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EVALUATION OF THE BOEING PAN AIR TECHNOLOGIES CODE (A502I) THROUGH PREDICTION OF SEPARATION FORCES ON THE GBU-24

by

Matthew A. LeTourneau

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Thesis Advisor: Max F. Platzer

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Matthew A. LeTourneau
Lieutenant, United States Navy
B.S., The George Washington University, 1988

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of the requirements for the degree of

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ABSTRACT

The Boeing PAN AIR Technologies code (A502i) is investigated to explore its suitability for determination of separation forces on ordnance. To this end, A502i is first assessed by applying it to three problems for which other solutions and experimental data are available, i.e. steady flow past a rectangular, parabolic arc wing and a delta wing at both subsonic and supersonic conditions. Good agreement is found in all cases. A502i is then applied to the GBU-24's being in two configurations for a subsonic case and a supersonic case. Good agreement is found with data obtained from wind tunnel experiments for low angles of attack.

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I. INTRODUCTION

In the past, ballistic trajectory determination for manual or computer predicted ordnance delivery from an aircraft was determined through measurement of separation forces on the piece of ordnance via wind tunnel or captive carry measurements. The advent of panel method codes using linearized potential theory, such as A502i, or its full potential version TranAir, allow for a cheaper and safer method of predicting separation forces. Furthermore, A502i allows for any arbitrary configuration to be modelled within the limitations of the number of panels and networks allowed and excluding transonic flow.

The purpose of this work was to determine the separation forces on a GBU-24 carried by an F-14 on stations 3 or 6 or both. It was also the purpose of this work to provide an analysis of the code itself to see if it is a viable tool for the study of flow characteristics over arbitrary wing configurations for use in the Naval Postgraduate School's (NPS) Department of Aeronautics and Astronautics. The majority of the work was conducted on the NPS computer systems. The Department of Aeronautics and Astronautics Silicon Graphics Incorporated (SGI) workstations were utilized for most of the input files as well as the execution of the code. Due to the amount of disk space required, storage of the output files took place on the NPS Computer Center's Y-MP EL98 Cray computer. The bulk of the GBU-24 data was calculated using the SGI workstations at the Naval Air Warfare Center in Warminster.

The scope of this analysis was to understand the capabilities of the A502i code. The approach was to validate A502i against existing data and linear theory. The code was run for three different geometries under assorted Mach and AOA conditions. Comparisons were made for each of the geometries.

II. OVERVIEW OF THE A502i CODE

The A502i code is used to computationally analyze inviscid subsonic or supersonic flows about arbitrary configurations. The code differs from other panel methods in that it is a higher order panel method; that is, the singularity strengths are not constant on each panel. A502i solves the linearized potential flow boundary-value problem at subsonic and supersonic Mach numbers.

The aerodynamic solution provides surface flow properties (flow directions, pressures, Mach number), configuration forces and moments, sectional forces and moments, and pressures. Additionally, A502i calculates flow properties in the flow-field points and flow-field streamlines. Results are limited to subsonic and supersonic cases (transonic cases excluded) with attached flow. Results are not usually applicable to cases where viscous effects and separation are dominant.

A. THEORY

The basic equations describing the flow of a viscous, compressible, heat-conducting fluid are the Navier-Stokes equations. These are:

(a) The continuity equation,

$$\frac{\partial \rho}{\partial t} + \nabla \bullet (\rho \vec{V}) = \frac{\partial \rho}{\partial t} + \sum_{i=1}^{3} \frac{\partial (\rho V_i)}{\partial x_i} = 0 \qquad (2.1)$$

where $\nabla = (\frac{\partial}{\partial x_1}, \frac{\partial}{\partial x_2}, \frac{\partial}{\partial x_3})$ is the gradient operator with respect to the location vector $\vec{x} = (x_1, x_2, x_3)$, and where the conventional index notation is used instead of $\vec{x}=(x,y,z)$. In addition, t is time, $\rho(\vec{x},t)$ is the density and $\vec{V}(\vec{x},t)$ is the velocity vector, with components $\vec{V} = (V_1, V_2, V_3)$.

(b) The conservation of momentum equation,

$$\frac{\partial}{\partial t}(\rho V_j)+\sum_{i=1}^{3}\frac{\partial}{\partial x_i}(\rho V_i V_j)=\frac{-\partial p}{\partial x_j}+\sum_{i=1}^{3}\frac{\partial}{\partial x_i}\tau_{ji}+\rho f_j \quad (j=1,2,3) \tag{2.2}$$

where τ_{ij} is the deviatoric portion of the stress tensor which vanishes for a frictionless fluid, $\vec{f}(\vec{x},t)$ is an external body force per unit mass exerted on the fluid, and $p(\vec{x},t)$ is the pressure.

(c) The conservation of energy equation

$$\frac{\partial}{\partial t}(\rho e+\frac{1}{2}\rho|\vec{V}|^2+p)+\sum_{i=1}^{3}\frac{\partial}{\partial x_i}[(\rho e+\frac{1}{2}\rho|\vec{V}|^2+p)V_i] \\ =\frac{\partial p}{\partial t}+\sum_{i,m}\frac{\partial}{\partial x_i}(\tau_{im}V_m+k\frac{\partial T}{\partial x_i})+\rho\sum_i f_i V_i \tag{2.3}$$

where $e(\vec{x},t)$ is the internal energy of the fluid, k is the coefficient of heat conductivity for the fluid, and $T(\vec{x},t)$ is the temperature.

(d) The equation of state

$$f(\rho, p, T)=0 \tag{2.4}$$

where the function f depends on the type of fluid. The derivations of these equations can be found in Refs. 1,2 and 3.

The Navier-Stokes equations can be simplified by the neglect of viscosity, which is equivalent to setting the deviatoric stress tensor to zero. Combining the momentum and continuity equations yields

$$\rho\frac{dV_j}{dt}=-\frac{\partial p}{\partial x_j}+\rho f_j \quad j=1,2,3 \tag{2.5}$$

where the convective derivative operator is defined as

$$\frac{d}{dt}=\frac{\partial}{\partial t}+\sum_i V_i\frac{\partial}{\partial x_i}$$

Equation (2.5) is referred to as Euler's equation. The continuity and energy equations can

Equation (2.5) is referred to as Euler's equation. The continuity and energy equations can be reduced to

$$\rho \frac{d}{dt}\left(\frac{1}{2}|\vec{V}|^2\right) = -\vec{V} \bullet \nabla p + \rho \vec{V} \bullet \vec{f} \tag{2.6}$$

and the rate of increase of heat per unit mass is given by

$$q = \frac{1}{\rho} \nabla \bullet (k \nabla T) = \frac{d\rho}{dt} + p \frac{d}{dt}\left(\frac{1}{\rho}\right) \tag{2.7}$$

Equations 2.5, 2.6 and 2.7 can be reduced to a single equation when four further assumptions are made. First, assume isentropic flow, thus

$$q=0 \tag{2.8}$$

Second, assume irrotationality

$$\nabla x \vec{V} = 0 \tag{2.9}$$

which allows for the introduction of the potential function [Refs 2,3]

$$\nabla \Phi = \vec{V} \tag{2.10}$$

Third, assume the existence of a freestream potential Φ_∞, whose gradient is the uniform velocity $\vec{V}_\infty$ attained at points sufficiently distant from the disturbance being analyzed, and thus write

$$\phi = \Phi - \Phi_\infty \tag{2.11}$$

and

$$\vec{V} = (u, v, w) = \nabla \Phi = \nabla \Phi_\infty + \nabla \phi = \vec{V}_\infty + \nabla \phi \tag{2.12}$$

The quantities ϕ and $\vec{v}$ are called the perturbation potential and velocity [Ref 3]. Fourth, assume that

$$|\vec{v}|^2 \ll a_\infty \tag{2.13}$$

everywhere, where a_∞ is the freestream speed of sound.

