{\alpha}}}}$, $C_{M_{\hat{\dot{\alpha}}}}$, $C_{L_{\hat{\dot{\theta}}}}$, $C_{M_{\hat{\dot{\theta}}}}$, $C_{L_{n_Z}}$, $C_{M_{n_Z}}$, $C_{L_{\delta_H}}$, $C_{M_{\delta_H}}$, $C_{L_{\delta_E}}$, $C_{M_{\delta_E}}$

NO. S&C-4

TECHNICAL PROGRAM ELEMENT

TITLE Lateral Rate Derivatives

FORM PREPARED BY R. Middleton DATE 7/21/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^1 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

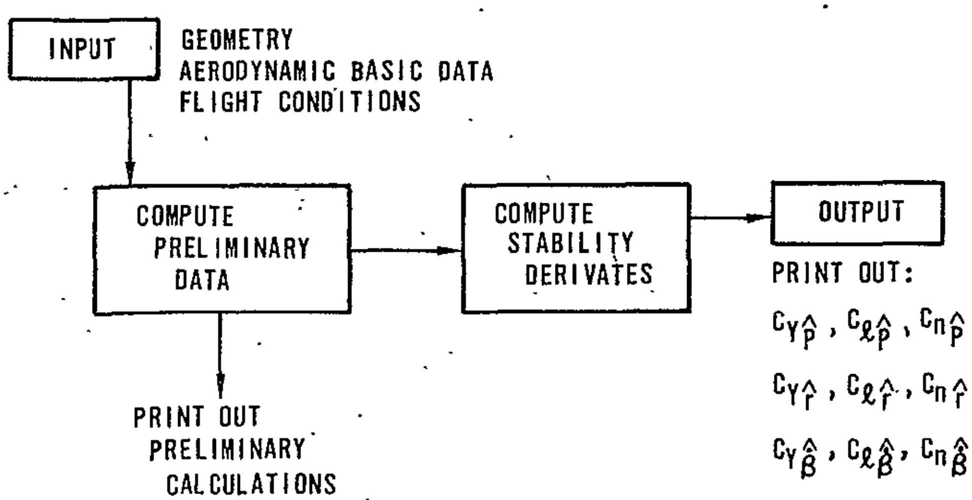
STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6-30639-TN, "Methods for Calculating the Nine Lateral-Directional Dynamic Stability Derivatives", W. J. Moore, V. M. Felix, November 1969.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

Current semi-empirical methods for calculating nine lateral-directional dynamic stability derivatives are collected in this program. Basic concepts are based on strip theory and effective two-dimensional lift curve slope. Empirical corrections have been added to account for compressibility and partial flow separation. The resulting equations are valid for conventional subsonic airplanes of moderate sweep and aspect ratio.



NO. S&C-5

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Sideslip Static Derivatives

FORM PREPARED BY R. Middleton DATE 8/3/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{1} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

Standard data sheet references (i.e., USAF S&C Handbook and Royal Aero Soc. Data Sheets) will be programmed for typical subsonic airplane configurations to provide the three basic sideslip derivatives C_{n_β}, C_{l_β}, C_{y_β}.

Aeroelastic correction factors based on historical experience will be applied where applicable.

*Estimate.

NO. S & C-6

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Dynamic Stability Characteristics

FORM PREPARED BY R. Middleton DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2.0 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE *

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

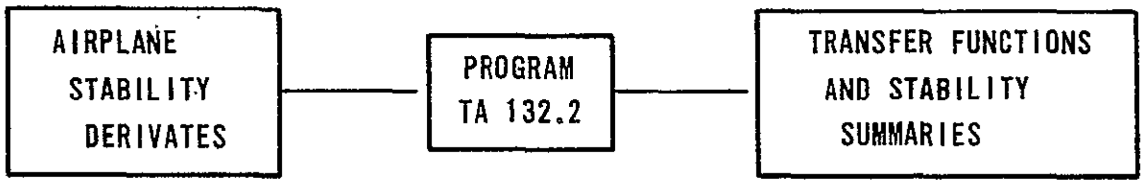
ABSTRACT

The program is divided into two basic parts, the lateral and the longitudinal stability characteristics of the airplane. Each of these parts are subdivided into the basic stability characteristics and the transfer function numerators due to control inputs. Small disturbance theory is used.

The lateral-directional program calculates the frequency, period, and cycles to damp to half amplitude of the dutch roll mode, and the time to damp to half amplitude of all modes. The ratios $|\phi/\beta|$ and $|\phi/V_e|$ are also computed. The lateral directional responce program calculates the roots of the numerators of the β/δ_w, ψ/δ_w, ϕ/δ_w, β/δ_r, ψ/δ_r, ϕ/δ_r transfer functions and forms the ratios of the natural frequencies of the numerators to the dutch roll natural frequence: ω_β/ω_D, ω_ψ/ω_D, $\omega\phi/\omega_D$.

The longitudinal program computes times and cycles to damp to half amplitude and to one-tenth amplitude. Also, the frequency and period of both phugoid and short period are computed in addition to the undamped natural pitch frequency and the damping ratio of the short period mode. The longitudinal control response portion of the program calculates the roots of the numerators of the θ/δ_e and α/δ_e transfer functions.

TECHNICAL PROGRAM ELEMENT NO. S&C-6 (Continued)



* Boeing Document No. D6-16322TN, "A Solution of The Longitudinal and Lateral Directional Small Disturbance Equations of Motion, Including Lateral Control Response. (A revision of Aerodynamic Tech. Note No. 61-004, David Kohlam, Jan Roskam, March 1965.)

Boeing Document No. D6-58077TN, "Program TA132-2, Longitudinal and Lateral Directional Small Disturbance Equations of Motion, Including Lateral Control Response and Longitudinal Control Response", L. W. Martin, Oct. 1965.

NO. S & C-7

TECHNICAL PROGRAM ELEMENT

TITLE Take Off Rotation Analysis

FORM PREPARED BY R. Middleton DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{2} (Words)

OUTPUT VOLUME 10^{1} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case

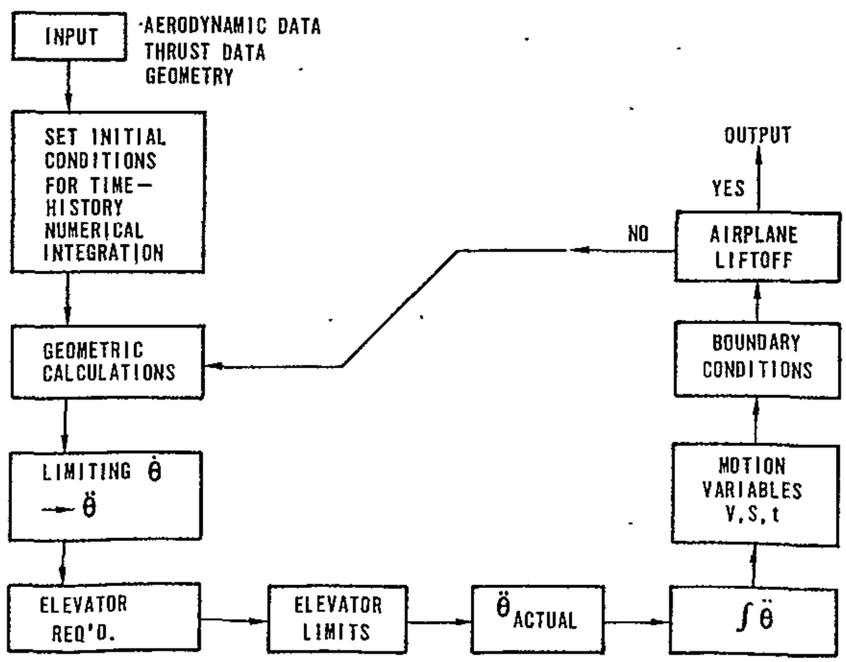
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program calculates the ground run and takeoff rotation maneuver of a jet transport configuration and the time history solution of these equations.



C-3

NO. S & C-8

TECHNICAL PROGRAM ELEMENT

TITLE Landing Flare Analysis

FORM PREPARED BY R. Middleton DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^1 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case

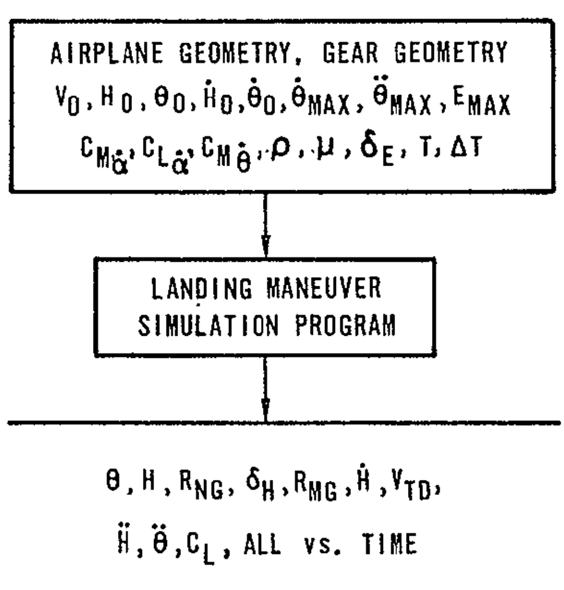
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6A11700-1, "A Digital Computer Program For Landing Maneuver Simulation," P.S. Kirk, October 1969

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This is a landing maneuver which allows the descent, touchdown, and rotation phases to be simulated, and calculates the airplane dynamic response with resulting gear loads, ground clearances, and pilot accelerations.



NO. S & C-9

TECHNICAL PROGRAM ELEMENT

TITLE Minimum Control Speed, Ground

FORM PREPARED BY R. Middleton DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^1 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case

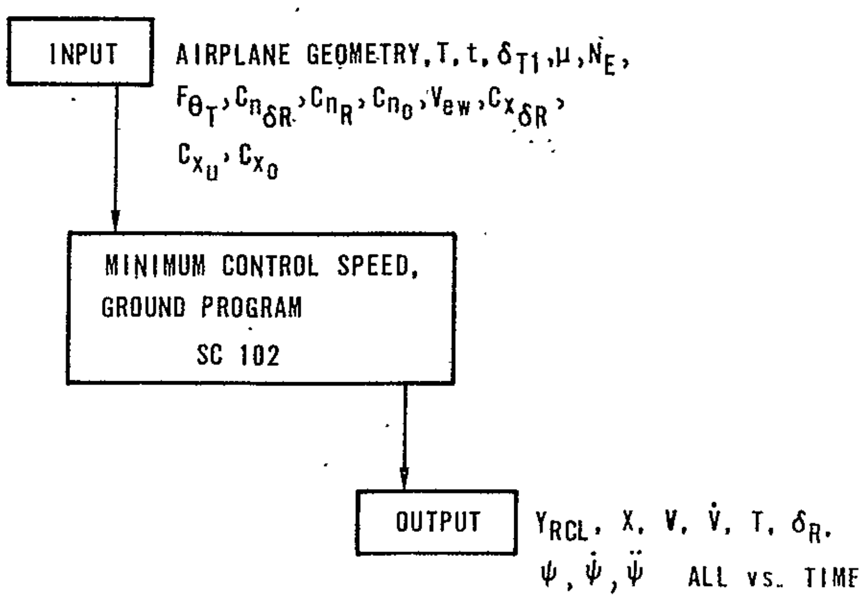
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6 A12261-1TN, "The Lateral-Directional Computer Programs For The SST," R.E. Quaglieri, April 1971.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The program solves for minimum speed at which airplane may take off with engine failure and meet prescribed runway deviations.



NO. S & C-10

TECHNICAL PROGRAM ELEMENT

TITLE Minimum Control Speed In Air

FORM PREPARED BY R. Middleton DATE 21 July, 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^1 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case

STATUS: Operational X , Programming In Development ___, Not Programmed ___

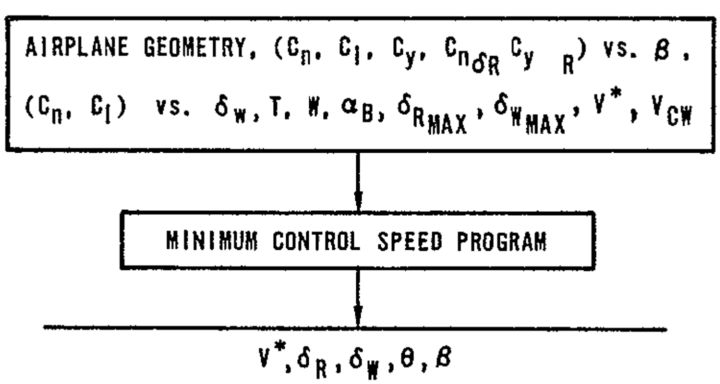
REFERENCE Boeing Document No. D6 A12261-1TN, "The Lateral - Directional Computer Programs for The SST," R. E. Quaglieri, April 1971.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This program solves for minimum control speed in the event of engine failure in air or a disturbance arising from a crosswind.

The three static lateral & directional equations are solved with the airplane trimmed using nonlinear gearing on the lateral controls and rudder control. The aerodynamic input can be nonlinear.



* VELOCITY, V, MAY BE OPTIONALY INPUT OR COMPUTED

NO. S&C-11

TECHNICAL PROGRAM ELEMENT

TITLE Roll Response

FORM PREPARED BY R. Middleton DATE 21 July, 1972

LANGUAGE Mimic Statements HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^1 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case

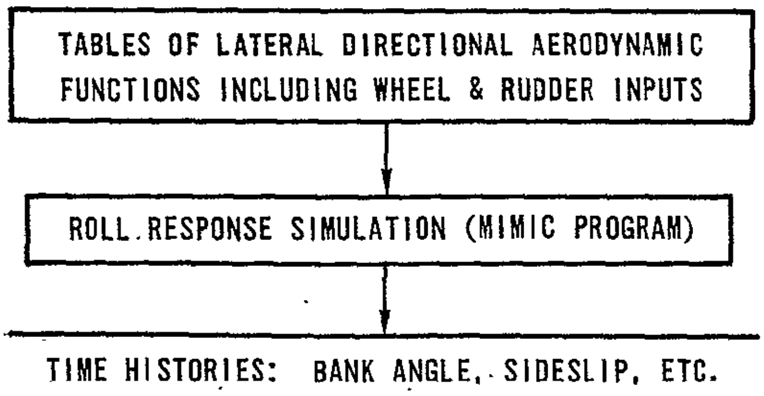
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Undocumented

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program is a specific application of the MIMIC program (No. FCS-10).



NO. S&C-12

TECHNICAL PROGRAM ELEMENT

TITLE Longitudinal Stability & Control Analysis (Elastic Airplane)

FORM PREPARED BY R. Middleton DATE 21 July, 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 3.0 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

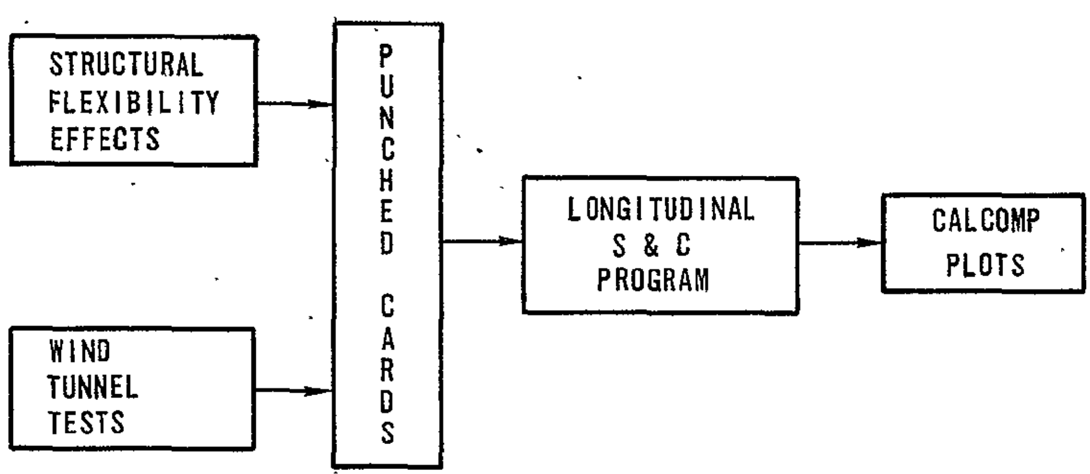
STATUS: Operational X ; Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6 A11684TN, "The Elasticizer - For Calculation of The Longitudinal Stability & Control Characteristics of a Flexible Aircraft." E.F. Carlson, Aug. 1969; Coordination Sheet 2707 Aero 969

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This program calculates the longitudinal stability and control characteristics of a flexible aircraft.



NO. S & C-13

TECHNICAL PROGRAM ELEMENT

TITLE Lateral - Directional Control From Wind Tunnel Data

FORM PREPARED BY R. Middleton DATE 21 July, 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2.0 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational X , Programming In Development - , Not Programmed ____

REFERENCE Boeing Document No. D6A 12261O1TN, "The Lateral-Directional Computer Programs For The SST," R. E. Quagleri, April 1971

OWNERSHIP: Public ____, Private X , Owner The Boeing Company

ABSTRACT

This program calculates and plots the increments between the six aerodynamic coefficients of selected wind tunnel runs. The increments can thus reflect changes due to engine out, control deflection, vertical tail location, etc.

NO. S&C-14

TECHNICAL PROGRAM ELEMENT

TITLE Lateral-Directional Stability Analysis

FORM PREPARED BY R. Middleton DATE 21 July, 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2.0 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6A 12261TN, "The Lateral - Directional Computer Programs For The SST." R.E. Quaglieri, April 1971.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program is the work-horse of the lateral-directional analysis. It provides final elastic airplane data by the following procedure:

1) Wind tunnel data characteristics are plotted vs. alpha for constant beta. Coefficients C_{YM}, C_{RM}, C_{SF}, are adjusted such that their value is zero at zero beta. Then, their magnitudes at equal betas of opposite sign are averaged and this average is plotted. Several configurations are input together, selections are made from among wing-body, wing-body ventral, wing-body-vertical and airplane to gain the desired final configuration characteristics.

2) Increments between the configurations are calculated to yield effects of the vertical and ventral together, separate or of one in the presence of the other.

3) The characteristics for each configuration are corrected for geometry changes and closure corrections.

4) Flexibility corrections are made to the data of item 3.

NO. S & C-15

TECHNICAL PROGRAM ELEMENT

TITLE Horizontal Tail Hinge Moment Analysis

FORM PREPARED BY R. Middleton DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational X, Programming In Development ___, Not Programmed X

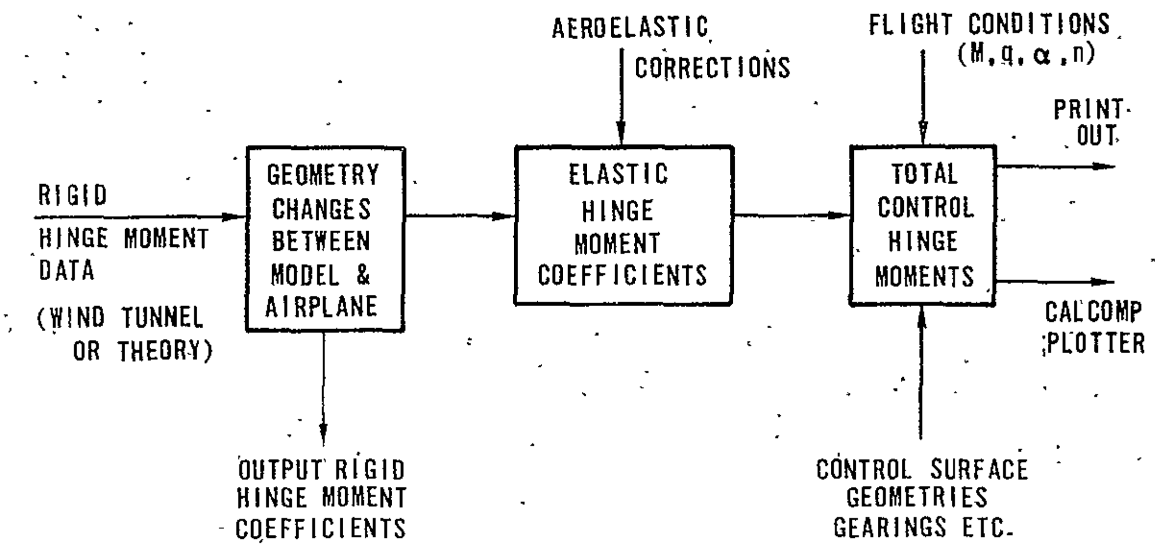
REFERENCE Boeing Document No. D6A12212-1TN, "The Pivoter - For Calculation of Flexible Horizontal Tail - Geared Elevator Hinge Moments," D. L. Wilson March 1971.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program calculates the hinge moment characteristics of an all moving flexible horizontal tail with a mechanically geared elevator.

