

CONCEPTUAL DESIGN AND ANALYSIS OF
THE TRACKED MAGNETICALLY LEVITATED VEHICLE
TECHNOLOGY PROGRAM (TMLV) - REPULSION SCHEME

VOLUME III - APPENDIX G
5 DOF COMPUTER PROGRAM

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PREFACE .

The study documented in this third volume of the MAGLEV Final Report was conducted by Ford Motor Co. under contract to the U.S. Department of Transportation (DOT), Federal Railroad Administration, Office of Research, Development and Demonstrations. The DOT Program Manager was Dr. John T. Harding. Additional support was provided by Mr. Arnold Gross of DOT and Dr. Roger Katz of MITRE Corp.

Overall program management and levitation magnet design were the responsibility of the Ford Scientific Research Staff. Vehicle and guideway conceptual designs and overall systems analysis were the responsibility of the Aeronutronic Division of Philco-Ford Corp. Dr. John R. Reitz of the Ford Motor Company was the Program Manager.

This volume contains Appendix G of the report "Conceptual Design and Analysis of the Tracked Magnetically Levitated Vehicle Technology Program (TMLV) - Repulsion Scheme", DOT Report No. FRA-ORD&D-75-21, February 1975. The three volumes of this report document the work done to define a conceptual Revenue MAGLEV; a potential system for High Speed Ground Transportation (HSGT) applicable to the heavily-traveled Northeast and California corridors for the 1985-1995 time frame.

The work described in this volume was under the direction of Mr. Robert L. Pons (Deputy Program Manager for Systems, Philco-Ford Corp.) and Dr. D. A. Rodriguez (Dynamics and Control). Dr. C. C. Wan was the author of this volume, and Mr. T. B. Clark the editor.

TABLE OF CONTENTS

APPENDIX		PAGE
G.1	INTRODUCTION	G-1
G.2	ANALYTICAL PRELIMINARIES	G-2
	G.2.1 Force Model for Levitation Coils	G-2
	G.2.2 Mass Properties of Vehicle	G-3
	G.2.3 Equations of Motion for Constant Speed Operation	G-3
	G.2.4 Control Functions	G-6
	G.2.5 Stability Analysis	G-6
	G.2.6 Guideway Irregularities	G-22
	G.2.7 Frequency Response	G-29
	G.2.8 Power Spectral Density	G-30
	G.2.9 Organization of Computer Programs	G-30
G.3	PROGRAMS FOR ANALYSIS OF VEHICLE DYNAMICS	G-34
	G.3.1 Stability Analysis	G-35
	G.3.2 Vehicle Response and Ride Quality Calculations	G-36
	G.3.2.1 Program VHDYNO	G-38
	G.3.2.2 Program VHDYN1	G-38
	G.3.2.3 Program VHDYN2	G-39
	G.3.2.4 Amplitudes of Guideway Irregularities	G-40
	G.3.2.5 Sample Runs and Output Format	G-40
	G.3.2.6 Listing of Programs	G-42

APPENDIX G

FIVE DEGREE-OF-FREEDOM COMPUTER PROGRAM

G.1 INTRODUCTION

This appendix contains the computer programs for the solution of the equations of motion pertaining to constant speed operation of a magnetically levitated vehicle over an at-grade guideway, and a summary of the analytical background for the programs. These programs provide the capability for performing stability analyses of vehicles with control functions based on both relative and absolute measurements at individual coil locations, and for evaluating vehicle response and ride quality characteristics for operations over guideways with irregularities.

Section G.2 describes the numerous analytical simplifications which lead to a compact set of computing programs. The five degree-of-freedom problem is reduced to two sets of equations of lower order by virtue of the symmetry in coil* placement on the vehicle. The surface irregularity distribution among the two parallel guideway tracks are resolved into symmetrical and anti-symmetrical components so as to render them compatible to the reduced set of equations.

Two groups of programs are summarized in Section G.3. The first group consists of a single program, called STAB, which is devoted to evaluation of roots of the stability equations. This is used for parametric studies of control gain constants leading to the selection of a baseline set of these constants. The second group consists of three programs, named VHDYNO, VHDYN1 and VHDYN2, to be used in sequence to provide both unit solutions for each

*In this appendix, "coils" refer to the levitation coil modules, each of which actually consists of two separate superconducting magnets for the purpose of redundancy.

type of guideway irregularities and specific response and ride quality information for a particular distribution of guideway irregularities.

Section G.3 lists each of these programs along with a sample run. The set of control gain constants selected for the preliminary conceptual Revenue vehicle is used in these samples. The programs are written in BASIC language for use on time-sharing systems. Manual inputs from the time-share terminal keyboard are shown underlined in the sample runs presented in Section G.3.

G.2 ANALYTICAL PRELIMINARIES

Analytical techniques used in the studies of vehicle stability and vehicle response to guideway disturbances are summarized in this section. The starting point is provided by the equations of motion derived in Appendix B. These equations are repeated here for reference. Schemes to simplify the computation sequence are included in the discussion in this section.

G.2.1 FORCE MODEL FOR LEVITATION COILS

Forces and moment acting on the vehicle at the center of a levitation coil assembly, expressed in the local coordinate system, are:

$$F_L = F_{L0} + F_{Lh} \Delta h + F_{Lh'} \Delta h' + F_{L\phi} \phi + F_{L\alpha} \alpha$$

$$F_G = F_{G0} + F_{Gh} \Delta h + F_{Gh'} \Delta h' + F_{G\phi} \phi + F_{G\alpha} \alpha$$

$$L = L_0 + L_h \Delta h + L_{h'} \Delta h' + L_\phi \phi + L_\alpha \alpha$$

where F_{L0} , F_{G0} , and L_0 are the forces and moments acting at the center of a coil with the coil in its nominal position relative to the L-shaped guideway. The other terms constitute a linear representation of variations in forces and moments for other positions relative to this nominal position.

The magnetic drag force due to eddy currents, acting at the center of a coil, is approximated by

$$F_X = - (F_L + F_G) K_1 \quad \text{where} \quad K_1 = 1 / (F_L / F_D)_V$$

The lift to drag ratio is to be evaluated at the appropriate speed, as indicated by the subscript V. An additional correction term to account for the effect of changes in coil elevation has been obtained by curve fitting and is retained in the data file, but was not used.

The force coefficient matrix of order (3,5), the two drag coefficients, and the thrust force for an operational speed of 134 m/s constitute the data file MFRV (Magnetic Force coefficients for Revenue Vehicle), as displayed on Page G-8.

G.2.2 MASS PROPERTIES OF THE VEHICLE

Mass properties and locations of the four levitation coil assemblies for the preliminary Revenue Vehicle are compiled into a data file, called MPRV (Mass Property Revenue Vehicle), as displayed on Page G-9. This file also includes five blanks at the end, which are set up as the values for external forces and moments that may be applied to the vehicle. These are taken to be zeros for the example cases.

G.2.3 EQUATIONS OF MOTION FOR CONSTANT SPEED OPERATION

Equations of motion for constant speed operation showing the effect of control currents in its most general form, as derived in Appendix B, are reproduced here as Tables G-1 and G-2. On account of the symmetrical placement of the levitation coils, there is no significant coupling between longitudinal and lateral dynamics. Furthermore, the equation corresponding to the longitudinal axis is trivial by virtue of the constant speed stipulation. Thus, the five degree-of-freedom system is reduced to a longitudinal set with two degrees of freedom and a lateral set with three degrees of freedom. Programs are written for a three degree-of-freedom problem, with provisions to reduce the order from three to two wherever necessary.

Elements in the various matrices identified in Tables G-1 and G-2 can be formed at the outset of a study of a particular vehicle configuration. Program MATCOEF was prepared to perform these preliminary calculations. This program also provides the calculation of pitching moment about the vehicle center of gravity due to thrust, and transfers those force coefficients associated with control current parameter for further use in determining the equilibrium position of the vehicle and in evaluating the power requirements for the control coils. The output of this program is written onto a file, which is identified as MFCOEF in this instance. Listing of MATCOEF and results of a sample run using coefficients corresponding to the preliminary vehicle configuration used in the dynamics and control analyses are shown on

TABLE G-1. FORCE EQUATIONS FOR PITCH AND HEAVE

$$I_s \ddot{q}_s = A_s q_s + B_s \alpha + C_s \gamma + D_s \eta + L_s$$

$$K_1 = \frac{1}{(f_L/f_0)_Y}$$

$$q_s = \begin{bmatrix} Z \\ \Theta \end{bmatrix}$$

$$L_s = \begin{bmatrix} mg - 4F_{L0} + Z_{ext} \\ -4cK_1(F_{L0} + F_{G0}) + 2(a_F - a_R)F_{L0} + M_T + M_{ext} \end{bmatrix}$$

$$\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix}$$

$$\gamma = \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \end{bmatrix}$$

$$\eta = \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{bmatrix}$$

$$I_s = \begin{bmatrix} m & 0 \\ 0 & B \end{bmatrix}$$

m = VEHICLE WEIGHT (in kg)

B = VEHICLE PITCHING INERTIA (in kg.m²)

$$A_s = \begin{bmatrix} a_{zz} & a_{z\theta} \\ a_{\theta z} & a_{\theta\theta} \end{bmatrix}$$

$$X_h = K_1(F_{Lh} + F_{Gh})$$

$$a_{zz} = 4F_{Lh}$$

$$a_{z\theta} = -2(a_F - a_R)F_{Lh}$$

$$a_{\theta z} = -2(a_F - a_R)F_{Lh} + 4cX_h$$

$$a_{\theta\theta} = 2(a_F^2 + a_R^2)F_{Lh} - 2(a_F - a_R)[cX_h - K_1(F_{L0} + F_{G0})] + 4cF_{L0}$$

$$B_s = \begin{bmatrix} b_z & b_z & b_z & b_z \\ b_{\theta F} & b_{\theta F} & b_{\theta R} & b_{\theta R} \end{bmatrix}$$

$$b_z = -F_{L0}$$

$$b_{\theta F} = a_F F_{L0} - cK_1(F_{L0} + F_{G0})$$

$$b_{\theta R} = -a_R F_{L0} - cK_1(F_{L0} + F_{G0})$$

$$C_s = \begin{bmatrix} c_z & c_z & c_z & c_z \\ c_{\theta F} & c_{\theta F} & c_{\theta R} & c_{\theta R} \end{bmatrix}$$

$$c_z = F_{Lh}$$

$$c_{\theta F} = -a_F F_{Lh} + cK_1(F_{Lh} + F_{Gh})$$

$$c_{\theta R} = a_R F_{Lh} + cK_1(F_{Lh} + F_{Gh})$$

$$D_s = \begin{bmatrix} d_z & d_z & d_z & d_z \\ d_{\theta F} & d_{\theta F} & d_{\theta R} & d_{\theta R} \end{bmatrix}$$

$$d_z = F_{Lh'}$$

$$d_{\theta F} = -a_F F_{Lh'} + cK_1(F_{Lh'} + F_{Gh'})$$

$$d_{\theta R} = a_R F_{Lh'} + cK_1(F_{Lh'} + F_{Gh'})$$

TABLE G-2. FORCE EQUATIONS FOR ROLL, SWAY, AND YAW MOTION

$$I_A \ddot{q}_A = A_A q_A + B_A \alpha + C_A j + D_A \eta + L_A$$

$$q_A = \begin{bmatrix} Y \\ \phi \\ \Psi \end{bmatrix} \quad L_A = \begin{bmatrix} Y_{ext} \\ L_{ext} \\ N_{ext} \end{bmatrix}$$

$$I_A = \begin{bmatrix} m & 0 & 0 \\ 0 & A & 0 \\ 0 & 0 & C \end{bmatrix}$$

m = VEHICLE WEIGHT (IN KG)

A = VEHICLE ROLLING INERTIA (IN kg m^2)

C = VEHICLE YAWING INERTIA (IN kg m^2)

$$A_A = \begin{bmatrix} a_{yy} & a_{y\phi} & a_{y\psi} \\ a_{\phi y} & a_{\phi\phi} & a_{\phi\psi} \\ a_{\psi y} & a_{\psi\phi} & a_{\psi\psi} \end{bmatrix}$$

$$a_{yy} = 4 F_{Gh'} \quad a_{y\phi} = -4 (b F_{Gh} + c F_{Gh'} + F_{G\phi}) = a_{\phi y}$$

$$a_{y\psi} = 2(a_f - a_R) F_{Gh'}$$

$$a_{\phi\phi} = 4 [b(b F_{Lh} + c F_{Lh'} + F_{L\phi} + L_h - F_{G0}) + c(b F_{Gh} + c F_{Gh'} + F_{G\phi} + L_h' + F_{L0}) + L_\phi]$$

$$a_{\phi\psi} = -2(a_f - a_R)(b F_{Lh'} + c F_{Gh'} + L_h') - 4c K_1 (F_{L0} + F_{G0})$$

$$a_{\psi y} = 2(a_f - a_R) F_{Gh'} + 4b K_1 (F_{Lh'} + F_{Gh'})$$

$$a_{\psi\phi} = -2(a_f - a_R)(b F_{Gh} + c F_{Gh'} + F_{G\phi} + F_{L0}) - 4b K_1 [b F_{Lh} + c F_{Lh'} + F_{L\phi} + b F_{G0} + c F_{G\phi} + F_{G\phi}]$$

$$a_{\psi\psi} = 2(a_f^2 + a_R^2) F_{Gh'} + 2(a_f - a_R) K_1 [b(F_{Lh'} + F_{Gh'}) + F_{L0} + F_{G0}] - 4b F_{G0}$$

$$B_A = \begin{bmatrix} b_y & -b_y & b_\phi & -b_\phi \\ b_\phi & -b_\phi & b_\psi & -b_\psi \\ b_{\phi\psi} & -b_{\phi\psi} & b_{\psi\phi} & -b_{\psi\phi} \end{bmatrix}$$

$$b_y = F_{G0} \quad b_\phi = -(b F_{L0} + c F_{G0} + L_0)$$

$$b_{\phi\psi} = b K_1 (F_{L0} + F_{G0}) + a_f F_{G0} \quad b_{\psi\phi} = b K_1 (F_{L0} + F_{G0}) - a_R F_{G0}$$

$$C_A = \begin{bmatrix} c_y & -c_y & c_\phi & -c_\phi \\ c_\phi & -c_\phi & c_\psi & -c_\psi \\ c_{\phi\psi} & -c_{\phi\psi} & c_{\psi\phi} & -c_{\psi\phi} \end{bmatrix}$$

$$c_y = -F_{Gh} \quad c_\phi = b F_{Lh} + c F_{Gh} + L_h$$

$$c_{\phi\psi} = -b K_1 (F_{Lh} + F_{Gh}) - a_f F_{Gh} \quad c_{\psi\phi} = -b K_1 (F_{Lh} + F_{Gh}) + a_R F_{Gh}$$

$$D_A = \begin{bmatrix} d_y & -d_y & d_\phi & -d_\phi \\ d_\phi & -d_\phi & d_\psi & -d_\psi \\ d_{\phi\psi} & -d_{\phi\psi} & d_{\psi\phi} & -d_{\psi\phi} \end{bmatrix}$$

$$d_y = -F_{Gh'} \quad d_\phi = b F_{Lh'} + c F_{Gh'} + L_h'$$

$$d_{\phi\psi} = -b K_1 (F_{Lh'} + F_{Gh'}) - a_f F_{Gh'} \quad d_{\psi\phi} = -b K_1 (F_{Lh'} + F_{Gh'}) + a_R F_{Gh'}$$

Pages G-10 through G-12. This is followed by a listing of data files MPRV, MFRV and MFCOEF (Page G-13).

G.2.4 CONTROL FUNCTIONS

Control current commands are generated from weighted sums of filtered signals from both relative measurements (gap sensors) and absolute measurements (accelerometers) at individual coil locations. A schematic showing information flow for the control concept considered in this study is presented in Figure G-1. Detailed steps showing the mathematical representation of this control concept are reproduced on Pages G-14 through G-16 for ready reference. The last two groups of equations contain explicit expressions for control current commands and the final equations of motion in terms of the vehicle's center of gravity.

Values of gain parameters and time constants assigned to the various control functions are collected into a single data file, called "C" in this study. The content of this file is displayed on Page G-8. Values of individual elements are either selected on the basis of simplified preliminary analyses, as described in Section 4.3.2B, or obtained as a result of parametric solution of the stability equation to be discussed in the next section.

G.2.5 STABILITY ANALYSIS

Stability analyses entail determination of roots of the characteristic equation formed from the coefficients of the final equations of motion. The influence of control functions is contained in the term of matrix product, namely:

$$B_S Q_{SS} K_S K_{OS} \quad \text{and} \quad B_A Q_{AA} K_A K_{OA}$$

The first three matrices in these products are independent of frequency and thus may be evaluated in advance. K_{OS} is a diagonal matrix with identical diagonal elements which are functions of frequency. Thus, the frequency-dependent function can be factored out as a scalar multiplier. K_{OA} can be reduced to the sum of two matrices, each being multiplied by a scalar multiplier which is a frequency-dependent function. Explicit expressions for the matrix products $B_S Q_{SS} K_S$ and $B_A Q_{AA} K_A$ and manipulation of K_{OA} and K_{OA} matrices are displayed on Page G-17.

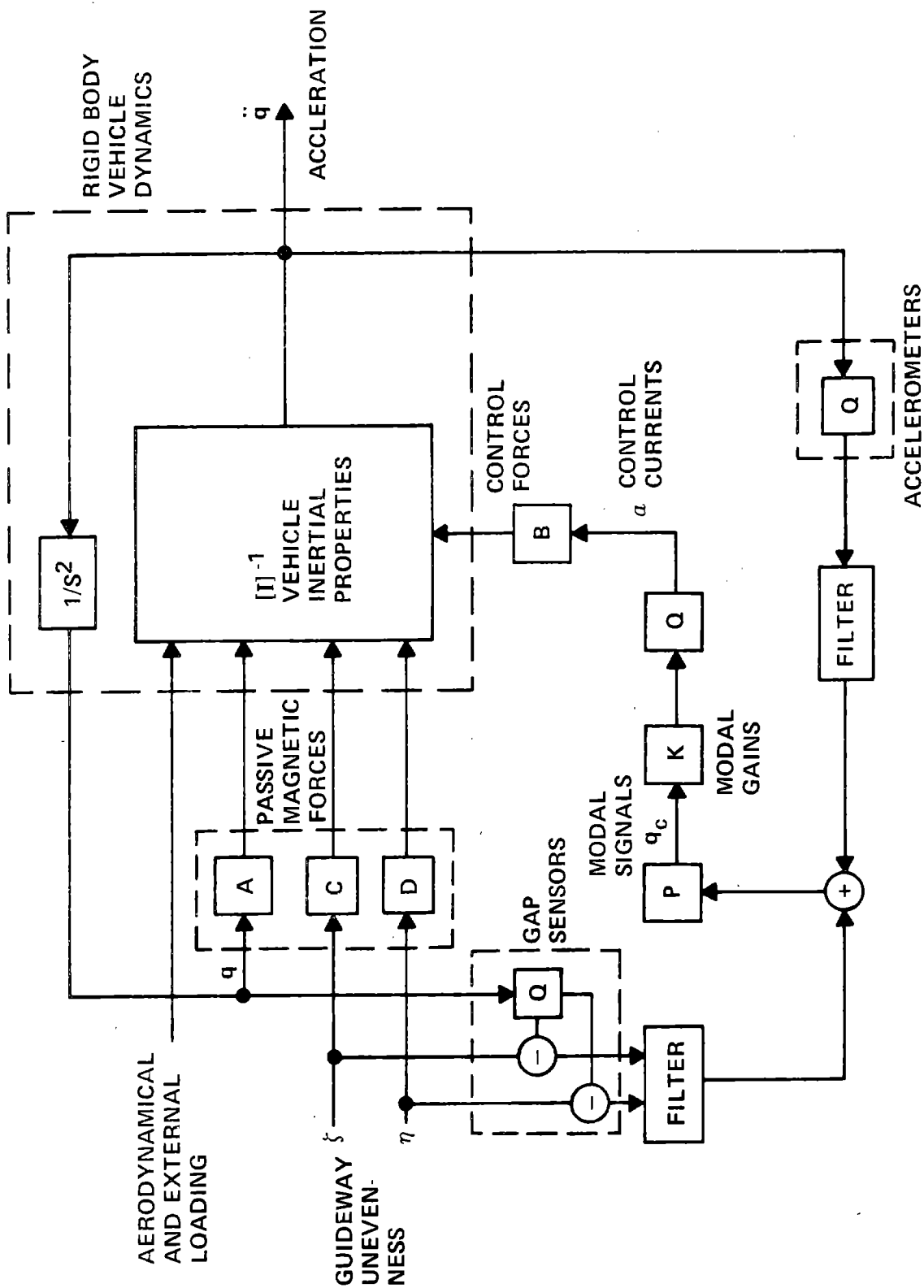


FIGURE G-1. BLOCK DIAGRAM FOR MAGLEV CONTROL DYNAMICS AND RIDE QUALITY CHARACTERISTICS

FILE "MFRV" (18 ITEMS)

(Magnetic Force Coefficients for Revue Vehicle)

(3,5) matrix of force coefficients

$F_{L0}, F_{Lh}, F_{Lh'}, F_{L\phi}, F_{L\alpha},$

$F_{G0}, F_{Gh}, F_{Gh'}, F_{G\phi}, F_{G\alpha},$

$L_0, L_h, L_{h'}, L_{\phi}, L_{\alpha}$

Lift/drag ratio at speed V: $(F_L/F_D)_V$

Drag correction coefficient for change in coil elevation: K_2

Thrust at speed V: T in Newtons.

Note: The drag force may be expressed by

$$F_X = -(F_L + F_G) / \left[(F_L/F_D)_V + K_2 \Delta h \right]$$

FILE "C" (19 ITEMS)

(Control Gains and Time Constants)

Gap sensor, vertical: $K_h, K_{h'}$

Gap sensor, lateral: $K_{h'}, K_{h''}$

Acceleration, vertical: K_z, K_z', K_s

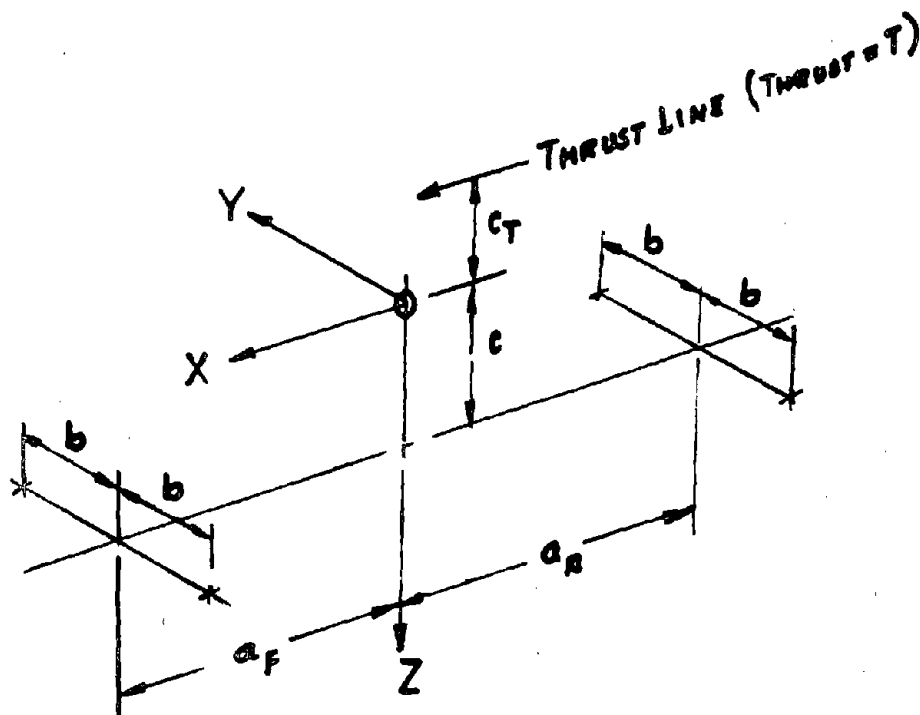
Acceleration, lateral: K_y, K_y', K_a

Modal gains: $K_z, K_{\theta}, K_y, K_{\phi}, K_{\psi}$

Time constants: $\tau_h, \tau_{h'}, \tau_z, \tau_y$

FILE "MPRV" (14 ITEMS)
(Mass Properties-Revenue Vehicle)

		Values for Preliminary Revenue Vehicle
m	vehicle mass (kg)	45,400
A	roll moment of inertia (kg-m^2)	75,000
B	pitch moment of inertia (kg-m^2)	3.4×10^6
C	yaw moment of inertia (kg-m^2)	3.4×10^6
a_F	x-distance from c.g. to front coil (m)	9.00
a_R	x-distance from c.g. to rear coil (m)	7.65
b	y-distance from c.g. to coil center (m)	0.965
c	z-distance from c.g. to coil center (m)	1.21
c_T	z-distance of thrust line above c.g. (m)	2.72
Z_{ext}	Externally applied forces and moments excluding thrust force from prime mover (nominally zeros)	
M_{ext}		
Y_{ext}		
L_{ext}		
N_{ext}		



PROGRAM "MATCOEF"

```

10 DIM A(3,3),B(4),C(4),D(4)
20 FILES INPUT1;INPUT2;OUTPUT1
30 PRINT"MASS PROPERTY INPUT DATA FILENAME ";\INPUT AS
40 PRINT"FORCE COEF INPUT DATA FILENAME ";\INPUT BS
50 PRINT"LAT. AND LONG. OUTPUT COEF. FILENAME ";\INPUT CS
60 PRINT\PRINT\PRINT
70 FILE #3,CS \ FILE #1,AS \ FILE #2,BS
80 SCRATCH#3
90 READ#1,M,A,B,C,A1,A2,B1,C1,C2
100 READ#2,L0,L1,L2,L3,L4
110 READ#2,G0,G1,G2,G3,G4
120 READ#2,M0,M1,M2,M3,M4
130 READ#2,K1,K2
140 D0=(L0+G0)/K1\D1=(L1+G1)/K1\D2=(L2+G2)/K1\D3=(L3+G3)/K1
150 D4=(L4+G4)/K1
160 READ#2,T
170 WRITE #3, L4,G4,M4
180 MAT A=ZER(3,3)
190 MAT B=ZER(4)
200 MAT C=ZER(4)
210 MAT D=ZER(4)
220 O1=B1*L1+C1*L2+L3
230 O2=B1*G1+C1*G2+G3
240 O3=B1*D1+C1*D2+D3
250 G5=M1+O1-G0
260 L5=M2+O2+L0
270 A(1,1)=4*G2\A(1,2)=-4*O2
280 A(1,3)=2*(A1-A2)*G2
290 A(2,1)=A(1,2) \ A(2,2)=4*B1*G5+4*C1*L5+4*M3
300 A(2,3)=-2*(A1-A2)*O2-4*C1*L0
310 A(3,1)=4*B1*D2+2*(A1-A2)*G2
320 A(3,2)=-4*B1*O3-2*(A1-A2)*(O2+L0)
330 A(3,3)=-4*B1*G0+2*(B1*D2+D0)*(A1-A2)+2*(A1*A1+A2*A2)*G2
340 B(1)=G4\B(2)=-M4-C1*G4-B1*L4
350 B(3)=D4*B1+G4*A1\B(4)=D4*B1-G4*A2
360 C(1)=-G1\C(2)=O1
370 C(3)=-A1*G1-B1*D1
380 C(4)=A2*G1-B1*D1
390 D(1)=-G2\D(2)=O2
400 D(3)=-A1*G2-B1*D2
410 D(4)=A2*G2-B1*D2
420 PRINT\PRINT
430 PRINT"LATERAL A MATRIX COEFICIENTS"\PRINT
440 MAT PRINT A
450 PRINT"BY,B0,BPF,BFR"\PRINT
460 PRINT B(1),B(2),B(3),B(4)\PRINT
470 PRINT"CY,C0,CPF,CPR"\PRINT
480 PRINT C(1),C(2),C(3),C(4)\PRINT
490 PRINT"DY,D0,DPF,DPR"\PRINT
500 PRINT D(1),D(2),D(3),D(4)\PRINT
510 MAT WRITE #3, A,B,C,D
520 PRINT

```


PROGRAM "MATCOEF" CONTINUED

```

530 MAT A = ZER(3,3)
540 MAT B=ZER(4)
550 MAT C=ZER(4)
560 MAT D=ZER(4)
570 A(1,2)=4*D1 \ A(1,3)=-2*(A1-A2)*D1
580 A(2,2)=4*L1\A(2,3)=-2*(A1-A2)*L1
590 A(3,2)=C1*A(1,2)-2*(A1-A2)*L1
600 A(3,3)=C1*(4*L2+A(1,3))+2*(A1-A2)*L2+2*(A1*A1+A2*A2)*L1
610 B(1)=-D4\B(2)=-L4
620 B(3)=-D4*C1+L4*A1
630 B(4)=-D4*C1-L4*A2
640 C(1)=D1\C(2)=L1
650 C(3)=-A1*L1+C1*D1
660 C(4)=A2*L1+C1*D1
670 D(1)=D2\D(2)=L2
680 D(3)=-A1*L2+C1*D2
690 D(4)=A2*L2+C1*D2
700 M9=-4*C1*D2+2*(A1-A2)*L2-C2*T
710 PRINT"LONGITUDINAL A MATRIX COEFFICIENTS"\PRINT
720 MAT PRINT A
730 PRINT"BX,BZ,BTF,BTR"\PRINT
740 PRINT B(1),B(2),B(3),B(4)\PRINT
750 PRINT"CX,CZ,CTF,CTR"\PRINT
760 PRINT C(1),C(2),C(3),C(4)\PRINT
770 PRINT"DX,DZ,DTF,ETR"\PRINT
780 PRINT D(1),D(2),D(3),D(4)\PRINT
790 PRINT"M2=";M9\PRINT\PRINT
800 MAT WRITE#3,A,B,C,D
810 WRITE #3,M9
820 STOP
830 END

```

RUN MATCOEF

MASS PROPERTY INPUT DATA FILENAME ?MPRV
FORCE COEF INPUT DATA FILENAME ?MFRV
LAT. AND LONG. OUTPUT COEF. FILENAME ?MFCOEF

LATERAL A MATRIX COEFFICIENTS

-1297200	1440225	-875609.9
1440225	-4724083	960281.9
-890789.1	743184.1	-9.06509E 07

BY,BO,BPF,BPR

63716	-432476.4	579775.1	-481096.3
-------	-----------	----------	-----------

CY,CO,CPF,CPR

-82437	-775590	-729204.1	643371.9
--------	---------	-----------	----------

DY,DO,DPF,DPR

324300	-360056.3	2922495	-2477100
--------	-----------	---------	----------

LONGITUDINAL A MATRIX COEFFICIENTS

0	-52762.08	35614.4
0	-3574880	2413044
0	2349202	-2.48800E 08

BX,BZ,BTF,BTR

-6560.702	-339800	3050262	-2607408
-----------	---------	---------	----------

CX,CZ,CTF,CTR

-13190.52	-893720	8027519	-6852919
-----------	---------	---------	----------

DX,DZ,DTF,DTR

-3932.412	82437	-746691.2	625884.8
-----------	-------	-----------	----------

M0= 215746

DATA FILES MPRV, MFRV, AND MFCOEF

LIST MPRV:MFRV:MFCOEF

10 45400, 75000, 3400000, 3400000, 9.0, 7.65, .965, 1.21, 2.72
20 0, 0, 0, 0, 0

10 1.112E5, -8.9372E5, 8.2437E4, -1.2899E4, 3.398E5
20 3.964E4, 8.2437E4, -3.243E5, -4.7205E4, 6.3716E4
30 1.1768E4, -1.2899E4, -4.7205E4, -2.3642E4, 2.7473E4
40 61.505, 10.95
50 26700

000010	339800,	63716,	27473,
000020	-1297200,	1440225,	-875609.9,
000030	1440225,	-4724083,	960281.9,
000040	-890789.1,	743184.1,	-9.06509E 07,
000050	63716,		
000060	-432476.4,		
000070	579775.1,		
000080	-481096.3,		
000090	-82437,		
000100	-775590,		
000110	-729204.1,		
000120	643371.9,		
000130	324300,		
000140	-360056.3,		
000150	2922495,		
000160	-2477100,		
000170	0,	-52762.08,	35614.4,
000180	0,	-3574880,	2413044,
000190	0,	2349202,	-2.48800E 08,
000200	-6560.702,		
000210	-339800,		
000220	3050262,		
000230	-2607408,		
000240	-13190.52,		
000250	-893720,		
000260	8027519,		
000270	-6852919,		
000280	-3932.412,		
000290	82437,		
000300	-746691.2,		
000310	625884.8,		
000320	215746,		