Based on these four assumptions, the unsteady potential equation is obtained [Refs 1,3]:

$$
\begin{aligned}
&(1 - M_\infty^2)\phi_{xx} + \phi_{yy} + \phi_{zz} - 2M_\infty^2\phi_{xt} - M_\infty^2\phi_{tt} \\
&= M_\infty^2[\frac{1}{2}(\gamma - 1)(2u + 2\phi_t + |\vec{v}|^2)\nabla^2\phi \\
&+ (2u - u^2)\phi_{xx} + v^2\phi_{yy} + 2vw\phi_{yz} + w^2\phi_{zz} \\
&+ 2(1 + u)(v\phi_{xy} + w\phi_{xz}) + 2(uu_t + vv_t + ww_t)]
\end{aligned}
\tag{2.14}
$$

Assuming the flow conditions do not change with time yields the steady non-linear potential equation.

$$
\begin{aligned}
&(1 - M_\infty^2)\phi_{xx} + \phi_{yy} + \phi_{zz} \\
&= M_\infty^2[\frac{1}{2}(\gamma - 1)(2u + |\vec{v}|^2)\nabla^2\phi \\
&+ (2u + u^2)\phi_{xx} + v^2\phi_{yy} + 2vw\phi_{yz} + w^2\phi_{zz} \\
&+ 2(1 + u)(v\phi_{xy} + w\phi_{xz})]
\end{aligned}
\tag{2.15}
$$

When M_∞=0, equation (2.15) reduces to Laplace's equation,

$$\nabla^2\phi = 0 \tag{2.16}$$

For the case of $M_\infty \neq 0$, the following is supposed,

$$M_\infty^2|\vec{v}| \ll 1 - M_\infty^2 \tag{2.17}$$

$$M_\infty^2|\vec{v}| \ll 1 \tag{2.18}$$

which are small perturbation assumptions [Refs. 1,2]. With these assumptions the steady non-linear potential equation reduces to the Prandtl-Glauert equation [Ref 1]:

$$(1 - M_\infty^2)\phi_{xx} + \phi_{yy} + \phi_{zz} = 0 \tag{2.19}$$

Through a coordinate transformation [Refs. 1,2,3], the Prandtl-Glauert equation can be re-written as:

$$s\phi_{\bar{x}\bar{x}} + \phi_{\bar{y}\bar{y}} + \phi_{\bar{z}\bar{z}} = 0 \tag{2.20}$$

where when s=1, it is the subsonic case and Laplace's equation applies and when s=-1, it is the supersonic case and the wave equation applies. Applying Green's third identity [Ref. 1] yields the following integral equation,

$$\phi(P) = -\frac{1}{4\pi}\int\int_s [\frac{\sigma}{R} - \mu\hat{n} \bullet \nabla\frac{1}{R}]dS \tag{2.21}$$

where σ represents the source strength and μ represents the doublet strength. When supplemented with boundary conditions, it is equation (2.21) that A502i solves.

A502i solves equation (2.21) through a discretization process. The general idea of the process falls into two parts. The first is developing finite dimensional approximate representation formulas for the singularity functions, which creates a system of equations with unknown coefficients, λ_i. The second part involves solving the set of equations for all λ_i. This allows for completely determining the source and doublet functions. Then, by virtue of equation (2.21), the potential function $\phi(P)$ is determined for all points P, solving the problem.

The features of A502i which distinguish it from predecessors are three-fold. The first is a feature known as "continuous geometry", the second is linear source and quadratic doublet variation, the third is continuity of doublet strength.

Most panel methods approximate the configuration geometry with panels whose planform is a quadrilateral. Thus, if the panels themselves are planar, only a small class of configurations (such as cylinders and flat wings) can be described without gaps being left between panels. These gaps are generally small, except for highly twisted surfaces. The gaps cause little numerical error in subsonic flow, but in supersonic flow, the cumulative effect of the gaps is serious [Ref. 1]. The problem is not associated with leakage of flow through the gaps, but with the doublet strength jumping abruptly from a non-zero value to zero at a panel edge which does not exactly meet the adjacent edge. In A502i, gaps are closed by means of panels which are comprised of several planar regions.

The feature of linear source and quadratic doublet variation is what makes A502i a higher order panel method. The basis function corresponding to a source parameter is locally linear, while the basis function corresponding to a doublet parameter is locally quadratic. This is what allows for A502i to find supersonic solutions. Numerical solution of the wave equation is far more sensitive to the numerical idiosyncracies of a panel method than is the solution of Laplace's equation for subsonic flow. Experimental evidence [Ref. 1] indicates that exact surface analysis is not feasible in supersonic flow without doublet continuity, thus the potential for numerical error is greatly reduced by requiring the doublet singularity strength to be continuous across panels.

B. GENERAL A502i USAGE

The use of the A502i code consists of generating an input file, which can be arbitrarily named, and which contains the information defining the geometry of the configuration, flow field points of interest, the flow conditions and wakes. The process of building a geometry is difficult in that A502i is particular about its input format. Simple configurations, such as a rectangular, planform wing can be modelled manually, but more complex structures require a pre-processing program, such as MACGS, where a geometry can be graphically built. MACGS will output a data file in a format that, with minor modifications, via another pre-processing program that can move the data from three columns to six columns, will be readily usable by A502i. Currently, the school does not have a copy of MACGS, but it can be acquired through McDonnell-Douglas. To complete this thesis, MACGS was used on the SGI workstations at NAWC Warminster. Wakes also must be constructed in the same manner as the structure to be analyzed. More detailed instructions on the specifics of wakes and surface geometries can be found in Ref. [4]. Appendix A is a portion of an output file, but lines 1 thru 1120 are an exact duplicate of the input file.

1. Running A502i with an Existing Executable

Assuming an A502i executable file (e.g., A502) has already been placed in a user executable directory (e.g., /usr/local/bin), the only other necessary items needed to produce a set of A502i output files is the input file and a large amount of storage space. Anything modelled with more than one thousand panels total will use more than one hundred mb of disk space. If the maximum number of panels (20,000) is used, the disk space required will be on the order of 2 gb.

To run A502i, enter after the UNIX prompt:

A502 *<input file > output file*

Prior to running the code, it is highly recommended that a Cray account be opened and linked to the department's SGI workstations. This is done by assigning the same user i.d. number to the Cray account as is assigned to the account with the department. User i.d. numbers can be changed by the computer center at the user's request. This is required due to the limited disk space available to individual accounts in the department. Once an account is opened, log on to a department workstation, change directories to an existing Cray directory, for example (after the UNIX prompt):

cd /jedi/d1/maletour

Transfer the input file to the Cray directory and execute the code. The screen will display what portion of the code it is performing and how long it took to perform each portion in CPU time. The code outputs numerous files in addition to the arbitrarily named output file.

The two output files of interest, in the vast majority of cases, are the arbitrarily named output file and the ft13 file. In order to run another solution all output files must be deleted or renamed prior to re-executing the code. Relevant results should not be kept on the Cray account as files on disks d1, d2 and u1 are considered temporary storage and subject to erasure after a period of time.

2. Creating an A502i Input File

The input file, which can be arbitrarily named, consists of two portions, the largest being the geometry data. Appendix A is a complete recreation of the input file for the GBU-24 with canards. The file begins with line 1, $TITLE, and ends with line 1120, $END. The line numbers are for reference only and are not part of the actual input file. The first portion consists of creating the initial conditions, i.e., the free-stream Mach number and angle of attack, the type of analysis to be performed, i.e., solution or datacheck, what types of output that are to be included in the arbitrarily named output file, and reference points to be used in calculating forces and moments. The geometry data consists of the points that bound each panel, that in turn belong to a specific group of panels that make up a network. The overall structure being modelled consists of a series of networks. A502i can run up to 150 networks and or 20,000 panels with a limit of 8,000 panels per network. Referencing Appendix A, line 28 represents the first network of the model, a canard. Line 29 represents the number of networks that will be classified under this $POINTS statement. Line 30 indicates what kind of surface the network will be, a three-dimensional surface with flow properties to be calculated, a wake and a base are several examples. Line 31 is the number of y points and the number of x points respectively that make up the grid of that network. Line 32 is where the panel points start. Reference 4 contains detailed instructions on the options and meaning of each of the non-geometry inputs, including some capabilities not shown in Appendix A.

Two types of solutions can be run, a datacheck and a full solution. Reference 4 explains how to enter either one into the input file. The datacheck only analyzes the geometry. This can be accomplished in a matter of seconds for a simple geometry as it is only running the first several portions of the code. The full solution can take a couple of hours for a geometry of the size of 4,000 panels. The datacheck should be run once the geometry has been modelled. It will check for any panel edges that do not abut properly, and when column 4 of line 20 in Appendix A is a 1, the datacheck will list the unit normal vectors, which must be facing outward. The datacheck will also see if the wakes are attached properly. A502i is capable of giving warnings both on-screen and in the arbitrarily named output file when an edge or a wake is not modelled properly, but it only lists the unit normal vectors. The directions of the vectors must be manually checked by the user. The full solution performs the datacheck first, so the data is repeated in the arbitrarily named output file. Appendix B is a portion of the output file that contains the summary of facing surfaces. Each panel edge is looked at to see what it abuts against. Sections such as wingtips, leading edges of a flat plate or any surface that does not need a wake attached, but is unabutted to any other panel on that edge will draw probable error messages or warnings from the code. The user must ensure that the edge is not supposed to abut against anything or need a wake attached. If that is the case, the warnings may be ignored. Appendix D is the first page of the portion of the output file that lists the unit normal vectors. The three columns under zc are the x-y-z coordinates of the given panel's center. The three columns under znc are the x-y-z coordinates of the unit normal vector. In most cases, when the y coordinates are of the same sign, then the unit normal vector is pointing outward.