Automation of rigid hinge moment coefficient estimation, in absence of wind tunnel data, is required.



NO. S&C-16

TECHNICAL PROGRAM ELEMENT

TITLE Lateral & Directional Control Hinge Moment Analysis

FORM PREPARED BY R. Middleton DATE 21 July, 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational X, Programming In Development ___, Not Programmed ___

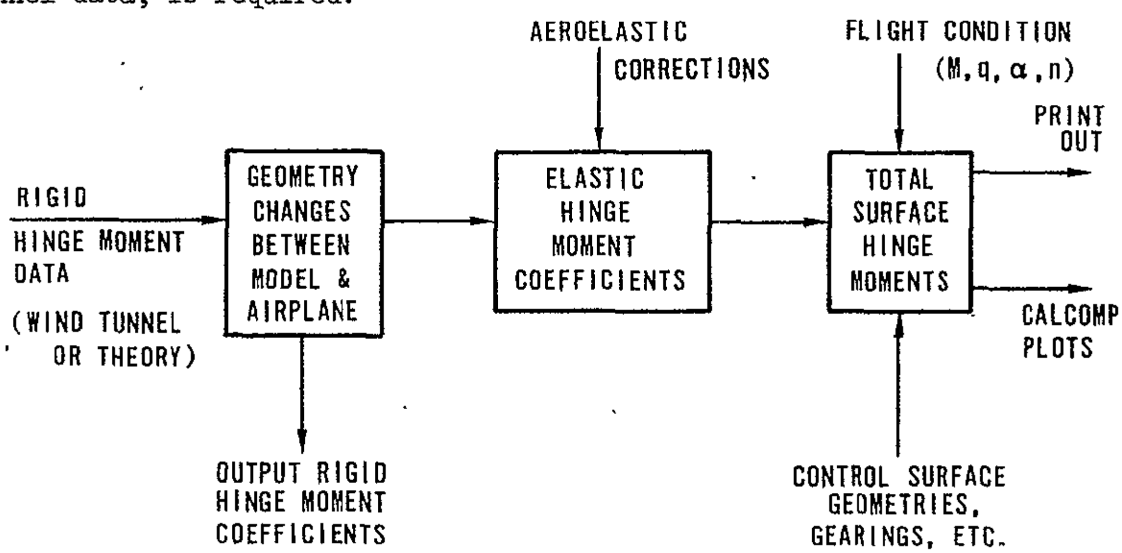
REFERENCE Boeing Document No. DGA 12213-1TN, "The Shaft - For Calculation of Flexible Lateral-Directional Control Surface Hinge Moments," D. L. Wilson, April 1971.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program calculates the hinge moment characteristics of lateral-directional control surfaces (rudders, flaperons, spoilers, etc.)

Automation of rigid hinge moment coefficient estimation, in absence of wind tunnel data, is required.



NO. S&C-17

TECHNICAL PROGRAM ELEMENT

TITLE Stability Characteristics of Flexible Configurations (FLEX STAB)

FORM PREPARED BY R. Middleton DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

* PROGRAM SIZE 14 (Boxes of Source Cards)

* TIMING 5000 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development X, Not Programmed ____

REFERENCE Boeing Document No. D6-24631

OWNERSHIP: Public X, Private ____, Owner ____

* Estimate

ABSTRACT

Flexstab is a system of computer programs designed to predict the stability characteristics of flexible configurations. The following programs are of use in IPAD for flight controls evaluation of an airplane.

PROGRAM	DESCRIPTION
Geometry Definition (GD)	Geometric configuration to comply with aerodynamic & structural theories
Steady Aerodynamic Influence Coefficients (SAIC)	Panel aerodynamic matrices
Internal Structural Influence Coefficients (ISIC)	Flexibility matrices based upon beam theory
Normal Modes (NM)	Free vibration Normal mode shapes

TECHNICAL PROGRAM ELEMENT NO. S&C-17 (Continued)

Stability Derivatives & Static Stability (SD&SS)	Static & dynamic stability characteristics
Characteristic Equation Rooting (CER)	Airplane stability using small disturbances
Time Histories (TH)	Airplane stability using large disturbances

NO. S & C-18

TECHNICAL PROGRAM ELEMENT

TITLE Automatic Handling Qualities Estimator

FORM PREPARED BY. T. M. Richardson DATE 24 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Per flight condition

STATUS: Operational___, Programming In Development___, Not Programmed X

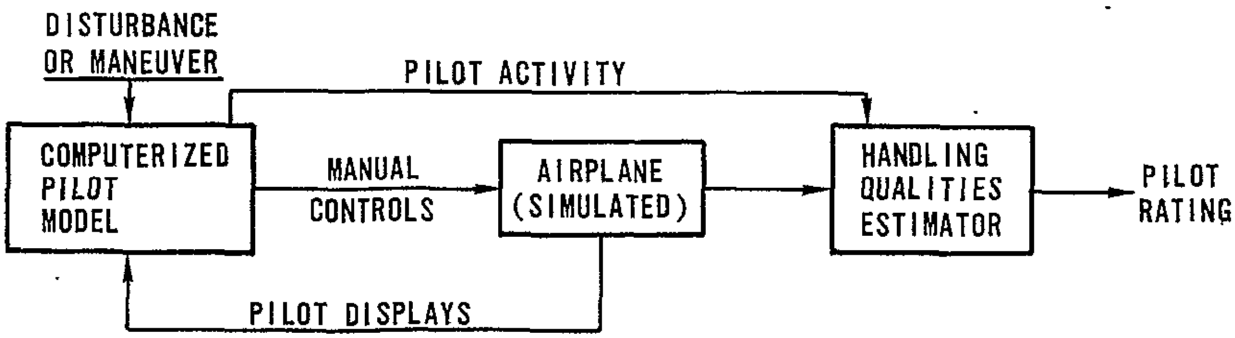
REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

A pilot transfer function is required to determine a computerized pilot rating. A describing function approach will probably be used for linear analyses. For simulation work, a nonlinear self-adaptive model is in order.

Investigations are required to determine appropriate pilot transfer functions and the procedure for converting pilot activity and error signals into pilot ratings. No code exists for these functions. However, the pilot and pilot rating resolver can be programmed as a component of the flight control system. Hence, the only significant increment of work will involve development of the methods.



* Estimate

NO. S&C-19

TECHNICAL PROGRAM ELEMENT

TITLE Handling Qualities Simulation

FORM PREPARED BY T. M. Richardson DATE 24 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC-6600 EAI-8400, XDS-930

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Per 1 second real time for a 6 degree of freedom simulation (5 min est/pass)

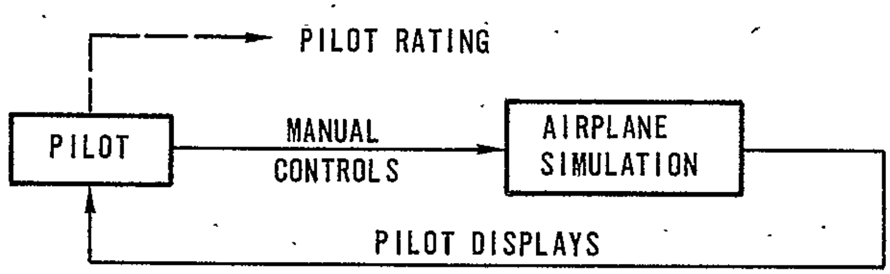
STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE Many airplane simulations exist. The simulations are usually tailored to fit a particular airplane.

OWNERSHIP: Public___, Private___, Owner___

ABSTRACT

Handling qualities are normally ascessed by use of piloted simulations--fixed base, moving base, or in-flight (a variable geometry airplane). The pilot assigns a numerical rating (1 best, 9 worst) to each task the simulated airplane is flown through.



NO. S&C-20

TECHNICAL PROGRAM ELEMENT

TITLE. SST Preliminary Airplane Balance, Tail Sizing, Gear Location & Lateral Control Check

FORM PREPARED BY R. Middleton DATE 18 Aug. 1972

LANGUAGE Fort. IV HOST MACHINE CDC-6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 66 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^2 (Words)

* OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

Theoretical & historical data will be used to calculate vertical & horizontal tail srufaces for a CG range calculated for minimum trim drag at cruise. The horizontal tail is sized to provide both control & stability in conjunction with a flight control system & SAS synthesized by a combination of factored historical data & simplified calculations. The vertical tail is sized for directional stability criteria and directional control requirements using a conventional rudder surface. Directional stability is augmented by a lateral SAS using inputs based on Boeing SST experience.

Lateral controls meet simplified roll response criteria and are identified in geometry to enable a preliminary wing control layout be drawn.

The main gear, location & size, is selected from standard balance & clearance critieria.

* Estimate

NO. S&C-21

TECHNICAL PROGRAM ELEMENT

TITLE Longitudinal S&C Program, Calculation of Static Coefficients

FORM PREPARED BY R. Middleton DATE 18 Aug. 1972

LANGUAGE Fort. IV HOST MACHINE CDC-6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^{2} (Words)

* OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE

OWNERSHIP: Public ___, Private ___, Owner ___

ABSTRACT

From a geometric description of an SST configuration an automated program, using standard text book & data sheet methods with historical & NASA wind tunnel data support, will calculate the basic rigid longitudinal aerodynamic characteristics including control effects, ie. C_L, C_m vs α, C_L C_m vs δ_H $C_{D\alpha}$ $C_{T\alpha}$ etc. Aeroelastic corrections based on historical SST data will be applied to provide flexible aerodynamic coefficients.

The data are calculated for each flight condition input.

* Estimate

NO. S&C-22

TECHNICAL PROGRAM ELEMENT

TITLE Longitudinal S&C Program, Calculation of Dynamic Derivatives

FORM PREPARED BY R. Middleton DATE 18 Aug. 1972

LANGUAGE Fort IV HOST MACHINE CDC-6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^{2} (Words)

* OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach.

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE

OWNERSHIP: Public ___, Private ___, Owner

ABSTRACT

This program operates with S&C-21 and uses both input & output from this program. Dynamic derivatives are calculated using standard text book & data sheet methods with empirical & historical data support.

These derivatives are:

$C_{L\dot{\alpha}}$, $C_{m\dot{\alpha}}$

$C_{L\dot{\theta}}$ $C_{m\dot{\theta}}$

C_{Ln} C_{mn}

C_{LM} C_{mM}, C_{DM}

C_{mq}, C_{Dq}

* Estimate

NO. S&C-23

TECHNICAL PROGRAM ELEMENT

TITLE Lateral & Directional S&C Program, Calculation of Static Coefficients

FORM PREPARED BY R. Middleton DATE 18 Aug. 1972

LANGUAGE Fort. IV HOST MACHINE CDC-6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^2 (Words)

* OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

From a geometric description of an SST configuration an automated program, using standard text book & data sheet methods with historical & NASA wind tunnel data support, will calculate the basic rigid lateral & directional aerodynamic characteristics, including control effectiveness:

C_n, C_y, C_e vs β & α

C_n, C_y, C_e vs δ_R

C_n, C_e vs δ_C

Aeroelastic corrections based on historical SST data will be applied to provide flexible aerodynamic coefficients.

The data are calculated for each flight condition input.

* Estimate

NO. S & C-24

TECHNICAL PROGRAM ELEMENT

TITLE Lateral & Directional S&C Program, Calculation of Dynamic Derivatives

FORM PREPARED BY R. Middleton DATE 18 Aug. 1972

LANGUAGE Fort. IV HOST MACHINE CDC 6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^2 (Words)

* OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Case, 1 Mach.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public____, Private____, Owner____

ABSTRACT

This program operates with S&C-23 and uses both input & output from this program. Dynamic derivatives are calculated using standard text book & data sheet methods with empirical & historical data support.

These Derivatives are: C_{np}, C_{ep}, C_{yp}

C_{nr}, C_{er}, C_{yp}

$C_{n\dot{\beta}}$, $C_{e\dot{\beta}}$, $C_{y\dot{\beta}}$

* Estimate

NO. SDL-1

TECHNICAL PROGRAM ELEMENT

TITLE Natural Vibration Modes

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran IV HOST MACHINE CDC- 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 147 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 124 degrees of freedom, 20 modes, free-free modes output.

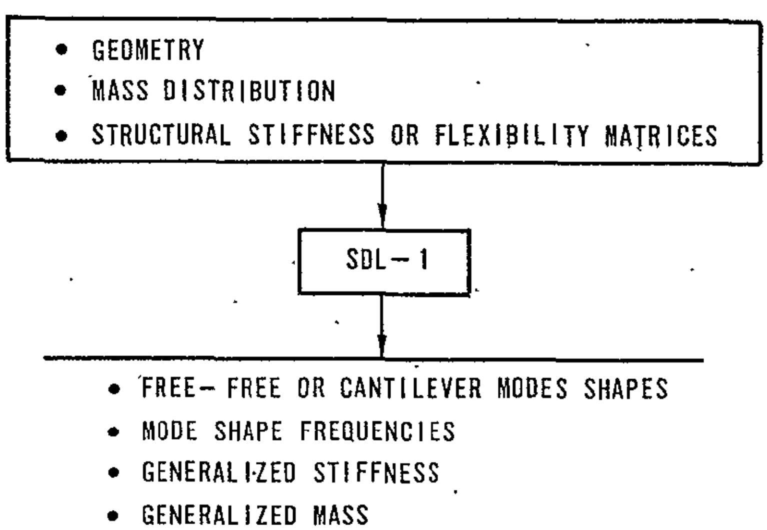
STATUS: Operational x , Programming In Development___, Not Programmed_____

REFERENCE Boeing Document No. D6-29649TN, " Normal Mode Solution Program Using The QR Eigenvalue Routine - TEV109," H. Noonchester, Jan. 1969.

OWNERSHIP: Public____, Private x , Owner The Boeing Company

ABSTRACT

This program computes vibrational frequencies and modal vectors from a dynamic matrix by the QR method. The program has the capability to form the dynamic matrix from flexibility and inertia matrices. Free-free modes can be found by use of a geometric matrix relating the motion of each element to the rigid body freedoms



NO. SDL-2

TECHNICAL PROGRAM ELEMENT

TITLE Force Matrices, Quasi-Steady Equations of Motion

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

* PROGRAM SIZE 5 (Boxes of Source Cards)

* TIMING 60 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^5 (Words)

* OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 flight condition, 65 load equations, 27 degrees of freedom with SAS by employing 12 elastic modes of 124 mass points to generate the E.O.M.

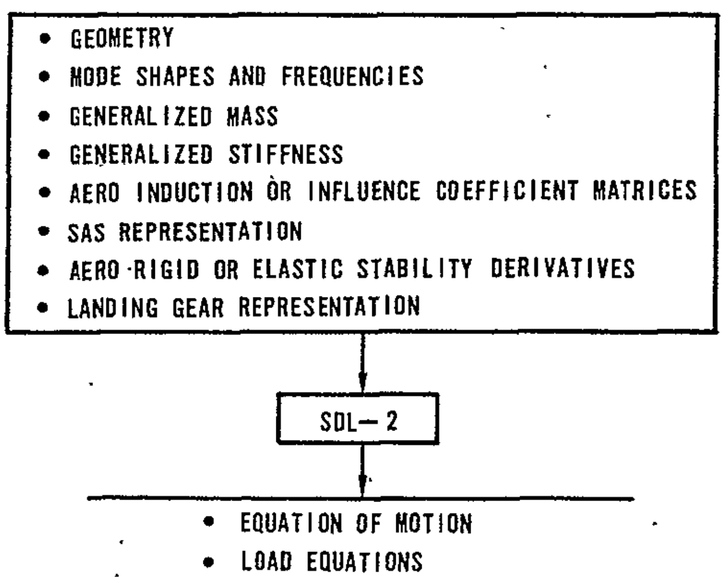
STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE Boeing Document No. D6-7394 TN Vol I & II, "IBM 7090 & 7094 Matrix Interpretive Scheme," D.D. Redhed, Sept. 1962

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

Matrix operative program



* Estimate

NO. SDL-3

TECHNICAL PROGRAM ELEMENT

TITLE Dynamic Loads and Ride Quality Evaluation

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 16 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 flight condition, 27 degrees of freedom, roots and residual stiffness

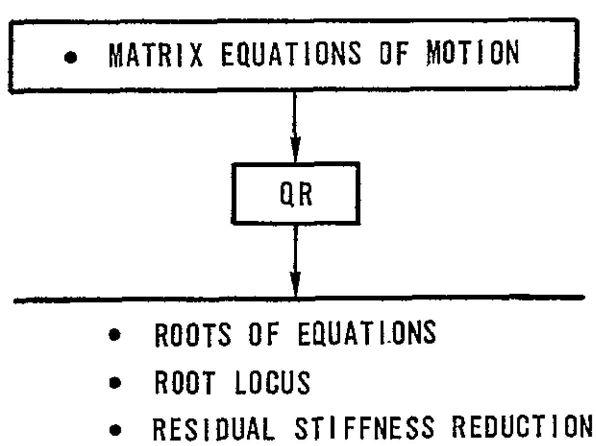
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6A11656-1 TN, :QR Users Quide," T. M. Richardson, July 1969.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Classical control systems analysis and synthesis techniques (root locus, time response, and frequency response) can be performed using this program. Laplace transformed differential equations form the basic input data.



NO. SDL-4

TECHNICAL PROGRAM ELEMENT

TITLE Dynamic Loads And Ride Quality Evaluation

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 510 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 27 degrees of freedom, 20 load eqns. (1 set) and 217 frequency points.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

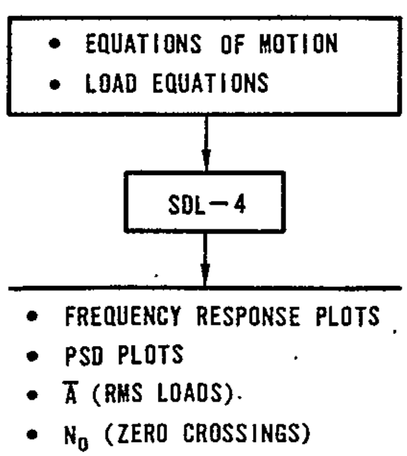
REFERENCE Boeing Document No. D6-29529TN-Vol. 1, " A Power Specral Digital Computer Program to Determine Airplane Dynamic Loads Due to Random Gusts - Users Guide" R.E. Clemmens, June 1970.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This is a power spectral digital computer program to determine airplane dynamic loads due to random gusts.

The airplane structure is idealized as a system of weightless elastic beams with lumped mass which approximates the original in terms of weight, inertia and stiffness. The loads may be due to either vertical or lateral gusts. The program has several optional capabilities including feedback damping, gradual gust penetration, and a static elastic solution.



NO. SDL-5

TECHNICAL PROGRAM ELEMENT

TITLE Dynamic Loads and Ride Quality Evaluation

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran II HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 mission profile of 10 flight conditions with 45 loads eqns and 7 load levels.

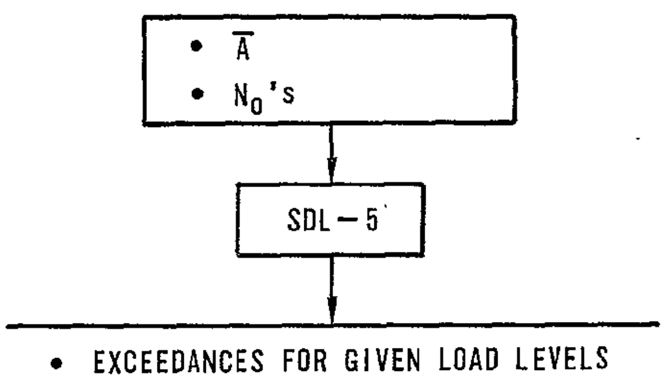
STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing Coord. Sheet PM-77B&C, "Frequency of Exceedance Program," T. D. Arthurs, Feb. 1965.

OWNERSHIP: Public___, Private x, Owner Boeing

ABSTRACT

Calculates exceedances for given load levels using $\bar{A}$ and N_0's for input



NO. SDL-6

TECHNICAL PROGRAM ELEMENT

TITLE Dynamic Loads and Ride Quality Evaluation

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 102 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 36 transfer functions of 242 freq. points transformed to time domain for time of 10 secs. with one (1-cos) forcing function freq.