READY

*

CONTROL CONCEPT MATHEMATICS

COIL ASSEMBLY DISPLACEMENTS

$$z = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \\ z_4 \end{bmatrix} \quad y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} \quad q_s = \begin{bmatrix} z \\ \phi \end{bmatrix} \quad q_A = \begin{bmatrix} Y \\ \Phi \\ \Psi \end{bmatrix}$$

$$\begin{bmatrix} z \\ y \end{bmatrix} = \begin{bmatrix} Q_{ss} & Q_{sA} \\ 0 & Q_{AA} \end{bmatrix} \begin{bmatrix} q_s \\ q_A \end{bmatrix}$$

$$Q_{ss} = \begin{bmatrix} -1 & a_F \\ -1 & a_F \\ -1 & -a_R \\ -1 & -a_R \end{bmatrix} \quad Q_{sA} = \begin{bmatrix} 0 & -b & 0 \\ 0 & b & 0 \\ 0 & -b & 0 \\ 0 & b & 0 \end{bmatrix} \quad Q_{AA} = \begin{bmatrix} 1 & -c & a_F \\ -1 & c & -a_F \\ 1 & -c & -a_R \\ -1 & c & a_R \end{bmatrix}$$

$$\begin{bmatrix} P_{ss} & 0 \\ P_{As} & P_{AA} \end{bmatrix} = \begin{bmatrix} Q_{ss} & Q_{sA} \\ 0 & Q_{AA} \end{bmatrix}^{-1}$$

$$P_{ss} = \begin{bmatrix} -\frac{a_R}{2D} & -\frac{a_R}{2D} & -\frac{a_F}{2D} & -\frac{a_F}{2D} \\ \frac{1}{2D} & \frac{1}{2D} & -\frac{1}{2D} & -\frac{1}{2D} \end{bmatrix}$$

$$(D = a_F + a_R)$$

$$P_{As} = \begin{bmatrix} -\frac{c}{4b} & \frac{c}{4b} & -\frac{c}{4b} & \frac{c}{4b} \\ -\frac{1}{4b} & \frac{1}{4b} & -\frac{1}{4b} & \frac{1}{4b} \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$P_{AA} = \begin{bmatrix} \frac{a_R}{2D} & -\frac{a_R}{2D} & \frac{a_F}{2D} & -\frac{a_F}{2D} \\ 0 & 0 & 0 & 0 \\ \frac{1}{2D} & -\frac{1}{2D} & -\frac{1}{2D} & \frac{1}{2D} \end{bmatrix}$$

$$P_{As} Q_{sA} = \begin{bmatrix} 0 & c & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$P_{AA} Q_{AA} = \begin{bmatrix} 1 & -c & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

CONTROL CONCEPT MATHEMATICS (Continued)

GAPS

$$h = \begin{bmatrix} \Delta h_1 \\ \Delta h_2 \\ \Delta h_3 \\ \Delta h_4 \end{bmatrix} \quad h' = \begin{bmatrix} \Delta h'_1 \\ \Delta h'_2 \\ \Delta h'_3 \\ \Delta h'_4 \end{bmatrix} \quad \zeta = \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{bmatrix} \quad \eta = \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{bmatrix}$$

$$\begin{bmatrix} h \\ h' \end{bmatrix} = \begin{bmatrix} z \\ y \end{bmatrix} \quad \begin{bmatrix} \zeta \\ \eta \end{bmatrix}$$

FILTERED SIGNALS

$$p = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \\ p_4 \end{bmatrix} \quad p' = \begin{bmatrix} p'_1 \\ p'_2 \\ p'_3 \\ p'_4 \end{bmatrix}$$

$$H_s = K_z \ddot{z} + K_2 \frac{\tau_z}{1 + \tau_z s}$$

$$H_A = K_y \ddot{y} + K_1 \frac{\tau_y}{1 + \tau_y s}$$

$$H_h = K_h + K'_h \frac{s}{1 + \tau_h s}$$

$$H_{h'} = K_{h'} + K''_{h'} \frac{s}{1 + \tau_{h'} s}$$

$$\begin{bmatrix} p \\ p' \end{bmatrix} = \begin{bmatrix} (H_s) \cdot I_4 & 0 \\ 0 & (H_A) \cdot I_4 \end{bmatrix} \begin{bmatrix} \ddot{z} \\ \ddot{y} \end{bmatrix} + \begin{bmatrix} (H_h) \cdot I_4 & 0 \\ 0 & (H_{h'}) \cdot I_4 \end{bmatrix} \begin{bmatrix} h \\ h' \end{bmatrix}$$

$$= \begin{bmatrix} (s^2 H_s + H_h) \cdot I_4 & 0 \\ 0 & (s^2 H_A + H_{h'}) \cdot I_4 \end{bmatrix} \begin{bmatrix} Q_{ss} & Q_{SA} \\ 0 & Q_{AA} \end{bmatrix} \begin{bmatrix} q_s \\ q_A \end{bmatrix} - \begin{bmatrix} (H_h) \cdot I_4 & 0 \\ 0 & (H_{h'}) \cdot I_4 \end{bmatrix} \begin{bmatrix} \zeta \\ \eta \end{bmatrix}$$

$$\bar{K}_{os} = s^2 H_s + H_h$$

$$\bar{K}_{oA} = s^2 H_A + H_{h'}$$

CONTROL CONCEPT MATHEMATICS (Concluded)

MODAL SIGNALS

q^c

$$q^c = \begin{bmatrix} q_s^c \\ q_A^c \end{bmatrix} = \begin{bmatrix} P_{ss} & 0 \\ P_{As} & P_{AA} \end{bmatrix} \begin{bmatrix} p \\ p' \end{bmatrix}$$

$$= \begin{bmatrix} K_{os} & 0 \\ 0 & K_{oA} \end{bmatrix} \begin{bmatrix} q_s \\ q_A \end{bmatrix} - \begin{bmatrix} P_{ss} & 0 \\ P_{As} & P_{AA} \end{bmatrix} \begin{bmatrix} (H_h)\zeta \\ (H_h')\eta \end{bmatrix}$$

$$K_{os} = (\bar{K}_{os}) \cdot I_2, \quad K_{oA} = (\bar{K}_{oA}) \cdot I_3 + (\bar{K}_{os} - \bar{K}_{oA}) P_{As} Q_{SA}$$

MODAL GAINS

K_s, K_A

$$K_s = \begin{bmatrix} K_z & 0 \\ 0 & K_\theta \end{bmatrix} \quad K_A = \begin{bmatrix} K_y & 0 & 0 \\ 0 & K_\phi & 0 \\ 0 & 0 & K_\psi \end{bmatrix}$$

CONTROL CURRENT PARAMETER COMMANDS

α

$$\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} = - \begin{bmatrix} Q_{ss} & Q_{AA} \end{bmatrix} \begin{bmatrix} K_s & 0 \\ 0 & K_A \end{bmatrix} \begin{bmatrix} q_s^c \\ q_A^c \end{bmatrix}$$

$$= - [Q_{ss} K_s K_{os}] q_s - [Q_{AA} K_A K_{oA}] q_A + [Q_{ss} K_s P_{ss} + Q_{AA} K_A P_{As}] [(H_h)\zeta] + [Q_{AA} K_A P_{AA}] [(H_h')\eta]$$

EQUATIONS OF MOTION WITH CONTROL FUNCTION

$$[s^2 I_s - A_s + B_s Q_{ss} K_s K_{os}] q_s = [(H_h) B_s Q_{ss} K_s P_{ss} + C_s] \zeta + [D_s] \eta + [L_s]$$

$$[s^2 I_A - A_A + B_A Q_{AA} K_A K_{oA}] q_A = [(H_h) B_A Q_{AA} K_A P_{As} + C_A] \zeta + [(H_h') B_A Q_{AA} K_A P_{AA} + D_A] \eta + [L_A]$$

MATRICES FOR STABILITY ANALYSIS

$$B_s Q_{ss} K_s = \begin{bmatrix} -4b_z K_z & 2(a_f - a_R)b_z K_\theta \\ -2(b_{\theta f} + b_{\theta R})K_z & 2(a_f b_{\theta f} - a_R b_{\theta R})K_\theta \end{bmatrix} = R_s$$

$$B_A Q_{AA} K_A = \begin{bmatrix} 4b_Y K_Y & -4cb_Y K_\phi & 2(a_f - a_R)b_Y K_\psi \\ 4b_\phi K_Y & -4cb_\phi K_\phi & 2(a_f - a_R)b_\phi K_\psi \\ 2(b_{\psi f} + b_{\psi R})K_Y & -2c(b_{\psi f} + b_{\psi R})K_\phi & 2(a_f b_{\psi f} - a_R b_{\psi R})K_\psi \end{bmatrix} = R_A$$

$$\bar{K}_{os} = s^2 \left(K_z + \frac{K_z \tau_z}{1 + \tau_z s} \right) + K_h + \frac{K_h s}{1 + \tau_h s}$$

$$\bar{K}_{oA} = s^2 \left(K_Y + \frac{K_Y \tau_Y}{1 + \tau_Y s} \right) + K_h' + \frac{K_h' s}{1 + \tau_h' s}$$

$$\begin{bmatrix} K_{os} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} (\bar{K}_{os})$$

$$\begin{bmatrix} K_{oA} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} (\bar{K}_{oA}) + \overbrace{\begin{bmatrix} 0 & c & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}}^{P_{As} Q_{sA}} (\bar{K}_{os} - \bar{K}_{oA})$$

$$B_A Q_{AA} K_A P_{As} Q_{sA} = \begin{bmatrix} 0 & 4cb_Y(K_Y - K_\phi) & 0 \\ 0 & 4cb_\phi(K_Y - K_\phi) & 0 \\ 0 & 2c(b_{\psi f} + b_{\psi R})(K_Y - K_\phi) & 0 \end{bmatrix} = R_{A1}$$

$$B_s Q_{ss} K_s K_{os} = R_s (\bar{K}_{os})$$

$$B_A Q_{AA} K_A K_{oA} = R_A (\bar{K}_{oA}) + R_{A1} (\bar{K}_{os} - \bar{K}_{oA})$$

In the literal expansion of a characteristic determinant containing elements which involve filtering, factors of the form $(1 + \tau s)$ in various combinations would appear. This tends to increase the order of the resulting polynomial. In the interest of avoiding undue numerical difficulties in root extraction, an assumption is introduced at this juncture that the filtering time constants for similar channels in vertical and lateral directions would be assigned the same values, i.e.,

$$\tau_h = \tau_{h'}; \quad \tau_z = \tau_y.$$

This artifice restricts the denominator to a polynomial of, at most, second degree. This also facilitates the computation of the K_{OA} matrix, as the scalar factor $(\bar{K}_{OS} - \bar{K}_{OA})$ can be formed by simple subtraction.

Frequency dependent functions \bar{K}_{OS} and \bar{K}_{OA} can be reduced to fractions of polynomials in s ; typically of the following form:

$$\frac{k_4 s^4 + k_3 s^3 + k_2 s^2 + k_1 s + k_0}{d_2 s^2 + d_1 s + d_0}.$$

Expressions for the k 's and the d 's are summarized in Table G-3 in terms of t 's which are identified with the appropriate gain constants.

The left hand side of the equations of motion may be written as

$$\left[s^2 I_S - A_S + \frac{s k_4 s^4 + s k_3 s^3 + s k_2 s^2 + s k_1 s + s k_0}{d_2 s^2 + d_1 s + d_0} R_S \right] q_S = \dots$$

$$\left[s^2 I_A - A_A + \frac{A k_4 s^4 + A k_3 s^3 + A k_2 s^2 + A k_1 s + A k_0}{d_2 s^2 + d_1 s + d_0} R_A \right. \\ \left. + \frac{A k'_4 s^4 + A k'_3 s^3 + A k'_2 s^2 + A k'_1 s + A k'_0}{d_2 s^2 + d_1 s + d_0} R_{A1} \right] q_A = \dots$$

When these equations are multiplied by the polynomial in the denominator, they are reduced to the final matrix polynomial which are to be solved for all their roots.

TABLE G-3. EXPANSION OF SIGNAL FILTER FUNCTIONS

	t_1	t_2	t_3	t_4	t_5	t_6	t_7
$K_{os}(\omega)$	τ_h	τ_f	K_h	K_h'	K_h''	K_h'''	K_{h0}
$\bar{K}_{os}(s)$	$\tau_{h'}$	$\tau_{f'}$	$K_{h'}$	$K_{h'}'$	$K_{h'}''$	$K_{h'}'''$	$K_{h'0}$

$$K_o(s) = t_3 + \frac{t_4 s}{(1+t_1 s)} + \left[t_5 + \frac{t_6 t_7}{(1+t_2 s)} \right] s^2, \quad t_1 \neq 0$$

$$= t_3 + t_7 s + t_5 s^2, \quad t_1 = t_2 = 0$$

	$t_1 \neq t_2 \neq 0$	$t_1 \neq t_2 \neq 0$	$t_1 = 0$	$t_1 = t_2 = 0$
d_0	1	1	1	1
d_1	$t_1 + t_2$	t_1	t_2	0
d_2	$t_1 t_2$	0	0	0
k_0	t_3	t_3	t_3	t_3
k_1	$t_2 t_3 + (t_1 t_3 + t_4)$	$t_1 t_3 + t_4$	$t_2 t_3 + t_4$	$t_1 + t_4$
k_2	$t_2(t_1 t_3 + t_4) + (t_5 + t_2 t_6)$	$t_5 + t_2 t_6$	$t_2 t_4 + (t_5 + t_2 t_6)$	t_5
k_3	$t_1(t_5 + t_2 t_6) + t_7 t_5$	$t_2 t_5$	$t_2 t_5$	0
k_4	$t_1 t_2 t_5$	0	0	0

The maximum possible degree of the polynomial obtained from expansion of the above matrix polynomial is $4N$ where N is the number of state variables included in the q 's. Thus for the longitudinal group, the maximum possible degree of the characteristic equation is 8, while for the lateral group, it is 12. The corresponding lowest possible degrees are 4 and 6, for the case when no filtering is used, or all time constants are zeros.

Expansion of the matrix polynomial is accomplished by obtaining an exact fit of a polynomial of n -th degree through $(n+1)$ points. Since the highest power of the polynomial will be known in advance from knowledge of the nature of time constants that appear in the problem, this will be denoted by M_0 in the following discussion. A sequence of values is selected for s as:

$$s = 0 \text{ and } \pm s_j \quad j = 1, 2, \dots, M$$

$$M = M_0/2 \text{ for } M_0 \text{ even}$$

$$= (M_0 + 1)/2 \text{ for } M_0 \text{ odd}$$

The numerical values of the determinant when s takes on the value of 0 and $\pm s_j$ will be denoted by D_0 and D_j^\pm . Since the elements of the determinant are algebraic functions of s it follows that

$$D(s) = a_0 + a_1 s + a_2 s^2 + \dots + a_k s^k + \dots + a_{M_0} s^{M_0} + a_{M_0+1} s^{M_0+1}$$

The last term is added to provide a consistent format for M_0 odd. Actually the coefficient a_{M_0+1} is restricted to a value of zero, as the polynomial must terminate with the s^{M_0} term. The above relation may be rearranged in matrix form as

$$\begin{bmatrix} s_j^{2M} & s_j^{2M-1} & \dots & s_j^2 & s_j & 1 \\ s_j^{2M} & -s_j^{2M-1} & \dots & s_j^2 & -s_j & 1 \\ 0 & 0 & \dots & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a_{2M} \\ a_{2M-1} \\ \dots \\ a_1 \\ a_0 \end{bmatrix} = \begin{bmatrix} D_j^+ \\ D_j^- \\ D_0 \end{bmatrix}$$

$j = 1, 2, \dots, M$

This system of $(2M+1)$ equations in $(2M+1)$ unknowns can be reduced to a system of M equations through addition and subtraction of appropriate equation pairs. Thus

$$a_0 = D_0$$

and

$$\begin{bmatrix} s_j^{2M-2} & s_j^{2M-4} & \dots & s_j^2 & 1 \end{bmatrix} \begin{bmatrix} a_{2M} & a_{2M-1} \\ a_{2M-2} & a_{2M-3} \\ \dots & \dots \\ \dots & \dots \\ a_2 & a_1 \end{bmatrix} = \begin{bmatrix} \frac{D_j^+ + D_j^- - 2D_0}{2 s_j^2}, \frac{D_j^+ - D_j^-}{2 s_j} \end{bmatrix}$$

During numerical calculation with the above scheme, a_{2M} may not be identically zero as required for M_0 odd. This is the result of round-off errors introduced during the intermediate steps. It is only necessary to ignore the computed value and to replace it with a zero.

Having obtained all the coefficients for the characteristic polynomial, roots are obtained by repeated application of Bairstow's method, followed by root refinement by using the original equation.

To avoid possible overflow during the computation of polynomial coefficients, the sequence s_j may be chosen in the following manner. Let $s_j = \beta^{j-1}$ and impose the condition that the product of all the left-handed diagonal elements cannot exceed a certain value, say, 10^K . Thus

$$\prod_{j=1}^M s_j^{2(j-1)} = \prod_{j=1}^M \beta^{2(j-1)^2} \leq 10^K$$

Since $\sum_{n=1}^N n^2 = N(N+1)(2N+1)/6$

$$(\log_{10} \beta)(M-1)(2M-1)M/3 \leq K$$

or $\beta \leq 10^{3K/(M-1)(2M-1)M}$

A value of 2 is used for β until the above condition is limiting.

G.2.6 GUIDEWAY IRREGULARITIES

Guideway irregularities enter into the equations of motion through the ζ and η matrices. Elements in these matrices define the position of the guideways at each coil location, reckoned from a set of nominal positions. The L-shaped configuration of the baseline guideway calls for specification of both vertical and lateral components. A third component related to the rotation of a guideway section from a nominal position has not been included in the present analysis.

As guideway irregularities are fixed with respect to the ground and hence to the inertial coordinate system, temporal variation of these irregularities (as seen from the vehicle) may be resolved into harmonical components. A systematic scheme in treating these components is presented in this section to facilitate the generation of frequency response information required for vehicle response and ride quality studies.

The midpoint of the centers of front and rear coils is used as a reference point in describing the guideway profile. From symmetry considerations, it follows that there are four possible combinations arising from the permutation of the following two conditions: both guideways having identical irregularity distribution in the same direction, and both guideways having irregularity distribution of the same amplitude but opposite directions. In addition to these four combinations, the presence of a finite magnet "wheel base" (the distance between front and rear coils) introduces a third factor; whether the front and the rear coils experience in-phase or out-of-phase excitations or a combination of both.

The case of both guideways having identical sinusoidal profiles in the vertical plane with wavelength L and half-wave amplitude A_1 will be examined in detail. The profiles may be represented by

$$\begin{aligned}\zeta_L &= \zeta_R = A_1 \sin 2 \pi x/L \\ &= A_1 \sin (2 \pi V/L) t \quad (x=Vt) \\ &= A_1 \sin \omega t \quad (\omega = 2 \pi V/L)\end{aligned}$$

The four coil modules will be numbered consecutively 1 through 4, denoting respectively the right front, left front, right rear, and left rear locations. The front coils are $(a_F + a_R)/2$ ahead of the reference point and the rear coils are at the same distance aft of the reference point. (Note that the reference point does not necessarily coincide with the vehicle center of gravity location). It follows that

$$\begin{aligned}
 \zeta_1 &= \zeta_2 = A_1 \sin \left(\omega t + \frac{\pi(a_F + a_R)}{L} \right) \\
 &= A_1 \sin (\omega t + \beta) \quad ; \quad \beta = \pi(a_F + a_R)/L = \omega(a_F + a_R)/2V \\
 &= (A_1 \cos \beta) \sin \omega t + (A_1 \sin \beta) \cos \omega t \\
 &= (A_1 \cos \beta) \sin \omega t + (A_1 \sin \beta) \sin(\omega t + \pi/2) \\
 \zeta_3 &= \zeta_4 = (A_1 \cos \beta) \sin \omega t - (A_1 \sin \beta) \sin(\omega t + \pi/2)
 \end{aligned}$$

Thus a symmetrical irregularity pattern of amplitude A_1 in the vertical plane can be decomposed into a pure heave of amplitude $A_1 \cos \beta$ and a pitching motion of amplitude $A_1 \sin \beta$. Furthermore, the pitching motion leads the heave motion by one quadrant.

Similar arguments can be applied to the other three types of irregularities, along with additional considerations of possible phase angle separations between these components from each other. In the present study, the in-phase lateral irregularity has been chosen to have zero phase angle. The phase angle of the out-of-phase lateral irregularity is denoted by ϕ_Y , and the phase angle of the in-phase vertical irregularity is denoted by ϕ_0 . Finally, the phase angle of the out-of-phase vertical irregularity is denoted by $\phi_0 + \phi_Z$, so that ϕ_Z reflects the relative phasing between irregularities only in the vertical plane. Therefore, the previously described vertical in-phase irregularity can be represented as

$$\begin{aligned}
 \zeta_1 &= \zeta_2 = (A_1 \cos \beta) \sin(\omega t - \phi_0) + (A_1 \sin \beta) \sin(\omega t - \phi_0 + \pi/2) \\
 \zeta_3 &= \zeta_4 = (A_1 \cos \beta) \sin(\omega t - \phi_0) - (A_1 \sin \beta) \sin(\omega t - \phi_0 + \pi/2)
 \end{aligned}$$

Thus all conceivable guideway irregularity patterns can be decomposed into no more than eight distinct patterns as summarized in Table G-4. These

eight "unit" input patterns can be viewed as an input matrix of eight columns as depicted on Page G-26. Certain matrix products are also displayed on Page G-27 to demonstrate the fact that many of these products vanish by virtue of the selection of the "unit" pattern. It shows that only four types of inputs need to be considered with each of the two basic sets of equations.

Longitudinal equations are excited only by the heave/pitch (A_1) and gauge variation (A_4) types of inputs. Lateral equations are excited only by rolling (A_2) and snaking (A_3) types of inputs. The equations to be used in frequency response calculations are those shown in the last two lines on Page G-27.

Mathematical representation of guideway profiles in terms of the four irregularity types is displayed on Page G-28. The position of a point on the guideway with respect to an arbitrary location on the vehicle is needed for studies of clearance and stroke parameters. This may be obtained by adding an appropriate phase angle to reflect the relative position of the point from the reference point used in defining guideway profile. For a point located a distance x from the vehicle center of gravity, the phase angle to be added is given by

$$\beta_x = \left(x - \frac{a_F - a_R}{2}\right) \frac{2\pi}{L} = (2x - a_F + a_R) \omega / 2V$$

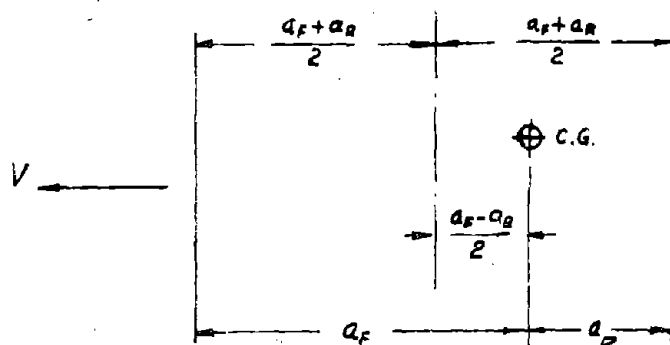
Results for guideway positions in both vertical and lateral directions are displayed on Page G-28.

Magnitudes of guideway irregularities may be specified in one of the two following methods:

- (a) Half-wave amplitude expressed as a function of wavelength (this is applicable strictly only to profiles of specific configuration).
- (b) Power spectral density of the half-wave amplitude (this permits studies of guideways with random irregularities).

However, frequency response solution for the eight types of unit inputs can be obtained without detailed knowledge of the actual guideway configuration.

TABLE G-4. UNIT INPUTS FOR GUIDEWAY IRREGULARITIES



$$\omega = 2\pi V/L$$

$$\beta = \omega(a_F + a_R)/2V$$

$$= \pi(a_F + a_R)/L$$

$$L = \text{WAVE LENGTH}$$

TYPE OF RESPONSE	HEAVE/PITCH				SIDESWAY/ROLL/YAW			
TYPE OF IRREGULARITY	A_1		A_4		A_2		A_3	
ζ_1	+1	+1	0	0	+1	+1	0	0
ζ_2	+1	+1	0	0	-1	-1	0	0
ζ_3	+1	-1	0	0	+1	-1	0	0
ζ_4	+1	-1	0	0	-1	+1	0	0
η_1	0	0	+1	+1	0	0	+1	+1
η_2	0	0	+1	+1	0	0	-1	-1
η_3	0	0	+1	-1	0	0	+1	-1
η_4	0	0	+1	-1	0	0	-1	+1
EFFECT OF "WHEEL BASE"	$\cos\beta$	$\sin\beta$	$\cos\beta$	$\sin\beta$	$\cos\beta$	$\sin\beta$	$\cos\beta$	$\sin\beta$
PHASE ANGLE RELATIVE TO TYPE 3 (A_3)	$-\Phi_0$	$-\Phi_0 + \frac{\pi}{2}$	$-\Phi_Y$	$-\Phi_Y + \frac{\pi}{2}$	$-\Phi_0 - \Phi_2$	$-\Phi_0 - \Phi_2 + \frac{\pi}{2}$	0	$+\frac{\pi}{2}$

UNIT MATRIX FOR GUIDEWAY IRREGULARITIES

$$\begin{bmatrix} \xi \\ \eta \end{bmatrix} = \begin{bmatrix} \gamma_s & \gamma_A \\ \eta_s & \eta_A \end{bmatrix} \begin{bmatrix} \Phi \end{bmatrix} \begin{bmatrix} A_g \end{bmatrix} \sin \omega t$$

$$\begin{bmatrix} \gamma_s \\ \eta_s \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & -1 & 0 & 0 \\ 1 & -1 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} \gamma_A \\ \eta_A \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 0 \\ -1 & -1 & 0 & 0 \\ 1 & -1 & 0 & 0 \\ -1 & 1 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} \eta_s \\ \eta_A \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & -1 \\ 0 & 0 & 1 & -1 \end{bmatrix}$$

$$\begin{bmatrix} \eta_A \\ \eta_A \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & -1 & -1 \\ 0 & 0 & 1 & -1 \\ 0 & 0 & -1 & 1 \end{bmatrix}$$

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$$\begin{bmatrix} \Phi \end{bmatrix} = \begin{bmatrix} e^{i(-\Phi_0)} & & & & & & \\ & e^{i(-\Phi_0 + \frac{\pi}{2})} & & & & & \\ & & e^{i(-\Phi_1)} & & & & \\ & & & e^{i(-\Phi_1 + \frac{\pi}{2})} & & & \\ & & & & e^{i(-\Phi_2 - \frac{\pi}{2})} & & \\ & & & & & e^{i(-\Phi_2 + \frac{\pi}{2})} & \\ & & & & & & e^{i(0)} \\ & & & & & & & e^{i(\frac{\pi}{2})} \end{bmatrix}$$

$$\begin{bmatrix} A_g \end{bmatrix} = \begin{bmatrix} A_1 \cos \beta \\ A_1 \sin \beta \\ A_2 \cos \beta \\ A_2 \sin \beta \\ A_3 \cos \beta \\ A_3 \sin \beta \end{bmatrix}$$

AFFECTING
LONGITUDINAL
DYNAMICS

PITCH/HEAVE

q_s

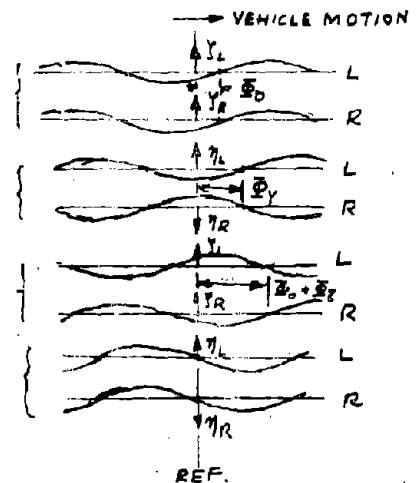
GAUGE VARIATION

AFFECTING
LATERAL
DYNAMICS

ROLLING

q_A

SNAKING



MATRIX PRODUCTS OF GUIDEWAY IRREGULARITIES

$$P_{ss} \zeta_s = \begin{bmatrix} -1 & \left(\frac{a_F - a_R}{a_F + a_R} \right) & 0 & 0 \\ 0 & \left(\frac{2}{a_F + a_R} \right) & 0 & 0 \end{bmatrix}$$

$$P_{ss} \zeta_A = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$P_{As} \zeta_s = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$P_{As} \zeta_A = \begin{bmatrix} -1/6 & 0 & 0 & 0 \\ -1/6 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$P_{AA} \eta_s = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$P_{AA} \eta_A = \begin{bmatrix} 0 & 0 & 1 & \left(\frac{a_R - a_F}{a_F + a_R} \right) \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(\frac{2}{a_F + a_R} \right) \end{bmatrix}$$

$$C_s \zeta_s = \begin{bmatrix} 4c_z & 0 & 0 & 0 \\ 2(c_{\theta F} + c_{\theta R}) & 2(c_{\theta F} - c_{\theta R}) & 0 & 0 \end{bmatrix}$$

$$C_s \zeta_A = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$D_s \eta_s = \begin{bmatrix} 0 & 0 & 4d_z & 0 \\ 0 & 0 & 2(d_{\theta F} + d_{\theta R}) & 2(d_{\theta F} - d_{\theta R}) \end{bmatrix}$$

$$D_s \eta_A = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$C_A \zeta_A = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$C_A \zeta_A = \begin{bmatrix} 4c_y & 0 & 0 & 0 \\ 4c_\phi & 0 & 0 & 0 \\ 2(c_{\psi F} + c_{\psi R}) & 2(c_{\psi F} - c_{\psi R}) & 0 & 0 \end{bmatrix}$$

$$D_A \eta_s = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$D_A \eta_A = \begin{bmatrix} 0 & 0 & 4d_y & 0 \\ 0 & 0 & 4d_\phi & 0 \\ 0 & 0 & 2(d_{\psi F} + d_{\psi R}) & 2(d_{\psi F} - d_{\psi R}) \end{bmatrix}$$

EQUATIONS OF MOTION (FOR UNIT SOLUTIONS)

LONGITUDINAL: $[s^2 I_s - A_s + (\bar{K}_{os}) R_s][q_s] = (H_h)[R_s][P_{ss} \zeta_s] + [C_s \zeta_s] + [D_s \eta_s]$

LATERAL: $[s^2 I_A - A_A + (\bar{K}_{oA}) R_A + (\bar{K}_{os} - \bar{K}_{oA}) R_{As}][q_A] = (H_h)[R_A][P_{As} \zeta_A] + (H_h)[R_A][P_{AA} \eta_A] + [C_A \zeta_A] + [D_A \eta_A]$

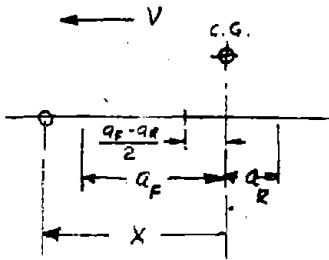
MATHEMATICAL REPRESENTATION OF GUIDEWAY IRREGULARITIES

$$\zeta_R = A_1 \sin(\omega t - \Phi_0) + A_2 \sin(\omega t - \Phi_0 - \Phi_z) = \{A_1 e^{i(-\Phi_0)} + A_2 e^{i(-\Phi_0 - \Phi_z)}\} \sin \omega t$$

$$\zeta_L = A_1 \sin(\omega t - \Phi_0) - A_2 \sin(\omega t - \Phi_0 - \Phi_z) = \{A_1 e^{i(-\Phi_0)} - A_2 e^{i(-\Phi_0 - \Phi_z)}\} \sin \omega t$$

$$\eta_R = A_3 \sin \omega t + A_4 \sin(\omega t - \Phi_Y) = \{A_3 e^{i(0)} + A_4 e^{i(-\Phi_Y)}\} \sin \omega t$$

$$\eta_L = -A_3 \sin \omega t + A_4 \sin(\omega t - \Phi_Y) = \{-A_3 e^{i(0)} + A_4 e^{i(-\Phi_Y)}\} \sin \omega t$$



$$\beta_x = \frac{2\pi}{L} \left(x - \frac{a_F - a_R}{2} \right) = (2x - a_F + a_R) \omega / 2V$$

$$\zeta_R(x) = \{A_1 e^{i(-\Phi_0 + \beta_x)} + A_2 e^{i(-\Phi_0 - \Phi_z + \beta_x)}\} \sin \omega t$$

$$\zeta_L(x) = \{A_1 e^{i(-\Phi_0 + \beta_x)} - A_2 e^{i(-\Phi_0 - \Phi_z + \beta_x)}\} \sin \omega t$$

$$\eta_R(x) = \{A_3 e^{i(\beta_x)} + A_4 e^{i(-\Phi_Y + \beta_x)}\} \sin \omega t$$

$$\eta_L(x) = \{-A_3 e^{i(\beta_x)} + A_4 e^{i(-\Phi_Y + \beta_x)}\} \sin \omega t$$

G.2.7 FREQUENCY RESPONSE

Frequency responses for vehicle state variables are obtained for each of the eight types of guideway irregularity unit inputs from the numerical solution of the matrix equations after substitution of $i\omega$ for s . These solutions are in complex form containing both in-phase and out-of-phase components.