C. GEOMETRY MODELLING

Five geometries needed to be modelled, each of increasing complexity. Modelling proved to be the most difficult task, in that A502i is a FORTRAN code and is very format sensitive, but the sheer number of points that need to be generated can take a lot of time and the order those points are listed in the input file is what determines whether or not the shape is correctly modelled. Of the five geometries modelled, none were done completely manually. A spreadsheet was used for generating the parabolic arc airfoil and the deltawing since those structures can be constructed out of one network, excluding wingtips and wakes, and the surface can be defined by a mathematical function. The bombs and the F-14 required the use of MACGS to be properly modelled. MACGS is indifferent as to the order that geometries are built, and often doesn't require many coordinate inputs if building a model on top of an existing IGS file. The output file from MACGS is automatically formatted and the points placed in the appropriate order for A502i to understand. Although, the order may be reversed where the unit outward normal vector is concerned. MACGS has the ability to output files in several different panel method code input formats, including PMARC. Reference 4 gives detailed instructions on how to properly order points to build a group of networks that will model a geometry. A502i uses a right-handed coordinate system that is similar to an aircraft body axes. When put in terms of a wing, the x axis is positive from leading edge to trailing edge. The z axis is positive up and the y axis is positive out the right wing

1. The Parabolic Arc Airfoil

The parabolic arc airfoil is the simplest of all the geometries. The airfoil has a chord of five and a span of ten. The maximum thickness is .15. The model consists of approximately 600 panels, including the wake and wingtips. A spreadsheet was used to develop the geometry portion of the input file. Line 32 of Appendix A demonstrates the format that the spreadsheet used. Rows consist of two points, with coordinates x1, y1, z1, x2, y2, z2 using a format of 6F10.0. The chord was divided into 25 points (x coordinate) from trailing edge to leading edge and then another 25 points from leading edge to trailing edge (bottom half). The span was divided into 12 points (y coordinate) from left to right. Due to the symmetry of a rectangular planform, the y coordinate was constant along the 50 x coordinates that constituted a chordwise cross-section. To attain a maximum thickness of .15 the formula,

$$z = .3 * \left(\frac{x}{c} - \frac{x}{c^2} \right) \tag{2.22}$$

was utilized to generate the values of the z coordinates. The wingtips simply connect the x coordinate on the top side with it's symmetrical counterpart on the bottom side. Due to a trailing edge composed of a straight line, the wake is modelled by a single panel that spans the trailing edge and has a length aft of 100. Figure 2.1 shows the panel distribution across the top surface of the parabolic arc airfoil, where the thickness is represented by the color scheme. A panel and a point are numbered to show how they were entered into the input file.

2. The Deltawing

The deltawing represented a step up in complexity over the parabolic arc airfoil. The chordwise cross-section is parabolic, while the spanwise cross-section is linear. The procedure for building the geometry on a spreadsheet was the same as that for the parabolic arc airfoil, only the chord length is not constant along the span. For simplicity in design, the number of panels per column of panels is constant on the deltawing, as on the parabolic arc airfoil. This means an increasing panel density in the direction of the wing tip. The wake is modelled the same as the airfoil. The right wingtip ended in a point, so no extra panelling was needed to close any gaps. The symmetry of the deltawing allowed for

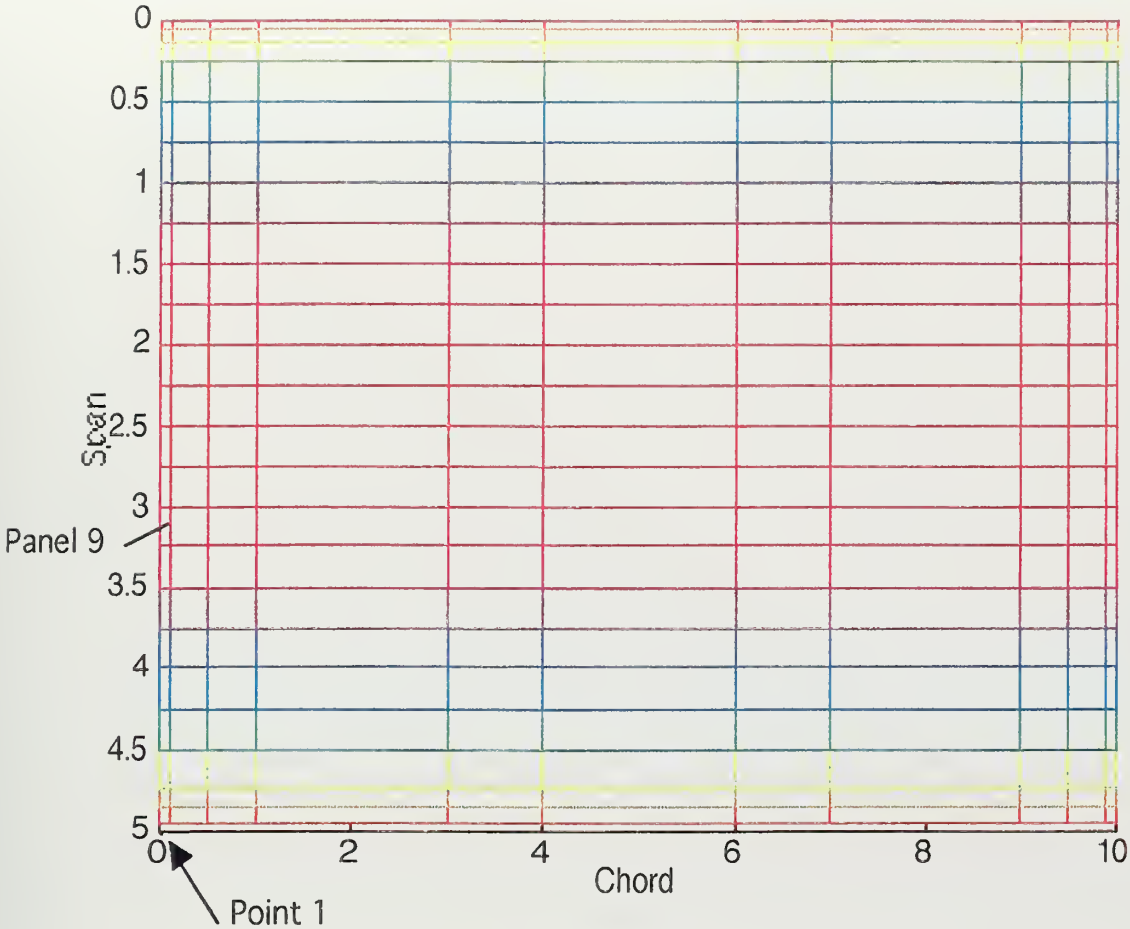

Figure 2.1 Parabolic Arc Panel Distribution

further simplification and reduction of the code's run time by only modelling from the centerline to the right tip. A502i allows the user to stipulate whether there is symmetry in the x-z plane and or the x-y plane (see line 5 and 6 of Appendix A). This means that the gap between the top and bottom panels at the center line does not need to be bridged as in the parabolic arc airfoil (symmetry could have also been used in the airfoil's case). The chord of the deltawing has a length of 90 and the semi-span has a length of 15. The maximum thickness occurs midway along the centerline and is .05. The model consists of 880 panels. Figure 2.2 shows the panel distribution along the top surface of the deltawing.

Thickness is represented by the color scheme.