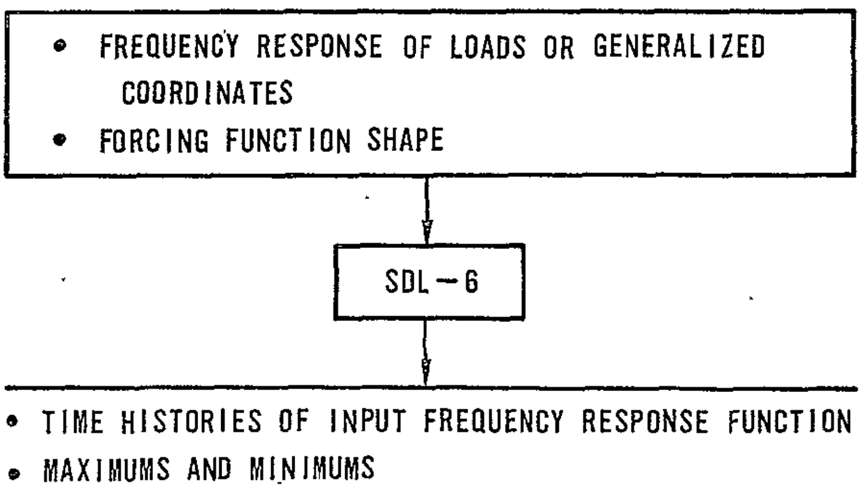
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6-29668TN, " Discrete Gust Convolution Program-TEV-126," M. R. Johnson, Nov. 1968

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

This program calculates system time responses by convoluting input transfer functions (frequency response functions) with time dependent excitation functions (gust time functions).



NO. SDL-7

TECHNICAL PROGRAM ELEMENT

TITLE Dynamic Loads and Ride Quality Evaluation

FORM PREPARED BY R. D. Miller DATE 7-24-72

LANGUAGE Fortran II HOST MACHINE CDC-6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 70 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Loading impact, 15 flexible modes, 3 gears.

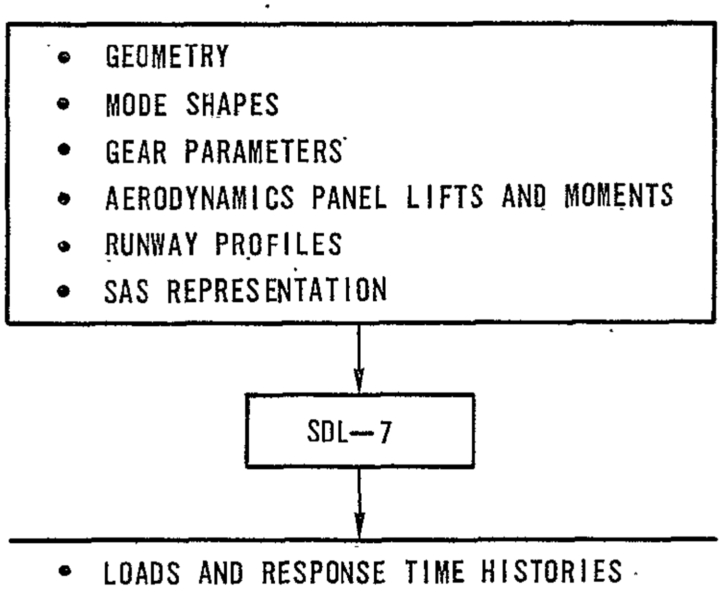
STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6-15931TN, "Flexible Airplane Landing Loads Analysis Digital Computer Program User's Manual, Falla, TEV-104," N. W. Brueske, Sept. 1967.

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

Calculates airplane dynamic response and loads due to taxi, landing, takeoff.



NO. SFL-1

TECHNICAL PROGRAM ELEMENT

TITLE Beam Modal Interpolation

FORM PREPARED BY Chen, C. C. DATE 26 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 18 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 30 Beam Stations, 48 Aerodynamic Control points, and 20 D.O.F.

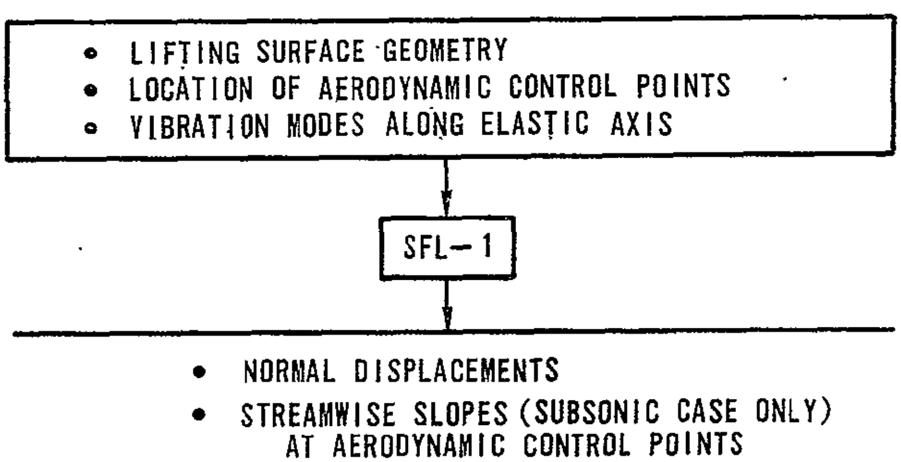
STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing document in draft form - Program TEV-129

OWNERSHIP: Public___, Private X, Owner Boeing Company

ABSTRACT

This is a modal interpolation program that interpolates (using a chain of cubics fitting scheme). The vibration mode shapes along the elastic axis of a high aspect ratio lifting surface to give normal displacements and streamwise slopes at aerodynamic control points for executing the lifting surface theory unsteady airloads programs (subsonic or supersonic).



NO. SFL-2

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Lifting Line Theory Unsteady Airloads

FORM PREPARED BY Chen, C.C. DATE 24 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One reduced frequency, 20 panels, 20 D.O.F.

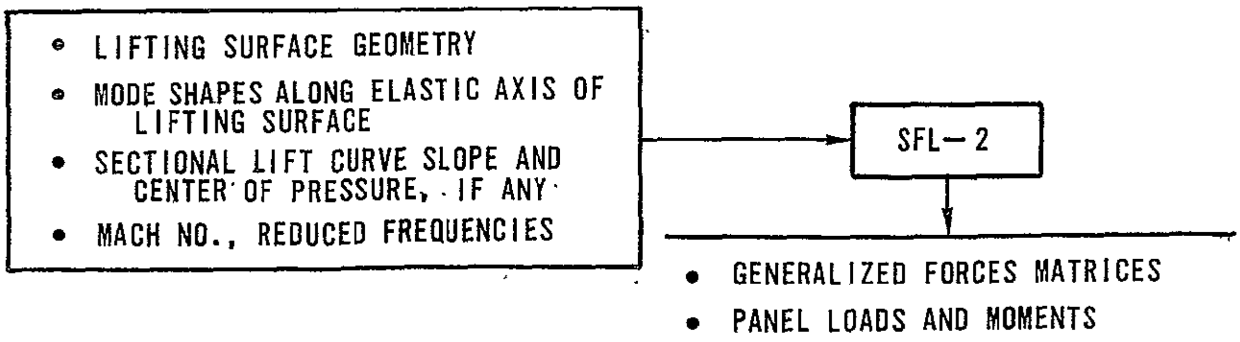
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE L. D. Richmond, "A Rational Method of Obtaining Three-Dimensional Unsteady Aerodynamic Derivatives of Intersection Airfoils in Subsonic Flow," Boeing Doc. D6-7401, 1962. Boeing program TEV-093.

OWNERSHIP: Public ___, Private X, Owner ___

ABSTRACT

This is an approximate 3-D subsonic unstead airloads program using lifting line theory for high aspect ratio lifting surfaces. The lifting surface(s) is divided into streamwise strips (panels) on which a system of horseshoe vortices (each of them is of constant strength) are placed. This program presents a rational way of obtaining 3-D unsteady airloads accounting for finite span effects and aerodynamic coupling between paneled sections of coplanar or inclined surfaces (V-tail, T-tail, etc.). Spanwise steady loads distribution may be corrected by using sectional lift curve slope and sectional center of pressure either from experimental wind tunnel data or from analytical lifting surface theory calculation.



NO. SFL-3

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Lifting Surface Theory Unsteady Airloads For Main Surface With or Without Trailing Edge Control Surface(s)

FORM PREPARED BY Chen, C.C. DATE 24 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One Mach no., One reduced Freq., 20 DOF

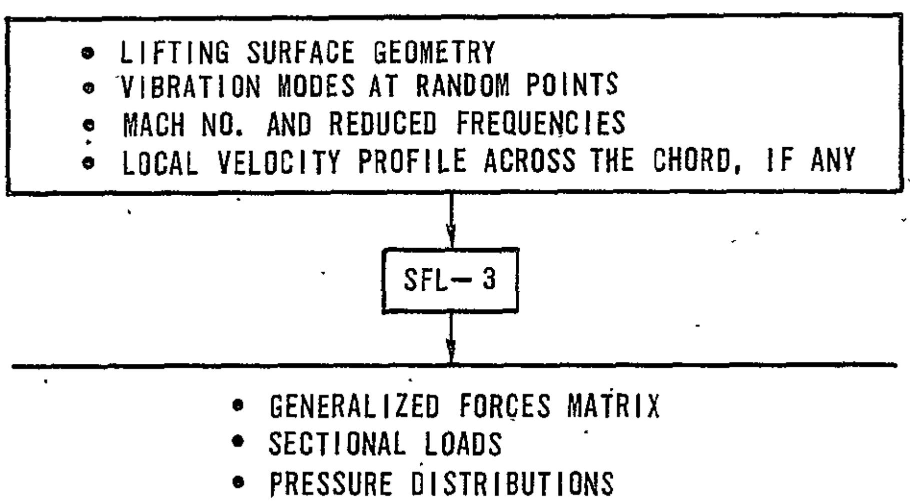
STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE W. S. Rowe, B. A. Winther, and M. C. Redman, Prediction of Unsteady Aerodynamic Loadings Caused by Trailing Edge Control Surface Motions in Subsonic Compressible Flow - Analysis and Results, NASA CR-2003, 1972. Program RHO III

OWNERSHIP: Public x, Private___, Owner___

ABSTRACT

This is a subsonic lifting surface theory unsteady airloads program using kernel function - assumed pressure modes approach for the prediction of unsteady lifting surface loadings caused by motions of a planar lifting surface with or without trailing edge control surface(s) having sealed gap(s). The final form of the downwash integral equation has been formulated by isolating the singularities from the non-singular terms and establishing a preferred solution process to remove and evaluate the downwash discontinuities in a systematic manner.



NO. SFL-4

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Unsteady Airloads For Single Rigid Cowl

FORM PREPARED BY Chen, C. C. DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 35 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One mach number, one reduced frequency, and 20 D.O.F.

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE Documentation in progress, Program number TEV 148.

OWNERSHIP: Public___, Private X, Owner The Boeing Co.

ABSTRACT

This is a lifting surface unsteady airloads program for a single, isolated, rigid cowl (ring wing) oscillating in subsonic compressible flow. Kernel function in cylindrical coordinates and assumed pressure modes approach is used.

- COWL GEOMETRY
- LOCATION OF COWL MOTION REFERENCE POINT
- MODE SHAPES AT COWL MOTION REFERENCE POINT
- MACH NO.
- REDUCED FREQUENCIES

↓

SFL - 4

↓

- GENERALIZED FORCES MATRICES
- PRESSURE DISTRIBUTIONS

NO. SFL-5

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Unsteady Aerodynamics Using Doublet-Lattice Method

FORM PREPARED BY Chen, C.C. DATE 27 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE J. P. Giesing, T. P. Kalman, W. P. Rodden, Subsonic Unsteady Aerodynamics for General Configurations, Part I, Part II, AFFDL-TR-75-5, WPAFB, Ohio, Nov. 1971, April 1972. Program H7WC

OWNERSHIP: Public X, Private ___, Owner ___

ABSTRACT

Program SFL-5 predicts steady and oscillatory aerodynamic loads on general configurations based on the nonplanar doublet-lattice method. Two methods of accounting for body-lifting surface interference in unsteady flow are considered. The first method is a direct application of nonplanar lifting surface elements to both lifting surfaces and the body surfaces. The second method uses an image system and an axial singularity system to account for the effects of the bodies. Chord and spanwise loading on lifting surfaces and longitudinal body load distributions are determined. Configurations may be composed of an assemblage of bodies (elliptic cross sections and a distribution of width or radius) and lifting surfaces (arbitrary planform and dihedral, with or without control surfaces).

*Estimate

NO. SFL-6

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Lifting Surface Unsteady Interaction Airloads

FORM PREPARED BY Chen, C. C. DATE 27 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational ___, Programming In Development X, Not Programmed ___

REFERENCE

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

A program is being developed using nonplanar kernel function and assumed pressure modes approach to predict unsteady interaction airforces for wing, tail, T-tail, wing-nacelle, folded wing tip and other general configuration in subsonic flow.

*Estimate

NO. SFL-7

TECHNICAL PROGRAM ELEMENT

TITLE Subsonic Unsteady Airloads For Lifting Surface With L.E. & T.E. Control Surface and Tab

FORM PREPARED BY Chen, C. C. DATE 27 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ______

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE W. S. Rowe, B. A. Winther, and M. C. Redman, Prediction of Unsteady Aerodynamic Loadings Caused by Trailing Edge Control Surface Motions in Subsonic Compressible Flow - Analysis and Results, NASA CR-2003, 1972

OWNERSHIP: Public___, Private X, Owner Boeing Company

ABSTRACT

The kernel function - assumed pressure modes techniques and the solution procedures used in the referenced paper are being extended to predict subsonic unsteady airloads caused by the motions of leading edge, trailing edge control surfaces(s) and tab of a planar lifting surface.

*Estimate

NO. SFL-8

TECHNICAL PROGRAM ELEMENT

TITLE Generalized Forces Matrices Summation

FORM PREPARED BY Chen, C. C. DATE 24 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 2 generalized forces matrices of the size 20 x 20 complex

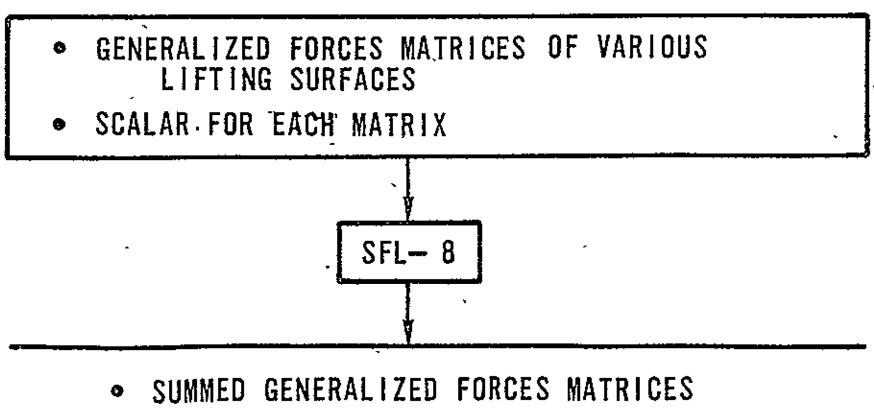
STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Waldron, J. "A Fortran IV Program to Form Coupled Generalized Air Forces From Component Air Forces," Boeing Coordination Sheet No. SSU-66-19, June 1966. Boeing Program TEV097

OWNERSHIP: Public ___, Private X , Owner Boeing Company

ABSTRACT

This program adds the generalized forces matrices of various lifting surfaces oscillating at the same frequency and speed ratios.



NO. SFL-9

TECHNICAL PROGRAM ELEMENT

TITLE Generalized Forces Matrices Interpolation

FORM PREPARED BY Chen, C. C. DATE 26 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 15 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 5 input matrices of the size 20 x 20 complex, 20 output matrices of same size

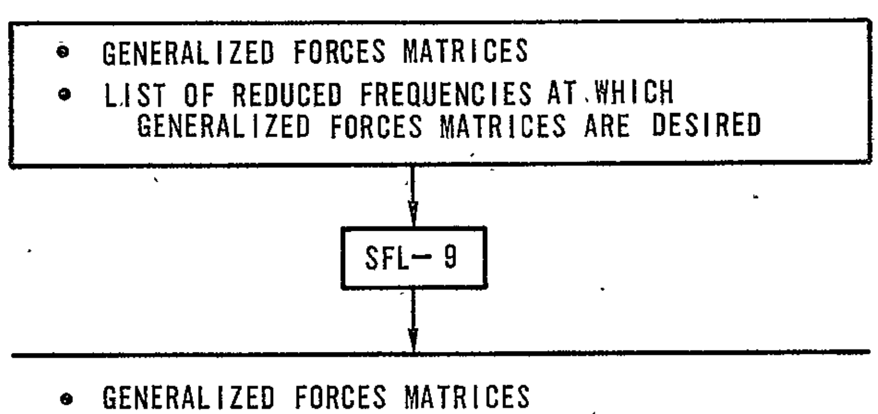
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Kramer, G., "Fortran IV Subroutine MXINTP," The Boeing Company Coordination Sheet PS-3903, Aug. 1968. Boeing Program TEL 122

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

This program interpolates independently the real and imaginary parts of the elements of input generalized forces matrices with respect to their reduced frequencies. The functions resulting from a chain of cubics fitting scheme are then evaluated to form the generalized forces matrices at intermediate reduced frequencies.



NO. SFL-10

TECHNICAL PROGRAM ELEMENT

TITLE Flutter Matrices Formulation & Solution

FORM PREPARED BY Chen, C. C. DATE 25 July 1972

LANGUAGE Fortran HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 20 D.O.F., 20 reduced frequencies, one density

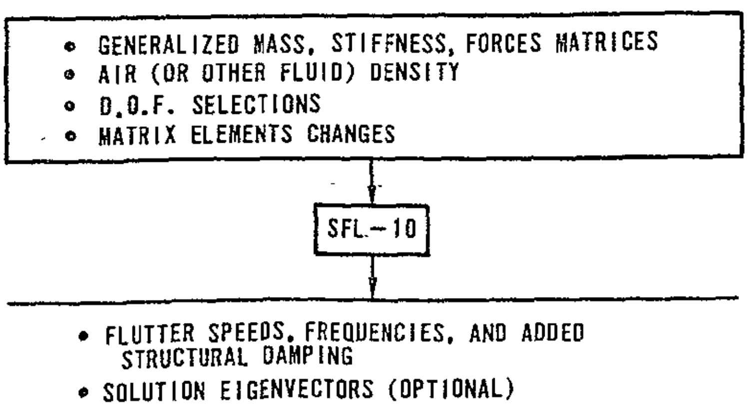
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Berendzen, T. A., "The Solution of the V-g Flutter Equations", Boeing Document D6-29835TN, December 1969. Boeing Program TEV133

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

This is a traditional American V-g method of flutter equation formulation and solution program. Flutter equations of motion are formed with complex generalized forces matrices and real generalized mass and stiffness matrices. The complex eigenvalue problem resulting from simple harmonic motion assumption is solved by the QR algorithms. The complex roots are then interpreted as the flutter speeds, frequencies, and added structural dampings. Options for selecting more than one set of D.O.F., modifying the elements of the mass and/or stiffness matrices, and specifying more than one air density are provided.