Control current command parameters defined by the expression on Page G-16 can be separated into two groups in a similar manner as has been done for the equations of motion. Manipulations of the various matrix products and the reduced form for numerical calculation are shown on Page G-31.

Frequency responses for vehicle state variables and control current command parameters for a particular guideway configuration are obtained by postmultiplying the above results by the $\begin{bmatrix} \Phi \end{bmatrix}$ and $\begin{bmatrix} A_G \end{bmatrix}$ matrices displayed on Page G-26.

Frequency responses for other variables associated with displacements and accelerations at various points on the vehicle are obtained from linear combinations of vehicle state variable frequency responses in accordance with their geometrical location. These will be done for three sets of points as follows:

- (a) Variables related to the centers of the coil assemblies.
- (b) Variables related to the extremities of the vehicle body for studies of clearances.
- (c) Variables related to the extreme corners of the passenger compartment for ride quality studies.

Physical interpretation of the complex representation is illustrated on Page G-32 prior to formulation of a matrix product to assess control power requirement. The column matrix of complex coefficients may be viewed as a matrix of two columns, with the first column specifying the in-phase components associated with a sine function of time and the second column specifying the out-of-phase components associated with a cosine function of time.

Control power required, excluding losses through resistances, is computed as the work done on the system per period. Manipulations leading to the final form used for this calculation is presented on Page G-32.

Note that the distribution of guideway irregularities in terms of the four basic types appear only in the outer matrices in these matrix products. The final summation can thus be made after all unit solutions have been obtained. For example, if only a heave/pitch type of irregularity is to be considered, it is only necessary to input the appropriate frequency-dependent guideway amplitude for A_1 and to set all the other three A_j 's to zero.

G.2.8 POWER SPECTRAL DENSITY

Having determined the frequency response characteristics of the system for unit inputs, the power spectral density for various quantities can be readily obtained by multiplying the frequency-dependent power spectral density function for guideway irregularities by the square of the relevant frequency response functions at each frequency. The root-mean-square value of the relevant quantity is then obtained as the square root of the integral of this power spectral density function over all positive frequencies from zero to infinity. For computational purposes, this numerical integration is carried out to an upper limit of around 100 Hz. The numerical integration is done in segments which correspond to the set of frequencies selected for evaluation of frequency response functions. It is assumed that the power spectral density function is a power function of frequency between the associated limits of a given segment, and the value of the integral for each segment is evaluated analytically in accordance with the formulas given on Page G-32.

The mean control power is evaluated as the integral of the product of the guideway power spectral density function times the control power over all positive frequencies.

G.2.9 ORGANIZATION OF COMPUTER PROGRAMS

The flow diagram shown in Figure G-2 describes the sequence of programs to be used for stability analyses and response analyses of the system. Vehicle characteristics already stored in files MPRV and MFCOEf and candidate control function variables stored in files C and G are used with a program called STAB to evaluate roots to the stability characteristic equations. A final set of control system parameters resulting from this evaluation is used to define the final control parameter data file C.

MATRICES FOR FREQUENCY RESPONSE

CONTROL CURRENT PARAMETERS: UNIT SOLUTION

$$[Q_{ss} \ K_S \ K_{os}] = (\bar{K}_{os}) [Q_{ss} \ K_S]$$

$$[Q_{AA} \ K_A \ K_{oA}] = (\bar{K}_{oA}) [Q_{AA} \ K_A] + (\bar{K}_{os} - \bar{K}_{oA}) [Q_{AA} \ K_A \ P_{AS} \ Q_{SA}]$$

$$[Q_{AA} \ K_A \ P_{AS} \ Q_{SA}] = (c(K_Y - K_\phi)) \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 1 & 0 \\ 0 & -1 & 0 \end{bmatrix}$$

$$[\alpha_s] = -(\bar{K}_{os}) [Q_{ss} \ K_S] [q_s] + (H_h) [Q_{ss} \ K_S] [P_{ss} \ Y_s]$$

$$[\alpha_A] = -(\bar{K}_{oA}) [Q_{AA} \ K_A] [q_A] - (c(\bar{K}_{os} - \bar{K}_{oA})(K_Y - K_\phi)) \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 1 & 0 \\ 0 & -1 & 0 \end{bmatrix} [q_A] +$$

$$+ (H_h) [Q_{AA} \ K_A] [P_{AS} \ Y_A] + (H_h') [Q_{AA} \ K_A] [P_{AA} \ Y_A]$$

RESULTS FOR A SPECIFIC GUIDEWAY IRREGULARITY DISTRIBUTION

$$[q] = \begin{bmatrix} Z \\ \Theta \\ Y \\ \Phi \\ \Psi \end{bmatrix} = \begin{bmatrix} [q_s] & 0 \\ 0 & [q_A] \end{bmatrix} \begin{bmatrix} [\Phi_s] & 0 \\ 0 & [\Phi_A] \end{bmatrix} \begin{bmatrix} A_g \end{bmatrix} \sin \omega t = [q^g] \sin \omega t$$

$$[\alpha] = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} = \begin{bmatrix} [\alpha_s] & [\alpha_A] \end{bmatrix} \begin{bmatrix} [\Phi_s] & 0 \\ 0 & [\Phi_A] \end{bmatrix} \begin{bmatrix} A_g \end{bmatrix} \sin \omega t = [\alpha^g] \sin \omega t$$

FREQUENCY RESPONSE ANALYSIS

CONTROL POWER ($P = \sum_j P_j$)

FOR THE j -TH COIL: $P_j = -\frac{1}{T} \int_0^T (F_{La} \alpha_j \dot{z}_j + F_{Ga} \alpha_j \dot{y}_j + L_a \alpha_j \dot{\phi}_j) dt$

$$\alpha_j = (\alpha_j^R + i \alpha_j^I) \sin \omega t \rightarrow \alpha_j^R \sin \omega t + \alpha_j^I \cos \omega t$$

$$z_j = (z_j^R + i z_j^I) \sin \omega t \rightarrow z_j^R \sin \omega t + z_j^I \cos \omega t$$

$$\dot{z}_j = \omega (z_j^R \cos \omega t - z_j^I \sin \omega t)$$

$$\text{HENCE } -\frac{1}{T} \int_0^T F_{La} \alpha_j \dot{z}_j dt = \frac{\omega}{2} (\alpha_j^R z_j^I - \alpha_j^I z_j^R) F_{La}$$

AND ANALOGOUS EXPRESSIONS FOR THE OTHER TERMS.

$$\begin{bmatrix} z \\ y \\ \phi \end{bmatrix} = \begin{bmatrix} z_1 \\ \vdots \\ z_4 \\ -\frac{z_4}{y_1} \\ -\frac{y_4}{\phi_1} \\ \vdots \\ \phi_4 \end{bmatrix} = \begin{bmatrix} Q_{ss} & Q_{sA} \\ 0 & Q_{AA} \\ 0 & (\frac{1}{b}) Q_{sA} \end{bmatrix} \begin{bmatrix} q_s^G \\ -\frac{q_s^G}{q_A^G} \end{bmatrix} \sin \omega t \rightarrow \begin{bmatrix} Q_{ss} & Q_{sA} \\ 0 & Q_{AA} \\ 0 & (\frac{1}{b}) Q_{sA} \end{bmatrix} \begin{bmatrix} q_s^{GR} & q_s^{GI} \\ q_A^{GR} & q_A^{GI} \end{bmatrix} \begin{bmatrix} \sin \omega t \\ \cos \omega t \end{bmatrix}$$

$$\begin{bmatrix} \alpha \\ \vdots \\ \alpha_4 \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} = \begin{bmatrix} \alpha^G \end{bmatrix} \sin \omega t \rightarrow \begin{bmatrix} \alpha^{GR} & \alpha^{GI} \end{bmatrix} \begin{bmatrix} \sin \omega t \\ \cos \omega t \end{bmatrix}$$

$$P = \sum_j P_j = \frac{\omega}{2} (P_{12} - P_{21}) \text{ WHERE } P_{12} \text{ AND } P_{21} \text{ ARE ELEMENTS}$$

$$\begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix} = [\alpha^G]^T \left[(F_{La}) [Q_{ss} q_s^G] + (F_{La} + \frac{L_a}{b}) [Q_{sA} q_A^G] + (F_{Ga}) [Q_{AA} q_A^G] \right]$$

INTEGRATION OF $\int_{\omega_1}^{\omega_2} \Phi d\omega = U$ FOR $\omega_2 > \omega_1$

$$\Phi(\omega_1) = \Phi_1, \quad \Phi(\omega_2) = \Phi_2$$

$$(a) \text{ IF } \Phi_2/\Phi_1 \leq 0: \quad U = (\Phi_2 + \Phi_1)(\omega_2 - \omega_1)/2,$$

$$(b) \text{ IF } \Phi_2/\Phi_1 > 0: \quad N = \frac{\log(\Phi_2/\Phi_1)}{\log(\omega_2/\omega_1)}$$

$$(b1) \text{ IF } N = -1 \quad U = \Phi_2 \omega_2 \log(\omega_2/\omega_1)$$

$$(b2) \text{ IF } N \neq -1 \quad U = (\Phi_2 \omega_2 - \Phi_1 \omega_1)/(N+1)$$

$$(c) \text{ IF } \omega_2 = \omega_1 \quad U = 0$$

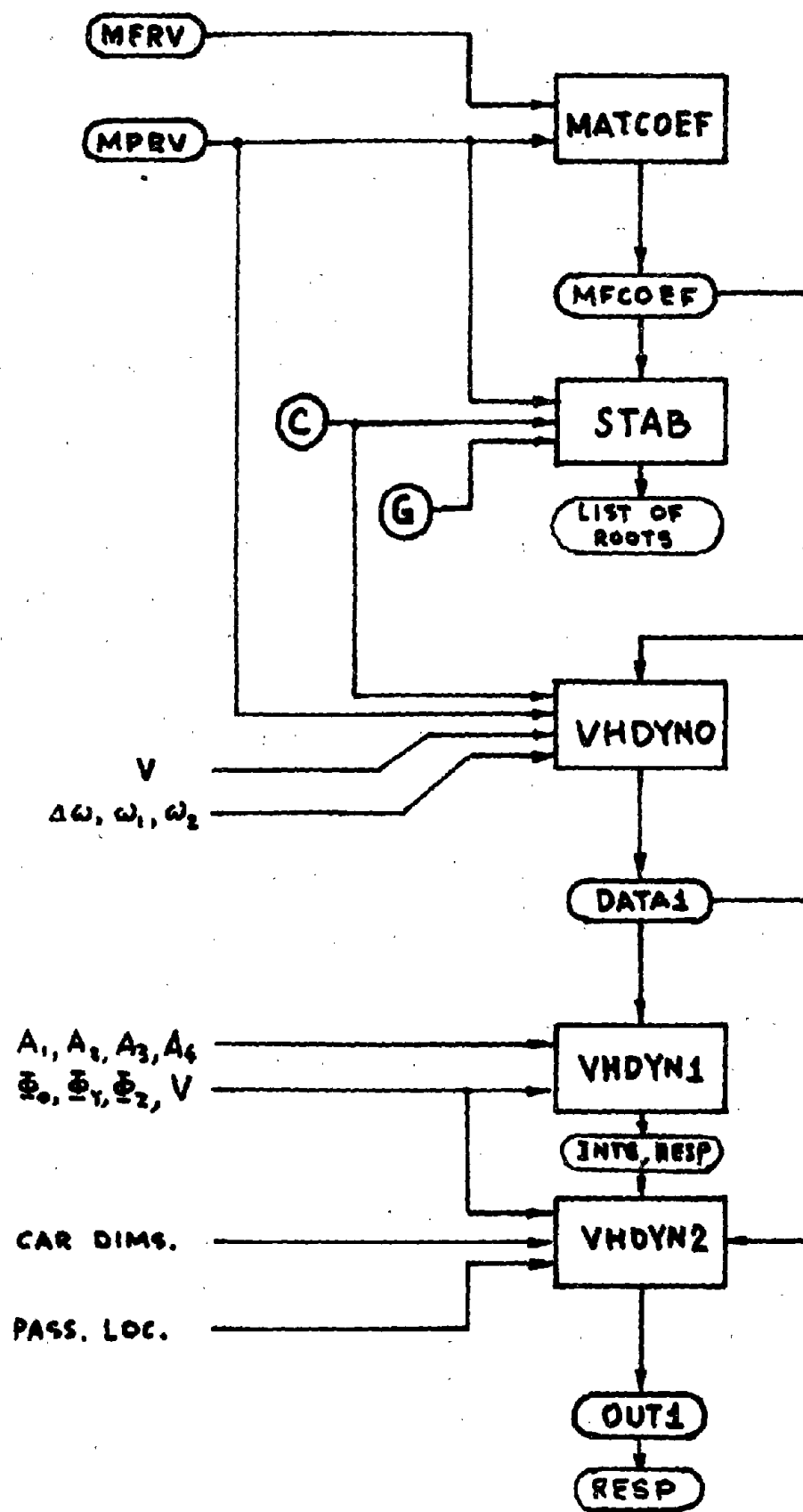


FIGURE G-2. SEQUENCE OF PROGRAMS

Files MPRV, MFCOEF, and C are used in program VHDYNO with manual terminal keyboard inputs for vehicle speed and the specification for a series of frequency values, to determine the unit responses in displacements (state variables) and control current commands. These results are stored in file DATA1.

Data file DATA1 is then used in program VHDYN1 with manual inputs specifying the distribution of guideway irregularities (A_j 's), their phase relationship (ϕ_j 's), and vehicle speed to generate frequency responses in state variables; control current commands; and control power for the specified type of guideway irregularity.

Data file DATA1, the output files from VHDYN1, manual terminal inputs specifying the phase relationship (ϕ_j 's), vehicle speed, and coordinates of vehicle extremities and passenger locations are used in program VHDYN2 to calculate both response information and power spectral density data for stroke and ride quality data.

Listing of these programs and commentaries on their usage are presented in Section G.3. Sample solutions associated with the baseline Revenue vehicle are included for reference.

G.3 PROGRAMS FOR ANALYSES OF VEHICLE DYNAMICS

Programs for use in analyses of vehicle dynamics are summarized in this section. These programs are written in BASIC language for use on time-sharing systems. Principal inputs to these programs are in the form of data files prepared in advance, which specify the geometrical and mass properties of the vehicle, the force model associated with the location of coil assemblies, and the values of control gain constants. Other program inputs required from the terminal keyboard provide flexibility to an analyst to choose the amount of detail desired for a particular problem.

Sample runs are included to illustrate typical operations of these programs. Inputs from the terminal keyboard are shown as underlined and a carriage return is to follow each set of inputs. Listings of programs are included at the end of this section.

G.3.1 STABILITY ANALYSIS

Program STAB is prepared for the evaluation of roots of stability equations. The necessary analytical basis for this program is described in Section G.2.5 of this appendix.

Four input data files are needed to operate this program:

- (1) MPRV-mass properties of the vehicle, described in Section G.2.2.
- (2) MFCOEF-matrix coefficients, described in G.2.3.
- (3) Cxx - control gain constants, described in G.2.4.
- (4) Gxx - an auxiliary file containing as many sets of the five modal gains (K_z , K_θ , K_y , K_ϕ , K_ψ) as needed for a parametric study.

After these four file names are supplied via the keyboard in response to input requests from the program, the sequence of operation is as follows:

- (5) Specify the name of an output file.
- (6) Specify the maximum value of K_y to be considered in the study.
- (7) Specify the type of problem being considered: 2 for longitudinal, and 3 for lateral dynamics.

Variation of the principal rate gain, (K_z and K_h in longitudinal dynamics and K_y and K_h in lateral dynamics), is provided in the program by statement 1620. For longitudinal dynamics, this statement must be typed in from the keyboard to specify the relevant constants as a function of an index counter K8, as follows:

```
1620 K9(1,2)=K9(1,6)=K9(1,7)= a function of K8 \ RETURN
```

For lateral dynamics this statement must be typed in from the keyboard as:

```
1620 K9(1,4)=K9(1,9)=K9(1,10)= a function of K8 \ RETURN
```

The number of cases that will be examined is specified by the upper limit for K8. An inequality statement to verify this fact appears in statement 420 for longitudinal dynamics and in statement 590 for lateral dynamics. The integer appearing after the inequality sign is always one less than the number

of cases desired. Thus if 10 sets of roots are desired in a study of lateral dynamics, statement 590 must be of the following form:

```
590  GOSUB 610 \ IF K8 > 9 THEN 600 \ GO TO 270
```

Provisions to vary the acceleration feedback gain K_y for lateral dynamics studies is contained in statement 1860. An increment of +0.01 is provided in the present program. This statement can be modified to reflect any other positive increment if desired.

The output files are to be listed separately under BATCH commands. Format of the output file is illustrated in the sample run reproduced on Page G-37. For each case analyzed, the first line lists the values assigned to the relevant control constants, and the second line lists the numerical code for the problem studied and the relevant modal gain values. This is followed by a list of all roots of the stability equation; the real part first and then the imaginary part. Only those roots with a negative real part are processed further to provide results for undamped frequency (in Hz) and critical damping ratio.

A listing of program STAB appears on Pages G-69 through G-72.

G.3.2 VEHICLE RESPONSE AND RIDE QUALITY CALCULATIONS

Calculations for determining vehicle response and ride quality characteristics are made with three programs, named VHDYNO, VHDYN1 and VHDYN2, to be run in sequence. Unit solutions for state variables and control current commands for each of the eight unit input types are processed by VHDYNO. Linear superposition of the unit solutions is performed in VHDYN1 to generate transfer functions, response in state variables, control current commands, and control power required. These reflect the actual distribution of guideway irregularities. Calculations of strokes and acceleration at coil locations, vehicle extremities and extreme passenger compartment locations are performed in VHDYN2 to provide both response and power spectral density information on relevant quantities. Particulars about running each of these programs are detailed below.

SAMPLE RUN OF PROGRAM "STAB"

*OLD STAB

READY

*420 GOSUB 650 \ IF K8>0 THEN 430 \ GO TO 270

*590 GOSUB 610 \ IF K8>0 THEN 600 \ GO TO 270

*1620 K9(1,4)=K9(1,9)=K9(1,10)=.2935 \ RETURN

*RUN

MASS PROPERTY INPUT DATA FILENAME ?MPRV

LAT. AND LONG. COEF. DATA FILENAME ?MFCCOEF

CONTROL GAINS AND T.C.S INPUT DATA FILENAME ?C80

CONTROL GAIN DATA FILENAME ?G

OUTPUT FILE NAME ?01

MAX K9(1,8)= ?-.02

TYPE 2 FOR LONG. PROB., 3 FOR LAT. PROB.: ?2

K9(1,8)= -.02 DONE 1 CASES.

JOB DONE; LIST FILE (01) FOR 1 CASES.

READY

MASS PROPERTY INPUT DATA FILENAME ?MPRV

LAT. AND LONG. COEF. DATA FILENAME ?MFCCOEF

CONTROL GAINS AND T.C.S INPUT DATA FILENAME ?C80

CONTROL GAIN DATA FILENAME ?G

OUTPUT FILE NAME ?02

MAX K9(1,8)= ?-.02

TYPE 2 FOR LONG. PROB., 3 FOR LAT. PROB.: ?3

K9(1,8)= -.02 DONE 1 CASES.

JOB DONE; LIST FILE (02) FOR 1 CASES.

READY

*LIST C00;G;01;02

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10	-2.155, .15,	K_h, K_h	} C80
20	0, .2935,	K_h', K_h'	
30	0, .15, .15	K_z, K_z, K_s	
40	-.02, .2935, .2935,	K_y, K_y, K_A	
50	1, 1, .5183, 1.25, 3.5,	$K_z, K_0, K_y, K_\phi, K_\psi$	
60	.637, .637, .637, .637,	T_h, T_h', T_z, T_y	
10	1, 1, .5183, 1.25, 3.5,	$K_z, K_0, K_y, K_\phi, K_\psi$	} G

000010	$K_h - 2.155, K_h .15, T_h .637, K_z 2, K_z .15, T_z .637,$	} 01
000020	$2, K_z 1, K_0 1, f, H_z$	
000030	$-1.569859, .0003453, .249851,$	
000040	$-1.979915, 2.91349, .5606347, .5620657,$	
000050	$-2.35658, 3.058378, .6144941, .6103584,$	
000010	$K_h' 0, K_h' .2935, T_h .637, K_y -.02, K_y .2935, T_y .637,$	} 02
000020	$3, K_y .5183, K_y 1.25, K_\psi 3.5,$	
000030	$-1.505837, f, H_z$	
000040	$-1.590617, .0462203, .2532616, .9995781,$	
000050	$-3.12283, 2.134443, .6020169, .8255819,$	
000060	$-3.061314, 2.401092, .6192112, .7868458,$	}
000070	$-4.350599, 4.711151, 1.020613, .6704354,$	

READY

G.3.2.1 Program VHDYNO

The sequence of keyboard inputs is as follows:

- (1) Supply file name for mass property: MPRV.
- (2) Supply file name for matrix coefficients: MFCOEF.
- (3) Supply the name of output file: use only DATA1
- (4) Supply file name for control gain constant: Cxx
- (5) Supply vehicle speed, in m/s units; a reference frequency will be printed at the terminal after this step, this is to be used in subsequent inputs for defining frequencies at which computations will be made.
- (6) Supply the first set of frequency increment, lower and upper limits of a frequency range: for the first set, the lower limit can be zero (0) if static solution is desired; all numerical values refer to the reference frequency printed out after step 5.
- (7) Supply subsequent sets of frequency increments and new lower and upper limits of another frequency range; the new lower limit is preferably the sum of the previous upper limit and the new frequency increment so as to minimize the calculations.
- (8) Repeat step 7 as many times as desired to cover the required frequency range.
- (9) To terminate the calculation, input three zeros in response to input request.

The printout format for the eventual results has provisions for 39 lines of data. Therefore, it is best that only multiples of 39 frequency values are selected. The total number of points is printed out at the terminal, and this number is needed as an input to facilitate formatting of the other two programs.

G.3.2.2 Program VHDYN1

The sequence of keyboard inputs is as follows:

- (1) Supply the relative proportion of the four types of guideway irregularities in the order (heave/pitch, gauge variation,

rolling, snaking): use zero to indicate the absence of a component and a value 10 to indicate the use of a straight line relationship between amplitudes of irregularities and frequencies. If the amplitudes for guideway irregularities are to be limited to be equal or less than a certain amount, this limit is to be inputted in meter units.

- (2) Supply the name of output file from VHDYNO: use DATA1.
- (3) Supply the number of points: use the number printed out from VHDYNO.
- (4) Supply phase angle information and vehicle speed: phase angles are to be in degree units, and vehicle speed is to be in m/s units.

The output of program VHDYN1 consists of three files, as follows:

- (1) OUT1 file containing formatted tabulated results for state variables and control current commands for each coil, total control current command and power requirement.
- (2) RESP file containing a portion of the information of OUT1 for use with a graphics terminal for curve plotting.
- (3) INT6 file containing numerical results in rectangular format of state variables for use in VHDYN2.

G.3.2.3 Program VHDYN2

Program VHDYN2 performs the necessary computations for generating displacement and acceleration data at various points on the vehicle body. The entire process is repeated three times; the first time for the coil assemblies at their respective centers, the second time for the extremities of the vehicle, and the third time for the corners of the passenger compartment. The sequence of keyboard inputs is as follows:

- (1) Supply the name of the output file from VHDYNO: use DATA1.
- (2) Supply the phase angles and vehicle speed: these are to be identical to those used in VHDYN1.

- (3) Supply the coordinates for vehicle extremities: these consist of the fore and aft distances, the half width and the vertical elevation of the four corners of interest, referred to the vehicle center of gravity, in meters, with downward distance treated as positive.
- (4) Supply the coordinates for extreme passenger locations: these are similar data for the four corners of the passenger compartment.

The output of program VHDYN2 consists of two files as follows:

- (1) An augmented OUT1 file containing additional formatted tables of response and power spectral density information for various variables.
- (2) An augmented RESP file containing additional results for use with a graphics terminal for curve plotting.

G.3.2.4 Amplitudes of Guideway Irregularities

Guideway irregularities are specified in the VHDYN1 and VHDYN2 programs in terms of amplitudes of sinusoidal component waveforms, and in terms of power spectral density for random irregularities.

Amplitude specification is used in response calculations. The half-wave amplitude of a sinusoidal profile of wavelength L is defined as $(A1)/L$, with a value of $(1/2750)$ currently specified for $A1$. Power spectral density function for random irregularities is defined as AV/ω^2 for a vehicle speed of V m/s and a frequency of ω rad/sec with A currently given the value of 1.5×10^{-6} m. These specifications appear in statement 80 of VHDYN1 and in statement 50 of VHDYN2. They may be changed to other values when desired.

G.3.2.5 Sample Runs and Output Format

Sample runs for the preliminary revenue vehicle parameters for two types of guideway irregularities are described in this section to identify the format of output tables and to provide a numerical reference to data presented in Section 4.3.2 of the main report.

Printout at the keyboard terminal for VHDYN0 is reproduced on Page G-43 for the Revenue vehicle, for a vehicle speed of 134 m/s. A partial listing of the output DATA1 file is reproduced on Pages G-44 through G-45, wherein the various matrices are identified by marginal notes.

Printout at the keyboard terminal for VHDYN1 and VHDYN2 for a pure heave/pitch type of irregularity is reproduced on Page G-46, using outputs from the above sample problem. The complete set of output tables for this case is reproduced on Pages G-47 through G-63 in the sequence of their generation. The format is self-explanatory as may be noted from the printout. Following the sequence of this set, there are:

- (1) Transfer functions for displacements and accelerations in z and y directions at vehicle center of gravity.
- (2) Transfer functions for roll angle and angular accelerations of the vehicle.
- (3) Transfer functions for control current commands in each coil.
- (4) Response of control current commands for individual coils for specified A_1 , and power spectral density of control current commands for specified A .
- (5) Response and power spectral density for total current and control power; the corresponding rms values are listed at the bottom of this table.
- (6) Transfer functions for strokes at each coil in z direction.
- (7) Transfer functions for strokes at each coil in y direction.
- (8) Stroke responses in z- and y- directions at each coil.
- (9) Power spectral density of strokes in z- and y- directions at each coil, the corresponding rms values are listed at the end of the table.
- (10) Transfer functions for vertical clearances at vehicle extremities.
- (11) Transfer functions for lateral clearances at vehicle extremities.

- (12) Clearance responses in z- and y- directions at vehicle extremities.
- (13) Power spectral density of clearances in z- and y- directions at vehicle extremities, with rms values listed at the end of the table.
- (14) Transfer functions of passenger compartment accelerations in z-direction.
- (15) Transfer functions of passenger compartment accelerations in y-direction.
- (16) Acceleration responses in z- and y-directions for corners of passenger compartment.
- (17) Ride quality (power spectral density of acceleration) in z- and y-directions, with rms values listed at the end of the table.

It will be noted that in this set of tables, all quantities related to the lateral directions are identically zeros.

The RESP file contains the number of points included in the solution and information in those tables in OUT1-file that contains response and power spectral density results.

Printout at the keyboard terminal for VHDYN1 and VHDYN2 for a pure snaking type of irregularity is reproduced on Page G-64. Formatted outputs from OUT1 file on power spectral density functions for control currents, coil strokes, vehicle clearances and passenger ride quality for this case are reproduced on Pages G-65 through G-68.

G.3.2.6 Listing of Programs

The following programs are listed:

Program VHDYN0 on Pages G-73 through G-77.

Program VHDYN1 on Pages G-78 through G-82.

Program VHDYN2 on Pages G-83 through G-87.

*RUN VHDYNG

SAMPLE RUN FOR PRELIMINARY REVENUE VEHICLE

MASS. PROPERTY INPUT DATA FILENAME ?MPRV
LAT. AND LONG. COEF. DATA FILENAME ?MFCOEF
FREQUENCY RESPONSE FILENAME ?DATA1
CONTROL GAINS AND T.C.S INPUT DATA FILENAME ?C80
TYPE IN VEHICLE SPEED IN M/S: ?134
REF. FREQ. (V1) = 4.024024 HZ.
ENTER DELTA, INITIAL, FINAL FREQ.; HZ/V1; ?.025, 0., .25

STATIC SOLUTION:

.0032938	.0032938	.0032938	.0032938
.0048797	.0048797	.0048797	.0048797
.0875439	.0875439	.0875439	.0875439
.0875439	.0875439	.0875439	.0875439
-.0875439	-.0875439	-.0875439	-.0875439
-.0875439	-.0875439	-.0875439	-.0875439

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

ENTER DELTA, INITIAL, FINAL FREQ.; HZ/V1; ?.125, .375, 1
ENTER DELTA, INITIAL, FINAL FREQ.; HZ/V1; ?.25, 1.25, 2.5
ENTER DELTA, INITIAL, FINAL FREQ.; HZ/V1; ?.5, 3, 4
ENTER DELTA, INITIAL, FINAL FREQ.; HZ/V1; ?1, 5, 17
ENTER DELTA, INITIAL, FINAL FREQ.; HZ/V1; ?0, 0, 0
JOB DONE; 39 POINTS

*LIST C80

10 -2.155,.15,
 20 0,.2935,
 30 0,.15,.15
 40 -.02,.2935,.2935,
 50 1,1,.5183,1.25,3.5,
 60 .637,.637,.637,.637.

LISTING OF DATA1 FILE

	9.	7.65.	.965.	1.21.
000010				
000020	339800.	63716.	27473.	
000030	0.	0.		
000040	.0032938.	.0032938.	.0032938.	.0032938.
000050	.0048797.	.0048797.	.0048797.	.0048797.
000060	0.	0.	0.	0.
000070	0.	0.	0.	0.
000080	.0875439.	.0875439.	.0875439.	.0875439.
000090	.0875439.	.0875439.	.0875439.	.0875439.
000100	-.0875439.	-.0875439.	-.0875439.	-.0875439.
000110	-.0875439.	-.0875439.	-.0875439.	-.0875439.
000120	0.	0.	0.	0.
000130	0.	0.	0.	0.
000140	0.	0.	0.	0.
000150	0.	0.	0.	0.
000160	0.	0.	0.	0.
000170	0.	0.	0.	0.
000180	0.	0.	0.	0.
000190	0.	0.	0.	0.
000200	0.	0.	0.	0.
000210	0.	0.	0.	0.
000220	0.	0.	0.	0.
000230	0.	0.	0.	0.
000240	0.	0.	0.	0.
000250	0.	0.	0.	0.
000260	0.	0.	0.	0.
000270	0.	0.	0.	0.
000280	0.	0.	0.	0.
000290	0.	0.	0.	0.
000300	.025.	.6320922.		
000310	-1.090569.	.0921532.	.5039268.	-.0425466.
000320	-.0003231.	.1328737.	.0002581.	-.0614022.
000330	.0472644.	-.0047785.	.1035165.	.0091153.

000340	.0001016.	-.0061521.	-2.22577E-05.	.0127998.
000350	.2174043.	.2515481.	-1.081173.	.1.08915.
000360	.2174043.	.2515481.	-1.081173.	.1.08915.
000370	.2287665.	-.2620473.	-1.071876.	.1.093801.
000380	.2287666.	-.2620473.	-1.071876.	.1.093801.
000390	-.1214238.	-.1320823.	.270646.	.2769711.
000400	-.1214238.	-.1320823.	.270646.	.2769711.
000410	-.1255773.	.1352468.	.2710371.	.2792293.
000420	-.1255773.	.1352468.	.2710371.	.2792293.
000430	-.9326261.	.0121826.	.1.025468.	.0832966.
000440	-.2772507.	-.0122933.	.0118835.	.004904.
000450	.0008429.	-.0302407.	-.0001843.	.1260513.
000460	.3177803.	-.0037469.	.0139226.	.0144895.
000470	.4512528.	-.0015206.	.019798.	.0177281.
000480	-.0016373.	.0038945.	-4.33684E-05.	-.0029781.
000490	-1.826079.	.0548064.	-.0113368.	.1668398.
000500	.1.826079.	-.0548064.	.0113368.	.1668398.
000510	-1.807986.	-.001379.	-.0109538.	.1922067.
000520	.1.807986.	.001379.	.0109538.	.1922067.
000530	-.9649967.	.1657296.	-.0411486.	.1596462.
000540	.9649967.	-.1657296.	.0411486.	.1596462.
000550	-.9566468.	-.1593924.	-.0431617.	.0842552.
000560	.9566468.	.1593924.	.0431617.	.0842552.
000570	.05.	1.264184.	rad/sec	ω
000580	-1.222658.	.1104255.	.4784644.	-.042733t.
000590	-.0011408.	.1495239.	-2.85715E-05.	-.0584318.
000600	.2773996.	-.0311532.	-.2154072.	.0219695.
000610	.0010041.	-.0353525.	-.0003586.	.0259444.
000620	.4994463.	.5452563.	-.9914098.	.9993757.
000630	.4994464.	.5452563.	-.9914098.	.9993757.
000640	.5372088.	-.5834228.	-.9892524.	.1.012129.
000650	.5372089.	-.5834228.	-.9892524.	.1.012129.
000660	-.6931936.	-.7377395.	.5480262.	.5668608.
000670	-.6931936.	-.7377395.	.5480262.	.5668608.
000680	-.7328221.	.7727625.	.5608031.	.5844097.
000690	-.7328221.	.7727625.	.5608031.	.5844097.
000700	-1.044489.	.0034943.	.1.140942.	.0657415.
000710	-.3541658.	-.023832.	.0911798.	.0433924.
000720	.0011588.	-.0295523.	-.0009149.	.1356988.
000730	.4168609.	-.0032392.	.0233684.	.0407863.
000740	.5516393.	.00323.	.0311781.	.0380162.
000750	-.0024025.	.0078194.	.0001241.	.0167954.
000760	-1.746735.	.1619936.	-.1236533.	.2315289.
000770	.1.746735.	-.1619936.	.1236533.	.2315289.
000780	-1.69263.	-.0621246.	-.1280399.	.4213215.
000790	.1.69263.	.0621246.	.1280399.	.4213215.
000800	-1.132782.	.3052579.	-.0536686.	.7401886.
000810	.1.132782.	-.3052579.	.0536686.	.7401887.
000820	-1.11122.	-.3191639.	-.0732205.	.5870913.
000830	.1.11122.	.3191639.	.0732205.	.5870913.
000840	.075.	.1.896277.		
000850	-1.214346.	.1112203.	.415917.	-.0363353.