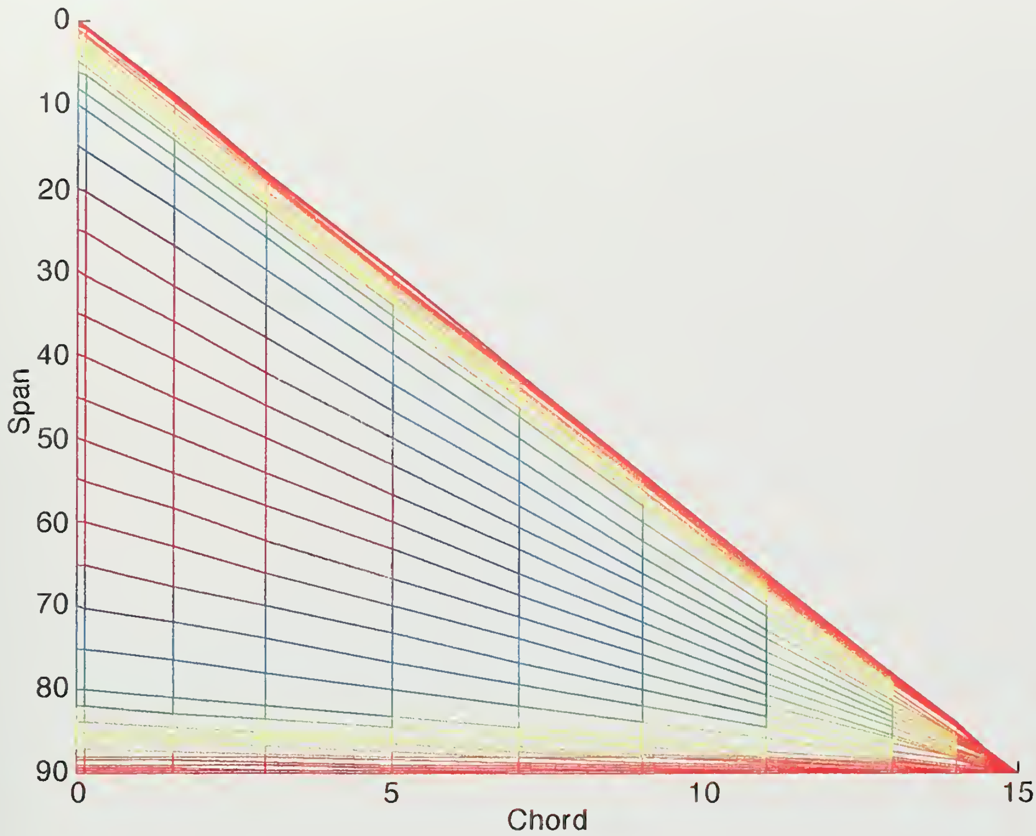

Figure 2.2 Panel Distribution of Deltawing

3. GBU-24

Wind tunnel experiments were run on the GBU-24 without canards attached, so it was deemed relevant to build a model with and without canards as a comparison of the code's performance. The model of the GBU-24 was too complex to build with a spreadsheet, so MACGS was used. The bomb was modelled at NAWC Warminster by superimposing a group of networks on top of an IGS file being displayed by MACGS. The complete configuration consists of approximately 1300 panels. Figures 2.3 and 2.4 are displays of the GBU-24 with canards, with Figure 2.4 including the wakes. Figure 2.5

is included to show how the GBU-24 model was assembled. Each different color represents a network.

Several features of the geometry are relevant to point out. Two of them are modifications made to the geometry that differ from the actual dimensions of the bomb. Dr. Alex Cenko of NAWC Warminster has extensive experience with modelling stores in A502i. The modifications were made on his knowledge of how to get the most accurate results from the code when modelling stores. The first is to model the fins and canards as flat plates, i.e., no thickness, which A502i allows you to do through a single numerical change in the input code for each network that represents a flat plate (see line 30 of Appendix A). The fins and canards are extremely thin when compared to the rest of the bomb, and to add a third dimension to the geometry complicates the construction of the fin or canard for several reasons. The leading and trailing edges must be sharp and the surface the fin or canard attaches to would have to be modified to abut properly with two edges instead of one. Experience has shown that the simpler version yields accurate predictions. A502i is an inviscid code, so it cannot take into account separation effects on its own. The GBU-24 does not have a flat base. In reality, it is more bullet nosed in shape. However, at the speeds with which the bomb is being analyzed, separation does occur near the trailing edge of the bomb. Experience has shown that truncating the end into a flat base and designating it a separated flow region through an appropriate input (see line 702, column 1, Appendix A) yields better results than attempting to model the bomb to exact physical dimensions. The last feature to point out are the wakes, as seen in Figure 2.4. A502i has a limitation in that the wakes must be modelled by the user, and they have the same abutment requirements as physical surfaces. Regardless of angle of attack, the wakes remain stationary with respect to the body to which they are attached. At higher angles of attack, the wakes are no longer close to paralleling the free-stream velocity. Remodelling the wakes is nearly an impossible task. The fin and base wakes would not be too difficult

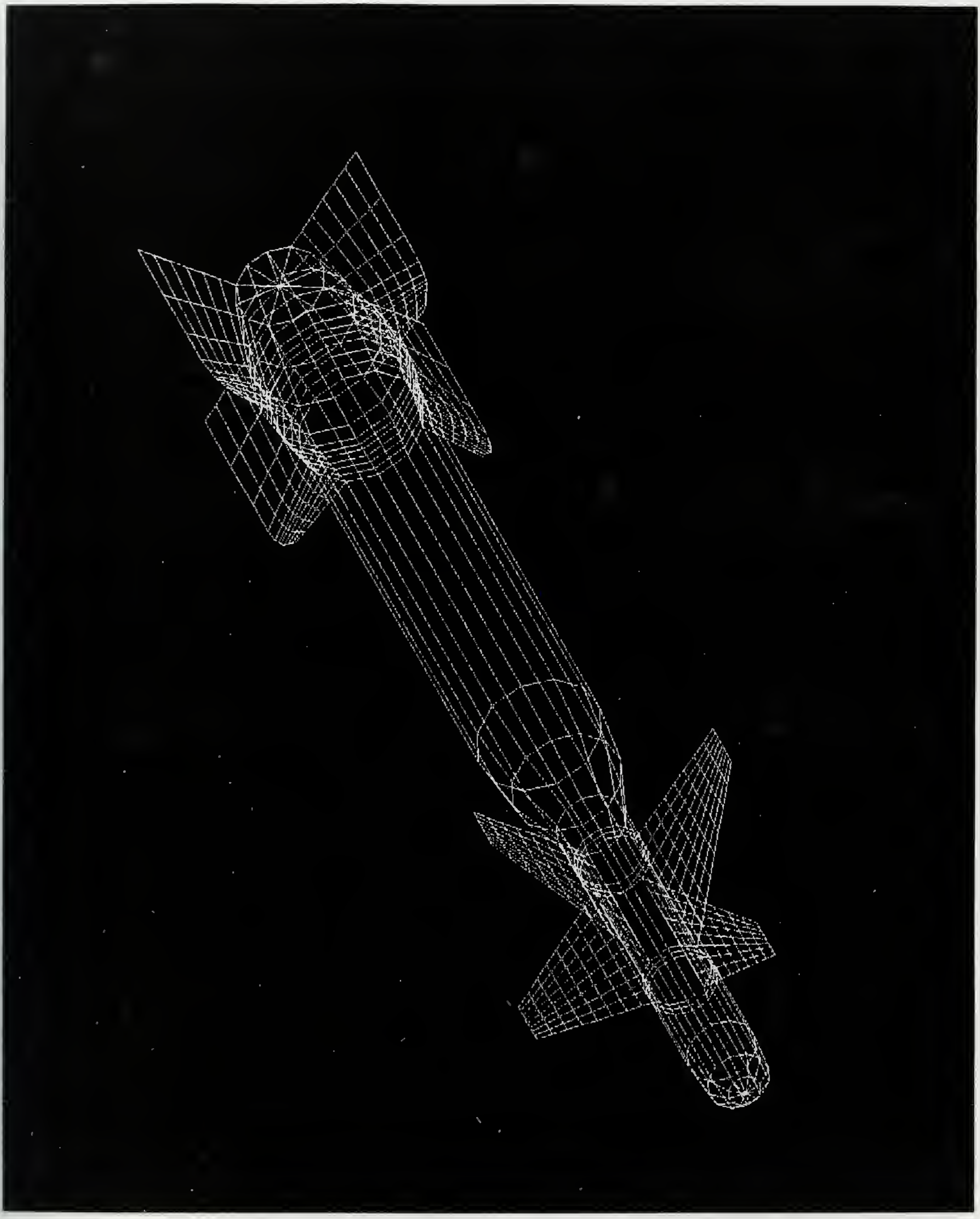

Figure 2.3 GBU-24 Geometry (Wakes not Shown)