NO. SFL-11

TECHNICAL PROGRAM ELEMENT

TITLE Flutter Matrices Formulation and Solution

FORM PREPARED BY Chen, C. C. DATE 25 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 35 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 20 D.O.F., 20 reduced frequencies, one density

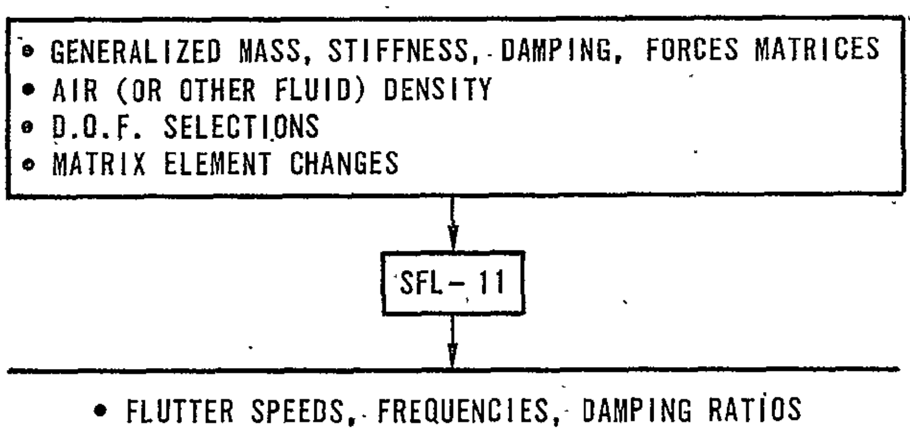
STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Billing, J. R. & Jennings, W. P., "A Rational Quadratic Flutter Solution Procedure, Programs CASBAH/COIR", Boeing Document D6-24812TN, Sept. 1971

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

Program SFL-11 provides a "Classical British" flutter solution procedure where the imaginary part and the real part of the generalized forces matrix are treated as viscous damping and stiffness terms respectively. A quadratic eigen-problem is formed and solved by the QR algorithm. Flutter speeds (V), frequencies (f), and damping ratios (γ) interpreted from eigen values are consistent with the mach no. and altitude considered but not with reduced frequencies. Manual instructions of how the curves γ-v, f-v should be plotted are input to the second part of the program to get the final matched flutter results.



NO. SFL-12

TECHNICAL PROGRAM ELEMENT

TITLE Automated Flutter Solution

FORM PREPARED BY Chen, C. C. DATE 27 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 45 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One mach number, 20 D.O.F.

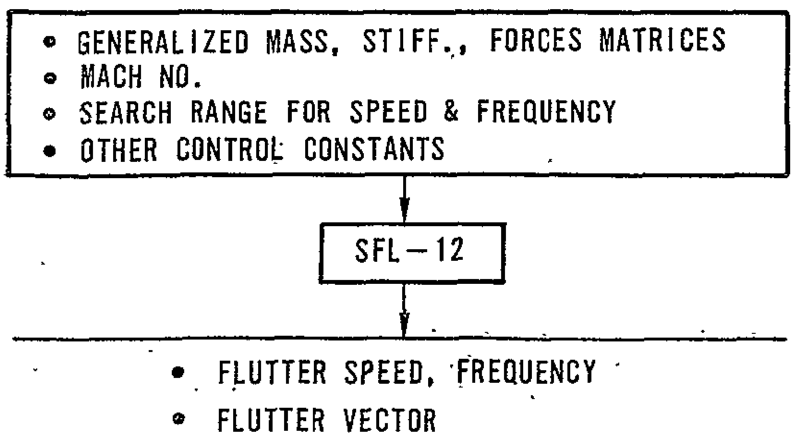
STATUS: Operational ___, Programming In Development X, Not Programmed ___

REFERENCE Not documented. Boeing Program AFA.

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

SFL-12 is a numerical procedure to solve flutter equations completely automatically. The approach taken to arrive at a computerized evaluation of flutter speed, frequency and mode is based on the fact that the characteristic equation of a fluttering system (at a given mach no.) can be identified as the condition that the open loop frequency responses of the aero-elastic system must equal -1. The standard atmosphere relationships for flight speed, mach no. and air density have been included in the program such that the search for flutter condition is confined to finding the combination of speed and frequency which satisfy the flutter equations.



NO. SFL- 13

TECHNICAL PROGRAM ELEMENT

TITLE - Energy Loops

FORM PREPARED BY Chen, C. C. DATE 27 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{5} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One flutter condition for 20 D.O.F. problem.

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE M. C. Redman, "Energy Loops - TEV117," Boeing Document D6-29488TN, Sept. 1969

OWNERSHIP: Public___, Private X, Owner Boeing Company

ABSTRACT

Program SFL-13 provides the capability to calculate and display the energy exchange between the various degrees of freedom included in an analytical flutter solution, enabling the appraisal of the mechanisms of flutter.

- GENERALIZED MASS AND STIFFNESS MATRICES
- GENERALIZED FORCES MATRICES OR NEAR FLUTTER CONDITIONS
- EIGENVALUES & EIGENVECTORS AT OR NEAR FLUTTER CONDITIONS FROM A V-g SOLUTION
- OTHER CONTROL CONSTANTS

↓

SFL-13

↓

- THE WORK DONE PER CYCLE FOR EACH D.O.F. BY THE GENERALIZED MASS, COMPLEX STIFFNESS (INCLUDING ADDED STRUCTURAL DAMPING), FORCES ASSOCIATED WITH EACH D.O.F.
- THE WORK DONE PER CYCLE DUE TO EACH D.O.F.
- FORCE LOOP COMPONENTS FOR EACH D.O.F.
- VECTOR PLOT OF FORCE LOOP (OPTIONAL)

NO. SFL-14

TECHNICAL PROGRAM ELEMENT

TITLE Interpolation By Surface Splines

FORM PREPARED BY Chen, C. C. DATE 21 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 15 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 100 input structural grid point, 48 aerodynamic grid points, and 20 vibration mode shapes

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE R. L. Harder, R. N. Desmarais, "Interpolation Using Surface Splines," Journal of Aircraft, Vol. 9, No. 2, Feb. 1972

OWNERSHIP: Public X, Private ___, Owner ___

ABSTRACT

The surface spline method described in the reference has been programmed for general surface interpolation. A surface deformation function is derived by fitting through the known surface deflections with the bending deformation function of a pinned infinite plate.

NO. SFL-15

TECHNICAL PROGRAM ELEMENT

TITLE Surface Interpolation Using Beam Splines

FORM PREPARED BY Chen, C. C. DATE 21 July 1972

LANGUAGE Snark, Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 40 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 175 input structural grid points, 48 aerodynamic grid points, and 20 vibration mode shapes.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Structures Research Group, "ATLAS - An Integrated Structural Analysis and Design System - Complete User's Input Outline," Boeing DOC. D6-25400-003TN, June 1971. Boeing Program TEV 140.

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

This is the interpolation technical module (TCM) of the Atlas System. The program is written in SNARK, a special purpose precompiler for translating a matrix language program into an equivalent Fortran program, and Fortran IV for CDC 6600 computer. The program interpolates the vibration modes (out of plane displacements) from the structural grid points of a surface to the modal values (out of plane displacements and streamwise slopes) at the aerodynamic control points. The interpolation is achieved by the method of beam spline fitting. A transformation matrix is formed relating the deflection at the structural grid points to the modal values at the aerodynamic control points.

NO. SFL-16

TECHNICAL PROGRAM ELEMENT

TITLE Unsteady Aerodynamic Loadings in Supersonic Flow, Box Method

FORM PREPARED BY Chen, C. C. DATE 18 July 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 6 (Boxes of Source Cards)

TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One mach number, one k-val 20 D.O.F., single surface with 230 total box, no subdivision applied.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE J. M. Ii, C. J. Borland, J. R. Hogley, Prediction of Unsteady Aerodynamic Loadings of Non-Planar Wings and Wing-Tail Configurations in Supersonic Flow, AFFDL-TR-70-108, Part I and Part II, August 1971

OWNERSHIP: Public X, Private ___, Owner ___

ABSTRACT

This Fortran computer program was written based on a three-dimensional extension of the mach box technique for the unsteady aerodynamic analysis of non-planar wings and wing-tail configurations in supersonic flow. The program is capable of treating wing tail combinations with or without vertical separation, longitudinal separation, and dihedral on either surface. However, aerodynamic interaction of the tail affecting the wing may be evaluated only for the coplanar case. First order piston theory thickness correction is available. Two refinement procedures are also provided: subdivision with averaging and velocity potential smoothing. For input oscillatory mode shapes the program calculates normal washes, velocity potentials, lifts, pressures, and generalized forces matrices. Applicable mach number is larger than 1.0 and less than 5.0 (recommended range from 1.2 to 3.0).

NO. SFL-17

TECHNICAL PROGRAM ELEMENT

TITLE Unsteady Aerodynamic Loadings in Supersonic Flow, Kernel Function - Assumed Pressure Mode Method

FORM PREPARED BY Chen, C. C. DATE 15 Aug. 1972

LANGUAGE ______ HOST MACHINE ______

* PROGRAM SIZE 2 (Boxes of Source Cards)

* TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ______

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE H. J. Cunningham, "Improved Numerical Procedure for Harmonically Deforming Lifting Surfaces from the Supersonic Kernel Function Method", AIAA J.; Vol. 4, No. 11, Nov. 1966, pp. 1961 - 1968

OWNERSHIP: Public x, Private ___, Owner ______

ABSTRACT

This is an improved numerical procedure developed to predict supersonic unsteady airloads based on the supersonic kernel function method for harmonically deforming lifting surface. Solutions are obtained to the linear integral equation, which relates distributions of downwash and lifting pressure on oscillating and steady thin lifting surfaces in supersonic potential flow. The improvement is primarily in the choice of a series for approximating the lifting pressure distribution.

*Estimate

NO. SFL-18

TECHNICAL PROGRAM ELEMENT

TITLE Unsteady Aerodynamic Loadings in Supersonic Flow, Consistent Finite Elements Approach

FORM PREPARED BY Chen, C. C. DATE 15 Aug. 1972

LANGUAGE ________ HOST MACHINE ________

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ________

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Kariappa and G. C. C. Smith, "Further Development in Consistent Unsteady Supersonic Aerodynamic Coefficients," J. Aircraft; Vol. 9, No. 2, Feb. 1972

OWNERSHIP: Public X, Private ___, Owner ________

ABSTRACT

Supersonic unsteady airloads are predicted by the method of source pulse distributions, relating downwash and source strength in velocity potential distribution. Lifting surface is divided into a finite element type grid system which can be the same as in the structural analysis. Partial elements at lifting surface and diaphragm edges are avoided, and downwash continuity is maintained, thereby yielding improved pressure distribution. Use of quadratic interpolation of velocity potentials and displacements improves accuracy, or leads to the necessity for fewer elements. Unsteady supersonic aerodynamic coefficients evaluated are kinematically consistent with structural analysis approach.

*Estimate

NO. SFL-19

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Unsteady Aerodynamics for Multiple Lifting Surfaces - Body Configurations

FORM PREPARED BY Chen, C. C. DATE 15 Aug. 1972

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ____

STATUS: Operational ___, Programming In Development X, Not Programmed ___

REFERENCE J. M. Ii, C. J. Borland, J. R. Hogley, Prediction of Unsteady Aerodynamic Loadings of Non-Planar Wings and Wing-Tail Configurations In Supersonic Flow, AFFDL-TR-70-108, Part I & Part II, Aug. 1971

OWNERSHIP: Public X, Private ___, Owner ____

ABSTRACT

This program will evaluate the aerodynamic pressures, perturbation velocity components, local lift and moment coefficients, and generalized aerodynamic forces on multiple lifting surfaces - body configurations in supersonic unsteady flow. The aerodynamic influence coefficient (AIC) method of lifting surface theory with three dimensional mach box approach and the box method refinement technique used in the reference will be extended in the numerical evaluation of the unsteady interaction of the general configuration.

*Estimate

NO. SFL-20

TECHNICAL PROGRAM ELEMENT

TITLE Piston Theory Unsteady Aerodynamics

FORM PREPARED BY Chen, C. C. DATE 19 July 1972

LANGUAGE Fortran HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 3.5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One mach number, one density, one reduced frequency, 400 boxes on the planform, 20 D.O.F.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE J. L. Stelma, R. G. Zuelow, "Development of Piston Theory Generalized Air Forces for Supersonic Flutter Analysis," Boeing Document No. D6A11522-1, Apr. 1969, Boeing Program TEV130

OWNERSHIP: Public ___, Private X, Owner ___

ABSTRACT

This program calculates generalized airforce matrices for lifting surface oscillating in supersonic flow. The piston analogy of determining the instantaneous pressure distribution is used and expanded to the fifth order. The effects of initial angle of attack and airfoil thickness are included. Applicable mach range is of $\sqrt{M^2 - 1} \approx M$ and $M \delta \leq 1$ where

M = Mach No.

δ = The greater of the two:

- Airfoil thickness ratio
- Oscillating amplitude-to-chord ratio

NO. SFL-21

TECHNICAL PROGRAM ELEMENT

TITLE Scale-Merge-Reduce Operation for Substructure Stiffness Matrices

FORM PREPARED BY Chen, C. C. DATE 17 Aug. 1972

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ______

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE F. A. Hanna, A Scale-Merge-Reduce Capability of Substructures Stiffness Matrices

OWNERSHIP: Public X, Private___, Owner______

ABSTRACT

This program provides the capability for generating a gross structure stiffness matrix from existing substructures stiffness matrices. This allows the analyst to modify regions of the structure by working with small local stiffness matrices. Optional generation of the reduced stiffness, flexibility, and mass matrices is also provided.

*Estimate

NO. SFL-22

TECHNICAL PROGRAM ELEMENT

TITLE Flat Plate Panel Flutter

FORM PREPARED BY Chen, C. C. DATE 24 Aug. 1972

LANGUAGE Fortran IV HOST MACHINE IBM 360/65

PROGRAM SIZE 2 (Boxes of Source Cards)

* TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Murray, James F. "Vibration and Flutter of Flat Rectangular Panels", Boeing Document No. AS2295, 1969

OWNERSHIP: Public ___, Private X, Owner

ABSTRACT

This program solves the general flutter equations for a flat, rectangular panel having one surface exposed to supersonic flow (Mach number $> \sqrt{2}$ for preliminary design purposes). The flutter equations were derived for a variety of boundary conditions by application of the Principal of Minimum Potential Energy in conjunction with the Rayleigh-Ritz method. Quasi-steady supersonic aerodynamics, accurate to the first order in frequency, were used to represent the aerodynamic forces. The input consists of length to width ratios, angles of orthotropicity, flow angles, structural and viscous damping constants, cavity constants, midplane edge loads and dynamic pressures. The output consists of the aerodynamic, stiffness, and flutter matrices, the eigenvalues and eigenvectors, and the mode shapes.

*Estimate

NO. SLO-1

TECHNICAL PROGRAM ELEMENT

TITLE Rigid Wing Aerodynamics

FORM PREPARED BY Manning/Palotas DATE 7-28-72

LANGUAGE FTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Check Case

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE " The development and digital programming of a subsonic and supersonic elastic airload solution" - Vol. V D6-3393 Boeing Program TES-055.

OWNERSHIP: Public___, Private X, Owner Boeing Company

ABSTRACT

Determines subsonic pressure distributions over wing surface with arbitrary planform, camber and thickness using modified Kuchemann lifting surface theory. Chordwise pressure distributions are calculated at several spanwise stations by introducing a distribution of sources to satisfy the requirement of streamwise flow at the airfoil surface. Section aerodynamics are calculated by integrating $\Delta P/q$ over the chord.

NO. SLO-2

TECHNICAL PROGRAM ELEMENT

TITLE Aeroelastic Wing Loads Distributions

FORM PREPARED BY Manning/Palotas DATE 7-28-72

LANGUAGE FRTRN IV HOST MACHINE CDC6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{4} (Words)

OUTPUT VOLUME 10^{6} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical production run.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE "An integral structural analysis method for preliminary design wing studies." D6-8161 Boeing Program TESS4

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

The wing aeroelastic solution is based on the modified Weissinger Lifting Line Theory presented in NACA TN-3030. Potential flow; small t/c; seperation and compressibility effects negligible; small angle of attack; Kutta Condition at trailing edge is satisfied; are assumed.

Lift distribution, balancing tail load and angle of attack are simultaneously solved for. Spanwise lift and pitching moment distributions are combined with inertia loads and thrust loads (due to wing mounted engines) to give total wing loads distribution about the Loads Reference Axis.

NO. SLO-3

TECHNICAL PROGRAM ELEMENT

TITLE Body and Empennage Loads Distribution

FORM PREPARED BY Manning/Palotas DATE 7-28-72

LANGUAGE FTRN IV HOST MACHINE CDC6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Production LEMBO run.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Preliminary Design Loads Prediction Methods - Fuselage, Empennage and Landing Gear. D3-7931 Boeing Program LEMBO.

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

The following conditions may be analysed:

Lateral Discrete Gust;

Rudder Maneuvers;

Engine Failure and Rudder Checkback;

Vertical Discrete Gust;

Balanced Symmetrical Maneuvers;

Elevator Check Maneuvers;

2 Point Landing, 2 G Taxi, Nosegear Yaw, Ground Turn and 2 and 3 Point Braked Roll.

Loads are claculated as a function of rigid airplane response to controls or gust. Empennage inertia and airloads, gear loads, thrust effects and body inertia are considered for total body loads. Airload distribution is calculated on the fin using a 3-dimensional induction matrix while an eliptical distribution is assumed on the horizontal stabilizer.

NO. SLO-4

TECHNICAL PROGRAM ELEMENT

TITLE Supersonic Load Distributions

FORM PREPARED BY K. Manning DATE 7-1-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 500 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate (50 CONDS)

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-23828TN Boeing Program TEA 196

OWNERSHIP: Public ___, Private X , Owner Boeing Company

ABSTRACT

Calculates aeroelastic load distributions on an arbitrary planform.
Uses Woodward Lift Surface Theory.
Matrix methods are used to solve simultaneous linear equations for loads, deflections, accelerations and stability derivatives. Computer unit and balanced loads solution for symmetric rigid or flexible airplanes.
This program forms the basis of the loads module in the Atlas system.

NO. SLO-5

TECHNICAL PROGRAM ELEMENT

TITLE Reduction of Symmetric Wing Wind Tunnel Data

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING .10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X , Programming In Development ___ , Not Programmed ___

REFERENCE Boeing Program MOABI

OWNERSHIP: Public ___ , Private X , Owner Boeing Company

ABSTRACT

Input wing geometry, model stiffness, linearised wind tunnel pressure data ($C\ell_o$, $C\ell_\alpha$, C_{mo}, $C_{m\alpha}$)

Computes M_o , α_{BI} , C_{m_o} and C_m/C_n for use in lifting line analysis, SLO-18.

NO. SLO-6

TECHNICAL PROGRAM ELEMENT

TITLE Reduce Flap Wind Tunnel Pressure Data

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational x, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program SUMFLAP

OWNERSHIP: Public ___, Private x, Owner Boeing Company

ABSTRACT

Integrate flap and wing box data to give total section coefficients and interpolates to aeroelastic analysis stations.

NO. SLO-7

TECHNICAL PROGRAM ELEMENT

TITLE Reduction of Control Surface Wind Tunnel Data

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program DADM

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

Reduces control surface wind tunnel data from input of δC_ℓ, δC_n, m_o and dCm/dCn

Compute δ_K and δC_m for input into unsymmetric analysis program TES145 (SLO-19).

NO. SLO-8

TECHNICAL PROGRAM ELEMENT

TITLE Spoiler Aerodynamics

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate from normal run.

STATUS: Operational x, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program SPOILER

OWNERSHIP: Public ___, Private XX, Owner Boeing Company

ABSTRACT

Spoiler is stored in tabular form following hand reduction from wind tunnel data. For a given condition values of δ_x and δC_m due to spoilers are determined, including the effects of spoiler blowdown and nonlinearity with airplane C_L if require. This data is used if the lifting line analysis program SLO-18.

NO. SLO-9

TECHNICAL PROGRAM ELEMENT

TITLE HI Lift Device Aerodynamics

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed XX

REFERENCE ______

OWNERSHIP: Public____, Private____, Owner______

ABSTRACT

Reduce wind tunnel data to produce alpha dependent tables of CN and CM at various spanwise lodations.

NO. SLO-10

TECHNICAL PROGRAM ELEMENT

TITLE Control Surface Aerodynamics

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

Reduce wind tunnel data into the form required by following modules including estimates of blowdown where applicable.

NO. SLO-11

TECHNICAL PROGRAM ELEMENT

TITLE Wing Pressure Distributions

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE ____________ HOST MACHINE ____________

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ____________

OWNERSHIP: Public____, Private____, Owner____________

ABSTRACT

Linearize wind tunnel pressure data to produce mach number dependent non-dimensional pressure data at two values of section C_n for each mach no./station combination.

NO. SLO-12

TECHNICAL PROGRAM ELEMENT

TITLE Body Aerodynamics For Wing Analysis

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed XX

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

Reduce wind tunnel data to produce Mach number dependent tables of fuselage C_{L_0}, C_{L_α}, C_{M_0}, C_{M_α} for wing analysis.

Also provide airload data for fuselage analysis.