[q_s^R][q_s^I][α_s^R][α_s^I][q_A^R][q_A^I][α_A^R][α_A^I]

SAMPLE RUN FOR "HEAVE/PITCH" TYPE IRREGULARITY

*RUN VHDYN1

MAX TRACK IRREG. AMPL.:VS;VA;HS;HA: = ?10,0,0,0
WHAT'S THE FREAK FILENAME ?DATA1
NUMBERS OF POINTS = ?39
PH10, PH12, PH1Y, V = ?0,0,0,134

JOE DONE, LIST FILE (OUT1); I9 = 39

READY

*RUN VHDYN2

WHAT'S THE FREAK FILENAME ?DATA1
PH10, PH12, PH1Y, V = ?0,0,0,134
INPUT VALUES OF A2,A3,B2,C5 ?16.2,13.8,.55,1.21
INPUT VALUES OF A2,A3,B2,C5 ?8.2,11.2,1.06,-.39

JOE DONE, LIST FILE (OUT1); I9 = 39

READY

*SYSTEM CARD

OLD OR NEW-O OUT1

READY

*BPRINT *

S IDENT 2L631320, WAN

LABELS?

TAB CHARACTERS AND SETTING?

SNUMB # 1446T

*

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TRANSFER FUNCTIONS FOR HUNTER INPUTS
 (PHI0 = 0. PHI2 = 0. PHIY = 0.)
 XF = 9.000 XR = 7.650 Y = (-) .968 Z = 1.210

FREQ HZ.	DISPLACEMENT (METERS) AT			ACCELERATION (G-UNIT) AT		
	C-G AMPL.	Z PHASE	C-G AMPL.	Y PHASE	C-G AMPL.	Z PHASE
.00	3.29E-03	.0	.00E 00	.0	.00E 00	+180.0
.10	1.09E 00	177.3	.00E 00	.0	4.44E-02	+2.7
.20	1.25E 00	166.8	.00E 00	.0	2.04E-01	+13.2
.30	1.37E 00	151.2	.00E 00	.0	5.01E-01	+28.8
.40	1.39E 00	132.7	.00E 00	.0	9.09E-01	+47.3
.50	1.31E 00	113.2	.00E 00	.0	1.34E 00	+66.8
.60	1.14E 00	95.2	.00E 00	.0	1.67E 00	+84.8
.70	9.36E-01	80.1	.00E 00	.0	1.87E 00	+99.9
.80	7.54E-01	68.3	.00E 00	.0	1.97E 00	+111.7
.91	6.06E-01	59.1	.00E 00	.0	2.00E 00	+120.9
1.01	4.90E-01	52.0	.00E 00	.0	2.00E 00	+128.0
1.51	1.97E-01	32.4	.00E 00	.0	1.80E 00	+147.6
2.01	9.31E-02	23.6	.00E 00	.0	1.52E 00	+156.4
2.52	4.63E-02	18.6	.00E 00	.0	1.18E 00	+161.4
3.02	2.18E-02	15.3	.00E 00	.0	8.01E-01	+164.7
3.52	7.87E-03	13.0	.00E 00	.0	3.93E-01	+167.0
4.02	4.52E-04	-166.1	.00E 00	.0	2.95E-02	+13.9
5.03	8.39E-03	-170.8	.00E 00	.0	8.55E-01	+9.2
6.04	1.06E-02	-172.3	.00E 00	.0	1.55E 00	+7.7
7.04	1.01E-02	-173.5	.00E 00	.0	2.01E 00	+6.5
8.05	8.33E-03	-174.3	.00E 00	.0	2.17E 00	+5.7
9.05	6.06E-03	-174.9	.00E 00	.0	2.00E 00	+5.1
10.06	3.75E-03	-175.4	.00E 00	.0	1.53E 00	+4.6
12.07	1.65E-05	4.6	.00E 00	.0	9.66E-03	+175.4
14.08	1.93E-03	3.3	.00E 00	.0	1.54E 00	+176.7
16.10	2.08E-03	2.9	.00E 00	.0	2.17E 00	+177.1
20.12	3.55E-06	-177.3	.00E 00	.0	5.78E-03	+2.7
24.14	9.25E-04	-178.1	.00E 00	.0	2.17E 00	+1.9
28.17	1.29E-06	2.0	.00E 00	.0	4.13E-03	+178.0
32.19	5.20E-04	1.4	.00E 00	.0	2.17E 00	+178.6
36.22	6.09E-07	-178.5	.00E 00	.0	3.21E-03	+1.5
40.24	3.33E-04	-178.9	.00E 00	.0	2.17E 00	+1.1
44.26	3.34E-07	1.2	.00E 00	.0	2.63E-03	+178.8
48.29	2.31E-04	1.0	.00E 00	.0	2.17E 00	+179.0
52.31	2.01E-07	-178.9	.00E 00	.0	2.22E-03	+1.1
56.34	1.70E-04	-179.2	.00E 00	.0	2.17E 00	+1.8
60.36	1.31E-07	.9	.00E 00	.0	1.92E-03	+179.1
64.38	1.30E-04	.7	.00E 00	.0	2.17E 00	+179.3
68.41	9.02E-08	-179.2	.00E 00	.0	1.70E-03	+1.8

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
(PH10 = 0, PH12 = 0, PH1Y = 0.)
XF = 9.000 XR = 7.850 Y = (+-) .969 Z = 1.210

FREQ HZ.	ANGLE OF ROLL DEG		ANGULAR PITCH		ACCELERATION ROLL		RAD/S/S YAW	
	AMPL.	PHASE	AMPL.	PHASE	AMPL.	PHASE	AMPL.	PHASE
1.00	.00E 00	.0	.00E 00	-180.0	.00E 00	.0	.00E 00	.0
1.1	.00E 00	.0	2.12E-03	-89.1	.00E 00	.0	.00E 00	.0
1.2	.00E 00	.0	2.05E-02	-97.3	.00E 00	.0	.00E 00	.0
1.3	.00E 00	.0	8.14E-02	-112.4	.00E 00	.0	.00E 00	.0
1.4	.00E 00	.0	2.13E-01	-132.7	.00E 00	.0	.00E 00	.0
1.5	.00E 00	.0	4.10E-01	-156.3	.00E 00	.0	.00E 00	.0
1.6	.00E 00	.0	6.16E-01	-178.9	.00E 00	.0	.00E 00	.0
1.7	.00E 00	.0	7.83E-01	-162.8	.00E 00	.0	.00E 00	.0
1.8	.00E 00	.0	9.08E-01	-149.1	.00E 00	.0	.00E 00	.0
1.9	.00E 00	.0	1.01E 00	-139.2	.00E 00	.0	.00E 00	.0
1.01	.00E 00	.0	1.09E 00	-131.9	.00E 00	.0	.00E 00	.0
1.51	.00E 00	.0	1.44E 00	-114.4	.00E 00	.0	.00E 00	.0
2.01	.00E 00	.0	1.76E 00	-107.8	.00E 00	.0	.00E 00	.0
2.52	.00E 00	.0	2.03E 00	-104.5	.00E 00	.0	.00E 00	.0
3.02	.00E 00	.0	2.22E 00	-102.6	.00E 00	.0	.00E 00	.0
3.52	.00E 00	.0	2.34E 00	-101.4	.00E 00	.0	.00E 00	.0
4.02	.00E 00	.0	2.38E 00	-100.8	.00E 00	.0	.00E 00	.0
5.03	.00E 00	.0	2.18E 00	-100.5	.00E 00	.0	.00E 00	.0
6.04	.00E 00	.0	1.67E 00	-101.8	.00E 00	.0	.00E 00	.0
7.04	.00E 00	.0	9.07E-01	-107.3	.00E 00	.0	.00E 00	.0
8.05	.00E 00	.0	1.91E-01	-169.7	.00E 00	.0	.00E 00	.0
9.05	.00E 00	.0	9.36E-01	-96.1	.00E 00	.0	.00E 00	.0
10.06	.00E 00	.0	1.69E 00	-90.3	.00E 00	.0	.00E 00	.0
12.07	.00E 00	.0	2.37E 00	-86.4	.00E 00	.0	.00E 00	.0
14.08	.00E 00	.0	1.67E 00	-82.3	.00E 00	.0	.00E 00	.0
16.10	.00E 00	.0	1.91E-01	5.1	.00E 00	.0	.00E 00	.0
20.12	.00E 00	.0	2.37E 00	92.1	.00E 00	.0	.00E 00	.0
24.14	.00E 00	.0	1.91E-01	-176.6	.00E 00	.0	.00E 00	.0
28.17	.00E 00	.0	2.37E 00	-88.5	.00E 00	.0	.00E 00	.0
32.19	.00E 00	.0	1.91E-01	2.6	.00E 00	.0	.00E 00	.0
36.22	.00E 00	.0	2.37E 00	91.2	.00E 00	.0	.00E 00	.0
40.24	.00E 00	.0	1.91E-01	-178.0	.00E 00	.0	.00E 00	.0
44.26	.00E 00	.0	2.37E 00	-89.0	.00E 00	.0	.00E 00	.0
48.29	.00E 00	.0	1.91E-01	1.7	.00E 00	.0	.00E 00	.0
52.31	.00E 00	.0	2.37E 00	90.8	.00E 00	.0	.00E 00	.0
56.34	.00E 00	.0	1.91E-01	-178.5	.00E 00	.0	.00E 00	.0
60.36	.00E 00	.0	2.37E 00	-89.3	.00E 00	.0	.00E 00	.0
64.38	.00E 00	.0	1.91E-01	1.3	.00E 00	.0	.00E 00	.0
68.41	.00E 00	.0	2.37E 00	90.6	.00E 00	.0	.00E 00	.0

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
 (PHI0 = 0, PHI2 = 0, PHIY = 0.)
 XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

CONTROL COIL CURRENTS IN TERMS OF AMPERE-TURN RATIOS

FREQ HZ	COIL 1 AMPL.	PHASE	COIL 2 AMPL.	PHASE	COIL 3 AMPL.	PHASE	COIL 4 AMPL.	PHASE
0.00	8.75E-02	.0	8.75E-02	.0	8.75E-02	+180.0	8.75E-02	+180.0
10	2.49E-01	-26.6	2.49E-01	-26.6	2.61E-01	-31.3	2.61E-01	-31.3
20	8.54E-01	-49.4	8.54E-01	-49.4	9.10E-01	-58.5	9.10E-01	-58.5
30	1.61E 00	-68.3	1.61E 00	-68.3	1.75E 00	-82.9	1.75E 00	-82.9
40	2.38E 00	-85.3	2.38E 00	-85.3	2.60E 00	+106.5	2.60E 00	+106.5
50	3.04E 00	-101.5	3.04E 00	-101.5	3.23E 00	+129.3	3.23E 00	+129.3
60	3.43E 00	-116.1	3.43E 00	-116.1	3.51E 00	+149.3	3.51E 00	+149.3
70	3.55E 00	-128.0	3.55E 00	-128.0	3.50E 00	+165.2	3.50E 00	+165.2
80	3.49E 00	-136.6	3.49E 00	-136.6	3.36E 00	+177.3	3.36E 00	+177.3
91	3.35E 00	-142.4	3.35E 00	-142.4	3.18E 00	173.5	3.18E 00	173.5
101	3.19E 00	-146.0	3.19E 00	-146.0	3.02E 00	166.4	3.02E 00	166.4
151	2.60E 00	-147.4	2.60E 00	-147.4	2.49E 00	145.1	2.49E 00	145.1
201	2.32E 00	-139.0	2.32E 00	-139.0	2.25E 00	131.7	2.25E 00	131.7
252	2.17E 00	-128.2	2.17E 00	-128.2	2.14E 00	120.0	2.14E 00	120.0
302	2.10E 00	-116.7	2.10E 00	-116.7	2.07E 00	108.9	2.07E 00	108.9
352	2.05E 00	-105.1	2.05E 00	-105.1	2.03E 00	97.9	2.03E 00	97.9
402	2.02E 00	-93.5	2.02E 00	-93.5	2.00E 00	86.8	2.00E 00	86.8
503	1.99E 00	-70.5	1.99E 00	-70.5	1.97E 00	64.7	1.97E 00	64.7
604	1.97E 00	-47.6	1.97E 00	-47.6	1.96E 00	42.6	1.96E 00	42.6
704	1.96E 00	-24.9	1.96E 00	-24.9	1.95E 00	20.3	1.95E 00	20.3
805	1.95E 00	-2.2	1.95E 00	-2.2	1.94E 00	+1.9	1.94E 00	+1.9
905	1.94E 00	20.6	1.94E 00	20.6	1.94E 00	-24.2	1.94E 00	-24.2
1006	1.93E 00	43.3	1.93E 00	43.3	1.94E 00	-46.5	1.94E 00	-46.5
1207	1.93E 00	88.6	1.93E 00	88.6	1.93E 00	-91.2	1.93E 00	-91.2
1408	1.93E 00	133.8	1.93E 00	133.8	1.93E 00	+136.1	1.93E 00	+136.1
1610	1.93E 00	178.9	1.93E 00	178.9	1.93E 00	179.0	1.93E 00	179.0
2012	1.92E 00	-90.8	1.92E 00	-90.8	1.92E 00	89.3	1.92E 00	89.3
2414	1.92E 00	-.7	1.92E 00	-.7	1.92E 00	-.7	1.92E 00	-.7
2817	1.92E 00	89.4	1.92E 00	89.4	1.92E 00	-90.5	1.92E 00	-90.5
3219	1.92E 00	179.4	1.92E 00	179.4	1.92E 00	179.5	1.92E 00	179.5
3622	1.92E 00	-90.5	1.92E 00	-90.5	1.92E 00	89.6	1.92E 00	89.6
4024	1.92E 00	-.4	1.92E 00	-.4	1.92E 00	-.4	1.92E 00	-.4
4426	1.92E 00	89.6	1.92E 00	89.6	1.92E 00	-90.3	1.92E 00	-90.3
4829	1.92E 00	179.6	1.92E 00	179.6	1.92E 00	179.7	1.92E 00	179.7
5231	1.92E 00	-90.3	1.92E 00	-90.3	1.92E 00	89.7	1.92E 00	89.7
5634	1.92E 00	-.3	1.92E 00	-.3	1.92E 00	-.3	1.92E 00	-.3
6036	1.92E 00	89.7	1.92E 00	89.7	1.92E 00	-90.2	1.92E 00	-90.2
6438	1.92E 00	179.7	1.92E 00	179.7	1.92E 00	179.8	1.92E 00	179.8
6841	1.92E 00	-90.2	1.92E 00	-90.2	1.92E 00	89.8	1.92E 00	89.8

CONTROL COIL CURRENT SUMMARY

(PHI0 = 0. PHI2 = 0. PHIY = 0.)

XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

RESPONSE FOR CYL = 3.638E-04

PSD FOR PHI = 1.50E-06/M²

FREQ HZ	R E S P O N S E (ALPHA)				P S D (ALPHA)			
	COIL 1	COIL 2	COIL 3	COIL 4	COIL 1	COIL 2	COIL 3	COIL 4
1.00	8.78E-02	8.8E-02	8.8E-02	8.78E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.10	1.12E-01	1.2E-01	1.3E-01	1.3E-01	2.0E-04	2.0E-04	2.2E-04	2.2E-04
1.20	2.1E-01	2.1E-01	2.2E-01	2.2E-01	5.8E-04	5.8E-04	6.5E-04	6.5E-04
1.30	2.6E-01	2.6E-01	2.8E-01	2.8E-01	9.1E-04	9.1E-04	1.1E-03	1.1E-03
1.40	2.9E-01	2.9E-01	3.1E-01	3.1E-01	1.1E-03	1.1E-03	1.3E-03	1.3E-03
1.50	2.9E-01	2.9E-01	3.1E-01	3.1E-01	1.2E-03	1.2E-03	1.3E-03	1.3E-03
1.60	2.8E-01	2.8E-01	2.8E-01	2.8E-01	1.0E-03	1.0E-03	1.1E-03	1.1E-03
1.70	2.5E-01	2.5E-01	2.4E-01	2.4E-01	8.1E-04	8.1E-04	7.9E-04	7.9E-04
1.80	2.1E-01	2.1E-01	2.0E-01	2.0E-01	6.0E-04	6.0E-04	5.6E-04	5.6E-04
1.91	1.8E-01	1.8E-01	1.7E-01	1.7E-01	4.4E-04	4.4E-04	4.0E-04	4.0E-04
1.01	1.5E-01	1.5E-01	1.5E-01	1.5E-01	3.2E-04	3.2E-04	2.9E-04	2.9E-04
1.51	8.4E-02	8.4E-02	8.0E-02	8.0E-02	9.5E-05	9.5E-05	8.7E-05	8.7E-05
2.01	5.6E-02	5.6E-02	5.5E-02	5.5E-02	4.2E-05	4.2E-05	4.0E-05	4.0E-05
2.52	4.2E-02	4.2E-02	4.1E-02	4.1E-02	2.4E-05	2.4E-05	2.3E-05	2.3E-05
3.02	3.4E-02	3.4E-02	3.3E-02	3.3E-02	1.5E-05	1.5E-05	1.5E-05	1.5E-05
3.52	2.8E-02	2.8E-02	2.8E-02	2.8E-02	1.1E-05	1.1E-05	1.1E-05	1.1E-05
4.02	2.4E-02	2.4E-02	2.4E-02	2.4E-02	8.1E-06	8.1E-06	7.9E-06	7.9E-06
5.03	1.9E-02	1.9E-02	1.9E-02	1.9E-02	5.0E-06	5.0E-06	4.9E-06	4.9E-06
6.04	1.6E-02	1.6E-02	1.6E-02	1.6E-02	3.4E-06	3.4E-06	3.4E-06	3.4E-06
7.04	1.4E-02	1.4E-02	1.3E-02	1.3E-02	2.5E-06	2.5E-06	2.4E-06	2.4E-06
8.05	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.9E-06	1.9E-06	1.9E-06	1.9E-06
9.05	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.5E-06	1.5E-06	1.5E-06	1.5E-06
10.06	9.4E-03	9.4E-03	9.4E-03	9.4E-03	1.2E-06	1.2E-06	1.2E-06	1.2E-06
12.07	7.8E-03	7.8E-03	7.8E-03	7.8E-03	8.2E-07	8.2E-07	8.2E-07	8.2E-07
14.08	6.7E-03	6.7E-03	6.7E-03	6.7E-03	6.0E-07	6.0E-07	6.0E-07	6.0E-07
16.10	5.8E-03	5.8E-03	5.8E-03	5.8E-03	4.6E-07	4.6E-07	4.6E-07	4.6E-07
20.12	4.7E-03	4.7E-03	4.7E-03	4.7E-03	2.9E-07	2.9E-07	2.9E-07	2.9E-07
24.14	3.9E-03	3.9E-03	3.9E-03	3.9E-03	2.0E-07	2.0E-07	2.0E-07	2.0E-07
28.17	3.3E-03	3.3E-03	3.3E-03	3.3E-03	1.5E-07	1.5E-07	1.5E-07	1.5E-07
32.19	2.9E-03	2.9E-03	2.9E-03	2.9E-03	1.1E-07	1.1E-07	1.1E-07	1.1E-07
36.22	2.6E-03	2.6E-03	2.6E-03	2.6E-03	9.0E-08	9.0E-08	9.0E-08	9.0E-08
40.24	2.3E-03	2.3E-03	2.3E-03	2.3E-03	7.3E-08	7.3E-08	7.3E-08	7.3E-08
44.26	2.1E-03	2.1E-03	2.1E-03	2.1E-03	6.0E-08	6.0E-08	6.0E-08	6.0E-08
48.29	1.9E-03	1.9E-03	1.9E-03	1.9E-03	5.1E-08	5.1E-08	5.1E-08	5.1E-08
52.31	1.8E-03	1.8E-03	1.8E-03	1.8E-03	4.3E-08	4.3E-08	4.3E-08	4.3E-08
56.34	1.7E-03	1.7E-03	1.7E-03	1.7E-03	3.7E-08	3.7E-08	3.7E-08	3.7E-08
60.36	1.5E-03	1.5E-03	1.5E-03	1.5E-03	3.2E-08	3.2E-08	3.2E-08	3.2E-08
64.38	1.5E-03	1.5E-03	1.5E-03	1.5E-03	2.8E-08	2.8E-08	2.8E-08	2.8E-08
68.41	1.4E-03	1.4E-03	1.4E-03	1.4E-03	2.5E-08	2.5E-08	2.5E-08	2.5E-08
MEAN					3.0E-02	3.0E-02	3.0E-02	3.0E-02

CONTROL CURRENT AND POWER SUMMARY

(PH10 = 0, PH12 = 0, PH1Y = 8.)

XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

FREQ HZ.	TOTAL AMPL.	CURRENT PHASE	(RESP. PHASE	PSD) /HZ	POWER W/M+2	(RESP. W	PSD) W/HZ
.00	.00E 00	.0	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
.10	1.02E 00	-29.0	4.9E-01	3.3E-03	53.3E 03	12.5E 03	16.9E 02
.20	3.52E 00	-54.1	8.5E-01	9.8E-03	62.6E 04	36.7E 03	49.4E 01
.30	6.66E 00	-75.9	1.1E 00	1.6E-02	22.0E 05	97.3E 03	77.2E 01
.40	9.79E 00	-96.4	1.2E 00	1.9E-02	46.3E 05	68.0E 03	91.6E 01
.50	1.22E 01	-115.8	1.2E 00	1.9E-02	69.6E 05	65.3E 03	88.0E 01
.60	1.33E 01	-132.9	1.1E 00	1.6E-02	80.3E 05	52.3E 03	70.5E 01
.70	1.33E 01	-146.5	9.2E-01	1.1E-02	77.7E 05	37.2E 03	50.1E 01
.80	1.28E 01	-156.6	7.8E-01	8.1E-03	68.4E 05	25.1E 03	33.8E 01
.91	1.21E 01	-163.9	6.5E-01	5.7E-03	57.8E 05	16.7E 03	22.5E 01
1.01	1.14E 01	-169.1	5.5E-01	4.1E-03	48.3E 05	11.3E 03	15.3E 01
1.51	8.45E 00	179.6	2.7E-01	1.0E-03	21.4E 05	22.3E 02	30.1E 00
2.01	6.50E 00	177.1	1.6E-01	3.3E-04	11.6E 05	67.9E 01	91.4E-01
2.52	4.84E 00	176.7	9.4E-02	1.2E-04	71.2E 04	26.7E 01	36.0E-01
3.02	3.23E 00	176.9	5.2E-02	3.7E-05	47.9E 04	12.5E 01	16.8E-01
3.52	1.63E 00	177.8	2.3E-02	6.8E-06	34.4E 04	65.9E 00	88.9E-02
4.02	4.41E-02	-129.3	5.3E-04	3.8E-09	26.1E 04	38.3E 00	51.6E-02
5.03	3.02E 00	-3.4	2.9E-02	1.2E-05	17.1E 04	16.0E 00	21.6E-02
6.04	5.54E 00	-2.7	4.5E-02	2.7E-05	12.5E 04	81.6E-01	11.0E-02
7.04	7.21E 00	-2.3	5.0E-02	3.4E-05	97.0E 03	46.5E-01	62.6E-03
8.05	7.78E 00	-2.0	4.7E-02	3.0E-05	75.9E 03	27.8E-01	37.5E-03
9.05	7.18E 00	-1.8	3.9E-02	2.0E-05	58.7E 03	17.0E-01	22.9E-03
10.06	5.49E 00	-1.6	2.7E-02	9.5E-06	45.1E 03	10.6E-01	14.2E-03
12.07	1.29E-02	17.7	5.2E-05	3.6E-11	28.8E 03	46.9E-02	63.2E-04
14.08	5.45E 00	178.8	1.9E-02	4.8E-06	22.9E 03	27.4E-02	36.9E-04
16.10	7.70E 00	179.0	2.3E-02	7.3E-06	18.9E 03	17.4E-02	23.4E-04
20.12	7.65E-03	-169.4	1.9E-05	4.6E-12	10.4E 03	40.8E-03	81.9E-05
24.14	7.69E 00	-.7	1.6E-02	3.2E-06	84.2E 02	84.3E-03	46.2E-05
28.17	5.44E-03	7.6	9.4E-06	1.2E-12	52.8E 02	15.8E-03	21.3E-05
32.19	7.68E 00	179.5	1.2E-02	1.8E-06	47.3E 02	10.8E-03	14.6E-05
36.22	4.22E-03	-174.1	5.7E-06	4.3E-13	32.0E 02	57.9E-04	78.0E-06
40.24	7.68E 00	-.4	9.3E-03	1.2E-06	30.3E 02	44.4E-04	59.9E-06
44.26	3.44E-03	4.9	3.8E-06	1.9E-13	21.4E 02	25.9E-04	34.9E-06
48.29	7.68E 00	179.6	7.8E-03	8.1E-07	21.0E 02	21.4E-04	29.9E-06
52.31	2.94E-03	-175.9	2.7E-06	1.0E-13	15.3E 02	13.3E-04	17.9E-06
56.34	7.68E 00	-.3	6.6E-03	5.9E-07	15.5E 02	11.6E-04	15.6E-06
60.36	2.54E-03	3.5	2.1E-06	5.7E-14	11.5E 02	75.0E-05	10.1E-06
64.38	7.68E 00	179.7	5.8E-03	4.6E-07	11.8E 02	67.8E-05	91.3E-07
68.41	2.24E-03	-176.9	1.6E-06	3.4E-14	89.6E 01	45.4E-05	61.2E-07
MEAN				1.1E-01			5.5E 02

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
 (PHI0 = 0, PHI2 = 0, PHIY = 0.)
 XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

FREQ HZ.	GAP (M) AT		GAP (M) AT		GAP (M) AT		GAP (M) AT	
	COIL 1 - Z	PHASE	COIL 2 - Z	PHASE	COIL 3 - Z	PHASE	COIL 4 - Z	PHASE
AMPL.			AMPL.		AMPL.		AMPL.	
0.02	4.06E-02	.0	4.06E-02	.0	4.06E-02	-180.0	4.06E-02	+180.0
1.10	9.91E-02	-25.2	9.91E-02	-25.2	1.05E-01	-29.9	1.05E-01	-29.9
2.20	3.42E-01	-46.8	3.42E-01	-46.8	3.68E-01	-55.8	3.68E-01	-55.8
3.30	6.51E-01	-64.5	6.51E-01	-64.5	7.14E-01	-78.9	7.14E-01	-78.9
4.40	9.75E-01	-80.5	9.75E-01	-80.5	1.08E 00	+181.5	1.08E 00	+101.5
5.50	1.26E 00	-95.7	1.26E 00	-95.7	1.36E 00	+123.5	1.36E 00	+123.5
6.60	1.44E 00	-109.6	1.44E 00	-109.6	1.50E 00	-142.9	1.50E 00	+142.9
7.70	1.52E 00	-120.9	1.52E 00	-120.9	1.52E 00	+158.4	1.52E 00	+158.4
8.80	1.51E 00	-129.2	1.51E 00	-129.2	1.48E 00	+170.2	1.48E 00	+170.2
9.91	1.48E 00	-134.7	1.48E 00	-134.7	1.43E 00	+179.3	1.43E 00	+179.3
11.01	1.43E 00	-138.1	1.43E 00	-138.1	1.37E 00	173.7	1.37E 00	173.7
12.11	1.23E 00	-139.8	1.23E 00	-139.8	1.19E 00	151.8	1.19E 00	151.8
13.21	1.13E 00	-132.3	1.13E 00	-132.3	1.11E 00	137.5	1.11E 00	137.5
14.32	1.09E 00	-122.4	1.09E 00	-122.4	1.07E 00	125.0	1.07E 00	125.0
15.42	1.06E 00	-111.7	1.06E 00	-111.7	1.05E 00	113.2	1.05E 00	113.2
16.52	1.04E 00	-100.7	1.04E 00	-100.7	1.04E 00	101.7	1.04E 00	101.7
17.62	1.03E 00	-89.6	1.03E 00	-89.6	1.03E 00	90.3	1.03E 00	90.3
18.73	1.02E 00	-67.3	1.02E 00	-67.3	1.02E 00	67.6	1.02E 00	67.6
19.84	1.02E 00	-44.8	1.02E 00	-44.8	1.01E 00	45.1	1.01E 00	45.1
20.94	1.01E 00	-22.4	1.01E 00	-22.4	1.01E 00	22.5	1.01E 00	22.5
22.05	1.01E 00	.1	1.01E 00	.1	1.01E 00	.0	1.01E 00	.0
23.15	1.01E 00	22.5	1.01E 00	22.5	1.01E 00	-22.5	1.01E 00	-22.5
24.26	1.01E 00	45.0	1.01E 00	45.0	1.00E 00	-45.0	1.00E 00	-45.0
25.37	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
26.48	1.00E 00	135.0	1.00E 00	135.0	1.00E 00	+135.0	1.00E 00	+135.0
27.59	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
28.70	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
29.81	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
30.92	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
32.03	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
33.14	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
34.25	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
35.36	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
36.47	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
37.58	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
38.69	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
39.80	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
40.91	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
42.02	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
43.13	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
44.24	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
45.35	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
46.46	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
47.57	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
48.68	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
49.79	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
50.90	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
52.01	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
53.12	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
54.23	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
55.34	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0
56.45	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0	1.00E 00	.0
57.56	1.00E 00	90.0	1.00E 00	90.0	1.00E 00	-90.0	1.00E 00	-90.0
58.67	1.00E 00	-180.0	1.00E 00	-180.0	1.00E 00	+180.0	1.00E 00	+180.0
59.78	1.00E 00	-90.0	1.00E 00	-90.0	1.00E 00	90.0	1.00E 00	90.0

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
 (PHI0 = 0, PHI2 = 0, PHIY = 0.)
 XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

FREQ HZ.	GAP (M) AT COIL 1 - Y			GAP (M) AT COIL 2 - Y			GAP (M) AT COIL 3 - Y			GAP (M) AT COIL 4 - Y		
	AMPL.	PHASE		AMPL.	PHASE		AMPL.	PHASE		AMPL.	PHASE	
.00	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.10	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.20	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.30	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.40	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.50	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.60	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.70	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.80	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
.91	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
1.01	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
1.51	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
2.01	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
2.52	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
3.02	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
3.52	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
4.02	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
5.03	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
6.04	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
7.04	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
8.05	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
9.05	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
10.06	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
12.07	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
14.08	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
16.10	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
20.12	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
24.14	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
28.17	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
32.19	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
36.22	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
40.24	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
44.26	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
48.29	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
52.31	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
56.34	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
60.36	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
64.38	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	
68.41	.00E 00	.0		.00E 00	.0		.00E 00	.0		.00E 00	.0	

DISPLACEMENT RESPONSE SUMMARY FOR S/L = 31636E-04

(PHI0 = 0. PHI1 = 0. PHI2 = 0. PHI3 = 0.)