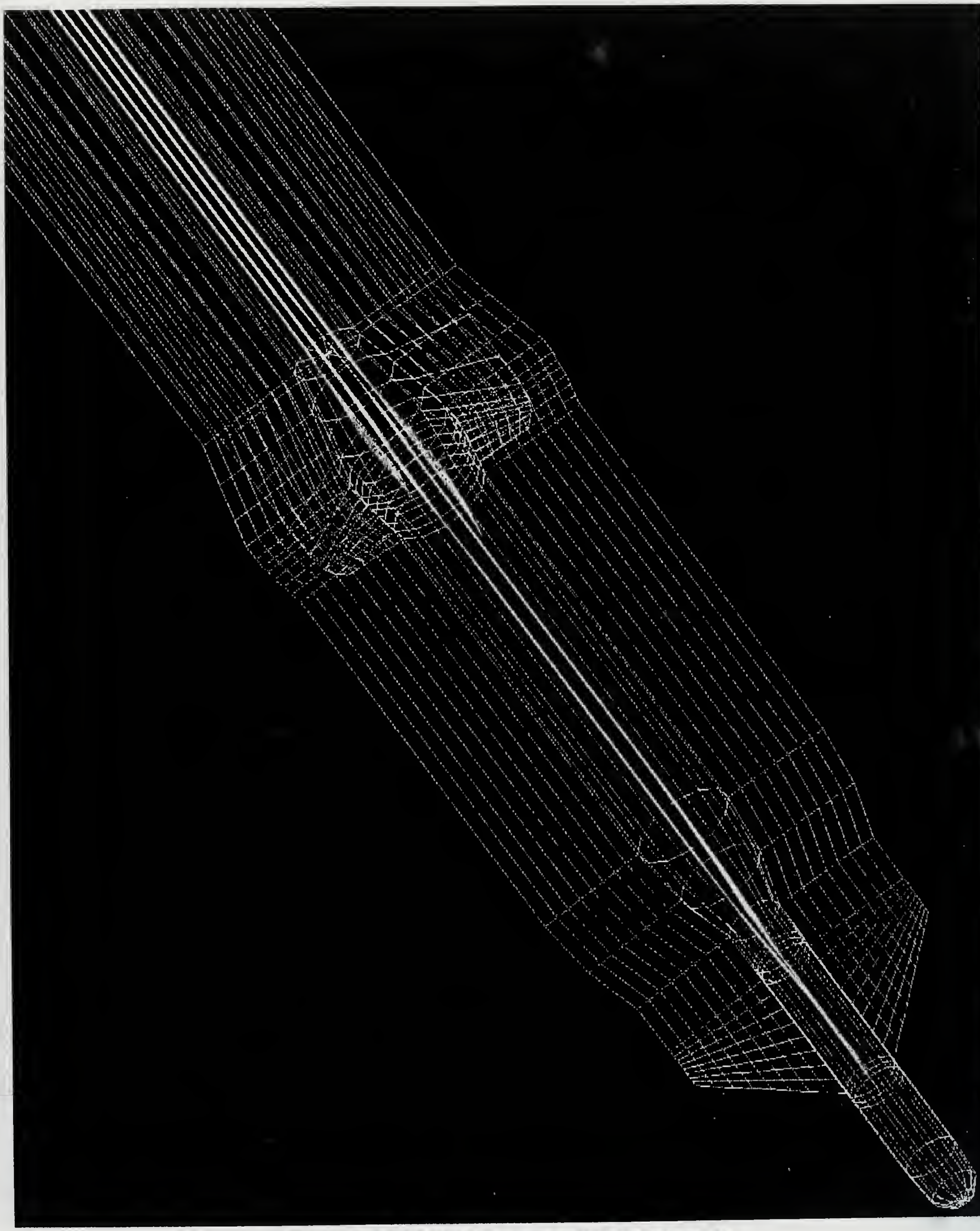

Figure 2.4 GBU-24 Geometry (Wakes Shown)

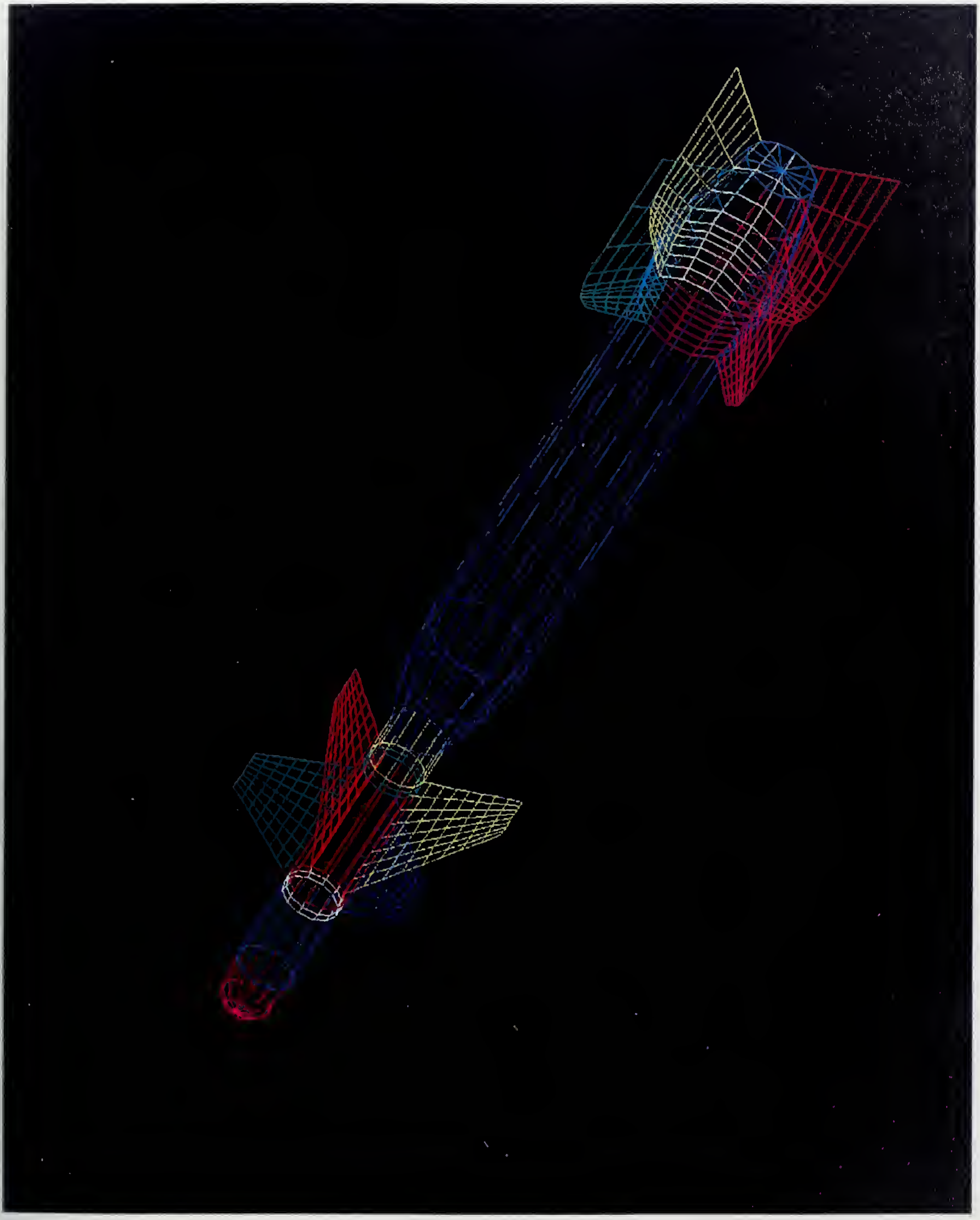

Figure 2.5 GBU-24 Geometry (Network Modelling)

because they do not abut against any physical surfaces except for the surfaces they are trailing from. The canard wakes must abut properly against the bomb's body all the way to the base. Modification of those wakes would entail modification of the entire body, or in a possible simplification, letting the wakes remain attached along the body until the base of the bomb and then shifting them relative to the free-stream.

4. The F-14

The F-14 geometry was modelled in the same fashion as the GBU-24. The geometry consists of approximately 1500 panels. While that may seem fairly coarse for such a complex structure, experience shows that it is all that is required to get accurate predictions. The primary area of interest is the underside of the fuselage forward and between the two nacelles. Higher panel density on the top half is not required. Figures 2.6 and 2.7 display the F-14 geometry without and with wakes shown. Several omissions are made to the model as having a trivial effect on the analysis or no effect at all. Phoenix rails and bomb racks are not modelled along with the chin pod because they are deemed insignificant to achieve reasonably accurate predictions over small angles of attack. External tanks were not considered, but could be modelled much in the same way as the bomb and inserted into the input file to see what effects the drop tanks have on separation forces. The vertical tails and horizontal stabilizers were deemed irrelevant to the prediction of the separation forces and were left out. This reduces the number of panels and networks, which also reduces the amount of time it takes to run a solution.

5. Combination Geometries

The F-14 and GBU-24 were modelled separately, but were combined together as shown in Figure 2.8. The first step to accomplish this was using the FORTRAN code NAVSEP which, among many of its functions will translate coordinates to relocate items in the flow-field. Once accomplished, the GBU-24 file was pasted into the F-14 input file.