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NO. SLO-13

TECHNICAL PROGRAM ELEMENT

TITLE Nacelle Aerodynamics

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed XX

REFERENCE None

OWNERSHIP: Public___, Private___, Owner___

ABSTRACT

Reduce wind tunnel data, to produce Mach number dependent tables of nacelle C_{L_O}, $C_{L\alpha}$, C_{M_O}, and $C_{M\alpha}$ for wing analysis, and local nacelle loads.

NO. SLO-14

TECHNICAL PROGRAM ELEMENT

TITLE Power On

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational XX, Programming In Development ___, Not Programmed ___

REFERENCE None

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

From power off analysis the effective thrust arm of wing mounted engines is computed. In addition Thrust/Altitude/Speed tables are interogated to determine the appropriate thrust for each condition. This data is then passed back to SLO-18 for power on analysis.

NO. SLO-15

TECHNICAL PROGRAM ELEMENT

TITLE Horizontal Tail Aerodynamics

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE ____ HOST MACHINE ____

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed XX

REFERENCE ____

OWNERSHIP: Public____, Private____, Owner ____

ABSTRACT

Reduce wind tunnel data into the format required by downstream modules.

NO. SLO-16

TECHNICAL PROGRAM ELEMENT

TITLE Horizontal Tail and Fin Aerodynamics Control Surface Reversal Characteristics

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational XX, Programming In Development ___, Not Programmed ___

REFERENCE D6-7500 "Computer Programs for Airplane Structural Loads Analysis'" Boeing Program TES077

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

Control surface reversal characteristics due to elevator deflection are assessed. The effect of aeroelasticity on elevator control characteristics are represented by:

$$\frac{M_E}{M_R} = \frac{\left(\frac{dM}{d\delta_E}\right)_{ELASTIC}}{\left(\frac{dM}{d\delta_E}\right)_{RIGID}}, \quad \frac{L_E}{L_R} = \frac{L_{\delta \, ELASTIC}}{L_{\delta \, RIGID}}, \quad \frac{dS}{d\delta_E} \quad \frac{\left(\frac{dM}{d\delta_E}\right)_{ELASTIC}}{\left(\frac{dM}{dS}\right)_{ELASTIC}}$$

This program also used to assess rudder control effectivity.

NO. SLO-17

TECHNICAL PROGRAM ELEMENT

TITLE Vertical Fin Aerodynamics

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{5} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed XX

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

Reduce wind tunnel data into format required by downstream modules.

NO. SLO-18

TECHNICAL PROGRAM ELEMENT

TITLE Symmetric Aeroelastic Wing Loads

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Run.

STATUS: Operational xx, Programming In Development ___, Not Programmed ___

REFERENCE D6-7500 - Computer Programs For Structural Analysis Boeing Program TES070

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Symmetric aeroelastic wing loads calculated for balanced airplane, also calculates tail-off aerodynamic coefficient and balancing tail load data for SLO-27.

Weissinger L method as documented in NACA TN3030 is used.

NO. SLO-19

TECHNICAL PROGRAM ELEMENT

TITLE Unsymmetric Aeroelastic Wing Loads

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Run

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-7500 - Computer Programs for Structure Analysis
Boeing Program TES 145.

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Calculate spanwise loads distribution for antisymmetrical load conditions and rolling maneuvers (steady roll, and roll initiation). Also used for control reversal analysis.

NO. SLO-20

TECHNICAL PROGRAM ELEMENT

TITLE Ground Handling Aeroelastic Wing Load - Inertia

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Run

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE None

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

For input geometry, stiffness and inertia distribution.. Load distributions are calculated for accelerations along and about 3 axes and velocities along 3 axes.

NO. SLO-21

TECHNICAL PROGRAM ELEMENT

TITLE Hi Lift Device Load Distributions

FORM PREPARED BY K. Manning DATE 6-30-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Compute spanwise distributions of hi lift device loads.

NO. SLO-22

TECHNICAL PROGRAM ELEMENT

TITLE Control Surface Load Distributions

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner ______

ABSTRACT

Compute total surface loads and local distributions over all control surfaces.

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NO. SLO-23

TECHNICAL PROGRAM ELEMENT

TITLE Wing Pressure Distributions

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Run

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing Program WNGPRES

OWNERSHIP: Public___, Private X, Owner Boeing

ABSTRACT

Linearized wind tunnel pressures distributions are input. SLO-18 output of section CN is matched to the tunnel data and a chordwise pressure distribution output.

NO. SLO-24

TECHNICAL PROGRAM ELEMENT

TITLE Chordwise Wing Loads

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Run

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program TES 079

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

To the loads output computer in SLO-18 chordwise loads are added and the loads are interpulated to the stress analysis stations.

NO. SLO-25

TECHNICAL PROGRAM ELEMENT

TITLE Spar Shear Flow

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program SHELOW

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Using the Loads output from SLO-24 and factors (q_v, q_m, q_t) shear flow are calculated in the spars.

NO. SLO-26

TECHNICAL PROGRAM ELEMENT

TITLE Upset Analysis

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE None

OWNERSHIP: Public___, Private X, Owner Boeing

ABSTRACT

Perform upset analysis to determine the airplane dive speed margin.

The airplane in stabilized flight (level if available thrust is sufficient or an initial dive if sufficient thrust is not available) is upset into a $7\frac{1}{2}^{o}$ dive for 20 seconds. This dive is followed by a 1.5g recovery with speedbrakes and power cut. A time history of critical parameters during the maneuver is output.

NO. SLO-27

TECHNICAL PROGRAM ELEMENT

TITLE Total Horizontal Tail Loads

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE $1\frac{1}{2}$ (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical run and estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29965TN, Boeing Program TES 276

OWNERSHIP: Public ___, Private ___, Owner ___

ABSTRACT

Calculates total horizontal tail loads for balanced, FAR gust and elevator maneuvers.

NO. SLO-28

TECHNICAL PROGRAM ELEMENT

TITLE Horizontal Tail and Fin Load Distributions

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-33215TN Boeing Program TES 331

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Calculates load distribution on a surface at known angle of attack and control surface deflection.

NO. SLO-29

TECHNICAL PROGRAM ELEMENT

TITLE Total Fin Loads

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/4 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{2} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program FING OST

OWNERSHIP: Public ___, Private X, Owner Boeing Company

ABSTRACT

Calculates FAR fin gust loads used data from SLO-16.

NO. SLO-30

TECHNICAL PROGRAM ELEMENT

TITLE Fuselage Load Distributions

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran 4 HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Production Run

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29889 TN, Boeing Program TES165

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Calculates fuselage shear and moment distributions resulting from fuselage inertia, payload, point loads and airload.

NO. SLO-31

TECHNICAL PROGRAM ELEMENT

TITLE Fuselage Load Distribution

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing program AXTOR

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Calculates fuselage torsion and axial load. Distribution resulting from inertia and point loads.

NO. SLO-32

TECHNICAL PROGRAM ELEMENT

TITLE Fuselage Load Distribution

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program SEC 4B

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Distributes vertical fin or horizontal tail load onto the rear fuselage and combines it with inertia loading.

NO. SLO-33

TECHNICAL PROGRAM ELEMENT

TITLE Fuselage Load Distribution

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT
Estimate

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE Boeing Program CSBAL

OWNERSHIP: Public___, Private X, Owner Boeing

ABSTRACT

Attempts to balance all loads being fed into the center section.

NO. SLO-34

TECHNICAL PROGRAM ELEMENT

TITLE Fuselage Loads

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing Program BETAYAW

OWNERSHIP: Public___, Private X, Owner Boeing

ABSTRACT

Calculates fuselage acceleration resulting from lateral maneuvers.

NO. SLO-35

TECHNICAL PROGRAM ELEMENT

TITLE Gear Loads

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE None

OWNERSHIP: Public___, Private X, Owner Boeing

ABSTRACT

Calculate gear loads for body and gear design to meet the requirement of FAR Part 25. (Current version of the program has some built-in 747 values).

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NO. SLO-36

TECHNICAL PROGRAM ELEMENT

TITLE Gear Loads - Flotation

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-24460 Portland Cement Associations - Rigid pavement

D6-4088TN Instruction Rpt. 4 U.S. Army Engineers Waterways Experimental Station

OWNERSHIP: Public ___, Private ___, Owner ___

ABSTRACT

Compute flotation loads based on:

(1) Portland Cement Associations rigid pavement analysis

(2) New York Port Authority pavement design analysis.

(3) Corps of Engineers CBR method to calculate pavement thickness requirements for any gear configuration.

NO. SLO-37

TECHNICAL PROGRAM ELEMENT

TITLE Select Critical SLO-14 Condition

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1/2 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program CRIT 70.

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Sorts on the shear, moment, and torsion output by SLO-14, output maximum and minimum envelopes of each variable with corresponding values of the other variables.

NO. SLO-38

TECHNICAL PROGRAM ELEMENT

TITLE Select Critical Condition from SLO-21

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational___, Programming In Development___, Not Programmed___

REFERENCE Boeing Program CRIT79

OWNERSHIP: Public___, Private X, Owner Boeing

ABSTRACT

Selectively sorts on shear, moment, torsion, chord shear and chord moment from SLO-21 to generate maximum and minimum envelope of each variable with corresponding values of the other variables.

NO. SLO-39

TECHNICAL PROGRAM ELEMENT

TITLE Select Critical Conditions From SLO-15

FORM PREPARED BY K.Manning DATE 8-30-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Program CRIT 145

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

This program sorts on the shear, moment, and torsion output by TES145 (SLO-19), and outputs maximum and minimum envelopes of each variable with corresponding values of the other variables.

NO. SLO-40

TECHNICAL PROGRAM ELEMENT

TITLE Select Critical Conditions Based on Spar Shearflow

FORM PREPARED BY K. Manning DATE 8-30-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing program PALLOW

OWNERSHIP: Public ___, Private X, Owner Boeing

ABSTRACT

Sorts on the Spar shear flows output by SLO-22. List all conditions where the shear flow exceeds a given percentage of the input allowable.

NO. SLO-41

TECHNICAL PROGRAM ELEMENT

TITLE Select Critical Conditions

FORM PREPARED BY K. Manning DATE 9-1-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^6 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Estimate

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

Select critical design condition for each airframe component (fuselage, horizontal tail, vertical pin and gear)

NO. STM-1

TECHNICAL PROGRAM ELEMENT

TITLE Systems Requirements Analysis

FORM PREPARED BY A. W. Waterman DATE 6-8-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Data on single airplane configuration

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner ______

ABSTRACT

Using airplane mission characteristics, engine characteristics, gross weight, center of gravity perturbations and runway characteristics, important system parameters are tabulated that affect the overall configuration.

The activities are to:

1) Develop parametric weight information for hydraulic, ECS, avionic, electric and landing gear systems based on historical data.

2) Calculate brake sizing and flotation requirements for assessment against stopping distance and field turnaround requirement.

NO. STM-2

TECHNICAL PROGRAM ELEMENT

TITLE Hydraulic Fluid Flow Determination

FORM PREPARED BY A. W. Waterman DATE 7-14-72

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Assumes logic for assumptions and basis for decisions is programmable

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ____

OWNERSHIP: Public____, Private____, Owner____

ABSTRACT

Using inputs, reliability analysis, actuator sizing from load analyses of primary flight controls, secondary controls and auxiliary services, calculations are performed to determine the hydraulic flow rates for the central fluid distribution systems. An iterative process is used to insure a near-even load distribution between multiple hydraulic systems and to insure that F.A.R. criteria for failures of hydraulic systems are not compromised. A hydraulic system diagram is developed.

*Estimate

NO. STM-3

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Hydraulic System Component Sizing

FORM PREPARED BY W. W. Waterman DATE 6-8-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 500 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Calculations for all principle components in a single system.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Reservoir volumes (weight and size), filter capacities, pump sizes and APU and engine power extraction data are calculated to satisfy the hydraulic flow requirements determined in STM-2. Performance of the calculations also require component design specification requirements, supplier hardware design data and fluid flow efficiency parametric data. In Level V, this supports component selection "off-the-shelf", and procurement specifications for new equipment.

*Estimate

NO. STM-4

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Hydraulic Cooling Requirements

FORM PREPARED BY A. W. Waterman

LANGUAGE ____________ HOST MACHINE ____________

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 300 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Based on having environment defined within the program.

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE ____________

OWNERSHIP: Public___, Private___, Owner____________

ABSTRACT

Heat generated within or transferred to the hydraulic system is determined from pump heat rejection, throttled flow at all valves and control packages and convection and conduction heat transfer from the environment. These data are used to produce a heat removal versus flight duration profile as an input to ECS for thermal management of hydraulic fluid temperature.

*Estimate

NO. STM-5

TECHNICAL PROGRAM ELEMENT

TITLE Hydraulic System Dynamic Analysis

FORM PREPARED BY A. W. Waterman DATE 6-9-72

LANGUAGE Fortran IV HOST MACHINE CDC6600

* PROGRAM SIZE 2 (Boxes of Source Cards)

* TIMING 500 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Requires a developed hyd. syst. schematic and known characteristics of the components.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE "User's Guide - Hydraulic System Transients Analysis (HYTRAN)," C. A. Galt and W. Zielke. Proprietary Boeing Document

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This element analyses the performance of the hydraulic system as a whole. All components are considered to the extent that they affect total system response.

The program provides a digital simulation of transient phenomena using the method of characteristics and numerical integration techniques. A large number of hydraulic components are analyzed and methods are developed for representing the combination of components into a math model of the hydraulic system.

Inputs required are descriptions of all components of a system and servo input for prescribed motions output is the time history of pressure and flow transients at any point in the system. Transients are evaluated as effects on system design and may suggest redesign to reduce the transients.

*Estimate

NO. STM-6

TECHNICAL PROGRAM ELEMENT

TITLE Hydraulic Line Sizing Optimization

FORM PREPARED BY A. W. Waterman DATE 6-9-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 400 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT For one airplane with 4 hydraulic systems, each system with about 40 lines and 10 loads.

STATUS: Operational x , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Computer Program "OPLINE"

OWNERSHIP: Public ___, Private x , Owner The Boeing Company

ABSTRACT

The program sizes hydraulic system line diameters such that the resulting system is the lightest of all possible fluid distribution systems that will satisfy the pressure and flow requirements (see STM-2). Inputs are system configurations, line lengths, flow and pressure required, fluid properties, tubing allowances. Outputs are optimum diameter for each line to give a minimum weight system and pressures available at each servo-actuator.

*Estimate

NO. STM-7

TECHNICAL PROGRAM ELEMENT

TITLE Refined Hydraulic System Thermal Analysis

FORM PREPARED BY A. W. Waterman DATE 6-9-72

LANGUAGE Fortran IV HOST MACHINE CDC6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 65 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 10 Conditions

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing Program TEM 185

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

This program would be used normally for about 10 ground, flight and system conditions to determine operating temperatures of a given hydraulic system configuration. The program selects heat exchanger size and/or requirements.

*Estimate

NO. STM-8

TECHNICAL PROGRAM ELEMENT

TITLE Determine APU Power Requirements

FORM PREPARED BY K. T. Tanamura DATE 7-8-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Sums accessory req. for all needs of one configuration

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Requirements for air and shaft power outputs are determined from STM-3, STM-11 and STM-20 tasks. This information is written into a procurement specification submitted to vendor bid.

*Estimate

NO. STM-9

TECHNICAL PROGRAM ELEMENT

TITLE APU Installation Requirements

FORM PREPARED BY K. T. Tanamura DATE 6-8-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Assumes logic for decisions and weighting of various considerations is programmable

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

This program requires the output from wind tunnel tests providing flow distributions for inlet and exhaust duct design. Interacting disciplines that influence the APU installation are:

- Engine startup air requirements
- Structural support and compartment availability
- Fuel system access
- Aircraft weight and balance
- Elec-hyd-pneu services requirements
- Ground crew comfort and noise requirements

*Estimate

NO. STM-10

TECHNICAL PROGRAM ELEMENT

TITLE Environmental Control System (ECS) Design Critèria and System Requirements

FORM PREPARED BY N. R. Matheson DATE ____

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each airplane configuration

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ____

OWNERSHIP: Public ___, Private ___, Owner ____

ABSTRACT

Using inputs from aerodynamics, propulsion, electronics, structures, configuration, mil specs, F.A.R., etc., the design criteria and system requirements are determined. Preliminary heating and cooling load analyses are performed.

*Estimate

NO. STM-11

TECHNICAL PROGRAM ELEMENT

TITLE E. C. S. System Trades

FORM PREPARED BY N. R. Matheson DATE 6-12-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 Design

STATUS: Operational ___, Programming In Development X, Not Programmed ___

REFERENCE

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Refrigeration cycle, air source and heat sink selection trades are performed using a combination of computer and manual studies and the results of STM-10. This requires close cooperation with propulsion regarding engine characteristics. The primary result is the preliminary system sizing.

*Estimate

NO. STM-12

TECHNICAL PROGRAM ELEMENT

TITLE E.C.S. System Selection and Integration

FORM PREPARED BY N. R. Matheson DATE 6-12-72

LANGUAGE ________ HOST MACHINE ________

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ________

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ________

OWNERSHIP: Public___, Private___, Owner________

ABSTRACT

Based on the results of STM-11, the various subsystems are selected and procurement specifications written. Integration of the ECS subsystems with the various interfacing systems is investigated in detailed analyses.

*Estimate

NO. STM-13

TECHNICAL PROGRAM ELEMENT

TITLE Avionics Requirements

FORM PREPARED BY G. L. Jonsen DATE 6-14-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Based on selection of std. components for stored tabulation of available equipment.

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Using Mission Profile Data, requirements are determined for the following major avionics subsystems: Navigations, flight instruments, communications, weather radar, utility and advisory equipment. These requirements will include development of information on space utilization and electrical and cooling loads for the avionics sub-systems. Procurement specifications would be written for each of the sub-system packages.

*Estimate

NO. STM-14

TECHNICAL PROGRAM ELEMENT

TITLE Brake Sizing

FORM PREPARED BY N. S. Attri DATE 6-15-72

LANGUAGE ______ HOST MACHINE ______

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^{3} (Words)

* OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each design

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public ___, Private ___, Owner ______

ABSTRACT

Inputs of airplane weight, landing velocity, C.G. variations, lift/drag coefficients, engine idle thrust and assumed ground characteristics are used to size brakes for a landing condition.

Inputs for airplane weight, decision speed, engine thrust and thrust decay characteristics, adverse C.G's and lift/drag characteristics in transition are used to calculate brake sizing for refused takeoff.

The brake sizing is used to test whether brakes will fit in the available envelop and whether the airplane will meet its performance goals for stopping distance and mission turnaround. Hydraulic power requirements are determined.

*Estimate

NO. STM-15

TECHNICAL PROGRAM ELEMENT

TITLE Landing Gear Flotation Analysis

FORM PREPARED BY N. S. Attri DATE 6-15-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each design

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public____, Private____, Owner______

ABSTRACT

Inputs of airplane weight, c.g. envelope and runway characteristics are used to calculate single wheel loads and equivalent wheel loads, runway stresses, braking coefficients, etc., needed to match the airplane to available runways.

*Estimate

NO. STM-16

TECHNICAL PROGRAM ELEMENT

TITLE Brake Sizing

FORM PREPARED BY A. W. Waterman DATE 6-15-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each design

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing D6-30196, "Kinetic Energy Absorbed by Brakes During Refused Takeoff - TEM 209"

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

Using inputs of gross weight, engine thrust characteristics, airplane dimensions, C.G. locations, segment delay times, initial velocities, aerodynamic parameters, altitude and temperature, the program solves the equations of motion for external braking forces on the airplane for a range of ground friction coefficients at high forward and low aft C.G.'s. A table of brake energies and stopping distances for a selected range of available ground friction coefficients is outputted.

*Estimate

NO. STM-17

TECHNICAL PROGRAM ELEMENT

TITLE Landing Gear Flotation Analysis

FORM PREPARED BY N. S. Attri DATE 6-15-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each design

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-54348 "Digital Computer Programs for Evaluating Ground Flotation Characteristics of Airplanes"

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The flotation analysis of Level IV (refer to STM-17) is updated using advanced information on the inputs needed in the calculations.

The program calculates the ground flotation characteristics of alternate gear arrangements. Methods used are (1) rigid pavement analysis by Portland Cement Ass'n., (2) load classification number for rigid and flexible pavement, and (3) California bearing ratio for flexible pavement.

Analysis is performed to match the airplane to available runways over its total route structure.