XF = 9.000 XR = 7.650 Y = (+-) .968 Z = 1.210

HZ	RESPONSES IN Z-DIRECTION				RESPONSES IN Y-DIRECTION			
	COIL 1	COIL 2	COIL 3	COIL 4	COIL 1	COIL 2	COIL 3	COIL 4
00	4.1E-02	4.1E-02	4.1E-02	4.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
10	4.8E-02	4.8E-02	5.1E-02	5.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
20	8.3E-02	8.3E-02	8.9E-02	8.9E-02	.0E 00	.0E 00	.0E 00	.0E 00
30	1.1E-01	1.1E-01	1.2E-01	1.2E-01	.0E 00	.0E 00	.0E 00	.0E 00
40	1.2E-01	1.2E-01	1.3E-01	1.3E-01	.0E 00	.0E 00	.0E 00	.0E 00
50	1.2E-01	1.2E-01	1.3E-01	1.3E-01	.0E 00	.0E 00	.0E 00	.0E 00
60	1.2E-01	1.2E-01	1.2E-01	1.2E-01	.0E 00	.0E 00	.0E 00	.0E 00
70	1.0E-01	1.0E-01	1.1E-01	1.1E-01	.0E 00	.0E 00	.0E 00	.0E 00
80	9.2E-02	9.2E-02	9.0E-02	9.0E-02	.0E 00	.0E 00	.0E 00	.0E 00
91	7.9E-02	7.9E-02	7.7E-02	7.7E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.01	6.9E-02	6.9E-02	6.7E-02	6.7E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.51	4.0E-02	4.0E-02	3.8E-02	3.8E-02	.0E 00	.0E 00	.0E 00	.0E 00
2.01	2.7E-02	2.7E-02	2.7E-02	2.7E-02	.0E 00	.0E 00	.0E 00	.0E 00
2.52	2.1E-02	2.1E-02	2.1E-02	2.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
3.02	1.7E-02	1.7E-02	1.7E-02	1.7E-02	.0E 00	.0E 00	.0E 00	.0E 00
3.52	1.4E-02	1.4E-02	1.4E-02	1.4E-02	.0E 00	.0E 00	.0E 00	.0E 00
4.02	1.3E-02	1.3E-02	1.2E-02	1.2E-02	.0E 00	.0E 00	.0E 00	.0E 00
5.03	9.9E-03	9.9E-03	9.9E-03	9.9E-03	.0E 00	.0E 00	.0E 00	.0E 00
6.04	8.2E-03	8.2E-03	8.2E-03	8.2E-03	.0E 00	.0E 00	.0E 00	.0E 00
7.04	7.0E-03	7.0E-03	7.0E-03	7.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
8.05	6.1E-03	6.1E-03	6.1E-03	6.1E-03	.0E 00	.0E 00	.0E 00	.0E 00
9.05	5.4E-03	5.4E-03	5.4E-03	5.4E-03	.0E 00	.0E 00	.0E 00	.0E 00
10.06	4.9E-03	4.9E-03	4.9E-03	4.9E-03	.0E 00	.0E 00	.0E 00	.0E 00
12.07	4.1E-03	4.1E-03	4.0E-03	4.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
14.08	3.5E-03	3.5E-03	3.5E-03	3.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
16.10	3.0E-03	3.0E-03	3.0E-03	3.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
20.12	2.4E-03	2.4E-03	2.4E-03	2.4E-03	.0E 00	.0E 00	.0E 00	.0E 00
24.14	2.0E-03	2.0E-03	2.0E-03	2.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
28.17	1.7E-03	1.7E-03	1.7E-03	1.7E-03	.0E 00	.0E 00	.0E 00	.0E 00
32.19	1.5E-03	1.5E-03	1.5E-03	1.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
36.22	1.3E-03	1.3E-03	1.3E-03	1.3E-03	.0E 00	.0E 00	.0E 00	.0E 00
40.24	1.2E-03	1.2E-03	1.2E-03	1.2E-03	.0E 00	.0E 00	.0E 00	.0E 00
44.26	1.1E-03	1.1E-03	1.1E-03	1.1E-03	.0E 00	.0E 00	.0E 00	.0E 00
48.29	1.0E-03	1.0E-03	1.0E-03	1.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
52.31	9.3E-04	9.3E-04	9.3E-04	9.3E-04	.0E 00	.0E 00	.0E 00	.0E 00
56.34	8.7E-04	8.7E-04	8.7E-04	8.7E-04	.0E 00	.0E 00	.0E 00	.0E 00
60.36	8.1E-04	8.1E-04	8.1E-04	8.1E-04	.0E 00	.0E 00	.0E 00	.0E 00
64.38	7.6E-04	7.6E-04	7.6E-04	7.6E-04	.0E 00	.0E 00	.0E 00	.0E 00
68.41	7.1E-04	7.1E-04	7.1E-04	7.1E-04	.0E 00	.0E 00	.0E 00	.0E 00

(PHI0 = 0. PHI2 = 0. PHIY = 0.)

GAP PSD (IN M+2/MZ FOR PHI=1.50E+06/W+2) FOR
 XF = 9.000 XR = 7.650 Y = (+-) .968 Z = 1.210

HZ	PSD IN Z-DIRECTION				PSD IN Y-DIRECTION			
	COIL 1	COIL 2	COIL 3	COIL 4	COIL 1	COIL 2	COIL 3	COIL 4
00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
10	3.1E-05	3.1E-05	3.5E-05	3.5E-05	.0E 00	.0E 00	.0E 00	.0E 00
20	9.2E-05	9.2E-05	1.1E-04	1.1E-04	.0E 00	.0E 00	.0E 00	.0E 00
30	1.5E-04	1.5E-04	1.8E-04	1.8E-04	.0E 00	.0E 00	.0E 00	.0E 00
40	1.9E-04	1.9E-04	2.3E-04	2.3E-04	.0E 00	.0E 00	.0E 00	.0E 00
50	2.0E-04	2.0E-04	2.3E-04	2.3E-04	.0E 00	.0E 00	.0E 00	.0E 00
60	1.8E-04	1.8E-04	2.0E-04	2.0E-04	.0E 00	.0E 00	.0E 00	.0E 00
70	1.5E-04	1.5E-04	1.5E-04	1.5E-04	.0E 00	.0E 00	.0E 00	.0E 00
80	1.1E-04	1.1E-04	1.1E-04	1.1E-04	.0E 00	.0E 00	.0E 00	.0E 00
91	8.5E-05	8.5E-05	8.0E-05	8.0E-05	.0E 00	.0E 00	.0E 00	.0E 00
1 01	6.4E-05	6.4E-05	6.0E-05	6.0E-05	.0E 00	.0E 00	.0E 00	.0E 00
1 51	2.1E-05	2.1E-05	2.0E-05	2.0E-05	.0E 00	.0E 00	.0E 00	.0E 00
2 01	1.0E-05	1.0E-05	9.7E-06	9.7E-06	.0E 00	.0E 00	.0E 00	.0E 00
2 52	6.0E-06	6.0E-06	5.8E-06	5.8E-06	.0E 00	.0E 00	.0E 00	.0E 00
3 02	3.9E-06	3.9E-06	3.9E-06	3.9E-06	.0E 00	.0E 00	.0E 00	.0E 00
3 52	2.8E-06	2.8E-06	2.8E-06	2.8E-06	.0E 00	.0E 00	.0E 00	.0E 00
4 02	2.1E-06	2.1E-06	2.1E-06	2.1E-06	.0E 00	.0E 00	.0E 00	.0E 00
5 03	1.3E-06	1.3E-06	1.3E-06	1.3E-06	.0E 00	.0E 00	.0E 00	.0E 00
6 04	9.0E-07	9.0E-07	9.0E-07	9.0E-07	.0E 00	.0E 00	.0E 00	.0E 00
7 04	6.6E-07	6.6E-07	6.6E-07	6.6E-07	.0E 00	.0E 00	.0E 00	.0E 00
8 05	5.0E-07	5.0E-07	5.0E-07	5.0E-07	.0E 00	.0E 00	.0E 00	.0E 00
9 05	4.0E-07	4.0E-07	3.9E-07	3.9E-07	.0E 00	.0E 00	.0E 00	.0E 00
10 06	3.2E-07	3.2E-07	3.2E-07	3.2E-07	.0E 00	.0E 00	.0E 00	.0E 00
12 07	2.2E-07	2.2E-07	2.2E-07	2.2E-07	.0E 00	.0E 00	.0E 00	.0E 00
14 08	1.6E-07	1.6E-07	1.6E-07	1.6E-07	.0E 00	.0E 00	.0E 00	.0E 00
16 10	1.2E-07	1.2E-07	1.2E-07	1.2E-07	.0E 00	.0E 00	.0E 00	.0E 00
20 12	7.9E-08	7.9E-08	7.9E-08	7.9E-08	.0E 00	.0E 00	.0E 00	.0E 00
24 14	5.5E-08	5.5E-08	5.5E-08	5.5E-08	.0E 00	.0E 00	.0E 00	.0E 00
28 17	4.0E-08	4.0E-08	4.0E-08	4.0E-08	.0E 00	.0E 00	.0E 00	.0E 00
32 19	3.1E-08	3.1E-08	3.1E-08	3.1E-08	.0E 00	.0E 00	.0E 00	.0E 00
36 22	2.4E-08	2.4E-08	2.4E-08	2.4E-08	.0E 00	.0E 00	.0E 00	.0E 00
40 24	2.0E-08	2.0E-08	2.0E-08	2.0E-08	.0E 00	.0E 00	.0E 00	.0E 00
44 26	1.6E-08	1.6E-08	1.6E-08	1.6E-08	.0E 00	.0E 00	.0E 00	.0E 00
48 29	1.4E-08	1.4E-08	1.4E-08	1.4E-08	.0E 00	.0E 00	.0E 00	.0E 00
52 31	1.2E-08	1.2E-08	1.2E-08	1.2E-08	.0E 00	.0E 00	.0E 00	.0E 00
56 34	1.0E-08	1.0E-08	1.0E-08	1.0E-08	.0E 00	.0E 00	.0E 00	.0E 00
60 36	8.8E-09	8.8E-09	8.8E-09	8.8E-09	.0E 00	.0E 00	.0E 00	.0E 00
64 38	7.7E-09	7.7E-09	7.7E-09	7.7E-09	.0E 00	.0E 00	.0E 00	.0E 00
68 41	6.8E-09	6.8E-09	6.8E-09	6.8E-09	.0E 00	.0E 00	.0E 00	.0E 00
MEAN	1.3E-02	1.3E-02	1.3E-02	1.3E-02	.0E 00	.0E 00	.0E 00	.0E 00

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
 (PHI0 = 0, PHI2 = 0, PHIY = 0.)
 KF = 16.200 XR = 13.800 Y = (+-) .556 Z = 1.210

FREQ HZ.	GAP (M) AT CORNER 1 - Z		GAP (M) AT CORNER 2 - Z		GAP (M) AT CORNER 3 - Z		GAP (M) AT CORNER 4 - Z	
	AMPL.	PHASE	AMPL.	PHASE	AMPL.	PHASE	AMPL.	PHASE
00	7.58E-02	.0	7.58E-02	.0	7.06E-02	*180.0	7.06E-02	*180.0
10	9.85E-02	-22.6	9.85E-02	-22.6	1.09E-01	-31.1	1.09E-01	-31.1
20	3.39E-01	-41.6	3.39E-01	-41.6	3.83E-01	-58.0	3.83E-01	-58.0
30	6.46E-01	-56.2	6.46E-01	-56.2	7.50E-01	-82.5	7.50E-01	-82.5
40	9.84E-01	-68.9	9.84E-01	-68.9	1.14E 00	*106.7	1.14E 00	*106.7
50	1.31E 00	-81.6	1.31E 00	-81.6	1.45E 00	*130.7	1.45E 00	*130.7
60	1.55E 00	-94.0	1.55E 00	-94.0	1.59E 00	*152.0	1.59E 00	*152.0
70	1.66E 00	-104.4	1.66E 00	-104.4	1.60E 00	*169.3	1.60E 00	*169.3
80	1.67E 00	-111.8	1.67E 00	-111.8	1.56E 00	177.4	1.56E 00	177.4
91	1.63E 00	-116.3	1.63E 00	-116.3	1.49E 00	166.9	1.49E 00	166.9
1.01	1.57E 00	-118.5	1.57E 00	-118.5	1.43E 00	158.5	1.43E 00	158.5
1.51	1.34E 00	-112.6	1.34E 00	-112.6	1.23E 00	129.3	1.23E 00	129.3
2.01	1.21E 00	-96.5	1.21E 00	-96.5	1.14E 00	107.2	1.14E 00	107.2
2.52	1.14E 00	-77.5	1.14E 00	-77.5	1.09E 00	86.6	1.09E 00	86.6
3.02	1.09E 00	-57.3	1.09E 00	-57.3	1.05E 00	66.5	1.05E 00	66.5
3.52	1.05E 00	-36.5	1.05E 00	-36.5	1.03E 00	46.4	1.03E 00	46.4
4.02	1.03E 00	-15.3	1.03E 00	-15.3	1.01E 00	26.3	1.01E 00	26.3
5.03	9.97E-01	27.7	9.97E-01	27.7	9.95E-01	-13.8	9.95E-01	-13.8
6.04	9.89E-01	70.7	9.89E-01	70.7	9.90E-01	-53.8	9.90E-01	-53.8
7.04	9.90E-01	113.2	9.90E-01	113.2	9.92E-01	-93.4	9.92E-01	-93.4
8.05	9.92E-01	155.4	9.92E-01	155.4	9.95E-01	*132.7	9.95E-01	*132.7
9.05	9.92E-01	-162.5	9.92E-01	-162.5	9.95E-01	*171.9	9.95E-01	*171.9
10.06	9.92E-01	-120.4	9.92E-01	-120.4	9.94E-01	148.9	9.94E-01	148.9
12.07	9.96E-01	*36.2	9.96E-01	-36.2	9.95E-01	70.4	9.95E-01	70.4
14.08	1.00E 00	47.7	1.00E 00	47.7	9.99E-01	*7.9	9.99E-01	*7.9
16.10	1.00E 00	131.5	1.00E 00	131.5	1.00E 00	-86.1	1.00E 00	-86.1
20.12	1.00E 00	-60.9	1.00E 00	-60.9	1.00E 00	117.5	1.00E 00	117.5
24.14	1.00E 00	107.0	1.00E 00	107.0	1.00E 00	-38.9	1.00E 00	-38.9
28.17	9.99E-01	-85.1	9.99E-01	-85.1	1.00E 00	164.7	1.00E 00	164.7
32.19	1.00E 00	82.7	1.00E 00	82.7	1.00E 00	8.1	1.00E 00	8.1
36.22	1.00E 00	-109.4	1.00E 00	*109.4	1.00E 00	*148.4	1.00E 00	*148.4
40.24	1.00E 00	58.4	1.00E 00	58.4	1.00E 00	55.1	1.00E 00	55.1
44.26	1.00E 00	-133.8	1.00E 00	*133.8	1.00E 00	*101.3	1.00E 00	*101.3
48.29	1.00E 00	34.1	1.00E 00	34.1	1.00E 00	102.2	1.00E 00	102.2
52.31	1.00E 00	-158.1	1.00E 00	*158.1	1.00E 00	*54.3	1.00E 00	*54.3
56.34	1.00E 00	9.7	1.00E 00	9.7	1.00E 00	149.2	1.00E 00	149.2
60.36	1.00E 00	177.6	1.00E 00	177.6	1.00E 00	*7.3	1.00E 00	*7.3
64.38	1.00E 00	-14.6	1.00E 00	-14.6	1.00E 00	*163.8	1.00E 00	*163.8
68.41	1.00E 00	153.3	1.00E 00	153.3	1.00E 00	39.7	1.00E 00	39.7

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
 (PH10 = 0, PH12 = 0, PH1Y = 8.)
 XF = 16.200 XR = 13.800 Y = (+-) .556 Z = 1.210

FREQ HZ.	GAP (M) AT CORNER 1 - Y			GAP (M) AT CORNER 2 - Y			GAP (M) AT CORNER 3 - Y			GAP (M) AT CORNER 4 - Y		
	AMPL.	PHASE		AMPL.	PHASE		AMPL.	PHASE		AMPL.	PHASE	
7.00	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
10	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
20	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
30	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
40	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
50	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
60	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
70	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
80	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
91	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
1.01	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
1.51	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
2.01	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
2.52	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
3.02	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
3.52	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
4.02	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
5.03	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
6.04	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
7.04	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
8.05	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
9.05	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
10.06	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
12.07	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
14.08	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
16.10	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
20.12	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
24.14	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
28.17	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
32.19	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
36.22	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
40.24	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
44.26	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
48.29	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
52.31	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
56.34	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
60.36	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
64.38	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0
68.41	.00E 00	.0	.00E 00	.0	.0	.00E 00	.0	.0	.00E 00	.0	.0	.0

DISPLACEMENT RESPONSE SUMMARY FOR B/L # 37535E-04

(PHI0 = 0, PHI2 = 0, PHIY = 0.)

XF = 16.200 XR = 13.800 Y = (+) .558 Z = 1.210

HZ.	RESPONSES IN Z-DIRECTION				RESPONSES IN Y-DIRECTION			
	CORN 1	CORN 2	CORN 3	CORN 4	CORN 1	CORN 2	CORN 3	CORN 4
1.00	7.6E-02	7.6E-02	7.1E-02	7.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.10	4.8E-02	4.8E-02	5.3E-02	5.3E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.20	8.2E-02	8.2E-02	9.3E-02	9.3E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.30	1.0E-01	1.0E-01	1.2E-01	1.2E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.40	1.2E-01	1.2E-01	1.4E-01	1.4E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.50	1.3E-01	1.3E-01	1.4E-01	1.4E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.60	1.3E-01	1.3E-01	1.3E-01	1.3E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.70	1.1E-01	1.1E-01	1.1E-01	1.1E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.80	1.0E-01	1.0E-01	9.4E-02	9.4E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.91	8.8E-02	8.8E-02	8.0E-02	8.0E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.01	7.6E-02	7.6E-02	6.9E-02	6.9E-02	.0E 00	.0E 00	.0E 00	.0E 00
1.51	4.3E-02	4.3E-02	4.0E-02	4.0E-02	.0E 00	.0E 00	.0E 00	.0E 00
2.01	2.9E-02	2.9E-02	2.8E-02	2.8E-02	.0E 00	.0E 00	.0E 00	.0E 00
2.52	2.2E-02	2.2E-02	2.1E-02	2.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
3.02	1.8E-02	1.8E-02	1.7E-02	1.7E-02	.0E 00	.0E 00	.0E 00	.0E 00
3.52	1.5E-02	1.5E-02	1.4E-02	1.4E-02	.0E 00	.0E 00	.0E 00	.0E 00
4.02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	.0E 00	.0E 00	.0E 00	.0E 00
5.03	9.7E-03	9.7E-03	9.6E-03	9.6E-03	.0E 00	.0E 00	.0E 00	.0E 00
6.04	8.0E-03	8.0E-03	8.0E-03	8.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
7.04	6.8E-03	6.8E-03	6.9E-03	6.9E-03	.0E 00	.0E 00	.0E 00	.0E 00
8.05	6.0E-03	6.0E-03	6.0E-03	6.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
9.05	5.3E-03	5.3E-03	5.4E-03	5.4E-03	.0E 00	.0E 00	.0E 00	.0E 00
10.06	4.8E-03	4.8E-03	4.8E-03	4.8E-03	.0E 00	.0E 00	.0E 00	.0E 00
12.07	4.0E-03	4.0E-03	4.0E-03	4.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
14.08	3.5E-03	3.5E-03	3.5E-03	3.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
16.10	3.0E-03	3.0E-03	3.0E-03	3.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
20.12	2.4E-03	2.4E-03	2.4E-03	2.4E-03	.0E 00	.0E 00	.0E 00	.0E 00
24.14	2.0E-03	2.0E-03	2.0E-03	2.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
28.17	1.7E-03	1.7E-03	1.7E-03	1.7E-03	.0E 00	.0E 00	.0E 00	.0E 00
32.19	1.5E-03	1.5E-03	1.5E-03	1.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
36.22	1.3E-03	1.3E-03	1.3E-03	1.3E-03	.0E 00	.0E 00	.0E 00	.0E 00
40.24	1.2E-03	1.2E-03	1.2E-03	1.2E-03	.0E 00	.0E 00	.0E 00	.0E 00
44.26	1.1E-03	1.1E-03	1.1E-03	1.1E-03	.0E 00	.0E 00	.0E 00	.0E 00
48.29	1.0E-03	1.0E-03	1.0E-03	1.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
52.31	9.3E-04	9.3E-04	9.3E-04	9.3E-04	.0E 00	.0E 00	.0E 00	.0E 00
56.34	8.7E-04	8.7E-04	8.6E-04	8.6E-04	.0E 00	.0E 00	.0E 00	.0E 00
60.36	8.1E-04	8.1E-04	8.1E-04	8.1E-04	.0E 00	.0E 00	.0E 00	.0E 00
64.38	7.6E-04	7.6E-04	7.6E-04	7.6E-04	.0E 00	.0E 00	.0E 00	.0E 00
68.41	7.1E-04	7.1E-04	7.1E-04	7.1E-04	.0E 00	.0E 00	.0E 00	.0E 00

(PHI0 = 0, PHI2 = 0, PHIY = 8.)

GAP PSD (IN M+2/MZ FOR PHI=1.50E+06/H+2) FOR
 XF = 16,200 XR = 13,800 Y = (+-) .556 Z = 1.210

HZ.	PSD IN Z-DIRECTION				PSD IN Y-DIRECTION			
	CORN 1	CORN 2	CORN 3	CORN 4	CORN 1	CORN 2	CORN 3	CORN 4
00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
10	3.1E-05	3.1E-05	3.7E-05	3.7E-05	.0E 00	.0E 00	.0E 00	.0E 00
20	9.1E-05	9.1E-05	1.2E-04	1.2E-04	.0E 00	.0E 00	.0E 00	.0E 00
30	1.5E-04	1.5E-04	2.0E-04	2.0E-04	.0E 00	.0E 00	.0E 00	.0E 00
40	1.9E-04	1.9E-04	2.6E-04	2.6E-04	.0E 00	.0E 00	.0E 00	.0E 00
50	2.2E-04	2.2E-04	2.6E-04	2.6E-04	.0E 00	.0E 00	.0E 00	.0E 00
60	2.1E-04	2.1E-04	2.2E-04	2.2E-04	.0E 00	.0E 00	.0E 00	.0E 00
70	1.8E-04	1.8E-04	1.7E-04	1.7E-04	.0E 00	.0E 00	.0E 00	.0E 00
80	1.4E-04	1.4E-04	1.2E-04	1.2E-04	.0E 00	.0E 00	.0E 00	.0E 00
91	1.0E-04	1.0E-04	8.7E-05	8.7E-05	.0E 00	.0E 00	.0E 00	.0E 00
1.01	7.8E-05	7.8E-05	6.4E-05	6.4E-05	.0E 00	.0E 00	.0E 00	.0E 00
1.51	2.5E-05	2.5E-05	2.1E-05	2.1E-05	.0E 00	.0E 00	.0E 00	.0E 00
2.01	1.2E-05	1.2E-05	1.0E-05	1.0E-05	.0E 00	.0E 00	.0E 00	.0E 00
2.52	6.5E-06	6.5E-06	6.0E-06	6.0E-06	.0E 00	.0E 00	.0E 00	.0E 00
3.02	4.1E-06	4.1E-06	3.9E-06	3.9E-06	.0E 00	.0E 00	.0E 00	.0E 00
3.52	2.8E-06	2.8E-06	2.7E-06	2.7E-06	.0E 00	.0E 00	.0E 00	.0E 00
4.02	2.1E-06	2.1E-06	2.0E-06	2.0E-06	.0E 00	.0E 00	.0E 00	.0E 00
5.03	1.3E-06	1.3E-06	1.3E-06	1.3E-06	.0E 00	.0E 00	.0E 00	.0E 00
6.04	8.6E-07	8.6E-07	8.6E-07	8.6E-07	.0E 00	.0E 00	.0E 00	.0E 00
7.04	6.3E-07	6.3E-07	6.4E-07	6.4E-07	.0E 00	.0E 00	.0E 00	.0E 00
8.05	4.9E-07	4.9E-07	4.9E-07	4.9E-07	.0E 00	.0E 00	.0E 00	.0E 00
9.05	3.8E-07	3.8E-07	3.9E-07	3.9E-07	.0E 00	.0E 00	.0E 00	.0E 00
10.06	3.1E-07	3.1E-07	3.1E-07	3.1E-07	.0E 00	.0E 00	.0E 00	.0E 00
12.07	2.2E-07	2.2E-07	2.2E-07	2.2E-07	.0E 00	.0E 00	.0E 00	.0E 00
14.08	1.6E-07	1.6E-07	1.6E-07	1.6E-07	.0E 00	.0E 00	.0E 00	.0E 00
16.10	1.2E-07	1.2E-07	1.2E-07	1.2E-07	.0E 00	.0E 00	.0E 00	.0E 00
20.12	7.9E-08	7.9E-08	7.9E-08	7.9E-08	.0E 00	.0E 00	.0E 00	.0E 00
24.14	5.5E-08	5.5E-08	5.5E-08	5.5E-08	.0E 00	.0E 00	.0E 00	.0E 00
28.17	4.0E-08	4.0E-08	4.0E-08	4.0E-08	.0E 00	.0E 00	.0E 00	.0E 00
32.19	3.1E-08	3.1E-08	3.1E-08	3.1E-08	.0E 00	.0E 00	.0E 00	.0E 00
36.22	2.4E-08	2.4E-08	2.4E-08	2.4E-08	.0E 00	.0E 00	.0E 00	.0E 00
40.24	2.0E-08	2.0E-08	2.0E-08	2.0E-08	.0E 00	.0E 00	.0E 00	.0E 00
44.26	1.6E-08	1.6E-08	1.6E-08	1.6E-08	.0E 00	.0E 00	.0E 00	.0E 00
48.29	1.4E-08	1.4E-08	1.4E-08	1.4E-08	.0E 00	.0E 00	.0E 00	.0E 00
52.31	1.2E-08	1.2E-08	1.2E-08	1.2E-08	.0E 00	.0E 00	.0E 00	.0E 00
56.34	1.0E-08	1.0E-08	1.0E-08	1.0E-08	.0E 00	.0E 00	.0E 00	.0E 00
60.36	8.8E-09	8.8E-09	8.8E-09	8.8E-09	.0E 00	.0E 00	.0E 00	.0E 00
64.38	7.7E-09	7.7E-09	7.7E-09	7.7E-09	.0E 00	.0E 00	.0E 00	.0E 00
68.41	6.8E-09	6.8E-09	6.8E-09	6.8E-09	.0E 00	.0E 00	.0E 00	.0E 00
MEAN	1.3E-02	1.3E-02	1.4E-02	1.4E-02	.0E 00	.0E 00	.0E 00	.0E 00

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
(PHI0 = 0. PHI2 = 0. PHIY = 0.)

ACCELERATION (G-UNITS) FOR PASSENGERS LOCATED AT
XF = 8.200 XR = 11.200 Y = (+-)1.066 Z = -.390

FREQ HZ.	CORNER AMPL.	1 - Z PHASE	CORNER AMPL.	2 - Z PHASE	CORNER AMPL.	3 - Z PHASE	CORNER AMPL.	4 - Z PHASE
7.00	6.92E 02	-180.0	6.92E 02	-180.0	1.09E 03	7.0	1.09E 03	.0
7.10	4.44E-02	179.6	4.44E-02	179.6	4.47E-02	174.2	4.47E-02	174.2
7.20	2.03E-01	171.6	2.03E-01	171.6	2.07E-01	160.3	2.07E-01	160.3
7.30	4.98E-01	159.0	4.98E-01	159.0	5.19E-01	140.9	5.19E-01	140.9
7.40	9.12E-01	143.9	9.12E-01	143.9	9.60E-01	118.1	9.60E-01	118.1
7.50	1.38E 00	127.6	1.38E 00	127.6	1.42E 00	94.0	1.42E 00	94.0
7.60	1.78E 00	111.9	1.78E 00	111.9	1.77E 00	71.7	1.77E 00	71.7
7.70	2.06E 00	98.5	2.06E 00	98.5	1.97E 00	53.3	1.97E 00	53.3
7.80	2.22E 00	88.0	2.22E 00	88.0	2.07E 00	38.6	2.07E 00	38.6
7.91	2.30E 00	80.2	2.30E 00	80.2	2.13E 00	27.0	2.13E 00	27.0
1.01	2.33E 00	74.6	2.33E 00	74.6	2.16E 00	17.5	2.16E 00	17.5
1.51	2.30E 00	63.6	2.30E 00	63.6	2.27E 00	-13.7	2.27E 00	-13.7
2.01	2.22E 00	64.9	2.22E 00	64.9	2.39E 00	-33.1	2.39E 00	-33.1
2.52	2.13E 00	71.0	2.13E 00	71.0	2.52E 00	-47.7	2.52E 00	-47.7
3.02	2.06E 00	79.7	2.06E 00	79.7	2.63E 00	-59.7	2.63E 00	-59.7
3.52	2.01E 00	90.2	2.01E 00	90.2	2.69E 00	-70.2	2.69E 00	-70.2
4.02	1.99E 00	101.6	1.99E 00	101.6	2.72E 00	-79.9	2.72E 00	-79.9
5.03	2.03E 00	125.3	2.03E 00	125.3	2.62E 00	-98.5	2.62E 00	-98.5
6.04	2.16E 00	147.6	2.16E 00	147.6	2.37E 00	*139.0	2.37E 00	*139.0
7.04	2.28E 00	167.5	2.28E 00	167.5	2.09E 00	*144.3	2.09E 00	*144.3
8.05	2.33E 00	-174.0	2.33E 00	*174.0	1.95E 00	*174.8	1.95E 00	*174.8
9.05	2.29E 00	-155.3	2.29E 00	-155.3	2.08E 00	194.8	2.08E 00	194.8
10.06	2.17E 00	-134.9	2.17E 00	-134.9	2.36E 00	129.9	2.36E 00	129.9
12.07	1.98E 00	-86.2	1.98E 00	-86.2	2.70E 00	93.4	2.70E 00	93.4
14.08	2.16E 00	-37.0	2.16E 00	-37.0	2.36E 00	57.1	2.36E 00	57.1
16.10	2.33E 00	3.0	2.33E 00	3.0	1.95E 00	2.6	1.95E 00	2.6
20.12	1.98E 00	92.3	1.98E 00	92.3	2.70E 00	-88.0	2.70E 00	-88.0
24.14	2.33E 00	-178.0	2.33E 00	-178.0	1.95E 00	*178.3	1.95E 00	*178.3
28.17	1.98E 00	-88.4	1.98E 00	-88.4	2.70E 00	91.4	2.70E 00	91.4
32.19	2.33E 00	1.5	2.33E 00	1.5	1.95E 00	1.3	1.95E 00	1.3
36.22	1.98E 00	91.3	1.98E 00	91.3	2.70E 00	-88.9	2.70E 00	-88.9
40.24	2.33E 00	-178.8	2.33E 00	*178.8	1.95E 00	*179.0	1.95E 00	*179.0
44.26	1.98E 00	-89.0	1.98E 00	-89.0	2.70E 00	90.9	2.70E 00	90.9
48.29	2.33E 00	1.0	2.33E 00	1.0	1.95E 00	.9	1.95E 00	.9
52.31	1.98E 00	90.9	1.98E 00	90.9	2.70E 00	-89.2	2.70E 00	-89.2
56.34	2.33E 00	-179.1	2.33E 00	*179.1	1.95E 00	*179.3	1.95E 00	*179.3
60.36	1.98E 00	-89.2	1.98E 00	-89.2	2.70E 00	90.7	2.70E 00	90.7
64.38	2.33E 00	.8	2.33E 00	.8	1.95E 00	.7	1.95E 00	.7
68.41	1.98E 00	90.7	1.98E 00	90.7	2.70E 00	-89.4	2.70E 00	-89.4

TRANSFER FUNCTIONS FOR "UNIT" INPUTS
(PHIO = 0, PHIZ = 0, PHIX = 0.)

ACCELERATION (G-UNITS) FOR PASSENGERS LOCATED AT
XF = 8.200 XR = 11.200 Y = (+-)1.060 Z = -.390

FREQ HZ.	CORNER AMPL.	1 - Y PHASE	CORNER AMPL.	2 - Y PHASE	CORNER AMPL.	3 - Y PHASE	CORNER AMPL.	4 - Y PHASE
.00	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.10	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.20	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.30	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.40	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.50	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.60	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.70	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.80	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
.91	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
1.01	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
1.51	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
2.01	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
2.52	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
3.02	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
3.52	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
4.02	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
5.03	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
6.04	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
7.04	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
8.05	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
9.05	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
10.06	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
12.07	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
14.08	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
16.10	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
20.12	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
24.14	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
28.17	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
32.19	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
36.22	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
40.24	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
44.26	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
48.29	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
52.31	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
56.34	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
60.36	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
64.38	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0
68.41	.00E 00	-180.0	.00E 00	+180.0	.00E 00	-180.0	.00E 00	+180.0

(PHI0 = 0, PHI2 = 0, PHIY = 0.)