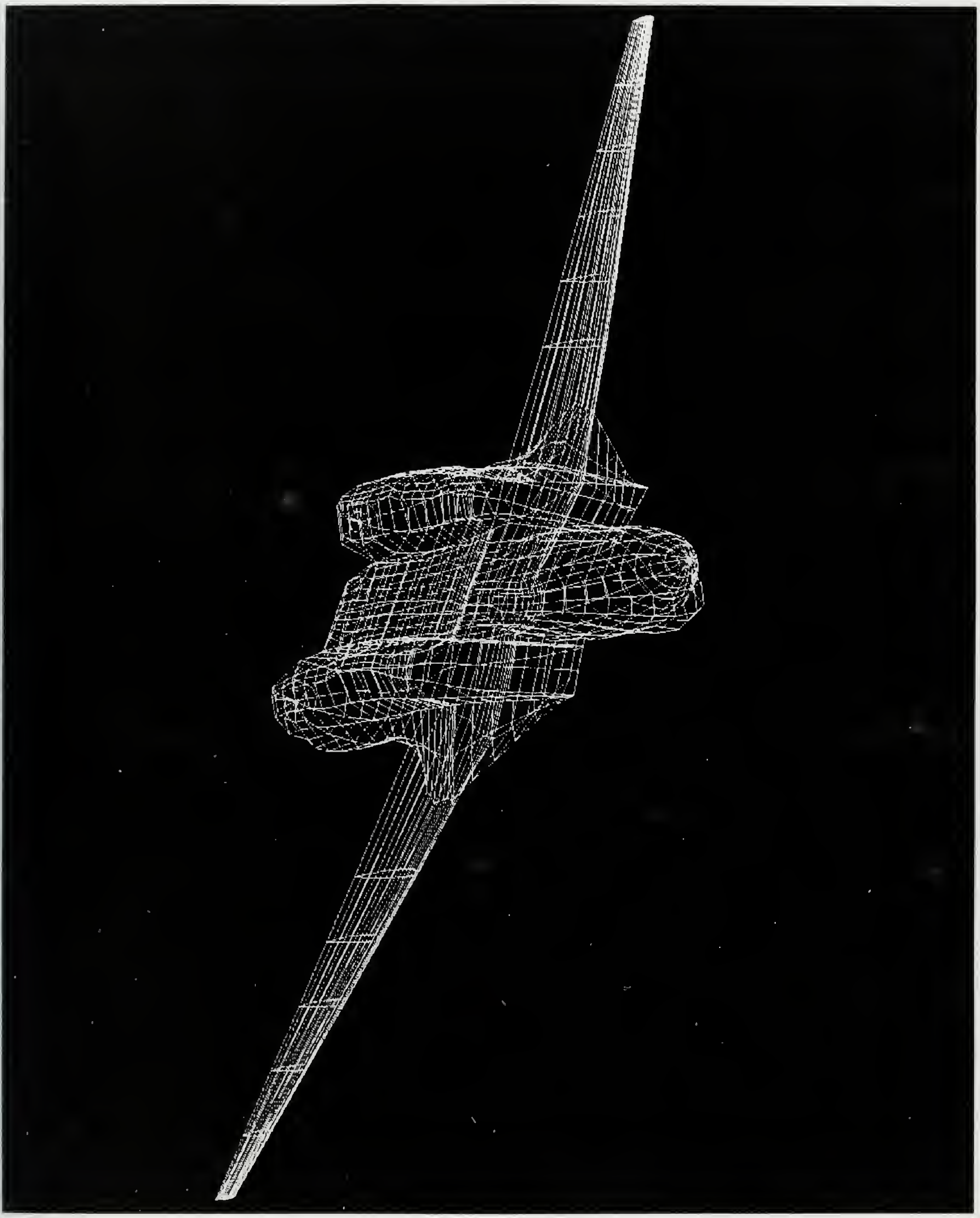

Figure 2.6 F-14 Geometry (Wakes not Shown)

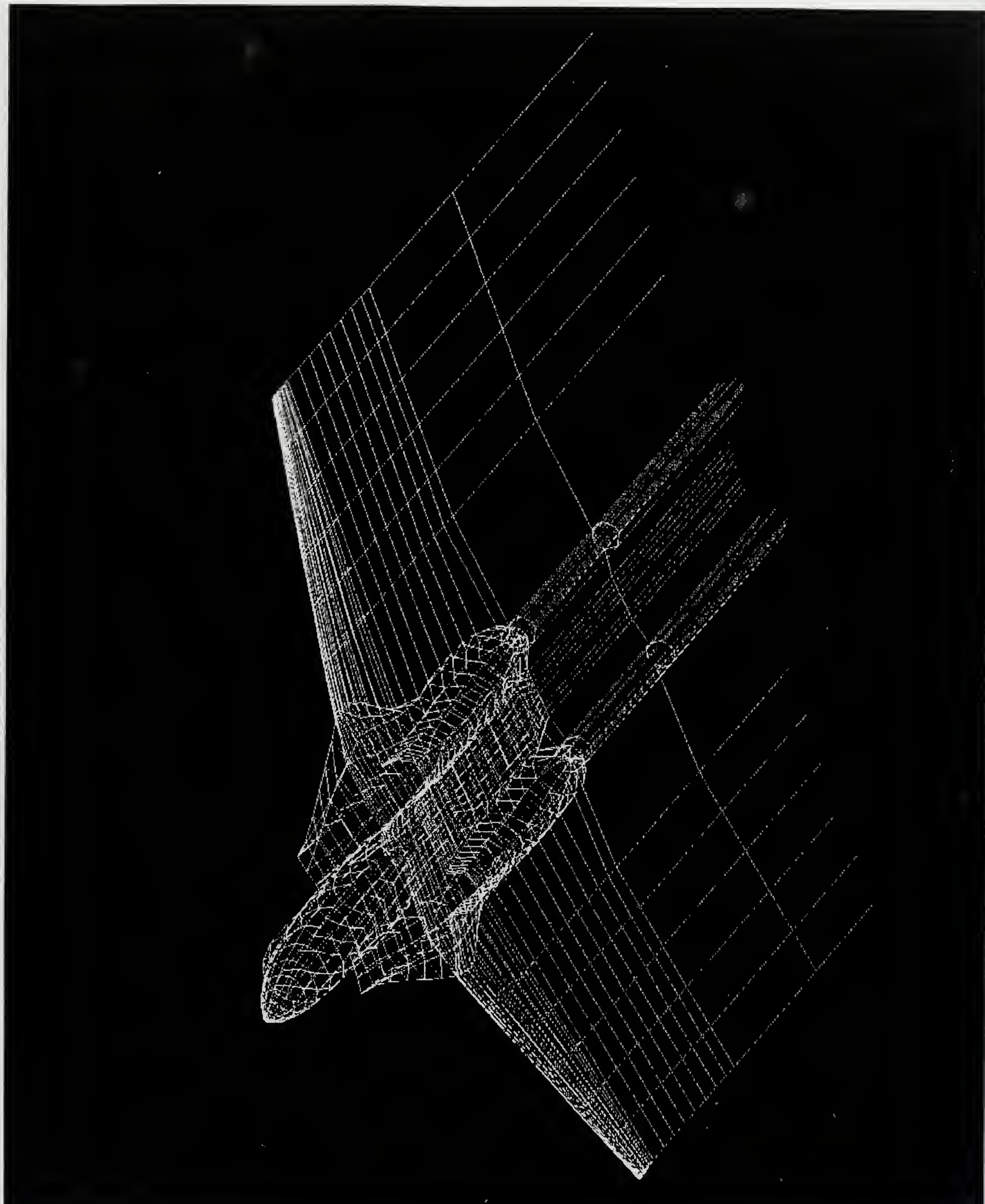

Figure 2.7 F-14 Geometry (Wakes Shown)