*Estimate

NO. STM-18

TECHNICAL PROGRAM ELEMENT

TITLE Steering System Sizing

FORM PREPARED BY N. S. Attri DATE 10-4-72

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ____

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ____

OWNERSHIP: Public___, Private___, Owner____

ABSTRACT

Inputs to this program will include airplane weight, nose and main landing gear data (tire size, tire pressure, pneumatic and mechanical trail, steering collar dimensions). No aerodynamics, no engine or gear detailed gear configuration of shock strut data is required).

This program will size steering actuators (torque, stroke) to assure desired steering rate. In addition, steering valve gain, flow and hydraulics power requirements will also be determined.

*Estimate

NO. STM-19

TECHNICAL PROGRAM ELEMENT

TITLE Steering and Ground Handling Simulation

FORM PREPARED BY N. S. Attri DATE 10-4-72

LANGUAGE ______ HOST MACHINE ______

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT ______

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE "Boeing Steering and Ground Handling Simulation" (Document to be released.)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Inputs include engine spinup and down data, stability derivatives, steering configuration (steering valve and actuator size are variables). 2 degree of freedom shock strut model, 6 degree of freedom airplane model, pilot operated or programmed input digital/cab simulator (EAI-8400).

This program enables sizing of optimum steering system (valve gain, dead band, hysteresis, actuator size) and determine critical failure and operation during failed engine, takeoff in presence of cross wind with initial crab condition, enable low speed and high speed taxi turns to assure meeting FAR requirement and assure good handling quality for ground maneuvers.

*Estimate

NO. STM-20

TECHNICAL PROGRAM ELEMENT

TITLE Electric Power Load Analysis

FORM PREPARED BY G. May DATE 6-16-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each condition described

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Computer Programs ECAP (TEE 178), Load (TEE 104), TEE 198, TEE 170, Wire (TEE 084)

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

Using inputs of aircraft mission requirements and electrical load requirements from all airplane technical disciplines, a preliminary electrical load analysis is performed. Consideration is given to source redundancy for critical flight controls and to meet fail safe/fail operative criteria. System arrangement studies are conducted considering type and number of sources, number of buses, switching requirements, power extraction penalties and type of sources (AC, DC, standby, etc.). First considerations are given to system protection and control, load center location and component selection.

Computer usage is presently limited to discrete problems within the above composite. There is no generalized integrated computer approach to the above task.

*Estimate

NO. STM-21

TECHNICAL PROGRAM ELEMENT

TITLE Electrical System Performance Analysis

FORM PREPARED BY G. May DATE 6-16-72

LANGUAGE ______ HOST MACHINE ______

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 40 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Each load condition analyzed

STATUS: Operational x , Programming In Development ___, Not Programmed ___

REFERENCE ______

OWNERSHIP: Public ___, Private x , Owner The Boeing Company

ABSTRACT

Electrical load studies from STM-20 are updated and expanded to include detail analysis of optimization for load center location, provisions for power quality, overload, isolation and separation of loads.

Wire sizing and component selection analyses are conducted. System performance programs are included to assess steady state, transient and fault conditions. Results are used to ensure that objectives, requirements and F.A.R. requirements are satisfied.

*Estimate

NO. STM-22

TECHNICAL PROGRAM ELEMENT

TITLE Wire Release System

FORM PREPARED BY E. Tramountanas DATE 9-1-72

LANGUAGE FAP HOST MACHINE 7094

* PROGRAM SIZE 3 (Boxes of Source Cards)

* TIMING 200 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^{4} (Words)

* OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing Computer Services

OWNERSHIP: Public ___, Private X, Owner Boeing Computer Services

ABSTRACT

The Wire Release System is a large integrated system which presently receives input from various departments and supports the flow of information from design to production and to the customer airlines. While the environment will change slightly on any new project, the same basic functions must be performed as described in the following paragraphs.

Electrical and Electronics System Engineers design the Systems and pass Schematic Wiring Diagrams to the Integration Engineers. The Integration Engineers with assistance from Installation Engineers and Mockup determine the routing of the various connecting wires in the airplane. Because of the large number of wires involved and the physical constrains imposed by the airplane the wires must be grouped "Bundles" which must be simple enough to facilitate assembly in the shop.

Equipment is actually placed in the Mockup Vehicle and wires are routed and bundled. The bundle is then removed from the Mockup and laid out on a formboard drawing. The length of each wire is determined and also the best way to sequence the subassembly of groups and assembly of the groups into

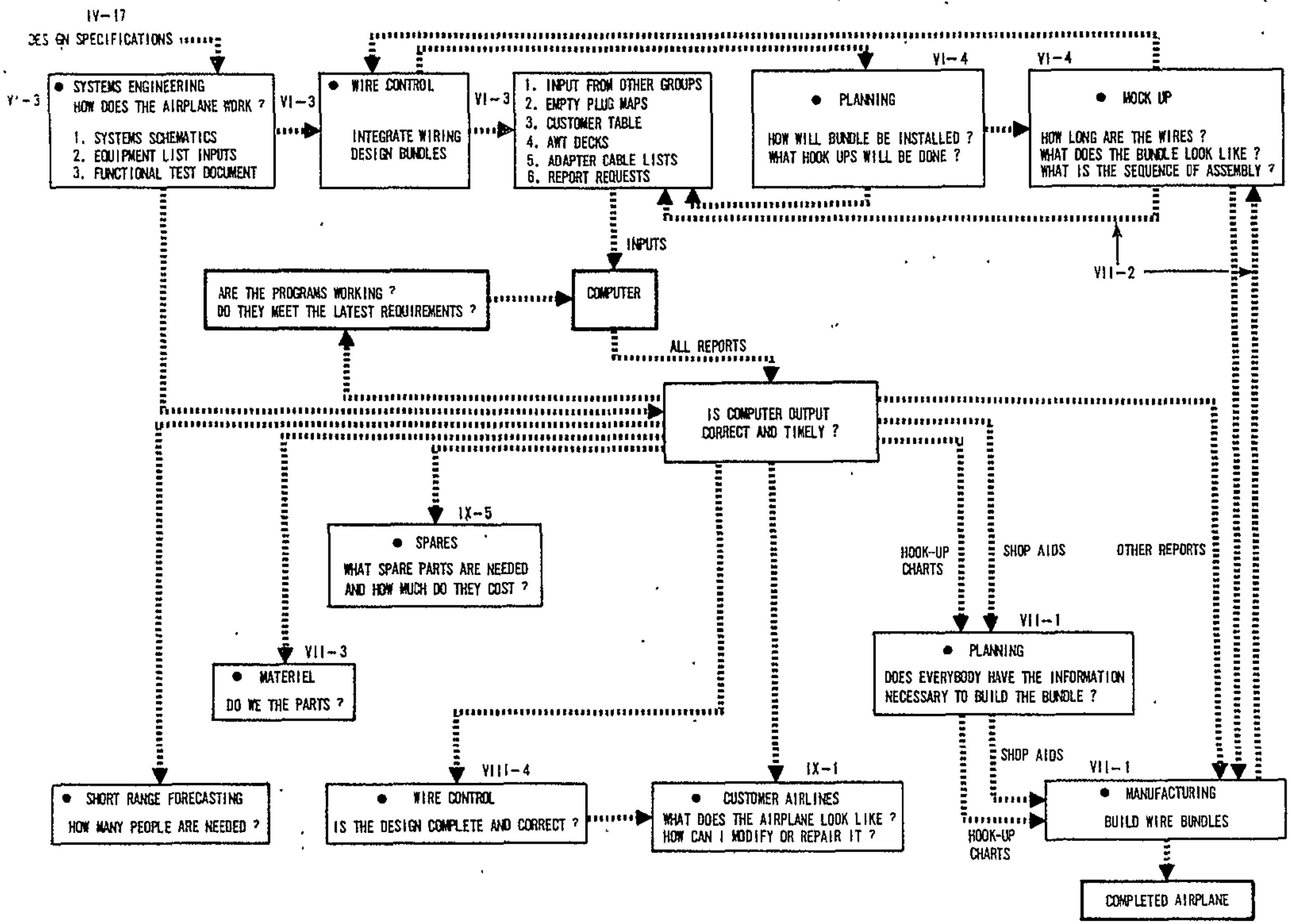
*Estimate

the bundle. Planning is brought into the picture to determine how and when to install the finished assy. in the customer airplane.

Information is passed to the wire shops in such a fashion as to facilitate cutting and marking the necessary wires to the correct length. Subassembly of groups and assy. and testing of the bundle in the form necessary to fit the airplane. The bundle or assembly is sent to the airplane at the correct time for installation and any necessary interconnections between bundles are made at that time.

Information of the quantity of wire of each type and gauge for the particular configuration is sent to the Material Department and a parts list of Equipment on each bundle is sent to the local stores. Information is passed by magnetic tape to the RQM system which permits determination of requirements of Electrical Disconnect Standards for purchased requirements.

WIRE RELEASE SYSTEM



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NO. STM-23

TECHNICAL PROGRAM ELEMENT

TITLE Fuel Tank Arrangement

FORM PREPARED BY I. R. Strauss DATE 8-8-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public ___, Private___, Owner______

ABSTRACT

This module defines fuel storage requirements in terms of tank locations and arrangement.

Inputs consist of engine number and location, approx. wing volume available, fuel volume required (reserves, mission fuel and trade fuel), G.G. range, and whether fuel transfer is required for trim drag reduction or in the case of an SST for longitudinal stability.

Output consists of wing tank arrangement and possible body fuel tank requirements.

This task is to be coordinated with DSA-1, DSA-2 and DCA-1.

*Estimate

NO. STM-24

TECHNICAL PROGRAM ELEMENT

TITLE Wing Fuel Tank End Locations

FORM PREPARED BY I. R. Strauss DATE 8-8-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Using inputs of wing rib spacing (DSA-1), an assessment of wing bending relief requirements, refined wing fuel volume available (STM-32), approximate fuel vent surge tank requirements, and preliminary flutter considerations; tank end locations are determined with the goal of simplified fuel management (equal size main tanks).

This task is to be coordinated with DSA-1.

*Estimate

NO. STM-25

TECHNICAL PROGRAM ELEMENT

TITLE BODY AUXILIARY FUEL TANK SIZING AND LOCATIONS

FORM PREPARED BY I. R. Strauss DATE 8-9-72

LANGUAGE ______ HOST MACHINE ______

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^{2} (Words)

* OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public ___, Private ___, Owner ______

ABSTRACT

Where required for long range airplanes, for longitudinal stability on supersonic airplanes, or for center of gravity control to minimize trim drag; this module in conjunction with DSA-2 determined body fuel tank requirements.

*Estimated

NO. STM-26

TECHNICAL PROGRAM ELEMENT

TITLE REFUEL SYSTEM DESIGN

FORM PREPARED BY I. R. Strauss DATE 8-9-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^2 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Using the results of STM-24 and STM-25 along with DCA-1, a refuel system schematic is designed and within refuel time and pressure constraints the most light-weight system is determined using STM-31.

The output in addition to the system schematic is the line size determination and preliminary refuel valve selection.

*Estimated

NO. STM-27

TECHNICAL PROGRAM ELEMENT

TITLE FUEL VENT SYSTEM DESIGN

FORM PREPARED BY I. R. Strauss DATE 8-9-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Using results of STM-24 and STM-25, the amount of wing dihedral or anhedral; a fuel vent system schematic is developed. In addition using the refuel shutoff valve failure case from STM-26, a program similar to "747 vent system" for flight condition and program STM-31 for pressure drop computation the sizing of vent lines, structural box vent stringers, and vent valve sizing is determined.

*Estimated

NO. STM-28

TECHNICAL PROGRAM ELEMENT

TITLE FUEL VENT SURGE TANK DESIGN

FORM PREPARED BY I. R. Strauss DATE 8-9-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Using the results of STM-24 and STM-25, amount of wing dihedral or anhedral vent system line volume from STM-27 and air and ground maneuver, the final requirements for the surge tanks are determined.

This task is to be coordinated with DSA-1.

*Estimated

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NO. STM-29

TECHNICAL PROGRAM ELEMENT

TITLE ENGINE FUEL FEED SYSTEM DESIGN

FORM PREPARED BY I. R. Strauss DATE 8-9-72

LANGUAGE ______ HOST MACHINE ______

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{2} (Words)

*OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Using inputs of tank end locations STM-24, body auxiliary fuel tank sizing and location STM-25, the engine fuel requirements with boost pumps off, engine fuel requirements for take-off from high altitude fields on hot days, and the natural head (tank to engine), a fuel feed system schematic is produced and using STM-31 the engine fuel feed andcross-feed lines are sized and fuel valves and pumps are selected.

*Estimated

NO. STM-30

TECHNICAL PROGRAM ELEMENT

TITLE FUEL QUANTITY MEASUREMENT SYSTEM DESIGN

FORM PREPARED BY I. R. Strauss DATE 8-9-72

LANGUAGE ____ HOST MACHINE ____

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^2 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 case

STATUS: Operational ___, Programming In Development ___, Not Programmed X

REFERENCE ____

OWNERSHIP: Public ___, Private ___, Owner ____

ABSTRACT

Using inputs of ground and flight attitudes, wing deflection data, wing twist data, results of STM-24 and STM-25; with the aid of STM-32 for height volume relationships, and STM-33 and STM-34 for fuel gage optimization; the measurement system is developed to give the best all attitude system with the minimum of elements.

*Estimated

NO. STM-31

TECHNICAL PROGRAM ELEMENT

TITLE Steady-State Performance of Aircraft

FORM PREPARED BY W. B. Gillette DATE 10-24-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 system analysis

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing document D6-29013-1, Feb. 18, 1969 (TEM 178)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program analyzes the steady-state performance of aircraft fuel systems.

*Estimate

NO. STM-32

TECHNICAL PROGRAM ELEMENT

TITLE Volume & C.G. Characteristics of Fuel Tanks

FORM PREPARED BY W. B. Gillette DATE 10/24/72

LANGUAGE Fortran IV HOST MACHINE CDC6600

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 tank

STATUS: Operational___, Programming In Development X , Not Programmed___

REFERENCE Boeing Document D6-A11163-1, March 18, 1968 (TEM-187)

OWNERSHIP: Public___, Private X , Owner The Boeing Company

ABSTRACT

The program calculates fuel height versus volume and fuel center of gravity versus volume for any shaped fuel tank or sections of fuel tanks. The program accounts for internal structure and all factors affecting tank position such as variable sweep, wing twist and deflection, and airplane pitch and roll.

*Estimate

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NO. STM-33

TECHNICAL PROGRAM ELEMENT

TITLE GAUGE DESIGN AND GAUGING ERROR AS A FUNCTION OF FUEL LEVEL AND TANK ATTITUDE

FORM PREPARED BY W. B. Gillette DATE 10/24/72

LANGUAGE Fortran IV HOST MACHINE CDC6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 40 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 gauge design

STATUS: Operational X, Programming In Development___, Not Programmed___

REFERENCE Boeing Document D6A11163-3 June 20, 1969 (TEM-255)

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

This program is used for optimizing the characterization of linear and exponential capacitance-type aircraft fuel tank gauging probes. The program provides an optimum solution for the characterization of a given set of fuel probes such that the optimum gauging accuracy will be achieved for specified fuel level and tank attitude conditions. Output from the programs includes the optimum capacitance variation along the length of the probes and a complete set of tables for the gauging error as a function of fuel level and fuel tank attitude.

*Estimated

NO. STM-34

TECHNICAL PROGRAM ELEMENT

TITLE GAUGING ERROR AS A FUNCTION OF FUEL LEVEL AND TANK ATTITUDE

FORM PREPARED BY W. B. Gillette DATE 10/24/72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 set of volumes and position

STATUS: Operational ___, Programming In Development X, Not Programmed ___

REFERENCE Boeing Computer Program TEM-314

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program takes the fuel gauge probe characteristics and evaluates the error in readout for specified fuel levels and tank attitude conditions.

*Estimated

NO. STR-1

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Wing Gross Stress Analysis and Sizing

FORM PREPARED BY F. D. Flood DATE 7-26-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 150 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{4} (Words)

OUTPUT VOLUME 10^{6} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT

Typical run for a preliminary design wing.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing Document No. D6-8161, "An Integral Structural Analysis Method for Preliminary Design Wing Studies", Boeing Coord. Sht. #CPDS-72-020,"Computerized Preliminary Design System(CPDS) Level 2," C. Mounier, et al, May 1972 (Program TESS4)

OWNERSHIP: Public ___, Private X , Owner Boeing Co.

ABSTRACT

This capability exists as an integral part of a structures module (c.f., Technical Program Element SLO-2) within the Boeing Computerized Preliminary Design System (CPDS). The predicted wing net loads are used to size the wing upper panel, lower panel, front spar web and rear spar web for a one or two cell box. This procedure iterates until the sized-wing flexibility is consistent with that used for load prediction. The sizing/analysis is based on a wing box section wherein each surface is described by a segment of a parabolic arc. Elementary beam theory is the basis for the sizing/analysis. Sweep effects are considered via effectiveness factors based on test and analysis. Wing shear and torque are reacted at the side-of-body. Internal body pressure effects are considered on the wing center box.

Load condition data are the major portion of the STR-1 input. Additional input data are minimum gages for spars and panels, the mid-spar web gage (if any), and material (and/or structural component) properties and allowables. Some allowables data are stored within the program.

NO. STR-2

TECHNICAL PROGRAM ELEMENT

TITLE Preliminary Body and Empennage Stress Analysis and Sizing

FORM PREPARED BY F. D. Flood DATE 7-26-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT
Production LEMBO (TES-341) run for preliminary design

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing D3-7931, "Preliminary DEsign Loads Prediction Methods-Fuselage, Empennage and Landing Gear", Boeing Coord. Sht. ~~#CPDS-72-020, "Computerized Preliminary DEsign System (CPDS) Level~~ 2," C. Mounier, et al, May 1972 (PROGRAM LEMBO).

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This capability exists as an integral part of a module (c.f., Technical Program Element SLO-3) within Boeing CPDS.

For body sizing/analysis, section cuts are required corresponding to each loads analysis station. Each section is apportioned into four segments; i.e., the upper lobe, the lower lobe and the two side-walls. Semi-monocoque or longeron-type body construction may be sized/analyzed. Sizing is determined for each segment for each of the load conditions. The maximum for each segment comprises the resultant sizing. Section constants are determined to define vertical and lateral bending stiffnesses and torsional stiffness. Structural allowables for commonly-used constructions are stored in the program for compression, shear, longitudinal tension and hoop tension stresses. Routines are available to compute allowables for constructions not having stored allowables.

For empennage sizing/analysis, two-spar semi-monocoque construction is assumed for both the vertical and horizontal tails. The primary structure is assumed to be a box beam. Maximum principal stresses are computed for each load case at each section analyzed. The box construction is sized for the most critical load case at each section.

NO. STR-3

TECHNICAL PROGRAM ELEMENT

TITLE Detail Stress Analysis and Sizing - Wing and Empennage

FORM PREPARED BY F. D. Flood DATE 7-26-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 1/4 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Three sections of a two-cell box with 42 stringers per section. Fifty load conditions. Stress analysis, equilibrium check and M.S. summary.

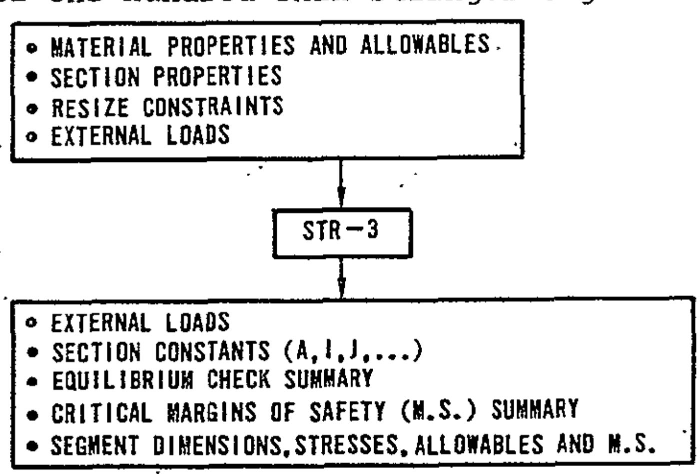
STATUS: Operational x, Programming In Development __, Not Programmed __

REFERENCE Boeing D6-13147, "Stress Analysis of a One and Two Cell Wing Box', R. Giles and J. Ventenbergs, October 1966 (Prog. #TES-170)

OWNERSHIP: Public __, Private X, Owner The Boeing Company

ABSTRACT

Calculates cross section stresses and margins of safety (M.S.) for applied shears, moments and torque. Sweep effectiveness factors may be included in analysis. Shear stresses resulting from cross-shear may be determined alternatively from VQ/I or P/L methods. At each section analyzed, each surface may be resized (scaled, with constraints) to obtain a specified M.S. An equilibrium check may be performed. The program is limited to twenty sections per run (ten for P/L analysis) with fifty load conditions per section. Each section may have a maximum of one hundred skin-stringer segments.