ACC. RESP. (G-UNITS FOR C/L=3.634E-04) FOR PASSENGERS AT
XF = 8,200 XR = 11,200 Y = (+)1.066 Z = 2.390

HZ.	RESPONSES IN Z-DIRECTION				RESPONSES IN Y-DIRECTION			
	CORN 1	CORN 2	CORN 3	CORN 4	CORN 1	CORN 2	CORN 3	CORN 4
00	6.9E-02	6.9E-02	1.1E-03	1.1E-03	.0E 00	.0E 00	.0E 00	.0E 00
10	2.1E-02	2.1E-02	2.2E-02	2.2E-02	.0E 00	.0E 00	.0E 00	.0E 00
20	4.9E-02	4.9E-02	5.0E-02	5.0E-02	.0E 00	.0E 00	.0E 00	.0E 00
30	8.0E-02	8.0E-02	8.4E-02	8.4E-02	.0E 00	.0E 00	.0E 00	.0E 00
40	1.1E-01	1.1E-01	1.2E-01	1.2E-01	.0E 00	.0E 00	.0E 00	.0E 00
50	1.3E-01	1.3E-01	1.4E-01	1.4E-01	.0E 00	.0E 00	.0E 00	.0E 00
60	1.4E-01	1.4E-01	1.4E-01	1.4E-01	.0E 00	.0E 00	.0E 00	.0E 00
70	1.4E-01	1.4E-01	1.4E-01	1.4E-01	.0E 00	.0E 00	.0E 00	.0E 00
80	1.3E-01	1.3E-01	1.3E-01	1.3E-01	.0E 00	.0E 00	.0E 00	.0E 00
91	1.2E-01	1.2E-01	1.1E-01	1.1E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.01	1.1E-01	1.1E-01	1.0E-01	1.0E-01	.0E 00	.0E 00	.0E 00	.0E 00
1.51	7.4E-02	7.4E-02	7.3E-02	7.3E-02	.0E 00	.0E 00	.0E 00	.0E 00
2.01	5.4E-02	5.4E-02	5.8E-02	5.8E-02	.0E 00	.0E 00	.0E 00	.0E 00
2.52	4.1E-02	4.1E-02	4.9E-02	4.9E-02	.0E 00	.0E 00	.0E 00	.0E 00
3.02	3.3E-02	3.3E-02	4.2E-02	4.2E-02	.0E 00	.0E 00	.0E 00	.0E 00
3.52	2.8E-02	2.8E-02	3.7E-02	3.7E-02	.0E 00	.0E 00	.0E 00	.0E 00
4.02	2.4E-02	2.4E-02	3.3E-02	3.3E-02	.0E 00	.0E 00	.0E 00	.0E 00
5.03	2.0E-02	2.0E-02	2.5E-02	2.5E-02	.0E 00	.0E 00	.0E 00	.0E 00
6.04	1.7E-02	1.7E-02	1.9E-02	1.9E-02	.0E 00	.0E 00	.0E 00	.0E 00
7.04	1.6E-02	1.6E-02	1.4E-02	1.4E-02	.0E 00	.0E 00	.0E 00	.0E 00
8.05	1.4E-02	1.4E-02	1.2E-02	1.2E-02	.0E 00	.0E 00	.0E 00	.0E 00
9.05	1.2E-02	1.2E-02	1.1E-02	1.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
10.06	1.0E-02	1.0E-02	1.1E-02	1.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
12.07	8.0E-03	8.0E-03	1.1E-02	1.1E-02	.0E 00	.0E 00	.0E 00	.0E 00
14.08	7.5E-03	7.5E-03	8.2E-03	8.2E-03	.0E 00	.0E 00	.0E 00	.0E 00
16.10	7.1E-03	7.1E-03	5.9E-03	5.9E-03	.0E 00	.0E 00	.0E 00	.0E 00
20.12	4.8E-03	4.8E-03	6.5E-03	6.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
24.14	4.7E-03	4.7E-03	3.9E-03	3.9E-03	.0E 00	.0E 00	.0E 00	.0E 00
28.17	3.4E-03	3.4E-03	4.7E-03	4.7E-03	.0E 00	.0E 00	.0E 00	.0E 00
32.19	3.5E-03	3.5E-03	3.0E-03	3.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
36.22	2.7E-03	2.7E-03	3.6E-03	3.6E-03	.0E 00	.0E 00	.0E 00	.0E 00
40.24	2.8E-03	2.8E-03	2.4E-03	2.4E-03	.0E 00	.0E 00	.0E 00	.0E 00
44.26	2.2E-03	2.2E-03	3.0E-03	3.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
48.29	2.4E-03	2.4E-03	2.0E-03	2.0E-03	.0E 00	.0E 00	.0E 00	.0E 00
52.31	1.8E-03	1.8E-03	2.5E-03	2.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
56.34	2.0E-03	2.0E-03	1.7E-03	1.7E-03	.0E 00	.0E 00	.0E 00	.0E 00
60.36	1.6E-03	1.6E-03	2.2E-03	2.2E-03	.0E 00	.0E 00	.0E 00	.0E 00
64.38	1.8E-03	1.8E-03	1.5E-03	1.5E-03	.0E 00	.0E 00	.0E 00	.0E 00
68.41	1.4E-03	1.4E-03	1.9E-03	1.9E-03	.0E 00	.0E 00	.0E 00	.0E 00

(PHIO = 0, PHIZ = 0, PHIY = 0.)

ACC. PSD (IN G²/HZ FOR PHI=1.50E-06/W+2) FOR PASSENGERS AT
XF = 8.200 XR = 11.200 Y = (+-)1.068 Z = -.390

HZ.	PSD IN Z-DIRECTION				PSD IN Y-DIRECTION			
	CORN 1	CORN 2	CORN 3	CORN 4	CORN 1	CORN 2	CORN 3	CORN 4
00	00E 00	00E 00	00E 00	00E 00	00E 00	00E 00	00E 00	00E 00
10	6.2E-06	6.2E-06	6.3E-06	6.3E-06	00E 00	00E 00	00E 00	00E 00
20	3.2E-05	3.2E-05	3.4E-05	3.4E-05	00E 00	00E 00	00E 00	00E 00
30	8.7E-05	8.7E-05	9.5E-05	9.5E-05	00E 00	00E 00	00E 00	00E 00
40	1.6E-04	1.6E-04	1.8E-04	1.8E-04	00E 00	00E 00	00E 00	00E 00
50	2.4E-04	2.4E-04	2.5E-04	2.5E-04	00E 00	00E 00	00E 00	00E 00
60	2.8E-04	2.8E-04	2.7E-04	2.7E-04	00E 00	00E 00	00E 00	00E 00
70	2.7E-04	2.7E-04	2.5E-04	2.5E-04	00E 00	00E 00	00E 00	00E 00
80	2.4E-04	2.4E-04	2.1E-04	2.1E-04	00E 00	00E 00	00E 00	00E 00
91	2.1E-04	2.1E-04	1.8E-04	1.8E-04	00E 00	00E 00	00E 00	00E 00
101	1.7E-04	1.7E-04	1.5E-04	1.5E-04	00E 00	00E 00	00E 00	00E 00
151	7.5E-05	7.5E-05	7.2E-05	7.2E-05	00E 00	00E 00	00E 00	00E 00
201	3.9E-05	3.9E-05	4.5E-05	4.5E-05	00E 00	00E 00	00E 00	00E 00
252	2.3E-05	2.3E-05	3.2E-05	3.2E-05	00E 00	00E 00	00E 00	00E 00
302	1.5E-05	1.5E-05	2.4E-05	2.4E-05	00E 00	00E 00	00E 00	00E 00
352	1.0E-05	1.0E-05	1.9E-05	1.9E-05	00E 00	00E 00	00E 00	00E 00
402	7.8E-06	7.8E-06	1.5E-05	1.5E-05	00E 00	00E 00	00E 00	00E 00
503	5.2E-06	5.2E-06	8.7E-06	8.7E-06	00E 00	00E 00	00E 00	00E 00
604	4.1E-06	4.1E-06	4.9E-06	4.9E-06	00E 00	00E 00	00E 00	00E 00
704	3.4E-06	3.4E-06	2.8E-06	2.8E-06	00E 00	00E 00	00E 00	00E 00
805	2.7E-06	2.7E-06	1.9E-06	1.9E-06	00E 00	00E 00	00E 00	00E 00
905	2.0E-06	2.0E-06	1.7E-06	1.7E-06	00E 00	00E 00	00E 00	00E 00
1006	1.5E-06	1.5E-06	1.8E-06	1.8E-06	00E 00	00E 00	00E 00	00E 00
1207	8.6E-07	8.6E-07	1.6E-06	1.6E-06	00E 00	00E 00	00E 00	00E 00
1408	7.5E-07	7.5E-07	9.0E-07	9.0E-07	00E 00	00E 00	00E 00	00E 00
1611	6.7E-07	6.7E-07	4.7E-07	4.7E-07	00E 00	00E 00	00E 00	00E 00
2012	3.1E-07	3.1E-07	5.8E-07	5.8E-07	00E 00	00E 00	00E 00	00E 00
2414	3.0E-07	3.0E-07	2.1E-07	2.1E-07	00E 00	00E 00	00E 00	00E 00
2817	1.6E-07	1.6E-07	2.9E-07	2.9E-07	00E 00	00E 00	00E 00	00E 00
3219	1.7E-07	1.7E-07	1.2E-07	1.2E-07	00E 00	00E 00	00E 00	00E 00
3622	9.5E-08	9.5E-08	1.8E-07	1.8E-07	00E 00	00E 00	00E 00	00E 00
4024	1.1E-07	1.1E-07	7.5E-08	7.5E-08	00E 00	00E 00	00E 00	00E 00
4426	6.4E-08	6.4E-08	1.2E-07	1.2E-07	00E 00	00E 00	00E 00	00E 00
4829	7.4E-08	7.4E-08	5.2E-08	5.2E-08	00E 00	00E 00	00E 00	00E 00
5231	4.6E-08	4.6E-08	8.5E-08	8.5E-08	00E 00	00E 00	00E 00	00E 00
5634	5.5E-08	5.5E-08	3.8E-08	3.8E-08	00E 00	00E 00	00E 00	00E 00
6036	3.4E-08	3.4E-08	6.4E-08	6.4E-08	00E 00	00E 00	00E 00	00E 00
6438	4.2E-08	4.2E-08	2.9E-08	2.9E-08	00E 00	00E 00	00E 00	00E 00
6841	2.7E-08	2.7E-08	5.0E-08	5.0E-08	00E 00	00E 00	00E 00	00E 00
MEAN	1.8E-02	1.8E-02	1.8E-02	1.8E-02	00E 00	00E 00	00E 00	00E 00

SAMPLE RUN FOR "SNAKING" TYPE IRREGULARITY

*RUN VHDYN1

MAX TRACK IRREG. AMPL.:US:VA:HS:HA: = 20,0,10,0
WHAT'S THE FREAK FILENAME ?DATA1
NUMBERS OF POINTS = 39
PH10, PH12, PH1Y, V = 20,0,0,134

JOB DONE, LIST FILE (OUT1); 19= 39

READY

*RUN VHDYN2

WHAT'S THE FREAK FILENAME ?DATA1
PH10, PH12, PH1Y, V = 20,0,0,134
INPUT VALUES OF A2,A3,B2,C5 16.2,13.8,.55,1.21
INPUT VALUES OF A2,A3,B2,C5 8.2,11.2,1.06,-.39

JOB DONE LIST FILE (OUT1); 19 = 39

READY

*SYSTEM CARD

OLD OR NEW-0 OUT1;INT6

READY

*BPRINT *

\$ IDENT 2L631320,WAN

LABELS?

TAB CHARACTERS AND SETTING?

SNUMB # 0879T

*

CONTROL CURRENT AND POWER SUMMARY
(PH10 = 0, PH12 = 0, PH1Y = 0.)

XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

FREQ HZ.	TOTAL AMPL.	CURRENT PHASE	(RESP. /HZ)	PSD)	POWER W/M+2	(RESP. W)	PSD)
							W/HZ
.00	.00E 00	.0	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
.10	4.19E-09	-90.0	2.0E-09	5.6E-20	33.7E 02	79.0E 01	10.6E 00
.20	7.45E-09	-90.0	1.8E-09	4.4E-20	10.9E 03	64.0E 01	36.2E-01
.30	1.07E-08	-90.0	1.7E-09	4.0E-20	-8.0E 03	-2.1E 02	-2.8E 00
.40	7.45E-08	-90.0	9.0E-09	1.1E-18	-1.7E 04	-2.4E 02	-3.3E 00
.50	1.74E-07	-90.0	1.0E-08	1.4E-18	49.2E 04	46.2E 02	62.3E 00
.60	1.04E-07	-90.0	3.4E-09	9.6E-19	24.1E 05	15.7E 03	21.2E 01
.70	1.06E-06	-169.5	7.3E-08	7.3E-17	43.0E 05	20.6E 03	27.8E 01
.80	2.01E-07	-90.0	1.2E-08	2.0E-18	51.5E 05	18.9E 03	25.4E 01
.91	2.01E-07	-90.0	1.1E-08	1.6E-18	54.2E 05	15.7E 03	21.2E 01
1.01	2.68E-07	-90.0	1.3E-08	2.3E-18	54.1E 05	12.7E 03	17.1E 01
1.51	9.69E-08	-90.0	3.1E-09	1.3E-19	26.7E 05	27.8E 02	37.5E 00
2.01	5.96E-08	-90.0	1.4E-09	2.8E-20	19.8E 05	11.6E 02	15.7E 00
2.52	2.98E-07	-90.0	5.8E-09	4.5E-19	14.2E 05	53.3E 01	71.8E-01
3.02	2.98E-07	-90.0	4.8E-09	3.1E-19	10.0E 05	26.1E 01	35.2E-01
3.52	5.07E-07	-90.0	7.0E-09	6.6E-19	71.0E 04	13.6E 01	18.3E-01
4.02	5.96E-07	-90.0	7.2E-09	7.0E-19	50.6E 04	74.2E 00	99.9E-02
5.03	5.36E-07	-90.0	5.2E-09	3.6E-19	31.2E 04	29.2E 00	39.4E-02
6.04	2.98E-07	-90.0	2.4E-09	7.8E-20	25.3E 04	16.5E 00	22.2E-02
7.04	2.38E-07	-90.0	1.6E-09	3.7E-20	25.7E 04	12.3E 00	16.6E-02
8.05	1.15E-07	-90.0	7.0E-10	6.6E-21	27.4E 04	10.1E 00	13.5E-02
9.05	1.34E-07	-90.0	7.2E-10	7.0E-21	26.7E 04	77.3E-01	10.4E-02
10.06	2.68E-07	-90.0	1.3E-09	2.3E-20	21.9E 04	51.3E-01	59.2E-03
12.07	2.38E-07	-90.0	9.6E-10	1.2E-20	56.1E 03	91.4E-02	12.3E-03
14.08	2.68E-07	-90.0	9.3E-10	1.2E-20	-6.6E 03	-7.9E-02	-1.1E-03
16.10	2.24E-08	-90.0	6.8E-11	6.2E-23	65.4E 03	59.9E-02	80.7E-04
20.12	5.96E-07	-90.0	1.4E-09	2.8E-20	20.3E 03	11.9E-02	16.1E-04
24.14	7.45E-09	-90.0	1.5E-11	3.0E-24	44.3E 03	18.0E-02	24.3E-04
28.17	2.38E-07	-90.0	4.1E-10	2.3E-21	10.3E 03	30.9E-03	41.7E-05
32.19	2.24E-08	-90.0	3.4E-11	1.5E-23	21.7E 03	49.8E-03	57.1E-05
36.22	1.61E-06	-89.6	2.2E-09	6.3E-20	62.5E 02	11.3E-03	15.2E-05
40.24	2.79E-09	-90.0	3.4E-12	1.5E-25	12.6E 03	18.5E-03	25.0E-05
44.26	2.38E-07	-90.0	2.6E-10	9.3E-22	41.8E 02	50.6E-04	68.2E-06
48.29	1.12E-08	-90.0	1.1E-11	1.7E-24	81.8E 02	83.3E-04	11.2E-05
52.31	5.96E-07	-90.0	5.6E-10	4.2E-21	29.9E 02	25.9E-04	34.9E-06
56.34	1.86E-09	-90.0	1.6E-12	3.5E-26	56.9E 02	42.6E-04	57.4E-06
60.36	7.75E-07	-90.0	6.3E-10	5.3E-21	22.4E 02	14.6E-04	19.7E-06
64.38	5.59E-09	-90.0	4.2E-12	2.4E-25	41.8E 02	23.9E-04	32.2E-06
68.41	5.96E-07	-90.0	4.2E-10	2.4E-21	17.4E 02	88.5E-05	11.9E-06
MEAN				3.3E-09			1.8E 02

(PHI0 = 0. PHI2 = 0. PHIY = 0.)

GAP PSD (IN M*2/HZ FOR PHI=1.50E-06/W+2) FOR
 XF = 9.000 XR = 7.650 Y = (+-) .965 Z = 1.210

HZ	PSD IN Z-DIRECTION				PSD IN Y-DIRECTION			
	COIL 1	COIL 2	COIL 3	COIL 4	COIL 1	COIL 2	COIL 3	COIL 4
.00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
.10	1.5E-06	1.5E-06	1.5E-06	1.5E-06	6.0E-07	6.0E-07	8.8E-07	8.8E-07
.20	6.6E-06	6.6E-06	6.6E-06	6.6E-06	9.7E-07	9.7E-07	1.2E-06	1.2E-06
.30	1.8E-05	1.8E-05	1.8E-05	1.8E-05	5.2E-06	5.2E-06	2.0E-06	2.0E-06
.40	4.1E-05	4.1E-05	4.1E-05	4.1E-05	2.6E-05	2.6E-05	1.1E-05	1.1E-05
.50	8.1E-05	8.1E-05	8.1E-05	8.1E-05	9.1E-05	9.1E-05	5.0E-05	5.0E-05
.60	1.0E-04	1.0E-04	1.0E-04	1.0E-04	1.7E-04	1.7E-04	1.1E-04	1.1E-04
.70	7.1E-05	7.1E-05	7.1E-05	7.1E-05	1.8E-04	1.8E-04	1.2E-04	1.2E-04
.80	4.2E-05	4.2E-05	4.2E-05	4.2E-05	1.5E-04	1.5E-04	1.1E-04	1.1E-04
.91	2.4E-05	2.4E-05	2.4E-05	2.4E-05	1.2E-04	1.2E-04	8.5E-05	8.5E-05
1.01	1.4E-05	1.4E-05	1.4E-05	1.4E-05	9.3E-05	9.3E-05	6.9E-05	6.9E-05
1.51	4.8E-07	4.8E-07	4.8E-07	4.8E-07	2.5E-05	2.5E-05	2.6E-05	2.6E-05
2.01	8.6E-08	8.6E-08	8.6E-08	8.6E-08	1.3E-05	1.3E-05	1.1E-05	1.1E-05
2.52	1.7E-08	1.7E-08	1.7E-08	1.7E-08	7.4E-06	7.4E-06	6.4E-06	6.4E-06
3.02	3.9E-09	3.9E-09	3.9E-09	3.9E-09	4.7E-06	4.7E-06	4.2E-06	4.2E-06
3.52	1.4E-09	1.4E-09	1.4E-09	1.4E-09	3.3E-06	3.3E-06	3.0E-06	3.0E-06
4.02	1.0E-09	1.0E-09	1.0E-09	1.0E-09	2.4E-06	2.4E-06	2.2E-06	2.2E-06
5.03	7.7E-10	7.7E-10	7.7E-10	7.7E-10	1.4E-06	1.4E-06	1.4E-06	1.4E-06
6.04	5.5E-10	5.5E-10	5.5E-10	5.5E-10	9.8E-07	9.8E-07	9.7E-07	9.7E-07
7.04	3.2E-10	3.2E-10	3.2E-10	3.2E-10	7.0E-07	7.0E-07	7.0E-07	7.0E-07
8.05	1.6E-10	1.6E-10	1.6E-10	1.6E-10	5.3E-07	5.3E-07	5.3E-07	5.3E-07
9.05	6.3E-11	6.3E-11	6.3E-11	6.3E-11	4.1E-07	4.1E-07	4.1E-07	4.1E-07
10.06	2.0E-11	2.0E-11	2.0E-11	2.0E-11	3.3E-07	3.3E-07	3.2E-07	3.2E-07
12.07	1.4E-12	1.4E-12	1.4E-12	1.4E-12	2.3E-07	2.3E-07	2.2E-07	2.2E-07
14.08	3.3E-12	3.3E-12	3.3E-12	3.3E-12	1.6E-07	1.6E-07	1.6E-07	1.6E-07
16.10	2.5E-12	2.5E-12	2.5E-12	2.5E-12	1.3E-07	1.3E-07	1.3E-07	1.3E-07
20.12	6.3E-14	6.3E-14	6.3E-14	6.3E-14	8.0E-08	8.0E-08	7.9E-08	7.9E-08
24.14	2.1E-13	2.1E-13	2.1E-13	2.1E-13	5.5E-08	5.5E-08	5.5E-08	5.5E-08
28.17	8.6E-15	8.6E-15	8.6E-15	8.6E-15	4.1E-08	4.1E-08	4.0E-08	4.0E-08
32.19	3.9E-14	3.9E-14	3.9E-14	3.9E-14	3.1E-08	3.1E-08	3.1E-08	3.1E-08
36.22	1.9E-15	1.9E-15	1.9E-15	1.9E-15	2.4E-08	2.4E-08	2.4E-08	2.4E-08
40.24	1.0E-14	1.0E-14	1.0E-14	1.0E-14	2.0E-08	2.0E-08	2.0E-08	2.0E-08
44.26	5.7E-16	5.7E-16	5.7E-16	5.7E-16	1.6E-08	1.6E-08	1.6E-08	1.6E-08
48.29	3.4E-15	3.4E-15	3.4E-15	3.4E-15	1.4E-08	1.4E-08	1.4E-08	1.4E-08
52.31	2.1E-16	2.1E-16	2.1E-16	2.1E-16	1.2E-08	1.2E-08	1.2E-08	1.2E-08
56.34	1.3E-15	1.3E-15	1.3E-15	1.3E-15	1.0E-08	1.0E-08	1.0E-08	1.0E-08
60.36	8.9E-17	8.9E-17	8.9E-17	8.9E-17	8.8E-09	8.8E-09	8.8E-09	8.8E-09
64.38	6.1E-16	6.1E-16	6.1E-16	6.1E-16	7.7E-09	7.7E-09	7.7E-09	7.7E-09
68.41	4.2E-17	4.2E-17	4.2E-17	4.2E-17	6.8E-09	6.8E-09	6.8E-09	6.8E-09
MEAN	6.4E-03	6.4E-03	6.4E-03	6.4E-03	1.1E-02	1.1E-02	1.0E-02	1.0E-02

(PHI0 = 0. PHI2 = 0. PHIY = 0.)

GAP PSD (IN M+2/WZ FOR PHI=1.50E-06/W+2) FOR
 XF = 16.200 XR = 13.800 Y = (+-) .550 Z = +1.210

HZ.	PSD IN Z-DIRECTION				PSD IN Y-DIRECTION			
	CORN 1	CORN 2	CORN 3	CORN 4	CORN 1	CORN 2	CORN 3	CORN 4
00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
10	5.0E-07	5.0E-07	5.0E-07	5.0E-07	6.3E-07	6.3E-07	1.1E-06	1.1E-06
20	2.1E-06	2.1E-06	2.1E-06	2.1E-06	1.6E-06	1.6E-06	1.8E-06	1.8E-06
30	5.7E-06	5.7E-06	5.7E-06	5.7E-06	9.3E-06	9.3E-06	2.4E-06	2.4E-06
40	1.3E-05	1.3E-05	1.3E-05	1.3E-05	4.1E-05	4.1E-05	1.0E-05	1.0E-05
50	2.6E-05	2.6E-05	2.6E-05	2.6E-05	1.3E-04	1.3E-04	4.6E-05	4.6E-05
60	3.2E-05	3.2E-05	3.2E-05	3.2E-05	2.3E-04	2.3E-04	1.0E-04	1.0E-04
70	2.3E-05	2.3E-05	2.3E-05	2.3E-05	2.4E-04	2.4E-04	1.2E-04	1.2E-04
80	1.4E-05	1.4E-05	1.4E-05	1.4E-05	2.0E-04	2.0E-04	1.1E-04	1.1E-04
91	7.8E-06	7.8E-06	7.8E-06	7.8E-06	1.6E-04	1.6E-04	8.7E-05	8.7E-05
101	4.6E-06	4.6E-06	4.6E-06	4.6E-06	1.3E-04	1.3E-04	7.1E-05	7.1E-05
151	1.6E-07	1.6E-07	1.6E-07	1.6E-07	3.6E-05	3.6E-05	3.0E-05	3.0E-05
201	2.8E-08	2.8E-08	2.8E-08	2.8E-08	1.9E-05	1.9E-05	1.3E-05	1.3E-05
252	5.7E-09	5.7E-09	5.7E-09	5.7E-09	1.0E-05	1.0E-05	6.8E-06	6.8E-06
302	1.3E-09	1.3E-09	1.3E-09	1.3E-09	6.0E-06	6.0E-06	4.3E-06	4.3E-06
352	4.5E-10	4.5E-10	4.5E-10	4.5E-10	3.8E-06	3.8E-06	2.9E-06	2.9E-06
402	3.4E-10	3.4E-10	3.4E-10	3.4E-10	2.6E-06	2.6E-06	2.1E-06	2.1E-06
503	2.5E-10	2.5E-10	2.5E-10	2.5E-10	1.3E-06	1.3E-06	1.3E-06	1.3E-06
604	1.3E-10	1.8E-10	1.3E-10	1.8E-10	8.5E-07	8.5E-07	8.4E-07	8.4E-07
704	1.0E-10	1.0E-10	1.0E-10	1.0E-10	6.1E-07	6.1E-07	6.1E-07	6.1E-07
805	5.0E-11	5.0E-11	5.0E-11	5.0E-11	4.6E-07	4.6E-07	4.7E-07	4.7E-07
905	2.0E-11	2.0E-11	2.0E-11	2.0E-11	3.7E-07	3.7E-07	3.7E-07	3.7E-07
1006	6.4E-12	6.4E-12	6.4E-12	6.4E-12	3.0E-07	3.0E-07	3.0E-07	3.0E-07
1207	4.5E-13	4.5E-13	4.5E-13	4.5E-13	2.1E-07	2.1E-07	2.1E-07	2.1E-07
1408	1.1E-12	1.1E-12	1.1E-12	1.1E-12	1.6E-07	1.6E-07	1.6E-07	1.6E-07
1610	8.0E-13	8.0E-13	8.0E-13	8.0E-13	1.2E-07	1.2E-07	1.2E-07	1.2E-07
2012	2.1E-14	2.1E-14	2.1E-14	2.1E-14	8.0E-08	8.0E-08	8.0E-08	8.0E-08
2414	7.0E-14	7.0E-14	7.0E-14	7.0E-14	5.5E-08	5.5E-08	5.5E-08	5.5E-08
2817	2.8E-15	2.8E-15	2.8E-15	2.8E-15	4.0E-08	4.0E-08	4.0E-08	4.0E-08
3219	1.3E-14	1.3E-14	1.3E-14	1.3E-14	3.1E-08	3.1E-08	3.1E-08	3.1E-08
3622	6.2E-16	6.2E-16	6.2E-16	6.2E-16	2.5E-08	2.5E-08	2.4E-08	2.4E-08
4024	3.3E-15	3.3E-15	3.3E-15	3.3E-15	2.0E-08	2.0E-08	2.0E-08	2.0E-08
4426	1.9E-16	1.9E-16	1.9E-16	1.9E-16	1.6E-08	1.6E-08	1.6E-08	1.6E-08
4829	1.1E-15	1.1E-15	1.1E-15	1.1E-15	1.4E-08	1.4E-08	1.4E-08	1.4E-08
5231	6.8E-17	6.8E-17	6.8E-17	6.8E-17	1.2E-08	1.2E-08	1.2E-08	1.2E-08
5634	4.4E-16	4.4E-16	4.4E-16	4.4E-16	1.0E-08	1.0E-08	1.0E-08	1.0E-08
6036	2.9E-17	2.9E-17	2.9E-17	2.9E-17	8.8E-09	8.8E-09	8.8E-09	8.8E-09
6438	2.0E-16	2.0E-16	2.0E-16	2.0E-16	7.7E-09	7.7E-09	7.7E-09	7.7E-09
6841	1.4E-17	1.4E-17	1.4E-17	1.4E-17	6.3E-09	6.3E-09	6.3E-09	6.3E-09
MEAN	3.6E-03	3.6E-03	3.6E-03	3.6E-03	1.3E-02	1.3E-02	1.0E-02	1.0E-02

(PHI0 = 0, PHI2 = 0, PHIY = 0.)