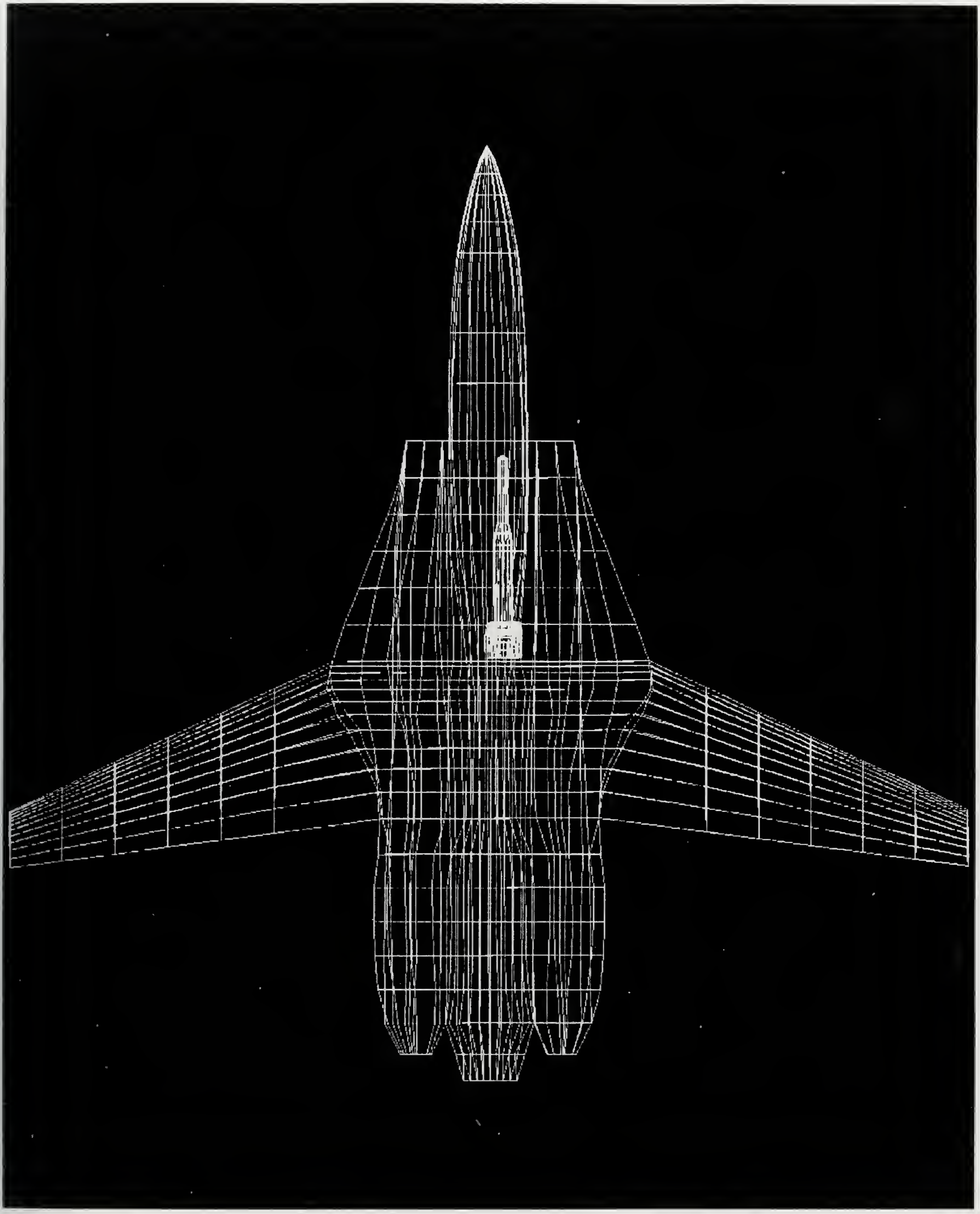

Figure 2.8 F-14 and GBU-24 on Station 3 Combined Geometries

D. GRAPHICS VISUALIZATION

One of the pre/post-processing codes that came with A502i is called RAID. Currently an executable exists in the department's computer system that can be accessed through typing after the UNIX prompt,

raid

Raid is a basic graphics program that can read A502i and TRANAIR input files and display geometries and flow properties from solutions. After accessing raid, it will ask what type of input file it is being asked to visualize. It can handle five other modes of input besides A502i/TRANAIR [Ref. 10]. It will then ask for the name of the input file. A prompt will follow asking about object definition matrices which needs to be answered by,

EACH

The next prompt will ask if the panels are going to be shaded by a Cp value. Cp is used generically in that Cp can be displayed or Mach or any of the relevant 49 surface flow properties [Ref. 4]. This is only used after a solution has been run, data has been extracted and a colorscale for contour plots has been determined. If only the geometry is to be displayed, then hit carriage return for all the next questions until a pink window appears with a menu in the lower left corner of the window. An anomaly of the program is that if you want to display the wakes, then wake display must be deselected. To view the geometry select view on the menu. All selections with the mouse in RAID are made with the center mouse button. A new window appears with a menu bar at the bottom and left and the geometry in the center. From there, rotation, translation, scaling, axes, reflections and other manipulation of the geometry is possible. Figures 2.3 through 2.8 are examples of geometries displayed on RAID.

When presentation of solutions (i.e., Cp or Mach contours) are desired, the use of another post-processing program is required to generate a colormap file. The program is called crebar. An executable currently exists on the department's system. Type in,

crebar

after the UNIX prompt. The program will ask straightforward questions. Number values associated with colors available can be found in Ref. 10. The color file can be saved under any name, but must lie in the same directory as the input and solution files. The first line of the color file will list four numbers. The first number is the number of colors assigned to the colormap (248 maximum). Occasionally, the color bar displayed in RAID when using a colormap will disappear when certain menu items are selected. To prevent this, change the last three numbers to read 6, 1, -1. Plotting outputs from RAID requires saving the file in a format, such as RGB, that a printer will recognize. It is possible to change the text color and background color, the default is black, to avoid excessive use of black ink in hard copies.

III. DATA EXTRACTION

When a solution has run to completion, there are two files of interest, the arbitrarily named output file and the ft13 file. The arbitrarily named output file contains results for everything that A502i solves for. The ft13 file contains only the 49 surface flow properties on each panel. Appendix D is the solution portion of an arbitrarily named output file for the first network.

For purposes of displaying flow properties on RAID, it is necessary to utilize the ft13 file. A post-processing code called RAIDCONV is used to extract the specific information. To access RAIDCONV, type

raidconv

after the UNIX prompt. An executable currently exists in the department's system. The ft13 file must be in the same directory as RAIDCONV is accessed in. RAIDCONV will prompt the user for which kind of panel method is being used (A502i is one of three choices). The next prompt will ask for the name of the ft13 file. The last prompt will ask for the flow property that is to be extracted. A file called ft13.cp will be created. It can be renamed for purposes of multiple flow properties extraction. Abbreviations for the 49 flow properties can be found at the bottom of page 1 of Appendix D. The two primary flow properties are

LMACHU for local Mach number

CP2ND for second order pressure coefficient

CP2ND is the default setting for RAIDCONV. Once the ft13.cp file is created, RAID can be used as previously discussed to display the flow properties. An anomaly of RAIDCONV is that it does not recognize kt=20 type wakes, used where wakes from a wing abut against a body [Ref. 4]. To assist in extracting all the data, the kt=20 wakes should be placed at the end of the input file. In general, it is good practice to place all wakes at the end of the input file when using A502i.

The arbitrarily named output file duplicates the data found in the ft13 file and includes moments and forces. A502i will sum up the moments and forces on each network and for all networks so far [App. D]. The moments are computed based on the coordinates entered into the input file [Ref. 4 and App. A].

IV. RESULTS OF A502i COMPUTATIONS

A. PARABOLIC ARC AIRFOIL DISCUSSION

This simple geometry was analyzed primarily to evaluate A502i's capabilities by a comparison to known linear theory. To this end, the geometry discussed in section II-C and shown in Figure 2.1 was run by A502i at a Mach of 0.3 and a Mach of 1.5 at an angle of attack of zero. Two of the 49 flow properties that A502i computes [Ref. 4] for each panel are linear Cp and second order Cp, given by

$$CPLIN = -2u_c \qquad (4.1)$$

$$CP2ND = -2u_c-[(1-M_\infty^2)u_c^2+v_c^2+w_c^2] \qquad (4.2)$$

Where u_c, v_c and w_c are the compressible components of the perturbation velocity. Figure 4.1 plots the linear theory, A502i linear and second order results for the subsonic case, while Figure 4.2 represents the supersonic solution.

Linear theory for parabolic arc airfoils is outlined in Refs. 2 and 3. The equation representing the subsonic case is given by:

$$Cp(x) = \frac{-8*\tau_{max}}{\pi*chord*\sqrt{1-M_\infty^2}}*(1-(.5-x)*\ln\left|\frac{1-x}{x}\right|) \quad \text{where } 0<x<1 \qquad (4.3)$$

Equation 4.3 includes a Prandtl-Glauert compressibility correction. The equation representing the supersonic case is given by:

$$Cp(x) = \frac{2\theta}{\sqrt{M_\infty^2-1}} \quad \text{where } 0<x<chord$$
$$\text{and } \theta = \tau_{max}*(\frac{1}{chord}-\frac{2x}{chord^2}) \qquad (4.4)$$

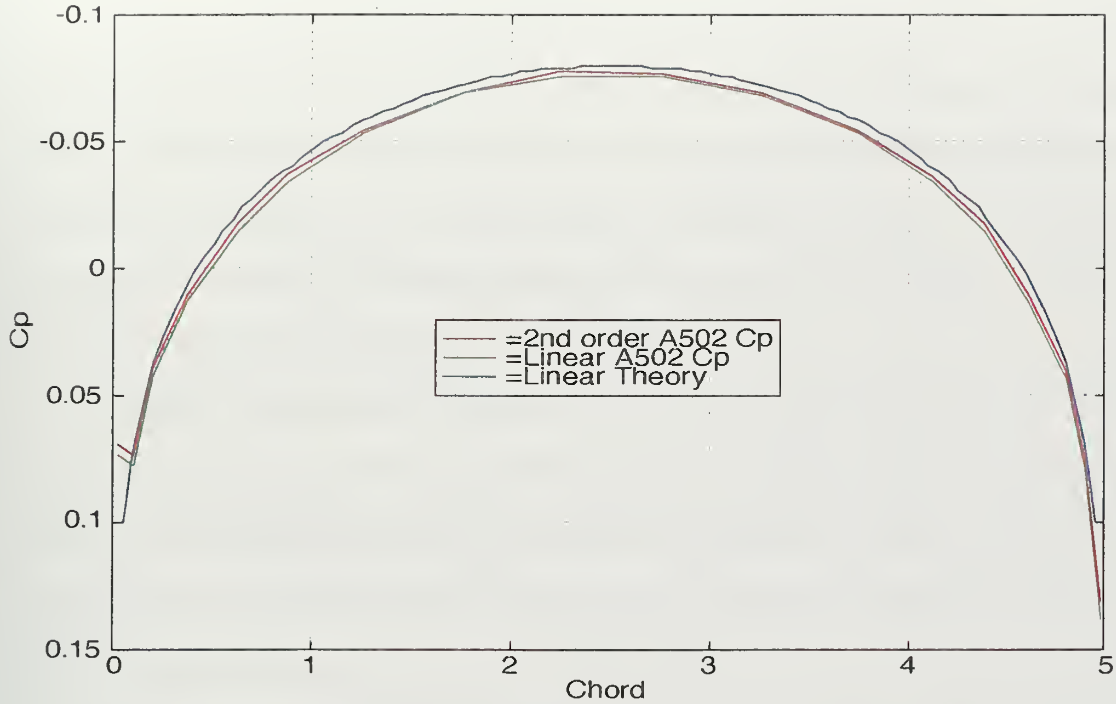

Figure 4.1 Cp Comparison of a Parabolic Arc Airfoil at Mach = 0.3.