NO. STR-4

TECHNICAL PROGRAM ELEMENT

TITLE Detail Stress Analysis and Sizing - Body

FORM PREPARED BY F. D. Flood DATE 7-26-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 160 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{5} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One section (two-cell) symmetric with a total of 68 stringers. Forty load conditions - VQ/I analysis with M.S. summary.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing D6-8989TN, "Body Section Properties", P. Geiser, February 1969, (Program No. TES-057).

OWNERSHIP: Public ___, Private XX, Owner The Boeing Company

ABSTRACT

This program performs stress analysis of semi-monocoque body structure. The analysis performed is conveniently considered in four phases.

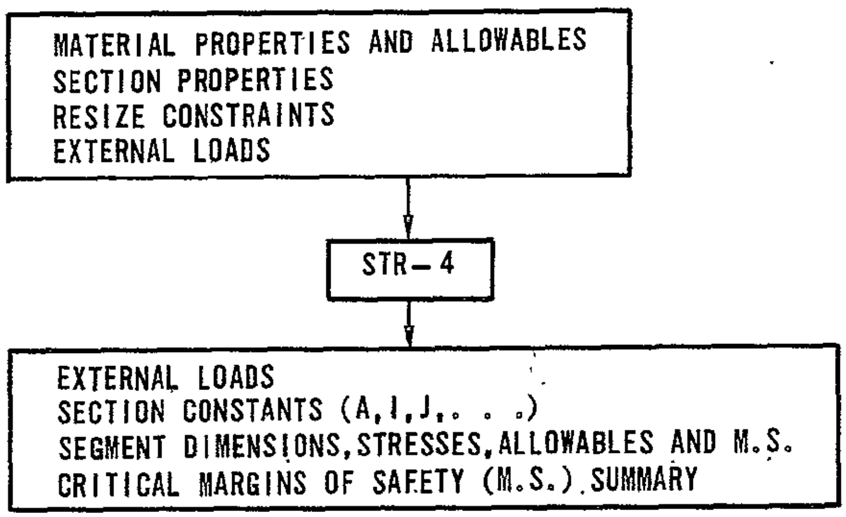
The first phase determines stiffener spacings, skin radii of curvature at stiffeners, incremental swept areas of skin segment lengths about an enclosed pole and the summation of these incremental swept areas for the cells defined. The cells are composed of segments which typically contain one stiffener and half the associated skin to each adjacent stiffener. Three types of segments are defined: 1) wall segments that define the cell wall, 2) floor segments that separate the cells, and 3) special segments.

The second phase of the analysis determines stresses using elementary beam theory (VQ/I shear flow) for any combination of vertical or lateral shear, vertical or lateral bending moment, torque, side load, axial load or internal pressure. This analysis determines the effective width of skin in compression. Segment efficiencies

may be assigned to account for behavior other than elementary beam theory. "Shear relief" from stringer slope is considered.

The third phase of the analysis determines, if desired, the section shear flow corrections resulting from section variation along the body length ($\Delta P/L$ shearflow). For the i^{th} section, shear flows are based on the change in axial load, ΔP, from the $i - 1^{th}$ to the $i + 1^{th}$ section, separated by a distance L. The spacing between adjacent sections is recommended to be 40-60 inches based on past experience. The concern is to determine peaks in shear flows, but not of an extremely localized nature.

The fourth phase of the analysis determines the margins of safety based on the following modes of failure: 1) tension in skin and stiffeners, 2) compression-shear interaction for stiffeners and skin, and 3) shear (skin alone). The resizing capability is a required program modification.



NO. STR-5

TECHNICAL PROGRAM ELEMENT

TITLE Fatigue Analysis and Design

FORM PREPARED BY F. D. Flood DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 2/detail (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^2 (Words)/Detail

OUTPUT VOLUME 10^0 (Pages/detail $\simeq 10^3$ words/detail)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimates per Michael Dilio, BCS Programmer.

STATUS: Operational ___, Programming In Development XX, Not Programmed ___

REFERENCE Boeing D6-24956, "Structural Design for Durability", Structural Durability Group, Jan. 1972; Boeing D6-24957, "Fatigue Design Methods and Allowables", Structural Durability Group, February 1972.

OWNERSHIP: Public ___, Private XX, Owner The Boeing Company

ABSTRACT (From D6-24957)

This fatigue analysis and design method includes the following significant features:

- A fatigue check and margin similar to the static strength check.
- Equivalent fatigue load conditions that replace exceedance type spectra.
- An estimating technique to size structure for fatigue in the earliest design stages.
- An inventory of fatigue-rated detail designs based on test and service experience and methods of determining fatigue ratings for new designs.
- Final fatigue check calculations reduced to a single major stress excursion expected each flight with a factor for the additional damage of smaller stress excursions.
- A visibility fatigue check format that relates detail design quality to the operating load environment.

NO. STR-6

TECHNICAL PROGRAM ELEMENT

TITLE Integrated Structural Analysis and Design (Finite Element) - ATLAS

FORM PREPARED BY F. D. Flood DATE 7-27-72

LANGUAGE * HOST MACHINE CDC 6600

PROGRAM SIZE 78 (Boxes of Source Cards)

TIMING 500 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{5} (Words)

OUTPUT VOLUME 10^{6} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 600 Nodes, 1200 Elements with 10 Loadcases.

STATUS: Operational X, Programming In Development ___, Not Programmed ____

REFERENCE Boeing D6-25400-0003TN, "ATLAS--An Integrated Structural Analysis and Design System - Vol. 0003, Complete User's Input Outline", ATLAS Task Force, June 1971.

OWNERSHIP: Public ____, Private X, Owner The Boeing Company

ABSTRACT

The ATLAS system is broad in scope since its modular schema spans many different but related technological disciplines. It is also flexible since execution of each of the system modules is user-controlled through a problem-oriented language. Each of the technical modules and the ATLAS control monitor require input from the user to define a problem.

* FORTRAN and Machine Language

NO. STR-7

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - SAMECS Structural Analysis System.

FORM PREPARED BY F. D. Flood DATE 8-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 20 (Boxes of Source Cards)

*TIMING 1500 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^4 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Typical Structural Analysis.

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE Boeing D6-23757-ITN, "SAMECS Structural Analysis System User's Document", N. Connacher et al, January 1969

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

This is a general purpose finite element structural analysis program.

* Estimate

NO. STR-8

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - SAMECS Automated Plotting Program (SAPP)

FORM PREPARED BY F. D. Flood DATE 8-16-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^4 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development __, Not Programmed __

REFERENCE Boeing D6-23757-3TN,"SAMECS Structural Analysis System Peripheral Programs User's Document",Andreassen, S.N. and Hansen, ~~S.D., June 1970, D6-29751TN-1, "SAPP User's Guide", J. C. Potter~~ August 1969.

OWNERSHIP: Public __, Private X, Owner The Boeing Company

ABSTRACT

This program plots SAMECS input and output data. The five types of plots that can be requested by the user are:

1) an isometric of the structural grid with user-defined scale factors and orientation of the view;
2) any one of thirty-six possible projected views with node, plate and beam numbers and plate and beam orientation identification;
3) an isometric with vectors(arrows) scaled to the output nodal deflections;
4) a grid as in 2) above with output plate stresses and plate orientation identification;
5) a grid as in 2) above with output beam stresses and beam orientation identification.

This program accommodates 2000 nodes, 9999 plates and 9999 beams in a given structure (or, substructure).

* Estimate

NO. STR-9

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - SAMECS Data Checker Program (SAMCHK)

FORM PREPARED BY F. D. Flood DATE 8-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

* PROGRAM SIZE 2 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^4 (Words)

* OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT. Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing D6-23747-3TN,"SAMECS Structural Analysis System Peripheral Programs User's Document", Andreassen, S.N. and Hansen, S.D.; June 1970.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program provides a rapid and inexpensive means of checking SAMECS input data for conformance with SAMECS input format specifications prior to the SAMECS execution. It checks the logical sequence of SAMECS input data sections (nodes, plates, beams and loads) and the logical sequence within each data section. It checks the format of each field of each data card(image). It will simulate a SAMECS execution through the data generation phase, providing identical output (including diagnostics) in 20-25% of the machine residency required for an equivalent SAMECS execution.

* Estimate

NO. STR-10

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - SAMECS Loads Transformation Program (LOADS).

FORM PREPARED BY F. D. Flood DATE 8-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

* PROGRAM SIZE 4 (Boxes of Source Cards)

* TIMING 500 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing D6-23757-3TN,"SAMECS Structural Analysis System Peripheral Programs User's Document", Andreassen, S.N. and Hansen, S.D.; June 1970.

OWNERSHIP: Public ___, Private XX, Owner The Boeing Company

ABSTRACT

This program transforms external loads to the SAMECS nodal grid in the required input format. It computes the data required for shear and moment diagrams. The program will also merge additional loads data with existing SAMECS load sets and will scale and combine load sets to form additional load sets. Equilibrium checks are performed.

* Estimate

NO. STR-11

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - SAMECS Merge Program (MERMAT)

FORM PREPARED BY F. D. Flood DATE 8-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 100 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing D6-23757-3TN, "SAMECS Structural Analysis System Peripheral Programs User's Document", Andreassen, S.N. and Hansen, S. D., June 1970.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program is used in the SAMECS interaction procedure to transform the SAMECS substructure reduced stiffness matrices to the format required to merge them into the primary structure stiffness matrix.

* Estimate

NO. STR-12

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element STructural Analysis - SAMECS Superposition Program (SUPERPO)

FORM PREPARED BY F. D. Flood DATE 8-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 200 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^4 (Words)

* OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational X, Programming In Development ___, Not Programmed ____

REFERENCE Boeing D6-23757-3TN, "SAMECS Structural Analysis System Peripheral Programs User's Document", Andreassen, S.N. and Hansen, S.D., June 1970.

OWNERSHIP: Public ____, Private X, Owner The Boeing Company

ABSTRACT

This program superposes the output (stresses, deflections, reactions) of selected load cases from previously executed SAMECS runs to form new load case results. These results are a summation of the previous load case results, each appropriately scaled. Data for the previous load cases are obtained from the SAMECS output. The program produces output with a maximum-minimum search; also, it produces data files corresponding to the SAMECS output, Data from three separate SAMECS outputs may be superposed to form new load case output data.

* Estimate

NO. STR-13

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - SAMECS
Deflections Back substitution Program (DEFPU)

FORM PREPARED BY F. D. Flood DATE 8-17-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 3 (Boxes of Source Cards)

*TIMING 200 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Estimate

STATUS: Operational xx, Programming In Development___, Not Programmed___

REFERENCE Boeing D6-23757-3TN, "SAMECS Structural Analysis System Peripheral Programs User's Document", Andreassen, S.N. and Hansen, S.D., June 1970

OWNERSHIP: Public___, Private x, Owner The Boeing Company

ABSTRACT

This program is used in the SAMECS interaction procedure to:

1) transform the SAMECS primary structure displacements to the order required for backsubstitution on the SAMECS substructures;
2) update the substructures input data to impose the primary structure displacements at interacted freedoms as substructure specified displacements;
3) update the substructure SAMECS control logic to prepare for the substructure backsubstitution run.

* Estimate

NO. STR-14

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Structural Analysis - ASTRA (Advanced Strustural Analyzer)

FORM PREPARED BY F. D. Flood DATE 8-25-72

LANGUAGE ______ HOST MACHINE ______

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 15 min. BOTS (~~Central Processor Decimal Seconds of CDC 6600~~)

* INPUT VOLUME 10^4 (Words)

* OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Structural model with 196 nodes, 339 elements and 1 Load case.

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE Boeing D2-125179-5, "ASTRA User's Manual", Ice, M.W. and Herness, E.D., April 1968.

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This is a general purpose, large modular program developed for direct stiffness analysis fo missile and spacecraft structures. It includes mode shapes and frequency, step-wise large deflection and stability analysis.

* Estimate

NO. STR-15

TECHNICAL PROGRAM ELEMENT

TITLE Aerodynamic Heating

FORM PREPARED BY F. D. Flood DATE

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

* PROGRAM SIZE 10 (Boxes of Source Cards)

* TIMING 3,000 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^3 (Words)

* OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Thermal model with 16 details, each made of 10 nodes, 30 thermal elements (capacitors, conductors, radiators, convectors) for a M2.7 SST typical mission profile.

STATUS: Operational___, Programming In Development X , Not Programmed____

REFERENCE

OWNERSHIP: Public____, Private X , Owner The Boeing Company

ABSTRACT

This program calculates heat transfer coefficients and adiabatic wall temperatures, using nodes made of representative capacitors, conductors and radiators, and using previously calculated local Mach numbers. These in turn allow the temperature history of the primary structure throughout the mission to be predicted.

A typical configuration will be modelled by:

5 fuel tanks with upper and lower surfaces;

3 fuselage monocoques (upper, lower, sidewall lobes);

2 details for passenger compartment floor structure;

and 1 detail for empennage, giving a total of 16 details.

The computing time would be around 3,000 seconds for one airplane mission.

* Estimate

NO. STR-16

TECHNICAL PROGRAM ELEMENT

TITLE Aerodynamic Heating - Preliminary Estimate.

FORM PREPARED BY W. B. Gillette DATE 10-20-72

LANGUAGE ____ HOST MACHINE ____

*PROGRAM SIZE 1 (Boxes of Source Cards)

*TIMING 30 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^{3} (Words)

*OUTPUT VOLUME 10^{5} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT 1 mission calculation. Estimate.

STATUS: Operational ___, Programming In Development ___, Not Programmed XX

REFERENCE ____

OWNERSHIP: Public ___, Private ___, Owner ____

ABSTRACT

This will be a program that will use pressure coefficients calculated by previously executed aerodynamics programs to determine local Mach numbers, then get local adiabatic wall temperatures. A statistical process will be used to determine heat transfer coefficients at the surface and internally thru the primary structure. Then, the thermal distribution can be determined for the airplane mission.

* Estimate

NO. WTS-1

TECHNICAL PROGRAM ELEMENT

TITLE Class O Weight Estimation

FORM PREPARED BY R. E. Bateman DATE 10/24/72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

* PROGRAM SIZE 1 (Boxes of Source Cards)

* TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^2 (Words)

* OUTPUT VOLUME 10^2 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational___, Programming In Development___, Not Programmed X

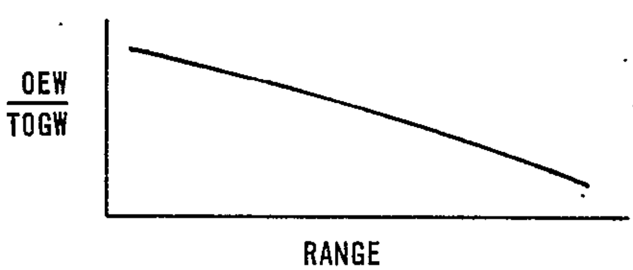
REFERENCE

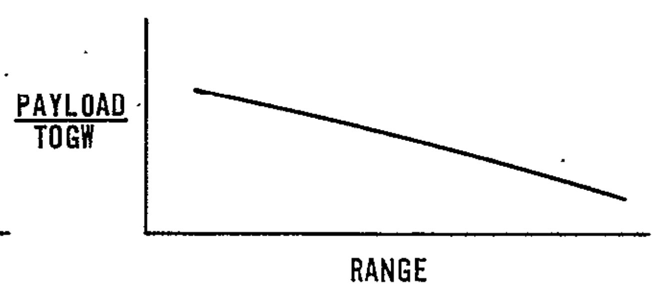
OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The purpose of this Technical Program Element will be to provide an initial estimate of airplane OEW for the airplane configuration and performance analysis in Level II. The estimate will probably be based on a series of equations in which OEW is predicted as a function of parameters such as:

- Payload
- Range
- Mach Number
- Takeoff Gross Weight
- Wing Loading
- Thrust Loading
- Technology





* Estimate

NO. WTS-2

TECHNICAL PROGRAM ELEMENT

TITLE Level I Weight and Balance System (Type A Weights)

FORM PREPARED BY R. E. Bateman DATE 7-18-72

LANGUAGE Fortran IV HOST MACHINE CDC-6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 3 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X, Programming In Development ___, Not Programmed X (1)

REFERENCE D6-40058 "Uses Manual For Level I Weight And Balance System" (To Be Released)

DC-23201TN "Weight Prediction Manual - Class I"

OWNERSHIP: Public ___, Private X, Owner The Boeing Company.

ABSTRACT

The Level I Weight And Balance System is an operational module taken from the Level I CPDS which calculates weight and balance for a subsonic commercial jet transport. The level I analysis contains:

1. Statistical OEW weight prediction methods
   a. Subsonic (D6-23201 TN) Base Buildup
   b. Transonic (NAP Scaling/Homework) Scaling
   c. C/STOL (Class I C/STOL) Base Buildup
2. Statistical OEW Horizontal CG Prediction Methods
   a. Subsonic (DG-23201 TN)
   b. Transonic (Homework)
3. Fuel Volume and Management Calculations
4. Passenger, Cargo, and Fuel Loading Calculations
5. Tail sizing and wing and gear positioning calculations
6. Balance and loadability limit calculations

The primary output consists of a group weight and CG statement, balance grid, and V-Bar diagram.

TECHNICAL PROGRAM ELEMENT NO. WTS-2 (Continued)

The accuracy of the level I analysis has not yet been determined.

(1) At present, the calculation of three axis mass moment of intertia about the airplane CG for activity III. 7 is not available.

ORIGINAL PAGE IS OF POOR QUALITY

NO. WTS-3

TECHNICAL PROGRAM ELEMENT

TITLE GEMPAK-A Wing Geometry And Dead Weight Generating and Distribution Package.

FORM PREPARED BY R. E. Bateman DATE 7-19-72

LANGUAGE Fortran IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-23202-1B TN " GEMPAK-A Wing Geometry And Dead Weight Weight Generating and Distribution Package . . ." (User and Theory Document)

OWNERSHIP: Public ___, Private X, Owner The Boeing Comapny

ABSTRACT

The GEMPAK module requires 50,000 octal core locations, approximately one second CP Time, and executes in 5 to 10 seconds. GEMPAK is written in FORTRAN IV. GEMPAK utilizing minimum input, generates the following data:

- Stations for Analysis
- Elastic Axis
- Interstation Distances
- Interspar Distances
- Dead Weight Panel Loads and Centers of Gravity
- Panel Centroidal Mass Moments of Inertia
- Dead Weight Fuel Loads and Centers of Gravity
- Aerodynamic Chord Lengths
- Spar Locations in Percent of Chord
- Slopes of Lines
- Front Spar Depth
- Mid Spar Depth
- Rear Spar Depth

- Maximum Section Depth
- Aerodynamic Quarter Chord Locaton
- Aerodynamic Panel Semi-Span
- Elastic Axis Sweep Angle at Each Station
- Tangent of Leading Edge Sweep Angles
- Tangent of Trailing Edge Sweep Angle

The present analysis assumes symmetry and is not suitable for conducting trade studies.

NO. WTS-4

TECHNICAL PROGRAM ELEMENT

TITLE Body, Fin, and Stabilizer Design System (Type A Weights)

FORM PREPARED BY R. E. Bateman DATE 7-19-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-23202-2 B TN Computerized Class II Body Weight and Center of Gravity Analysis. Boeing Program CONLD (LEMBO (2,2))

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This is a module which calculates preliminary estimates of the body and empennage panel weight, center of gravity, and inertias based on statistical body and contents and empennage and contents distributions of these items.

The present analysis assumes (empennage) symmetry and is not suitable for conducting trade studies.

NO. WTS-5

TECHNICAL PROGRAM ELEMENT

TITLE Wing Primary Structure Weight (Type B Weights)

FORM PREPARED BY R. E. Bateman DATE 7-19-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 5 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE Revision: Oracle-W2 (Ref. LR72-2)

Boeing Program Oracle (TESS04)

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

Based on the material properties defined in activity III. 14, the weights analysis takes the average bending and shear material thicknesses and calculates the material weights based on the panel areas. The calculated weights per panel are:

- upper surface bending material
- lower surface bending material
- front spar shear material
- mid spar shear material
- rear spar shear material

} Theoretical

The weights are "Theoretical" in nature in that they do not account for joints, splices, and fasteners.