ACC. PSD (IN G²/HZ FOR PHI=1.50E-06/W+2) FOR PASSENGERS AT
 XF = 8,200 XR = 11,200 Y = (+-)1.060 Z = -.390

HZ.	PSD IN Z-DIRECTION				PSD IN Y-DIRECTION			
	CORN 1	CORN 2	CORN 3	CORN 4	CORN 1	CORN 2	CORN 3	CORN 4
.00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00	.0E 00
.10	3.1E-09	3.1E-09	3.1E-09	3.1E-09	5.6E-06	5.6E-06	5.6E-06	5.6E-06
.20	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.9E-05	2.9E-05	2.9E-05	2.9E-05
.30	2.9E-06	2.9E-06	2.9E-06	2.9E-06	1.0E-04	1.0E-04	9.9E-05	9.9E-05
.40	2.1E-05	2.1E-05	2.1E-05	2.1E-05	3.0E-04	3.0E-04	3.1E-04	3.1E-04
.50	1.0E-04	1.0E-04	1.0E-04	1.0E-04	7.3E-04	7.3E-04	8.4E-04	8.4E-04
.60	2.6E-04	2.6E-04	2.6E-04	2.6E-04	1.0E-03	1.0E-03	1.5E-03	1.5E-03
.70	3.4E-04	3.4E-04	3.4E-04	3.4E-04	8.2E-04	8.2E-04	1.6E-03	1.6E-03
.80	3.4E-04	3.4E-04	3.4E-04	3.4E-04	5.2E-04	5.2E-04	1.3E-03	1.3E-03
.91	3.2E-04	3.2E-04	3.2E-04	3.2E-04	3.2E-04	3.2E-04	1.2E-03	1.2E-03
1.01	2.8E-04	2.8E-04	2.8E-04	2.8E-04	2.0E-04	2.0E-04	1.0E-03	1.0E-03
1.51	4.9E-05	4.9E-05	4.9E-05	4.9E-05	6.2E-05	6.2E-05	5.7E-04	5.7E-04
2.01	2.8E-05	2.8E-05	2.8E-05	2.8E-05	7.9E-05	7.9E-05	3.7E-04	3.7E-04
2.52	1.4E-05	1.4E-05	1.4E-05	1.4E-05	8.3E-05	8.3E-05	2.7E-04	2.7E-04
3.02	6.3E-06	6.3E-06	6.3E-06	6.3E-06	7.9E-05	7.9E-05	2.0E-04	2.0E-04
3.52	4.2E-06	4.2E-06	4.2E-06	4.2E-06	7.0E-05	7.0E-05	1.6E-04	1.6E-04
4.02	5.3E-06	5.3E-06	5.3E-06	5.3E-06	5.9E-05	5.9E-05	1.2E-04	1.2E-04
5.03	9.6E-06	9.6E-06	9.6E-06	9.6E-06	3.7E-05	3.7E-05	5.7E-05	5.7E-05
6.04	1.4E-05	1.4E-05	1.4E-05	1.4E-05	1.8E-05	1.8E-05	2.1E-05	2.1E-05
7.04	1.5E-05	1.5E-05	1.5E-05	1.5E-05	6.9E-06	6.9E-06	4.2E-06	4.2E-06
8.05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	2.5E-06	2.5E-06	8.7E-07	8.7E-07
9.05	8.2E-06	8.2E-06	8.2E-06	8.2E-06	2.7E-06	2.7E-06	5.2E-06	5.2E-06
10.06	4.0E-06	4.0E-06	4.0E-06	4.0E-06	4.7E-06	4.7E-06	1.1E-05	1.1E-05
12.07	5.8E-07	5.8E-07	5.8E-07	5.8E-07	6.3E-06	6.3E-06	1.3E-05	1.3E-05
14.08	2.5E-06	2.5E-06	2.5E-06	2.5E-06	2.9E-06	2.9E-06	4.6E-06	4.6E-06
16.10	3.2E-06	3.2E-06	3.2E-06	3.2E-06	5.9E-07	5.9E-07	1.7E-07	1.7E-07
20.12	2.0E-07	2.0E-07	2.0E-07	2.0E-07	2.2E-06	2.2E-06	4.8E-06	4.8E-06
24.14	1.4E-06	1.4E-06	1.4E-06	1.4E-06	2.6E-07	2.6E-07	7.5E-08	7.5E-08
28.17	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-06	1.1E-06	2.4E-06	2.4E-06
32.19	8.1E-07	8.1E-07	8.1E-07	8.1E-07	1.5E-07	1.5E-07	4.1E-08	4.1E-08
36.22	6.4E-08	6.4E-08	6.4E-08	6.4E-08	6.9E-07	6.9E-07	1.5E-06	1.5E-06
40.24	5.2E-07	5.2E-07	5.2E-07	5.2E-07	9.3E-08	9.3E-08	2.6E-08	2.6E-08
44.26	4.3E-08	4.3E-08	4.3E-08	4.3E-08	4.6E-07	4.6E-07	9.9E-07	9.9E-07
48.29	3.6E-07	3.6E-07	3.6E-07	3.6E-07	6.4E-08	6.4E-08	1.8E-08	1.8E-08
52.31	3.1E-08	3.1E-08	3.1E-08	3.1E-08	3.3E-07	3.3E-07	7.1E-07	7.1E-07
56.34	2.7E-07	2.7E-07	2.7E-07	2.7E-07	4.7E-08	4.7E-08	1.3E-08	1.3E-08
60.36	2.3E-08	2.3E-08	2.3E-08	2.3E-08	2.5E-07	2.5E-07	5.3E-07	5.3E-07
64.38	2.0E-07	2.0E-07	2.0E-07	2.0E-07	3.6E-08	3.6E-08	9.9E-09	9.9E-09
68.41	1.8E-08	1.8E-08	1.8E-08	1.8E-08	1.9E-07	1.9E-07	4.2E-07	4.2E-07
MEAN	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.8E-02	2.8E-02	4.5E-02	4.5E-02

PROGRAM "STAB"

```

10 DIM A(25),B(25),C(25),P(20),Q(20),X(25),A3(3,3),G7(6,6)
20 DIM A1(3,3),B1(4),C1(4),D1(4),A2(3,3),B2(4),C2(4),D2(4),M1(1)
30 DIM K9(1,15),T9(1,4),F(3,3),G(3,3),F0(3,3),F1(3,3),F2(3,3),F3(3,3)
40 DIM F4(3,3),F5(3,3),F6(3,3),F7(6,6),F8(6,2),F9(3,3),L0(6,2),E(3,3)
50 FILES INPUT1;INPUT2;OUTPUT;INPUT4;INPUT5
60 PRINT"MASS PROPERTY INPUT DATA FILENAME";\INPUT A$
70 PRINT"LAT. AND LONG. COEF. DATA FILENAME"; \ INPUT B$
80 PRINT"CONTROL GAINS AND T.C.S INPUT DATA FILENAME";\INPUT D$
90 PRINT"CONTROL GAIN DATA FILENAME";\INPUT E$
100 PRINT"OUTPUT FILE NAME"; \ INPUT F$
110 FILE #1,A$\FILE #2,B$\FILE #3,F3\FILE #4,D$\FILE #5,E$
120 SCRATCH #3
130 READ #1,M2,A1,B1,C1,A2,A3,B2,C2,C3
140 READ #2, O1,O2,O3
150 MAT REAL #3, A1,B1,C1,D1
160 MAT READ #2,A2,B2,C2,L2,M1
170 MAT REAL #4,K9,T9
180 A4=2*(A2+A3)\A5=2*(A2-A3)\PRINT"MAX K9(1,8)= ";\INPUT H
190 PRINT\PRINT"TYPE 2 FOR LONG. PROB., 3 FOR LAT. PROB.:";
200 INPUT N \ N1=N
210 MAT A3=ZER(N,N)\ MAT I=ZER(N,N)\ MAT F=ZER(N,N)\ MAT F0=ZER(N,N)
220 MAT F1=ZER(N,N)\MAT F2=ZER(N,N)\MAT F3=ZER(N,N)\MAT F4=ZER(N,N)
230 MAT F5=ZER(N,N)\MAT F6=ZER(N,N)\MAT F9=ZER(N,N)\MAT E=ZER(N,N)
240 MAT G=ZER(N,N)
250 IF END #5 THEN 1840\ FOR I=1 TO 5 \ READ #5, K(I) \ NEXT I
260 GOSUB 1630
270 GOSUB 1620\ K8=K8+1 \ I9=I9+1
280 M=4*N1 \ IF N1>2 THEN 440
290 FOR I=1 TO 2 \FORJ=1 TO 2\A3(I,J)=A2(I+1,J+1)\NEXTJ\NEXTI
300 I(1,1)=M2\I(2,2)=B1
310 WRITE #3,K9(1,1);K9(1,2);T9(1,1);K9(1,5);
320 IF T9(1,3)>0 THEN 330\ WRITE #3, K9(1,7);\GOTO 340
330 WRITE #3,K9(1,6);
340 WRITE #3,T9(1,3)
350 WRITE #3, N1;K(1);K(2)
360 E(1,1)=-4*B2(2)*K(1) \ E(2,1)=-2*(B2(3)+B2(4))*K(1)
370 E(1,2)=A5*B2(2)*K(2) \ E(2,2)=2*(A2*B2(3)-A3*B2(4))*K(2)
380 K0=L0\K1=L1\K2=L2\K3=L3\K4=L4
390 IF T2<>0 THEN 400\ M=M-N1
400 IF T1<>T2 THEN 410\ M=M-N1 \ GOTO 420
410 IF T1<>0 THEN 420\ M=M-N1
420 GOSUB 650\ IF K8>5 THEN 430\ GOTO 270
430 K8=0 \ GO TO 250
440 FOR I=1 TO 3\FOR J=1 TO 3 \ A3(I,J)=A1(I,J) \ NEXT J \ NEXT I
450 I(1,1)=M2\I(2,2)=A1\I(3,3)=C1
460 WRITE #3,K9(1,3);K9(1,4);T9(1,2);K9(1,8);
470 IF T9(1,4)>0 THEN 480\ WRITE #3,K9(1,10);\GOTO 490
480 WRITE #3, K9(1,9);
490 WRITE #3, T9(1,4)
500 WRITE #3,N1;K(3);K(4);K(5)
510 E(1,1)=4*B1(1)*K(3)\E(2,1)=4*B1(2)*K(3)\E(3,1)=2*(B1(3)+B1(4))*K(3)
520 E(1,2)=-4*C2*B1(1)*K(4)\E(2,2)=-4*C2*B1(2)*K(4)

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PROGRAM "STAB" CONTINUED

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530 E(3,2)=-2*C2*(B1(3)+B1(4))*K(4)\E(1,3)=A5*B1(1)*K(5)
540 E(2,3)=A5*B1(2)*K(5)\E(3,3)=2*(A2*B1(3)-A3*B1(4))*K(5)
550 T1=T9(1,2)\T2=T9(1,4)\T3=K9(1,3)\T4=K9(1,4)\T5=K9(1,8)\T6=K9(1,9)
560 IF T2<>0 THEN 570\ T7=K9(1,10) \ M=M-N1
570 IF T1<>T2 THEN 580\ M=M-N1 \ GO TO 590
580 IF T1<>0 THEN 590\ M=M-N1
590 GOSUB 610\ IF K8>5 THEN 600\ GO TO 270
600 K8=0 \ GO TO 250
610 D0=1\ D1=T1+T2\ D2=T1*T2\ K0=T3\ K1=T1*T3+T4\ K3=T5+T2*T6\ K4=T2*T5
620 IF T1<>T2 THEN 630\ D1=T1\ K2=K3\ K3=K4\ D2=K4=0 \ GO TO 640
630 K2=K3+K1*T2 \ K1=K1+T2*T3 \ K3=K3+T1+K4 \ K4=K4*T1
640 IF T2<>0 THEN 650\ K4=0\ K3=T1*T5\ K2=T5+T7*T1\ K1=T7+K1
650 M0=INT(M/2+.01) \ M1=M0 \ IF M0>=M/2 THEN 660\ M1=M0+1
660 MAT D0=ZER(M1,2)\ MAT F7=ZER(M1,M1)\ MAT F8=ZER(M1,2)\ MAT G7=ZER(M1,M1
)

670 MAT F0 = (K0)*E
680 MAT F0 = F0 - A3
690 MAT F1 = (K1)*E
700 MAT F9 = (D1)*A3
710 MAT F1 = F1-F9
720 MAT F2 = (K2)*E
730 MAT F9 = (D2)*A3
740 MAT F2 = F2-F9
750 MAT F2 = I+F2
760 MAT F3 = (K3)*E
770 MAT F9 = (D1)*I
780 MAT F3 = F3+F9
790 MAT F4 = (K4)*E
800 MAT F9 = (D2)*I
810 MAT F4 = F4+F9
820 IF M1<3 THEN 830\ GOSUB 1700
830 K7=10*(20/M1/(M1-1))/(2*M1-1) \ IF K7<2 THEN 840\ K7=2
840 FOR I=1 TO M1 \ S(I)=K7*(1-I) \ NEXT I
850 MAT F = (1)*F0
860 MAT G=INV(F)
870 D0(0,1)=DET(F)
880 FOR I=1 TO M1\ S=S(I) \ S2=S*S
890 MAT F5=(S2)*F3
900 MAT F5=F5+F1
910 MAT F5=(S)*F5
920 MAT F6=(S2)*F4
930 MAT F6=F6+F2
940 MAT F6=(S2)*F6
950 MAT F6=F6+F0
960 FOR J=-1 TO 1 STEP 2
970 MAT F=(J)*F5
980 MAT F=F+F6
990 MAT G=INV(F)
1000 D0(1,(J+3)/2)=DET(F)
1010 NEXT J \ NEXT I
1020 FOR J=1TOM1\ J1=2*(M1-J)\ FOR I=1TOM1
1030 F7(I,J)=S(I)+J1 \ NEXT I
1040 F8(J,1)=(D0(J,1)+D0(J,2)-2*D0(0,1))/S(J)/S(J)/2

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PROGRAM "STAB" CONTINUED

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1050 F8(J,2)=(D0(J,2)-D0(J,1))/S(J)/2\NEXT J
1060 MAT G7=INV(F7)
1070 MAT D0=G7*F8
1080 I8=1 \ A(0)=D0(1,2) \ IF M1>M0 THEN 1100
1090 I8=2 \ A(0)=D0(1,1) \ A(1)=D0(1,2)
1100 FOR I=2TOM1\FORJ=1T02\A(I8+J-1)=D0(I,J)\NEXTJ
1110 I8=I8+2 \ A(I8)=D0(0,1) \ NEXT I \ A0=A(0)
1120 K6=1E-6 \ N0=N=M \ L=M=K=C0=0=Z=0
1130 FOR I=0TON \ A(I)=A(I)/A0 \ B(I)=C(I)=A(I) \ NEXT I
1140 IF N<=2 THEN 1430
1150 IF A(N)=0 THEN 1440
1160 IF (N/2-INT(N/2))=0 THEN 1180
1170 GOSUB 1530\ IF C0=50 THEN 1490\ GO TO 1140
1180 IF ABS(A(N-2))< 1.E-25 THEN 1200
1190 P=A(N-1)/A(N-2) \ Q=A(N)/A(N-2) \ GO TO 1210
1200 P=A(N-1) \ Q=A(N)
1210 FOR I=0TON \ X(I)=A(I) \ NEXT I \ GOSUB 1510
1220 FOR I=0TON-2\ B(I)=X(I) \ NEXT I
1230 R=X(N-1) \ S=A(N)-P*X(N-1)-Q*X(N-2) \ GOSUB 1510
1240 X(N-1)=-P*X(N-2)-Q*X(N-3) \ D=X(N-2)*2-X(N-1)*X(N-3)
1250 IF ABS(D)<1.E-25 THEN 1490
1260 P1=P+(R*X(N-2)-S*X(N-3))/D\Q1=Q+(S*X(N-2)-R*X(N-1))/D
1270 IF ABS(P)>1.E-25 THEN 1290\ IF ABS(P1)>1.E-25 THEN 1290
1280 IF ABS(Q)>1.E-25 THEN 1300\ GOTO 1310
1290 IF ABS(P1/P-1)>K6 THEN 1310
1300 IF ABS(Q1/Q-1)<K6 THEN 1320
1310 P=P1 \ Q=Q1 \ C0=C0+1 \ IF C0=50 THEN 1490\ GO TO 1210
1320 FOR I=1TON-2\A(I)=B(I) \ NEXT I\ P=P1 \ Q=Q1
1330 IF K=1 THEN 1350\ N=N-2
1340 M=M+1\ P(M)=P\ Q(M)=Q \ IF N=0 THEN 1450\ IF K=0 THEN 1420
1350 D=P*P-4*Q \ IF D<0 THEN 1390\ D=SQR(D)
1360 WRITE #3, (D-P)/2
1370 WRITE #3, -(P+D)/2
1380 GO TO 1420
1390 D=SQR(-D)\ IF P<0 THEN 1410\ P9=SQR(P*P+D*D)/2 \ Z1=P/2/P9
1400 WRITE#3, -P/2,D/2,P9/6.28318,Z1 \ GO TO 1420
1410 WRITE #3, -P/2,D/2
1420 C0=0 \ IF K=1 THEN 1450\ IF N-2>0 THEN 1150
1430 P=B(1)/B(0) \ Q=B(2)/B(0) \ N=0 \ GOTO1340
1440 WRITE #3,Z \ N=N-1 \ GO TO 1140
1450 K=1 \ L=L+1 \ IF L<=M THEN 1460\ K=0 \ GO TO1490
1460 N=N0 \ P=P(L) \ Q=Q(L)
1470 FOR I=1TON \ B(I)=A(I)=C(I) \ NEXT I
1480 K6=1E-6 \ IF N>2 THEN 1210\ GO TO 1350
1490 IF K=0 THEN 1500\ P=P(L) \ Q=Q(L) \ GO TO 1350
1500 RETURN
1510 X(I)=X(I)-P*X(0) \ FOR I=2TON-1 \ X(I)=X(I)-P*X(I-1)-Q*X(I-2)
1520 NEXT I \ RETURN
1530 IF B(1)=0 THEN 1540\X=-B(1)/B(0) \ GO TO 1550
1540 X=-B(N)/B(0)
1550 F=0 \ F1=0 \ FOR I=0 TO N \ J=N-I \ IF B(J)=0 THEN 1570
1560 F=B(J)*X+I+F \ IF I=0 THEN 1570\ F1=I*B(J)*X+(I-1)+F1

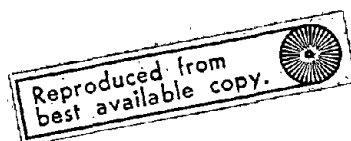
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PROGRAM "STAB" CONTINUED

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1570 NEXT I \ X1=X-F/F1 \ IF ABS(X/X1-1)<10*K6 THEN 1590
1580 X=X1 \ C0=C0+1 \ IF C0=50 THEN 1610 \ GO TO 1550
1590 WRITE #3,X1 \ N=N+1 \ FOR I=1 TO N
1600 A(I)=B(I)+X1*A(I-1) \ B(I)=A(I) \ NEXT I \ RETURN
1610 RETURN
1620 K9(1,4)=K9(1,9)=K9(1,10)=.2+K8/40 \ RETURN
1630 T1=T9(1,1)\T2=T9(1,3)\T3=K9(1,1)\T4=K9(1,2)\T5=K9(1,5)\T6=K9(1,6)
1640 IF T2<>0 THEN 1650 \ T7=K9(1,7)
1650 D0=1 \ D1=T1+T2 \ D2=T1*T2 \ L0=T3 \ L1=T1*T3+T4 \ L3=T5+T2*T6 \ L4=T2*T5
1660 IF T1<>T2 THEN 1670 \ D1=T1 \ L2=L3 \ L3=L4 \ D2=L4=0 \ GO TO 1680
1670 L2=L3+L1*T2 \ L1=L1+T2*T3 \ L3=L3*T1+L4 \ L4=L4*T1
1680 IF T2<>0 THEN 1690 \ L4=0 \ L3=T1*T5 \ L2=T5+T7*T1 \ L1=T7+L1
1690 RETURN
1700 MAT E0=ZER(3,3) \ MAT E1=ZER(3,3) \ MAT G0=ZER(3,3)
1710 E0(1,2)=C2 \ E0(2,2)=1
1720 MAT E1=E*E0
1730 MAT G0 = (L0-K0)*E1
1740 MAT F0 = F0+G0
1750 MAT G0 = (L1-K1)*E1
1760 MAT F1 = F1+G0
1770 MAT G0 = (L2-K2)*E1
1780 MAT F2 = F2+G0
1790 MAT G0 = (L3-K3)*E1
1800 MAT F3 = F3+G0
1810 MAT G0 = (L4-K4)*E1
1820 MAT F4 = F4+G0
1830 RETURN
1840 PRINT "K9(1,8)= ";K9(1,8);" DONE ";(19-10); " CASES."
1850 IF K9(1,8)>=(H-.005) THEN 1870 \ K8=0 \ 10=19
1860 RESTORE #5 \ K9(1,8)=K9(1,8)+.01 \ GO TO 250
1870 PRINT "JOB DONE; LIST FILE ("FS;") FOR ";19;" CASES."
1880 END

```



READY

*

PROGRAM "VHDYNO"

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10 DIM A1(3,3),B1(4),C1(4),A2(3,3),B2(4),C2(4),L2(4),M1(1)
20 DIM L(3,4),Q(4,5),Q1(4,5),P(5,8),K9(15),K(5,5),T9(8)
30 DIM D1(4),P1(4,8),L1(5)
40 FILES INPUT1;INPUT2;OUT5;INPUT4;INT2;INT3;INT4;INT5
50 PRINT"MASS PROPERTY INPUT DATA FILENAME";\INPUT A$
60 PRINT"LAT. AND LONG. COEF. DATA FILENAME"; \ INPUT B$
70 PRINT"FREQUENCY RESPONSE FILENAME";\INPUT F$
80 PRINT"CONTROL GAINS AND T.C.S INPUT DATA FILENAME";\INPUT D$
90 FILE #1,A$ \ FILE #2,B$ \ FILE #3,F$ \ FILE #4,D$
100 SCRATCH #3 \ SCRATCH #7 \ SCRATCH #8
110 READ #1,M2,A1,B1,C1,A2,A3,B2,C2,C3
120 MAT READ #1, L1
130 READ #2, O1,O2,O3
140 MAT READ #2, A1,B1,C1,D1
150 MAT READ #2,A2,B2,C2,D2,M1
160 MAT READ #4, K9,T9
170 SCRATCH #5\SCRATCH #6
180 PRINT "TYPE IN VEHICLE SPEED IN M/S: ";\INPUT V
190 D1=2*(A2+A3) \ V1=V/D1 \ PRINT "REF. FREQ. (V1) = ";V1;" HZ."
200 WRITE #3,A2,A3,B2,C2,O1,O2,O3
210 Q(1,1)=-1\Q(1,2)=A2\Q(1,3)=1\Q(1,4)=-C2\Q(1,5)=A2
220 Q(2,1)=-1\Q(2,2)=A2\Q(2,3)=-1\Q(2,4)=C2\Q(2,5)=-A2
230 Q(3,1)=-1\Q(3,2)=-A3\Q(3,3)=1\Q(3,4)=-C2\Q(3,5)=-A3
240 Q(4,1)=-1\Q(4,2)=-A3\Q(4,3)=-1\Q(4,4)=C2\Q(4,5)=A3
250 P(1,1)=-A3/D1\P(1,2)=-A3/D1\P(1,3)=-A2/D1\P(1,4)=-A2/D1
260 P(2,1)=1/D1\P(2,2)=1/D1\P(2,3)=-1/D1\P(2,4)=-1/D1
270 P(3,1)=-C2/(4*B2)\P(3,2)=C2/(4*B2)
280 P(3,3)=-C2/(4*B2)\P(3,4)=C2/(4*B2)
290 P(3,5)=A3/D1\P(3,6)=-A3/D1\P(3,7)=A2/D1\P(3,8)=-A2/D1
300 P(4,1)=-1/(4*B2)\P(4,2)=1/(4*B2)\P(4,3)=-1/(4*B2)\P(4,4)=1/(4*B2)
310 P(5,5)=1/D1\P(5,6)=-1/D1\P(5,7)=-1/D1\P(5,8)=1/D1
320 FOR I=1TO5 \ K(1,I)=K9(I+10) \ NEXT I
330 MAT Q1=Q*K
340 MAT P1=P1*P
350 PRINT"ENTER DELTA,INITIAL,FINAL FREQ.;HZ/V1; ";
360 INPUT W5,W0,W9 \ IF W5=0 THEN 2180
370 PRINT \ FOR N0=2TO3
380 MAT A=ZER(N0,N0)\MAT I=ZER(N0,N0)\MAT E1=ZER(N0,N0)
390 MAT C=ZER(N0,4)\MAT D=ZER(N0,4)\MAT L=ZER(N0,4)\MAT G1=ZER(N0,4)
400 MAT G2=ZER(N0,4)\ MAT G3=ZER(4,4)\ MAT G4=ZER(4,4)
410 MAT Q2=ZER(4,N0)\MAT P2=ZER(4,4)
420 MAT Z1=ZER(N0,N0)\MAT Z7=ZER(N0,N0)\MAT P3=ZER(4,4)
430 IF N0>2.5 THEN 590
440 FOR I=1 TO 2\FOR J=1 TO 2\A(I,J)=A2(I+1,J+1)\NEXT J\nEXT I
450 I(1,1)=M2\I(2,2)=B1
460 C(1,1)=4*C2(2)\C(2,1)=2*(C2(3)+C2(4))\C(2,2)=2*(C2(3)-C2(4))
470 D(1,3)=4*D2(2)\D(2,3)=2*(D2(3)+D2(4))\D(2,4)=2*(D2(3)-D2(4))
480 FOR I=1TO4\ L(1,I)=L1(I) \ L(2,I)=L1(I)+M1(1) \ NEXT I
490 FOR I=1 TO 4\FOR J=1 TO 2\Q2(I,J)=Q1(I,J)\NEXT J\nEXT I
500 FOR I=1 TO 4\FOR J=1 TO 4\P2(I,J)=P1(I,J)\NEXT J\nEXT I
510 FOR J=1TO2\ FOR I=1TO2 \ G3(I,J)=G4(I,J+2)=1
520 G3(I+2,J)=G4(I+2,J+2)=(-1)*(J-1)\ NEXT I \ NEXT J

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PROGRAM "VHDYNO" CONTINUED

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530 E1(1,1)=-4*B2(2)*K(1,1)
540 E1(1,2)=2*(A2-A3)*B2(2)*K(2,2)
550 E1(2,1)=-2*(B2(3)+B2(4))*K(1,1)
560 E1(2,2)=2*(A2*B2(3)-A3*B2(4))*K(2,2)
570 G1(1,1)=-1\G1(1,2)=(A2-A3)/(A2+A3)\G1(2,2)=2/(A2+A3)
580 GO TO 790
590 FOR I=1 TO 3\FOR J=1 TO 3\A(I,J)=A1(I,J)\L(I,J)=L1(I+2)\NEXT J\next I
600 I(1,1)=M2\I(2,2)=A1\I(3,3)=C1
610 C(1,1)=4*C1(1)\C(2,1)=4*C1(2)\C(3,1)=2*(C1(3)+C1(4))
620 C(3,2)=2*(C1(3)-C1(4))
630 D(1,3)=4*D1(1)\D(2,3)=4*D1(2)\D(3,3)=2*(D1(3)+D1(4))
640 D(3,4)=2*(D1(3)-D1(4))
650 FOR I=1 TO 4\FOR J=1 TO 3\G2(I,J)=G1(I,J+2)\NEXT J\next I
660 FOR I=1 TO 4\FOR J=1 TO 4\P2(I,J)=P1(I,J)\P3(I,J)=P1(I,J+4)
670 NEXT J\next I
680 G3(1,1)=G3(1,2)=G3(3,1)=G3(4,2)=G4(1,3)=G4(1,4)=G4(3,3)=G4(4,4)=1
690 G3(2,1)=G3(2,2)=G3(3,2)=G3(4,1)=G4(2,3)=G4(2,4)=G4(3,4)=G4(4,3)=-1
700 E1(1,1)=4*B1(1)*K(3,3) \ E1(1,2)=-4*C2*B1(1)*K(4,4)
710 E1(1,3)=2*(A2-A3)*B1(1)*K(5,5)
720 E1(2,1)=4*B1(2)*K(3,3) \ E1(2,2)=-4*C2*B1(2)*K(4,4)
730 E1(2,3)=2*(A2-A3)*B1(2)*K(5,5)
740 E1(3,1)=2*(B1(3)+B1(4))*K(3,3)
750 E1(3,2)=-2*C2*(B1(3)+B1(4))*K(4,4)
760 E1(3,3)=2*(A2*B1(3)-A3*B1(4))*K(5,5)
770 G1(1,1)=-C2/B2\G1(2,1)=-1/B2
780 G2(1,3)=1\G2(1,4)=(A3-A2)/(A2+A3)\G2(3,4)=2/(A2+A3)
790 FOR W1=W0 TO W9 STEP W5
800 IF W1>0 THEN 810 \ IF N0>2 THEN 810 \ PRINT "STATIC SOLUTION: "
810 W=W1*W1*6.2831853 \ I9=I9+1
820 FOR I=1 TO 4 \ T9(I+4)=T9(I)*W \ NEXT I
830 D4=1+T9(5)+2
840 D5=1+T9(6)+2
850 D6=1+T9(7)+2
860 D7=1+T9(8)+2
870 Y(1)=K9(2)*W/D4
880 X(1)=K9(1)+T9(5)*Y(1)
890 Y(2)=K9(4)*W/D5
900 X(2)=K9(3)+T9(6)*Y(2)
910 Y(3)=K9(6)*T9(7)*W/D6\X(3)=W*W*K9(5)+Y(3)\Y(3)=-Y(3)*T9(7)
920 IF T9(3)<>0 THEN 930\Y(3)=-K9(7)*W\X(3)=W*W*K9(5)
930 Y(4)=K9(9)*T9(8)*W/D7\X(4)=K9(8)*W*W+Y(4)\Y(4)=-Y(4)*T9(8)
940 IF T9(4)<>0 THEN 950\Y(4)=-K9(10)*W\X(4)=W*W*K9(8)
950 IF N0 > 2.5 THEN 990
960 L0(1)=K0(1)=-X(3)+X(1)
970 L0(2)=K0(2)=-Y(3)+Y(1)
980 GO TO 1010
990 K0(1)=-X(4)+X(2)
1000 K0(2)=-Y(4)+Y(2)
1010 MAT T1=I*(-W+2)
1020 MAT T2=T1-A
1030 MAT T3=E1*(K0(1))
1040 MAT F1=T2+T3

```


PROGRAM "VHDYNO" CONTINUED

```

1050 MAT F2=E1*(K0(2))
1060 IF N0<3 THEN 1070\ GOSUB 2030
1070 FOR K2=1 TO N0
1080 IF F1(K2,K2)>1 THEN 1110
1090 Z1(K2,K2)=1
1100 GO TO 1120
1110 Z1(K2,K2)=1/SQR(ABS(F1(K2,K2)))
1120 NEXT K2
1130 MAT U1=Z1*F1\MAT U2=U1*Z1
1140 MAT U3=INV(U2)\MAT U4=Z1*U3
1150 MAT T4=U4*Z1
1160 MAT T5=T4*F2
1170 MAT T6=F2*T5
1180 MAT T7=F1+T6
1190 FOR K2=1 TO N0
1200 IF T7(K2,K2)>1 THEN 1220
1210 Z7(K2,K2)=1\GO TO 1230
1220 Z7(K2,K2)=1/SQR(ABS(T7(K2,K2)))
1230 NEXT K2
1240 MAT U1=Z7*T7\MAT U2=U1*Z7
1250 MAT U3=INV(U2)\MAT U4=Z7*U3
1260 MAT F3=U4*Z7
1270 MAT T0=T5*F3
1280 MAT F4=T0*(-1)
1290 MAT T1=E1*G1
1300 MAT T2=T1*(X(1))
1310 MAT T3=T1*(Y(1))
1320 MAT T4=E1*G2
1330 MAT T5=T4*(X(2))
1340 MAT T6=T4*(Y(2))
1350 MAT T8=C+D
1360 MAT T0=T2+T5
1370 MAT G5=T8+T0
1380 MAT G6=T3+T6
1390 IF W1>0 THEN 1420
1400 MAT G5 = (1)*L
1410 MAT G6=ZER(N0,4)
1420 MAT T1=F3*G5
1430 MAT T2=F4*G6
1440 MAT S1=T1-T2
1450 MAT T3=F3*G6
1460 MAT T4=F4*G5
1470 MAT S2=T3+T4
1480 IF W1>0 THEN 1500
1490 MAT PRINT S1
1500 IF N0 > 2.5 THEN 1540
1510 WRITE #6, W1, W
1520 MAT WRITE #6, S1, S2
1530 GO TO 1560
1540 WRITE #8, W1, W
1550 MAT WRITE #8, S1, S2
1560 MAT T1=G2*S1

```

PROGRAM "VHDYNO" CONTINUED

```

1570 MAT T2=Q2*S2
1580 MAT T3=(-K0(1))*T1
1590 MAT T4=(K0(2))*T2
1600 MAT T5=(-K0(1))*T2
1610 MAT T6=(-K0(2))*T1
1620 MAT T7=T3+T4
1630 MAT T8=T5+T6
1640 IF N0<2.5 THEN 1650\ GOSUB 2120
1650 MAT T1=P2*G3
1660 IF W1>0 THEN 1680
1670 MAT T1=ZER(4,4)
1680 MAT T2=(X(1))*T1
1690 MAT T3=(Y(1))*T1
1700 MAT S3=T7+T2
1710 MAT S4=T8+T3
1720 IF N0>2.5 THEN 1750
1730 MAT WRITE #5, S3; S4;
1740 GO TO 1830
1750 MAT T4=P3*G4
1760 IF W1>0 THEN 1780
1770 MAT T4=ZER(4,4)
1780 MAT T5=(X(2))*T4
1790 MAT T6=(Y(2))*T4
1800 MAT S3=S3+T5
1810 MAT S4=S4+T6
1820 MAT WRITE #7, S3; S4;
1830 IF W1>0 THEN 1850
1840 MAT PRINT S3
1850 NEXT W1
1860 NEXT N0
1870 RESTORE #5 \ RESTORE #6 \ RESTORE #7 \ RESTORE #8
1880 FOR W1=W0TOW9 STEP W5
1890 READ #6,F, W
1900 WRITE #3, F, W
1910 MAT READ #6, S1(2,4), S2(2,4)
1920 MAT WRITE #3, S1,S2
1930 MAT READ #5, S3(4,4), S4(4,4)
1940 MAT WRITE #3, S3,S4
1950 READ #8, F, W
1960 MAT READ #8, S1(3,4), S2(3,4)
1970 MAT WRITE #3, S1,S2
1980 MAT READ #7, S3(4,4), S4(4,4)
1990 MAT WRITE #3, S3,S4
2000 NEXT W1
2010 SCRATCH #5 \ SCRATCH #6 \ SCRATCH #7 \ SCRATCH #8
2020 APPEND #3
2030 GO TO 350
2040 MAT E0=ZER(3,3)\MAT E=ZER(3,3) \ MAT G0=ZER(3,3)
2050 E(1,2)=C2\E(2,2)=1
2060 MAT E0=E1*E
2070 MAT G0=(L0(1)-K0(1))*E0
2080 MAT F1=F1+G0

```

PROGRAM "VHDYNO" CONTINUED

```

2090 MAT G0=(L0(2)-K0(2))*E0
2100 MAT F2=F2+G0
2110 RETURN
2120 C0=C2*(K(3,3)-K(4,4)) \ L1(1)=L0(1)-K0(1)
2130 L1(2)=L0(2)-K0(2) \ FOR I=1T04 \ FOR J=1T04
2140 T7(I,J)=T7(I,J)+(-1)*I*C0*(L1(1)*S1(2,J)-L1(2)*S2(2,J))
2150 T8(I,J)=T8(I,J)+(-1)*I*C0*(L1(2)*S1(2,J)+L1(1)*S2(2,J))
2160 NEXT J \ NEXT I
2170 RETURN
2180 PRINT "JOB DONE; ";I9/2;" POINTS"
2190 END

```

PROGRAM "VHDYN1"