The present analysis assumes symmetry and is not suitable for conducting trade studies.

ORIGINAL PAGE IS
OF POOR QUALITY

NO. WTS-6

TECHNICAL PROGRAM ELEMENT

TITLE Body/Empennage Primary Structure Weight (Type B Weights)

FORM PREPARED BY R. E. Bateman DATE 7-20-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational x, Programming In Development ___, Not Programmed ___

REFERENCE D6-23202-BTN "Computerized Class II Body Weight And Center of Gravity Analysis"

Boeing Programs LEMBO (2,2) and LEMBO (2,5)

OWNERSHIP: Public ___, Private x, Owner The Boeing Company

ABSTRACT

The body primary structure weights are based on the minimum required shear, tension, and compression material for each body panel segment. The material requirements are based on panel geometry and panel shear, moment, and torsion. Each panel is divided into four segments for load distrubution: top, bottom, and two sides.

The empennage primary structure is based directly on structural sizing. Two-spar semimonocoque construction is assumed for both the fin and stabilizer. The primary structure is assumed to be a box beam. Maximum principal stresses are computed for each load case in each panel, and the box material is sized according to the most severe stress combination in each panel.

The present analysis assumes (empennage) symmetry and is not suitable for conducting trade studies.

NO. WTS-7

TECHNICAL PROGRAM ELEMENT

TITLE Wing Secondary Structure Weight (Type B Weights)

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 6 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-23202-1DTN "Wing Secondary Structure Weight Estimation (TW 57) - User Manual"

D6-23202-1 TN "Weight Prediction Methods For Wing Secondary Structure"

OWNERSHIP: Public ___, Private X , Owner Boeing Program SWIM The Boeing Company

ABSTRACT

This SWIM program converts theoretical wing primary structure in to actual primary structure by applying factors to account for joints, splices, and fasteners.

The program calculates the wing secondary structure weight based on a statistical analysis which is sensitive to the wing geometry and the wing stress and moment distributions.

The program also presents all wing weight items in the form of mass elements which consists of:

1. The weight of the item
2. An idealization of each item (point, rod, or Polygonal plate) represented by three dimensional nodes.
3. An item identification number.

This data is transmitted to WTS-12 for the purpose of calculating mass properties.

The present analysis assumes symmetry and is not suitable for conducting trade studies.

NO. WTS-8

TECHNICAL PROGRAM ELEMENT

TITLE Body/Empennage Secondary Structure Weight (Type B and C weights)

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 5 (Boxes of Source Cards)

TIMING 25 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^4 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-23202-BTN "Computerized Class II Body Weight and Center of Gravity Analysis" D6-23202-2 TN "Weight Prediction Manual - Body" Boeing Program LEMBO (2,6)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This module converts theoretical body and empennage primary structure to actual primary structure by applying factors to account for items such as joints, splices, and fasteners.

The module calculates secondary structure weights using a combination of analytical and statistical methods based on significant physical parameters.

The module also presents the body and empennage weight items in the form of mass elements which consists of:

1. The weight of the item
2. The idealization of each item (point, rod, polygonal plate) represented by three dimensional nodes.
3. An item identification number.

The data is transmitted to WTS-12 for the purpose of calculating mass properties.

The present analysis assumes (empennage) symmetry and is not suitable for conducting trade studies.

NO. WTS-9

TECHNICAL PROGRAM ELEMENT

TITLE Landing Gear Weight
(Type D Weights)

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 3 (Boxes of Source Cards)

TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D6-23202-TN "Weight Prediction Manual - Class II"
D6-23202-DTN "Landing Gear Mass Properties" Program - TEW 063
Boeing Program GEAR

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The gear program predicts the weight, center of gravity and mass moments of inertia of landing gear systems. Both nose gear and main gear assemblies can be considered. The main gear footprint type may be selected. Five different ground conditions are used to produce the maximum axial and bending loads for the main and nose gear; ground turning, drift landing, ground braking, wheel spin-up, and dynamic spring-back. Individual gear component weights are estimated by considering the imposed loads, the physical geometry of the gear and, where pertinent, the fabrication details of the parts.

The gear control weights are based upon the weights of those items being moved or activated. Electrical systems weight associated with the gear group is computed from the wire run lengths. Weight calculation for the nose gear includes provisions for nose gear braking. Steering system weight is based upon the maximum nose gear static load, which in turn is directly related to the maximum torque requirement of the overall gear assembly.

NO. WTS 10

TECHNICAL PROGRAM ELEMENT

TITLE Propulsion and Fixed Equipment Weight (Type B weights)

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 40 (Boxes of Source Cards)

TIMING 70 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{5} (Words)

OUTPUT VOLUME 10^{5} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational x, Programming In Development ___, Not Programmed ___

REFERENCE D6-23202 TN " Weight Prediction Manual - Class II" D6-23202 C TN "Class II Propulsion and Fixed Equipment Weight Prediction (PROFIX) Users Manual" Boeing Program PROFIX

OWNERSHIP: Public ___, Private x, Owner The Boeing Company

ABSTRACT

WTS-10 computes the weights and locations of propulsion, fixed equipment and miscellaneous groups. The weight estimation methods are statistical and are sensitive to configuration and loads. This program can operate with a relatively small input for preliminary design; however, if detailed data is available, highly sophisticated and accurate weight predictions are obtained. The applicability of WTS-10 to analyze a supersonic transport design is yet to be determined.

The weight prediction capabilities are listed below:

- Cruise Engines
- Cruise Engine Controls
- Cruise Engine Accessories
- Cruise Engine Starting System
- Fuel System
- Thrust Reverser
- Community Noise Abatement
- Nacelle and Strut
- Flight Deck Accommodations
- Instruments
- Surface Controls
- Hydraulics
- Passenger Accommodations
- Cargo Accommodations
- Standard and Operational Items
- Emergency Equipment
- Air Conditioning
- Pheumatics
- Electronics
- Electronics
- Auxiliary Power Unit
- Anti-icing

NO. WTS-11

TECHNICAL PROGRAM ELEMENT

TITLE Fuel Distribution (Type C weights)

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^3 (Words)

OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational x (1), Programming In Development ___, Not Programmed ___

REFERENCE D6-26036 "A Program For The Generation of Fuel Volume, Distribution, And Management (FUELT)" (1)

Boeing Program FUELT

OWNERSHIP: Public ___, Private x, Owner The Boeing Company

ABSTRACT

Fuel volume calculations are based upon an input or internally-generated wing paneling and tank definition. The outboard paneling scheme is streamwise while the center section paneling is perpendicular to the chord. It is assumed that the entire wing box is potentially capable of carrying fuel. The fuel volumes and centers of gravity are computed for a series of incremental levels.

Using the actual airplane fuel requirements, the program then adjusts the fuel tank sizes to carry the required fuel and locates the tank ends. The fuel for each level in each tank is idealized for WTS-12 and its weight is calculated. As an option, the sized tanks can be used to calculate a loading and usage vector.

(1) Although this program is operational and documented, it is currently being replaced with an improved version.

NO. WTS-12

TECHNICAL PROGRAM ELEMENT

TITLE Mass Properties

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 2 (Boxes of Source Cards)

TIMING 72 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^5 (Words)

OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29 403 TN "SCOWL - Systematic Computation of Weights and Lumping of General Structures" D6-24849 TN "Airplane Mass Properties Computation Program: (User Manual) Boeing Brogram SAMPAN

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program accepts as input the weights, locations, and shape idealizations for fuel and all weight items computed by upstream programs. Wing and body structural paneling schemes required by those particular modules are also input.

This program does the following with the input:

- Sums the structure and contents weights for the wing, body, and empennage.
- Computes structure and contents inertias and centers of gravity for the wing, body, and empennage.
- Determines weight, center of gravity, and inertias for each input wing and body panel. The idealized shape of each weight item is apportioned to the panels which it intersects. Weights, center of gravity, and inertias are accumulated in this way for portions of each item in each panel.
- Calculates a table of weight, center of gravity, and inertia data for the fuel by level and tank.

WTS-12 output can be passed to WTS-14 which produces mass distribution data for the entire airplane for various loading conditions.

NO. WTS-13

TECHNICAL PROGRAM ELEMENT

TITLE Weight Statement Summary.

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{5} (Words)

OUTPUT VOLUME 10^{4} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X , Programming In Development ___, Not Programmed ___

REFERENCE D183-10138-1 "Weight Statement Generators"

Boeing Program WEST

OWNERSHIP: Public ___, Private X , Owner The Boeing Company

ABSTRACT

The Weight Statement Summary program collects all the weight and location information computed by upstream weight calculation programs, sorts the information according to standard groupings, and produces weight and center of gravity statements for each grouping in the standard AN 8102-D format. The program can be used to extract any subset of the group weight breakdowns, as well as a weight statement for the entire airplane.

NO. WTS-14

TECHNICAL PROGRAM ELEMENT

TITLE Airplane Mass Distribution

FORM PREPARED BY R. E. Bateman DATE 7-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 4 (Boxes of Source Cards)

TIMING 40 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{5} (Words)

OUTPUT VOLUME 10^{5} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-29732 TN "Payload and Fuel Loading and Paneling TEW053"

Boeing Program PAYOLA

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

Because of the nature of the aircraft preliminary design process, a mass distribution must be assumed for initial computation of the inertial component of aircraft loads. The resulting stress analysis, structural design, and weight calculations reflect this assumed distribution. WTS-14 enables the engineer to compute mass distributions before recycling the airplane weighing modules, thus minimizing the dependency on statistical methods or assumptions.

This program gathers mass properties from WTS-12, WTS-9, and WTS-10. These mass properties are rationally combined to achieve total airplane mass distribution for various points on the balance diagram. This program also generates the balance diagram.

These final mass distributions are combined with the design flight and ground conditions for an iterative pass through structural design and weights calculations.

NO. WTS-15

TECHNICAL PROGRAM ELEMENT

TITLE Weights Update Control

FORM PREPARED BY R. E. Bateman DATE 7-24-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600 (Assumed)

* PROGRAM SIZE 10 (Boxes of Source Cards)

* TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^5 (Words)

* OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross estimates - this depends upon how sophisticated this activity is desired to be.

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

In order to increase the accuracy of and decrease the computational time of the weights analysis, it would be desirable to develop a weights technical program element which would execute only those portions of the weights programs whose input has changed.

This would be more accurate than recalculating two separate, complete configurations and trying to determine trends which lie within the tolerance band of the answers.

The decrease in computational time would result from executing only the portion of the weights analysis which had changed. The cost of the weights update control program would have to be weighed against the saving in the weights analysis execution time.

* Estimate

NO. WTS-16

TECHNICAL PROGRAM ELEMENT

TITLE Wing Primary Structure Weight (Type B weights)

FORM PREPARED BY R. E. Bateman DATE 7-24-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600 (Assumed)

*PROGRAM SIZE 4 (Boxes of Source Cards)

*TIMING 20 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^5 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross Estimate - Based on four times the complexity of WTS-5.

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

A new wing primary structure weights analysis will have to be developed to respond to the refined skin/stringer material sizes supplied by the stress analysis.

* estimate

NO. WTS-17

TECHNICAL PROGRAM ELEMENT

TITLE Body/Empennage Primary Structure Weight

FORM PREPARED BY R. E. Bateman DATE 7-24-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600 (Assumed)

*PROGRAM SIZE 4 (Boxes of Source Cards)

*TIMING 2 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^5 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross estimate - based on four times the complexity of WTS-6

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE ______

OWNERSHIP: Public____, Private____, Owner______

ABSTRACT

A new Body/Empennage primary structure weights analysis will have to be developed to respond to the refined skin/stringer material sizes supplied by the stress analysis.

*Estimate

NO. WTS-18

TECHNICAL PROGRAM ELEMENT

TITLE Wing Secondary Structure Weight
(Type B weights)

FORM PREPARED BY R. E. Bateman DATE 7-24-72

LANGUAGE FORTRAN HOST MACHINE CDC 6600

*PROGRAM SIZE 8 (Boxes of Source Cards)

*TIMING 12 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^5 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross estimate based on two times the complexity of WTS-7

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE ______

OWNERSHIP: Public___, Private___, Owner______

ABSTRACT

Based on the refined information supplied by the design Level IV:

Geometry activities

Stability and Control activities

Structural Sizing Activities

It should be possible to develop a more refined statistical analysis of wing secondary structure weight than is done by WTS-7.

The technique for presenting all weight items in the form of mass elements would be the same as is done WTS-7.

* Estimate

NO. WTS-19

TECHNICAL PROGRAM ELEMENT

TITLE Body/Empennage Secondary Structure Weight

(Type C and D weights)

FORM PREPARED BY R. E. Bateman DATE 7-24-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600 (Assumed)

*PROGRAM SIZE 10 (Boxes of Source Cards)

*TIMING 50 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^5 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross estimate based on two times the complexity of WTS-8

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

Based on the refined information supplied by the design level IV:

Geometry Activities
Stability and Control Activities
Structural Sizing Activities

It should be possible to develop a more refined statistical anaysis of the Body/Empennage Secondary Structure Weight than is done by WTS-8

The technique for presenting all weight items in the form of mass elements would be the same as is done in WTS-8.

* Estimate

NO. WTS-20

TECHNICAL PROGRAM ELEMENT

TITLE Mass Matrix Formation

FORM PREPARED BY R. E. Bateman DATE 7-27-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600 (Assumed)

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^5 (Words)

*OUTPUT VOLUME 10^5 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross estimate based on the assumption that the required data will be generated in WTS-12 and WTS-14.

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

This element will form mass matrices which will contain the following for each predefined panel:

A. Weight

B Center of Gravity

C. Moments and products of inertia about the CG

There should be separate matrices formed for:

A. Wing (flaps up and down)
B. Body
C. Horizontal tail
D. Vertical Tail
E. (Each) Nacelle and strut
F. Landing gear (up and down)
G. Payload
H. Fuel

This will facilitate the analysis of various flight conditions by the other disciplines.

*Estimate

TECHNICAL PROGRAM ELEMENT NO. WTS-20 (Continued)

Most of the data required to form the matrices is available in technical program element WTS-14, therefore this element will be primarily concerned with the formation of the mass matrices.

NO. WTS-21

TECHNICAL PROGRAM ELEMENT

TITLE Finite Element Mass Module (Type B weights)

FORM PREPARED BY R. E. Bateman DATE 7-28-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

PROGRAM SIZE 10 (Boxes of Source Cards)

TIMING 30 (1) (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10~~5~~ (Words)

OUTPUT VOLUME 10~~5~~ (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT (1) (256 Elements, 117 Nodes, 29 retained degrees of freedom - NASA test wing)

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-25400-003 TN "ATLAS - An integrated Structural Analysis and Design System" (User Manual)

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

The mass module within the present ATLAS system has as its primary purpose the calculation of theoretical primary load-carrying structure mass matrices for input into the vibration analysis and panel loads for input into the loads analysis.. The mass module can apply non-theoretical material factors to the mass elements and also calculates mass element cg's and inertias.

At present, there is no capability for calculating secondary structure weight or non structure weight within the ATLAS finite element analysis, however this capability could be added, if desired.

Cyrrently a three dimensional solid element is being added to the ATLAS system which will be an extension of the two dimensional analysis.

NO. WTS-22

TECHNICAL PROGRAM ELEMENT

TITLE Standardized Weight Record System
(Type E weights)

FORM PREPARED BY R. E. Bateman DATE 7-28-72

LANGUAGE COBOL HOST MACHINE IBM 36002 370/165

PROGRAM SIZE 6 (Boxes of Source Cards)

TIMING 2400 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^8 (Words)

OUTPUT VOLUME 10^8 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT One current 747 project run
(This would be run once per week per project)

STATUS: Operational X, Programming In Development ___, Not Programmed ___

REFERENCE D6-23079 "Standardized Weights Record System
(SWRS) User's Manual"

OWNERSHIP: Public ___, Private X, Owner The Boeing Company

ABSTRACT

This program is designed to collect and disseminate weight, balance, and weight/cost data for all airplane models in Boeing CAG. It is a rolling wave status system. It has an accumulative data bank which operates to present and preserve relevant history.

The basic requirements are:

1. To provide integrity of weights data.
2. To provide meaningful history of weight evolution
3. To function with a minimum of input
4. To provide flexibility for accommodating a variety of different types of programs.
5. To provide a system which is usable at different levels of product definition.
6. To operate with a non-random weight breakdown system.

NO. WTS-23

TECHNICAL PROGRAM ELEMENT

TITLE Propulsion and Fixed Equipment Weight
(Type C and D weights)

FORM PREPARED BY R.E. Bateman DATE 8-11-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 100 (Boxes of Source Cards)

*TIMING 300 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^6 (Words)

*OUTPUT VOLUME 10^6 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross estimate based on four times the complexity of WTS-10

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE ___

OWNERSHIP: Public___, Private___, Owner___

ABSTRACT

This element would be primarily a Type C or D analysis of the aircraft systems. It would be reponsive to more detail than WTS-10 is capable of handling. This element should be capable of determining the mass properties of systems with known layouts, components, and loads.

* Estimate

NO. WTS-24

TECHNICAL PROGRAM ELEMENT

TITLE Parametric/Statistical Weight Estimating Methods (Type A weights)

FORM PREPARED BY R. E. Bateman DATE 2-21-72

LANGUAGE FORTRAN HOST MACHINE CDC 6600

PROGRAM SIZE 1 (Boxes of Source Cards)

TIMING 1 (Central Processor Decimal Seconds of CDC 6600)

INPUT VOLUME 10^{3} (Words)

OUTPUT VOLUME 10^{3} (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Average Execution

STATUS: Operational___, Programming In Development X, Not Programmed___

REFERENCE D6-15095 TN "Parametric/Statistical Weight Estimating Methods (Class I)" (Revision C) Coord Sheet: 2-2541-JMW-83 "Damps III - Weight Technology Update"

OWNERSHIP: Public___, Private X, Owner The Boeing Company

ABSTRACT

The parametric/statistical weight estimating methods presented in D6-15095 TN are intended to be more applicable for subsonic and supersonic bombers, fighters, and transports than current, existing Type A weight methods. The methods contained in D6-15095 TN do not produce valid data for delta wing aircraft or for aircraft which utilize exotic materials or construction techniques.

The equations are of a form which can be used for base buildup weight prediction or can be used for limited scaling.

The output from the program is a 30 item group weight statement.

NO. WTS-25

TECHNICAL PROGRAM ELEMENT

TITLE Wing, Body, and Empennage Paneling & Weight Distributions

FORM PREPARED BY R.E. Bateman DATE 2-21-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

* PROGRAM SIZE 6 (Boxes of Source Cards)

* TIMING 8 (Central Processor Decimal Seconds of CDC 6600)

* INPUT VOLUME 10^4 (Words)

* OUTPUT VOLUME 10^4 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross Estimate based on four times the complexity of WTS-3 and WTS-4

STATUS: Operational___, Programming In Development___, Not Programmed x

REFERENCE

OWNERSHIP: Public____, Private____, Owner

ABSTRACT

This element will generate structural and aerodynamic finite-element wing, body, and empennage panel definitions and apportion the type A weight, center of gravity, and inertia to each structural panel.

*Estimate

NO. WTS-26

TECHNICAL PROGRAM ELEMENT

TITLE Fuel Management Requirements

FORM PREPARED BY R. E. Bateman DATE 8-22-72

LANGUAGE FORTRAN IV HOST MACHINE CDC 6600

*PROGRAM SIZE 2 (Boxes of Source Cards)

*TIMING 10 (Central Processor Decimal Seconds of CDC 6600)

*INPUT VOLUME 10^3 (Words)

*OUTPUT VOLUME 10^3 (Words)

BASIS FOR TIMING, INPUT, AND OUTPUT Gross Estimate

STATUS: Operational___, Programming In Development___, Not Programmed X

REFERENCE

OWNERSHIP: Public___, Private___, Owner

ABSTRACT

In order to achieve supersonic transport designs wich are acceptable from the standpoints of balance and loadability, it has been necessary to introduce body fuel systems to control CG movement.

This technical program element would operate in conjunction with technical program element WTS-14 to determine what the requirements for a fuel management system would be to obtain a configuration which is balanced and loadable.

*Estimate