```

10 DIM U1(2,4),U2(2,4),V1(4,4),V2(4,4),U3(3,4),U4(3,4),V3(4,4),V4(4,4)
20 DIM B1(3,8),B2(3,8),A1(4,8),A2(4,8),F(8),P(8),A5(4),G1(4,2)
30 DIM Q2(4,3),G3(4,3),A(2,4),T1(2,2),T2(3,2)
40 DIM K(20),M(9),M1(9),M2(9),H(8,2),H1(8,2)
50 DIM N(8),N1(8),N2(8)
60 FILES DATA1;INT2;INT3;INT4;INT5;INT6;RESP;OUT1
70 P1=3.141592654 \ D2=180/P1 \ G=9.8062 \ P4=2*P1
80 P9=52 \ A1=1/2750 \ A=1.5E-6
90 PRINT "MAX TRACK IRREG. AMPL.:VS;VA;HS;HA: = ";
100 INPUT G1,G2,G3,G4
110 PRINT "WHAT'S THE FREAK FILENAME";\INPUT A$ \ FILE #1,A$
120 SCRATCH #2\SCRATCH #3\SCRATCH #4\SCRATCH #5\SCRATCH #6
130 SCRATCH #7\SCRATCH #8
140 PRINT"NUMBERS OF POINTS = ";\INPUT I6 \ WRITE #7,I6
150 READ #1,A2,A3,B2,C5,L1,L3,L4
160 PRINT "PH10, PH12, PH1Y, V = ";\INPUT T1,T2,T3,V
170 P0=T1/D2 \ P2=T2/D2 \ P3=T3/D2 \ B0=(A2-A3)/2 \ N=-1
180 GOSUB 1490
190 READ #1,W1,W2 \ I7=I7+1 \ I9=I9+1 \ A6=A7=0 \ B=W2*(A2+A3)/V/2
200 MAT READ #1,U1,U2,V1,V2,U3,U4,V3,V4
210 FORI=1TO2\FORJ=1TO4\B1(I,J)=U1(I,J)\B2(I,J)=U2(I,J)\NEXTJ\nEXTI
220 FORI=1TO4\FORJ=1TO4\A1(I,J)=V1(I,J)\A2(I,J)=V2(I,J)\NEXTJ\nEXTI
230 FORI=1TO3\FORJ=5TO8\B1(I,J)=U3(I,J-4)\B2(I,J)=U4(I,J-4)\NEXTJ\nEXTI
240 FORI=1TO4\FORJ=5TO8\A1(I,J)=V3(I,J-4)\A2(I,J)=V4(I,J-4)\NEXTJ\nEXTI
250 C1=COS(B) \ S1=SIN(B) \ F1=F2=F3=F4=1
260 IF W1>0THEN270\ K0=1\ K1=0 \ F1=F2=F3=F4=.5 \ GO TO 320
270 W3=W2*W2 \ K0=P4*A1*V/W2 \ K1=A*V/W3
280 IF F1*K0<G1 THEN 290\ F1=G1/K0
290 IF F2*K0<G2 THEN 300\ F2=G2/K0
300 IF F3*K0<G3 THEN 310\ F3=G3/K0
310 IF F4*K0<G4 THEN 320\ F4=G4/K0
320 WRITE #6, W2;F1;F2;F3;F4
330 F(1)=F1*C1 \ F(2)=F1*S1 \ F(3)=F4*C1 \ F(4)=F4*S1
340 F(5)=F2*C1 \ F(6)=F2*S1 \ F(7)=F3*C1 \ F(8)=F3*S1
350 P(7)=0 \ P(8)=P1/2 \ P(1)=-P0 \ P(3)=-P3 \ P(5)=P(1)-P2
360 FOR I=2TO6STEP2\ P(I)=P(I-1)+P(8)\NEXT I
370 FOR I=1TO8 \ C(I)=COS(P(I)) \ S(I)=SIN(P(I)) \ NEXT I
380 MAT R=ZER(5,2)
390 FORJ=1TO4\FORI=1TO2\ X=B1(I,J)*F(J) \ Y=B2(I,J)*F(J)
400 GOSUB1350\ R(1,1)=R(1,1)+X1\ R(1,2)=R(1,2)+X2\ NEXT I\nEXT J
410 FORJ=5TO8\FORI=1TO3\ X=B1(I,J)*F(J) \ Y=B2(I,J)*F(J) \ GOSUB1350
420 R(1+2,1)=R(1+2,1)+X1\ R(1+2,2)=R(1+2,2)+X2\nEXT I \ NEXT J
430 FOR I=1TO5\R5(I)=SQR(R(1,1)+2+R(1,2)+2)\ R6(I)=W3*R5(I)
440 IF ABS(R(1,1))>0 THEN 460\ P6(I)=90*SGN(R(1,2))
450 P7(I)=-P6(I) \ GO TO 500
460 P6(I)=ATN(R(1,2)/R(1,1))*D2\IF R(1,1)>0THEN480\ P6(I)=180+P6(I)
470 IF P6(I)<180 THEN 480\ P6(I)=P6(I)-360
480 P7(I)=P6(I)+180
490 IF P7(I)<180 THEN 500\ P7(I)=P7(I)-360
500 NEXT I \ W5=W2/P4\ R6(I)=R6(I)/G\ R6(3)=R6(3)/G \ R5(4)=R5(4)*D2
510 MAT WRITE #6,R
520 PRINT #8,USING1920,W5;R5(1);P6(1);R5(3);P6(3);R6(1);P7(1);R6(3);P7(3)

```

PROGRAM "VHDYN1" CONTINUED

```

530 WRITE #2,V2,R5(4),P6(4),R6(2),P7(2),R6(4),P7(4),R6(5),P7(5)
540 MAT A3=ZER(4)\MAT A4=ZER(4)
550 FOR I=1 TO 4 \ FORJ=1 TO 8 \ X=A1(I,J)*F(J) \ Y=A2(I,J)*F(J)
560 GOSUB 1350 \ A3(I)=A3(I)+X1 \ A4(I)=A4(I)+X2 \ NEXT J \ NEXT I
570 FOR I=1 TO 4 \ A5(I)=SQR(A3(I)+2+A4(I)+2) \ IF ABS(A3(I))>0 THEN 590
580 P5(I)=90*SGN(A4(I)) \ GOT0620
590 P5(I)=ATN(A4(I)/A3(I))*D2
600 IF A3(I)>0 THEN 620 \ P5(I)=180+P5(I)
610 IF P5(I)<180 THEN 620 \ P5(I)=P5(I)-360
620 A6=A6+A3(I) \ A7=A7+A4(I) \ NEXT I \ IF ABS(A6)+ABS(A7)>1E-6 THEN 630 \ A6=0
630 WRITE #3,V2,A5(1),P5(1),A5(2),P5(2),A5(3),P5(3),A5(4),P5(4)
640 M(1)=V2 \ FOR I=2 TO 5 \ M(I)=A5(I-1)*K0
650 M(I+4)=(A5(I-1))+2*K1 \ NEXT I
660 WRITE #4,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
670 FOR I=1 TO 4 \ N1(I)=M(I+5) \ NEXT I
680 A0=SQR(A6+2+A7+2) \ IF ABS(A6)>0 THEN 690 \ P5=90*SGN(A7) \ GOT0710
690 P5=ATN(A7/A6)*D2 \ IF A6>0 THEN 710 \ P5=180+P5
700 IF P5<180 THEN 710 \ P5=P5-360
710 FOR J=1 TO 4 \ A(1,J)=A3(J) \ A(2,J)=A4(J) \ NEXT J
720 GO SUB 1360
730 FOR I=1 TO 2 \ FOR J=1 TO 2 \ T1(I,J)=R(I,J) \ NEXT J \ NEXT I
740 FOR I=1 TO 3 \ FOR J=1 TO 2 \ T2(I,J)=R(I+2,J) \ NEXT J \ NEXT I
750 L2=L1+L4/B2
760 MAT R1=(L1)*A
770 MAT R2=Q1*T1
780 MAT R3=R1*D2
790 MAT S1=(L2)*A
800 MAT S2=Q2*T2
810 MAT S3=S1*S2
820 MAT T3=(L3)*A
830 MAT T4=Q3*T2
840 MAT T5=T3*T4
850 MAT T6=R3+S3
860 MAT Z3=T6+T5
870 M1=(Z3(1,2)-Z3(2,1))*W2/2
880 M(1)=W2 \ M(2)=A0 \ M(3)=P5 \ M(4)=A0*K0
890 M(5)=A0*A0*K1 \ M(6)=M1 \ M(7)=M1*K0*K0 \ M(8)=M1*K1
900 WRITE #5,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8)
910 N1(0)=W2 \ N1(5)=M(5) \ N1(6)=M(8) \ N8=6 \ GOSUB 1230
920 IF END #1, THEN 940 \ IF I7>39 THEN 930 \ GO TO 190
930 GOSUB 1880 \ I7=0 \ GO TO 180
940 RESTORE #2 \ RESTORE #3 \ RESTORE #4 \ RESTORE #5 \ RESTORE #6
950 FOR I=1 TO 5 \ N2(I)=SQR(N2(I)) \ NEXT I
960 GOSUB 1880 \ I7=0 \ GOSUB 1560
970 MAT READ #2,M
980 M(1)=M(1)/P4 \ GOSUB 1430
990 I7=I7+1 \ IF END #2 THEN 1010
1000 IF I7>39 THEN 960 \ GO TO 970
1010 GOSUB 1880 \ I7=0 \ GOSUB 1630
1020 MAT READ #3,M
1030 M(1)=M(1)/P4 \ GOSUB 1430
1040 I7=I7+1 \ IF END #3 THEN 1060

```

PROGRAM "VHDYN1" CONTINUED

```

1050 IF I7>39 THEN 1010\ GO TO 1020
1060 GOSUB 1880\ I7=0 \ GOSUB 1700
1070 MAT READ #4,M
1080 M(1)=M(1)/P4\ FOR I=6T09\ M(1)=M(1)*P4 \ NEXT I \ GOSUB 1450
1090 I7=I7+1 \ IF END #4 THEN 1110
1100 IF I7>39 THEN 1060\ GO TO 1070
1110 PRINT #8,USING1950
1120 PRINT #8,USING2220,N2(1);N2(2);N2(3);N2(4)
1130 P=P+2
1140 GOSUB 1880\ I7=0 \ GOSUB 1770
1150 READ #5,M(1),M(2),M(3),M(4),M(5),M(6),M(7),M(8)
1160 M(1)=M(1)/P4\M(5)=M(5)*P4\M(8)=M(8)*P4\GOSUB 1470
1170 I7=I7+1 \ IF END #5 THEN 1190
1180 IF I7>39 THEN 1140\ GOTO 1150
1190 PRINT #8,USING1950
1200 PRINT #8,USING2230,N2(5);N2(6)
1210 P=P+2 \ GOSUB 1880
1220 GO TO 1830
1230 IF N>0 THEN 1250
1240 FOR I=0 TO N8\N(1)=N1(1)\N2(1)=0\NEXT I \ GOTO 1290
1250 X1=N1(0)\X=N(0)\N0=LOG(X1/X)\N(0)=N1(0)
1260 IF ABS(N0)>1E-8 THEN 1270\ Z=0 \ GOTO 1290
1270 FOR I=1T0N8\ Y1=N1(I)\ Y=N(I)\ GOSUB 1300
1280 N2(I)=N2(1)+Z \ N(I)=N1(I) \ NEXT I
1290 N=N+1 \ RETURN
1300 IFABS(Y)<1E-8THEN1330\Y0=Y1/Y\IFY0<=0THEN1330\N7=LOG(Y0)/N0
1310 IF N7+1=0 THEN 1320\ Z=(Y1*X1-Y*X)/(N7+1) \ GO TO 1340
1320 Z=X1*Y1*N0 \ GO TO 1340
1330 Z=(Y1+Y)*(X1-X)/2
1340 RETURN
1350 X1=X*C(J)-Y*S(J) \ X2=X*S(J)+Y*C(J) \ RETURN
1360 Q1(1,1)=Q1(2,1)=Q1(3,1)=Q1(4,1)=-1
1370 Q1(1,2)=Q1(2,2)=A2\Q1(3,2)=Q1(4,2)=-A3
1380 Q2(1,2)=Q2(3,2)=-B2\Q2(2,2)=Q2(4,2)=B2
1390 Q3(1,1)=Q3(3,1)=1\Q3(2,1)=Q3(4,1)=-1
1400 Q3(1,2)=Q3(3,2)=-C5\Q3(2,2)=Q3(4,2)=C5
1410 Q3(1,3)=A2\Q3(2,3)=-A2\Q3(3,3)=-A3\Q3(4,3)=A3
1420 RETURN
1430 PRINT #8,USING1920,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
1440 RETURN
1450 PRINT #8,USING1930,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
1460 GOSUB 1910\ WRITE #7, M(9); \ RETURN
1470 PRINT #8,USING1940,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8)
1480 GOSUB 1910\ RETURN
1490 PRINT #8,USING1960
1500 GOSUB 1840
1510 PRINT #8,USING2000
1520 PRINT #8,USING2010
1530 PRINT #8,USING2110
1540 PRINT #8,USING1950
1550 P=P+5 \ RETURN
1560 PRINT #8,USING1960

```

PROGRAM "VHDYN1" CONTINUED

```

1570 GOSUB 1840
1580 PRINT #8,USING2020
1590 PRINT #8,USING2030
1600 PRINT #8,USING2110
1610 PRINT #8,USING1950
1620 P=P+5\ RETURN
1630 PRINT #8,USING1960
1640 GOSUB 1840
1650 PRINT #8,USING2090
1660 PRINT #8,USING2100
1670 PRINT #8,USING2110
1680 PRINT #8,USING1950
1690 P=P+5\ RETURN
1700 PRINT #8,USING2240
1710 GOSUB 1840
1720 PRINT #8,USING2140,A1;A
1730 PRINT #8,USING2150
1740 PRINT #8,USING2160
1750 PRINT #8,USING1950
1760 P=P+5\ RETURN
1770 PRINT #8,USING1990
1780 GOSUB 1840
1790 PRINT #8,USING2120
1800 PRINT #8,USING2130
1810 PRINT #8,USING1950
1820 P=P+4 \ RETURN
1830 PRINT\PRINT"JOB DONE, LIST FILE (OUT1)"; I9= "I9 \ STOP
1840 PRINT #8,USING1970,T1;T2;T3
1850 PRINT #8,USING1980,A2;A3;B2;C5
1860 PRINT #8,USING1950
1870 P=3 \ RETURN
1880 FOR I=1 TO P9-I7-P
1890 PRINT #8,USING1950
1900 NEXT I\RETURN
1910 WRITE #7, M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8); \ RETURN

```

PROGRAM "VHDYNI" CONTINUED

```

1920: #####.#####.#####.#####.#####.#####.#####.#####
1930: #####.#####.#####.#####.#####.#####.#####.#####
1940: #####.#####.#####.#####.#####.#####.#####.#####
1950:-

```

```

1960:          TRANSFER FUNCTIONS FOR "UNIT" INPUTS
1970:          (PHIO = ###. PHIZ = ###. PHIY = ###.)
1980:          XF = ##### XR = ##### Y = (+-)##### Z = #####
1990:          CONTROL CURRENT AND POWER SUMMARY
2000:          DISPLACEMENT (METERS) AT          ACCELERATION (G-UNIT) AT

```

```

2010:  FREQ      C-G  - Z      C-G  - Y      C-G  - Z      C-G  - Y

```

```

2020:          ANGLE OF          ANGULAR ACCELERATION      RAD/S/S
2030:  FREQ      ROLL DEG      PITCH      ROLL      YAW
2040:          GAP (M) AT      GAP (M) AT      GAP (M) AT      GAP (M) AT

```

```

2050:  FREQ      COIL 1 - Z      COIL 2 - Z      COIL 3 - Z      COIL 4 - Z

```

```

2060:  FREQ      COIL 1 - Y      COIL 2 - Y      COIL 3 - Y      COIL 4 - Y

```

```

2070:  FREQ      CORNER 1 - Z      CORNER 2 - Z      CORNER 3 - Z      CORNER 4 -

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```

2080:  FREQ      CORNER 1 - Y      CORNER 2 - Y      CORNER 3 - Y      CORNER 4 -

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```

2090:          CONTROL COIL CURRENTS IN TERMS OF AMPERE-TURN RATIOS
2100:  FREQ      COIL 1      COIL 2      COIL 3      COIL 4
2110:  HZ.      AMPL.  PHASE  AMPL.  PHASE  AMPL.  PHASE  AMPL.  PHA
E

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```

2120:  FREQ      TOTAL CURRENT (RESP. PSD)  POWER (RESP. PSD)
2130:  HZ.      AMPL.  PHASE  /HZ      W/M*2      W      W/HZ
2140:          RESPONSE FOR C/L = ##### PSD FOR PHI = #####/W*

```

```

2150:  FREQ      R E S P O N S E (ALPHA)      P - S - D (ALPHA)
2160:  HZ      COIL 1 COIL 2 COIL 3 COIL 4 COIL 1 COIL 2 COIL 3 COIL
4

```

```

2170:          RESPONSES IN Z-DIRECTION      RESPONSES IN Y-DIRECTION

```

```

2180:          DISPLACEMENT RESPONSE SUMMARY FOR C/L = #####
2190:  HZ.      CORN 1 CORN 2 CORN 3 CORN 4 CORN 1 CORN 2 CORN 3 CORN
4

```

```

2200:          ACCELERATION RESPONSES (G-UNITS) FOR PASSENGERS LOCATED AT

```

```

2210:          ACCELERATION (G*2/HZ) FOR PASSENGERS LOCATED AT
2220:  MEAN      #####.#####.#####.#####

```

```

2230:  MEAN      #####.#####.#####.#####

```

```

2240:          CONTROL COIL CURRENT SUMMARY
2250:          ACCELERATION (G-UNITS) FOR PASSENGERS LOCATED AT
2260:          PSD IN Z-DIRECTION      PSD IN Y-DIRECTION
2270:  MEAN      #####.#####.#####.#####.#####.#####.#####.#####

```


PROGRAM "VHDYN2"

```

10 DIM Q5(8,5),Q6(8,2),R(5,2),H(8,2),H1(8,2)
20 DIM K(16),M(9),N(8),N1(8),N2(8)
30 FILES DATA1;INT2;INT3;INT4;INT5;INT6;RESP;OUT1
40 P1=3.141592654 \ D2=180/P1 \ G=9.8062 \ P4=2*P1
50 P9=52 \ A1=1/2750 \ A=1.5E-6
60 PRINT "WHAT'S THE FREAK FILENAME";\INPUT AS\FILE #1,AS
70 APPEND #8
80 APPEND #7
90 READ #1,A2,A3,B2,C5,L1,L3,L4
100 PRINT "PHI0, PHI2, PHIY, V = ";\INPUT T1,T2,T3,V
110 P0=T1/D2 \ P2=T2/D2 \ P3=T3/L2 \ B0=(A2-A3)/2 \ N=-1
120 SCRATCH #2 \ SCRATCH #3 \ SCRATCH #4 \ SCRATCH #5
130 READ #6, W2,F1,F2,F3,F4
140 MAT READ #6, R
150 I9=I9+1\I7=I7+1\M(1)=W2\IFW2>0THENI60\K0=1\K1=F1=F2=F3=F4=0\GOTO170

160 W3=W2*W2 \ W4=W3/G \ K0=P4*V*A1/W2 \ K1=A*V/W3
170 MAT Q5=ZER(8,5) \ MAT Q6=ZER(8,2)
180 B8=(A2-B0)*W2/V\B9=(-A3-B0)*W2/V\GOSUB 1010
190 MAT H1=Q5*R
200 IF I8<2 THEN 230
210 MAT H = (1)*H1
220 GO TO 240
230 MAT H=H1-Q6
240 FOR I=1 TO 8
250 H1=H(1,1) \ H2=H(1,2) \ GOSUB960
260 J(1,1)=U1\J(1,2)=U2\NEXT I
270 IF I8=2 THEN 350
280 J=1\FOR I=1 TO 8
290 K(J)=J(1,1)\K(J+1)=J(1,2)\J=J+2\NEXT I
300 WRITE #2,W2;K(1);K(2);K(3);K(4);K(5);K(6);K(7);K(8)
310 WRITE #3,W2;K(9);K(10);K(11);K(12);K(13);K(14);K(15);K(16)
320 FOR I=1TO8 \ M(I+1)=K0*K(2*I-1) \ NEXT I
330 WRITE #4,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
340 GO TO 460
350 FOR I1=0TO1\FOR I2=1TO4 \ I=I1*4+I2
360 K(2*I-1)=W4*J(1,1) \ J(1,2)=J(1,2)+180
370 IF J(1,2)<180 THEN 380\ J(1,2)=J(1,2)-360
380 K(2*I)=J(1,2)\NEXT I2
390 IF I1>0 THEN 420
400 WRITE #2,W2;K(1);K(2);K(3);K(4);K(5);K(6);K(7);K(8)
410 GO TO 430
420 WRITE #3,W2;K(9);K(10);K(11);K(12);K(13);K(14);K(15);K(16)
430 NEXT I1
440 FOR I=1TO8 \ M(I+1)=K0*K(2*I-1) \ NEXT I
450 WRITE #4,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
460 FOR I=1TO8 \ M(I+1)=K1*(K(2*I-1))*2 \ NEXT I
470 WRITE #5,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
480 FOR I=1TO9\N1(I-1)=M(1)\NEXT I \ N8=8 \ GOSUB 830
490 IF END #6, THEN 510\ IF I7>39 THEN 500\ GO TO 130
500 I7=0 \ GO TO 130
510 I8=I8+1
520 RESTORE #2 \ RESTORE #3 \ RESTORE #4 \ RESTORE #5 \ RESTORE #6

```

PROGRAM "VHDYN2" CONTINUED

```

530 FOR I=1TON8 \ N2(I)=SQR(N2(I)) \ NEXT I
540 IF I7>0 THEN 560
550 GOSUB 1940
560 I7=0 \ GOSUB 1210
570 MAT READ #2,M
580 M(1)=M(1)/P4 \ GOSUB 1170
590 I7=I7+1 \ IF END #2 THEN 610
600 IF I7 > 39 THEN 550 \ GO TO 570
610 GOSUB 1940 \ I7=0 \ GOSUB 1400
620 MAT READ #3,M
630 M(1)=M(1)/P4 \ GOSUB 1170
640 I7=I7+1 \ IF END #3 THEN 660
650 IF I7>39 THEN 610 \ GO TO 620
660 GOSUB 1940 \ I7=0 \ IF I8>2 THEN 670 \ GOSUB 1580 \ GO TO 680
670 GOSUB 1670
680 MAT READ #4,M
690 M(1)=M(1)/P4 \ GOSUB 1190
700 I7=I7+1 \ IF END #4 THEN 720
710 IF I7>39 THEN 660 \ GO TO 680
720 GOSUB 1940 \ I7=0 \ GOSUB 1760
730 MAT READ #5,M
740 M(1)=M(1)/P4 \ FOR I=2TO9 \ M(1)=M(1)*P4 \ NEXT I \ GOSUB 1190
750 I7=I7+1 \ IF END #5 THEN 770
760 IF I7>39 THEN 720 \ GO TO 730
770 PRINT #8,USING2010
780 PRINT #8,USING2340,N2(1);N2(2);N2(3);N2(4);N2(5);N2(6);N2(7);N2(8)
790 P=P+2 \ GOSUB 1940
800 IF I8>=3 THEN 1890
810 PRINT "INPUT VALUES OF A2,A3,B2,C5 "; \ INPUT A2,A3,B2,C5
820 I7=I9=0 \ N=-1 \ GO TO 120
830 IF N>0 THEN 850
840 FOR I=0 TO N8 \ N(1)=N1(1) \ N2(1)=0 \ NEXT I \ GO TO 890
850 X1=N1(0) \ X=N(0) \ N0=LOG(X1/X) \ N(0)=N1(0)
860 IF ABS(N0)>1.E-8 THEN 870 \ Z=0 \ GO TO 890
870 FOR I=1TON8 \ Y1=N1(I) \ Y=N(I) \ GOSUB 900
880 N2(I)=N2(I)+Z \ N(I)=N1(I) \ NEXT I
890 N=N+1 \ RETURN
900 IF ABS(Y)<1E-8 THEN 930 \ Y0=Y1/Y \ IF Y0<=0 THEN 930 \ N7=LOG(Y0)/N0
910 IF N7+1=0 THEN 920 \ Z=(Y1*X1-Y*X)/(N7+1) \ GO TO 940
920 Z=X1*Y1*N0 \ GO TO 940
930 Z=(Y1+Y)*(X1-X)/2
940 RETURN
950 X1=X*C(J)-Y*S(J) \ X2=X*S(J)+Y*C(J) \ RETURN
960 U1=SQR(H1*2+H2*2) \ IF ABS(H1)>0 THEN 970 \ U2=90*SGN(H2) \ GO TO 1000
970 U2=ATN(H2/H1)*D2
980 IF H1>0 THEN 1000 \ U2=180+U2
990 IF U2<180 THEN 1000 \ U2=U2-360
1000 RETURN
1010 FOR I=1 TO 4 \ Q5(I,1)=-1 \ NEXT I
1020 Q5(1,2)=Q5(2,2)=A2 \ Q5(3,2)=Q5(4,2)=-A3
1030 Q5(1,4)=Q5(3,4)=-B2 \ Q5(2,4)=Q5(4,4)=B2
1040 Q5(5,3)=Q5(7,3)=1 \ Q5(6,3)=Q5(8,3)=-1

```

```

1050 Q5(5,4)=Q5(7,4)=-C5\Q5(6,4)=Q5(8,4)=C5
1060 Q5(5,5)=A2\Q5(6,5)=-A2\Q5(7,5)=-A3\Q5(8,5)=A3
1070 P5=-P0+B8 \ P6=P5-P2 \ GOSUB 1160\ Q6(1,1)=F1*C1+F2*C2
1080 Q6(1,2)=F1*S1+F2*S2 \ Q6(2,1)=F1*C1-F2*C2 \ Q6(2,2)=F1*S1-F2*S2
1090 P5=-P0+B9 \ P6=P5-P2 \ GOSUB 1160\ Q6(3,1)=F1*C1+F2*C2
1100 Q6(3,2)=F1*S1+F2*S2 \ Q6(4,1)=F1*C1-F2*C2 \ Q6(4,2)=F1*S1-F2*S2
1110 P5=B8 \ P6=P5-P3 \ GOSUB 1160\ Q6(5,1)=F3*C1+F4*C2
1120 Q6(5,2)=F3*S1+F4*S2 \ Q6(6,1)=-F3*C1+F4*C2 \ Q6(6,2)=-F3*S1+F4*S2
1130 P5=B9 \ P6=P5-P3 \ GOSUB 1160\ Q6(7,1)=F3*C1+F4*C2
1140 Q6(7,2)=F3*S1+F4*S2 \ Q6(8,1)=-F3*C1+F4*C2 \ Q6(8,2)=-F3*S1+F4*S2
1150 RETURN
1160 C1=COS(P5)\S1=SIN(P5)\C2=COS(P6)\S2=SIN(P6)\RETURN
1170 PRINT#8,USING1980,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
1180 RETURN
1190 PRINT #8,USING1990,M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8);M(9)
1200 GOSUB 1970\ WRITE #7, M(9); \ RETURN
1210 PRINT #8,USING2020
1220 IF I8>2 THEN 1300
1230 GOSUB 1900
1240 PRINT #8,USING 2100
1250 IF I8>1 THEN 1280
1260 PRINT #8,USING2110
1270 GO TO 1290
1280 PRINT #8,USING2130
1290 P=P+5\ GO TO 1370
1300 PRINT #8,USING2030,T1;T2;T3
1310 PRINT #8,USING 2010
1320 PRINT #8,USING2320
1330 PRINT #8,USING2040,A2;A3;B2;C5
1340 PRINT #8,USING2010
1350 PRINT #8,USING2130
1360 P=9
1370 PRINT #8,USING2170
1380 PRINT #8,USING2010
1390 RETURN
1400 PRINT #8,USING2020
1410 IF I8>2 THEN 1480\ GOSUB 1900
1420 PRINT #8,USING2100
1430 IF I8>1 THEN 1460
1440 PRINT #8,USING2120
1450 GO TO 1470
1460 PRINT #8,USING2140
1470 P=P+5 \ GO TO 1550
1480 PRINT #8,USING2030,T1;T2;T3
1490 PRINT #8,USING2010
1500 PRINT #8,USING2320
1510 PRINT #8,USING2040,A2;A3;B2;C5
1520 PRINT #8,USING2010
1530 PRINT #8,USING2140
1540 P=9
1550 PRINT #8,USING2170
1560 PRINT #8,USING2010

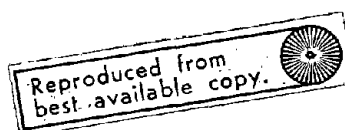
```

PROGRAM "VHDYN2" CONTINUED

```

1570 RETURN
1580 PRINT #8,USING2240,A1
1590 GOSUB 1900
1600 PRINT #8,USING2230
1610 IF I8>1 THEN 1640
1620 PRINT #8,USING2220
1630 GOTO 1650
1640 PRINT #8,USING 2250
1650 PRINT #8,USING2010
1660 P=P+4 \ RETURN
1670 PRINT #8,USING2030,T1;T2;T3
1680 PRINT #8,USING2010
1690 PRINT #8,USING2260,A1
1700 PRINT #8,USING2040,A2;A3;B2;C5
1710 PRINT #8,USING2010
1720 PRINT #8,USING2230
1730 PRINT #8,USING2250
1740 PRINT #8,USING2010
1750 P=8 \ RETURN
1760 PRINT #8,USING2030,T1;T2;T3
1770 PRINT #8,USING2010
1780 IF I8<3 THEN 1800
1790 PRINT #8,USING 2270,A \ GOTO 1810
1800 PRINT #8,USING 2280,A
1810 PRINT #8,USING2040,A2;A3;B2;C5
1820 PRINT #8,USING2010
1830 PRINT #8,USING2330
1840 IF I8>1 THEN 1860
1850 PRINT #8,USING 2220 \ GO TO 1870
1860 PRINT #8,USING2250
1870 PRINT #8,USING2010
1880 P=8 \ RETURN
1890 PRINT\PRINT\PRINT"JOB DONE LIST FILE (OUT1); I9 = ";I9\STOP
1900 PRINT #8,USING2030,T1;T2;T3
1910 PRINT #8,USING2040,A2;A3;B2;C5
1920 PRINT #8,USING2010
1930 P=3 \ RETURN
1940 FOR I=1 TO P9-I7-P
1950 PRINT #8,USING2010
1960 NEXT I\RETURN
1970 WRITE #7, M(1);M(2);M(3);M(4);M(5);M(6);M(7);M(8); \ RETURN

```



PROGRAM "VHDYN2" CONTINUED

```

1980: ###.## #.###1111 #####.## #.###1111 #####.## #.###1111 #####
#
1990: ###.## #.###1111 #.###1111 #.###1111 #.###1111 #.###1111 #.###1111 #.###1111 #.###1111
#
2000: ###.## #.###1111 #####.## #.###1111 #.###1111 #.###1111 #.###1111 #.###1111
2010:-
2020:                TRANSFER FUNCTIONS FOR "UNIT" INPUTS
2030:                (PHIO = ###. PHIZ = ###. PHIY = ###.)
2040:                XF = ###.### XR = ###.### Y = (+-)###.### Z = ###.###
2050:                CONTROL CURRENT AND CONTROL POWER SUMMARY
2060:                DISPLACEMENT (METERS) AT                ACCELERATION (G-UNIT) AT

2070:  FREQ          C-G   - Z          C-G   - Y          C-G   - Z          C-G   - Y

2080:                ANGLE OF                ANGULAR ACCELERATION  RAD/S/S
2090:  FREQ          ROLL DEG                PITCH                ROLL                YAW
2100:                GAP (M) AT                GAP (M) AT                GAP (M) AT                GAP (M) AT

2110:  FREQ          COIL 1 - Z          COIL 2 - Z          COIL 3 - Z          COIL 4 - Z
2120:  FREQ          COIL 1 - Y          COIL 2 - Y          COIL 3 - Y          COIL 4 - Y
2130:  FREQ          CORNER 1 - Z          CORNER 2 - Z          CORNER 3 - Z          CORNER 4 -
#
2140:  FREQ          CORNER 1 - Y          CORNER 2 - Y          CORNER 3 - Y          CORNER 4 -
#
2150:                CONTROL COIL CURRENTS IN TERMS OF AMPERE-TURN RATIOS
2160:  FREQ          COIL 1                COIL 2                COIL 3                COIL 4
2170:  HZ.          AMPL.  PHASE  AMPL.  PHASE  AMPL.  PHASE  AMPL.  PHA
#
2180:  FREQ          TOTAL CURRENT (RESP.  PSD)  POWER (RESP.  PSD)
2190:  HZ.          AMPL.  PHASE  W/M      W.
2200:                RESPONSE FOR C/L = ###.###1111  PSD FOR PHI = ###.###1111/W
#
2210:  FREQ          R E S P O N S E (ALPHA)  P - S - D (ALPHA)
2220:  HZ          COIL 1 COIL 2 COIL 3 COIL 4 COIL 1 COIL 2 COIL 3 COIL
#
2230:                RESPONSES IN Z-DIRECTION                RESPONSES IN Y-DIRECTION

2240:                DISPLACEMENT RESPONSE SUMMARY FOR C/L = ###.###1111
2250:  HZ.          CORN 1 CORN 2 CORN 3 CORN 4 CORN 1 CORN 2 CORN 3 CORN
#
2260:                ACC. RESP. (G-UNITS FOR C/L=###.###1111) FOR PASSENGERS AT
2270:                ACC. PSD (IN G+2/HZ FOR PHI=###.###1111/W+2) FOR PASSENGERS AT

2280:                GAP PSD (IN M+2/HZ FOR PHI=###.###1111/W+2) FOR
2290:  MEAN          #.###1111 #.###1111 #.###1111 #.###1111
#
2300:  MEAN          #.###1111 #.###1111
2310:                CONTROL COIL CURRENT SUMMARY
2320:                ACCELERATION (G-UNITS) FOR PASSENGERS LOCATED AT
2330:                PSD IN Z-DIRECTION                PSD IN Y-DIRECTION
2340:  MEAN          #.###1111 #.###1111 #.###1111 #.###1111 #.###1111 #.###1111 #.###1111 #.###1111
#

```