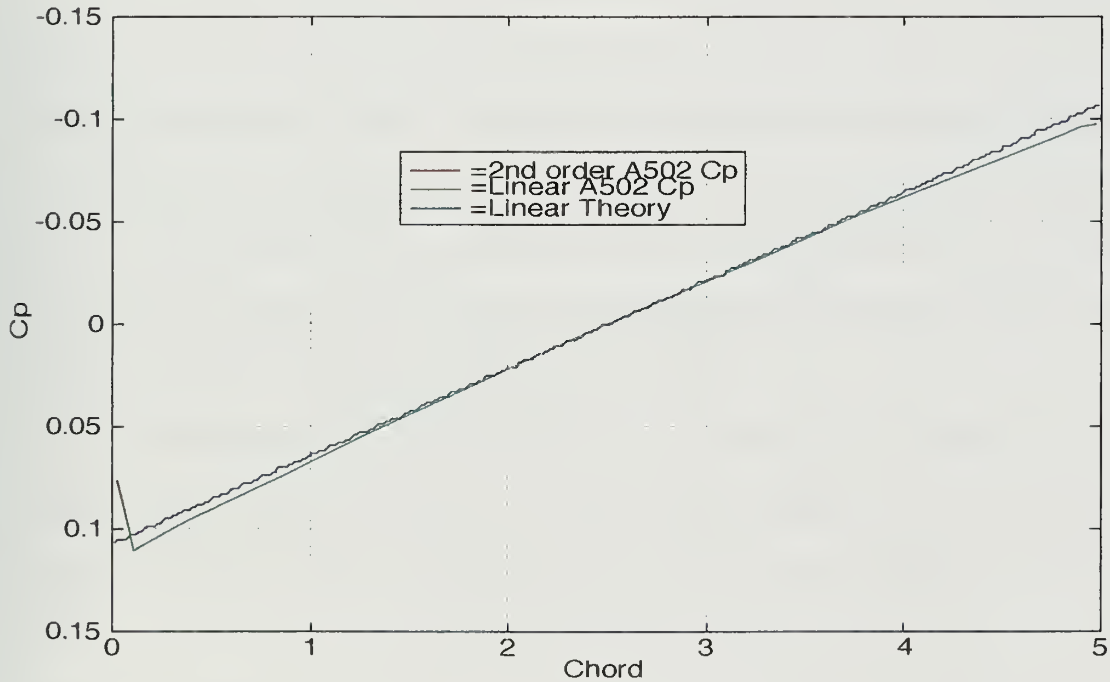

Figure 4.2 Cp Comparison of a Parabolic Arc Airfoil at Mach = 1.5.

Figure 4.1 shows very good agreement with the linear theory curve. There is a small but noticeable difference between A502i's linear results and second order results, with the second order results being more accurate, as expected. The maximum difference between the linear theory curve and the second order A502i curve amounts to a value of 2.5% right at mid-chord. The gap between the two curves from .25 chord to .75 chord were the result of thin panel density in that region.

Figure 4.2 shows excellent agreement with the linear theory curve. The A502i values of Cp for the linear and second order analysis are virtually identical. There are small deviations from linear theory near the leading and trailing edges, but this is expected due to numerical error associated with the discontinuity A502i would encounter right on the leading or trailing edges.

B. DELTAWING DISCUSSION

Reference 9 provides data on Mach distribution, using approximated linear theory, over a deltawing of the configuration discussed in section II-D. This simple geometry provided another test of A502i's capabilities. Figures 4.3 and 4.5 show the A502i results for the subsonic and supersonic case, while Figures 4.4 and 4.6 reflect the results from Ref. 9. For both cases, good agreement is found with the linear theory, with A502i's subsonic analysis being physically more accurate than the approximate linear theory, while A502i's supersonic analysis is not as physically accurate.

A comparison of Figures 4.3 and 4.4 reveals several points of interest. The Mach contour representing the free-stream value is given by the dashed line. All lines outside the dashed line represent areas where the Mach value is less than free-stream, and inside the dashed line is where the Mach value is more than free-stream. The location of where the free-stream Mach contour, in Figure 4.3, intersects the centerline agrees very well with Figure 4.4. However, Figure 4.4 does not have the contour extending all the way to the tip. This is a physical limitation of the approximate theory used in Figure 4.4 and A502i is giving a more realistic solution. Figure 4.4 suggests that the peak Mach value occurs at approximately two-thirds chord along the centerline. The A502i results show the peak Mach contour occurring out midway along the semi-span. Those Mach values are less than 1% larger than the yellow Mach contour surrounding it, and can be attributed to how the panel density increases with movement towards the wingtip. A502i performed very well for this subsonic case.

A comparison of Figures 4.5 and 4.6 shows that A502i did not perform as well as in the subsonic case. Again, the contour representing the free-stream value of Mach =1.414 is given by the dashed line. All lines forward are below free-stream and all lines aft are above free-stream. Figure 4.6 shows the intersection of the free-stream Mach contour on the centerline occurring at approximately 39% chord, which is in excellent agreement with A502i's result. Figure 4.6 shows the peak Mach value occurring at the trailing edge on the centerline. This makes more physical sense than the results that A502i yielded. The maximum thickness of the deltawing occurs along the centerline, allowing for greater expansion. The discrepancy may be attributable to panel density and accumulation of numerical error. A close study of the A502i results reveals some discontinuities along the column of panels out at the wing-tip which would have adversely affected the solution and caused errors to propagate along the semi-span.

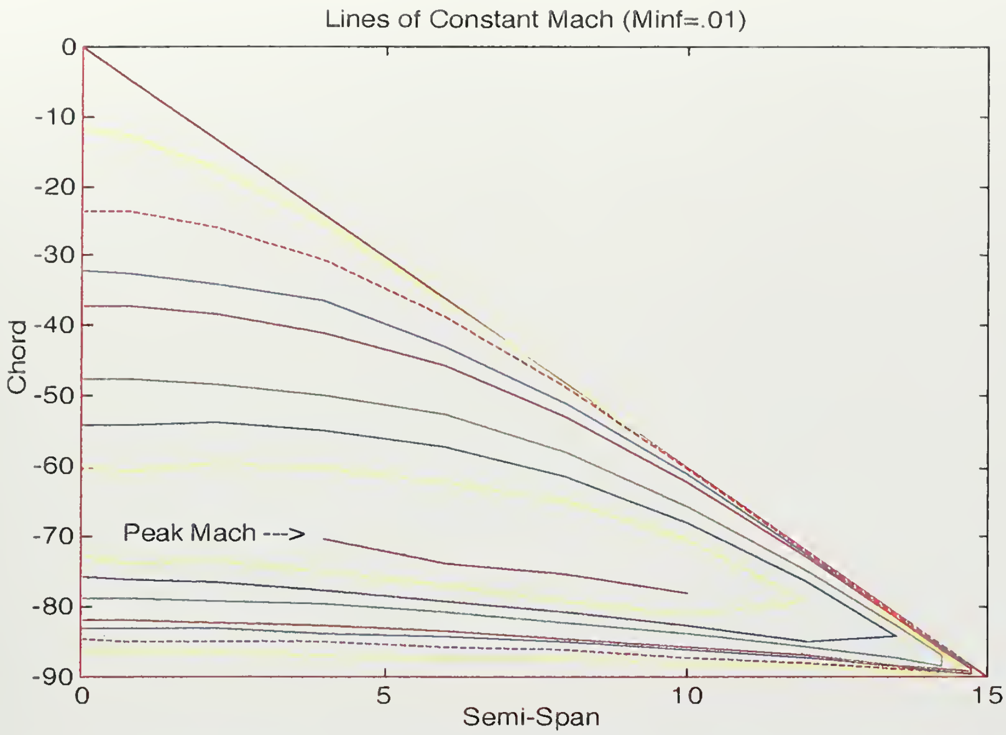

Figure 4.3 A502i Mach Contour Plot (M_∞=.01)

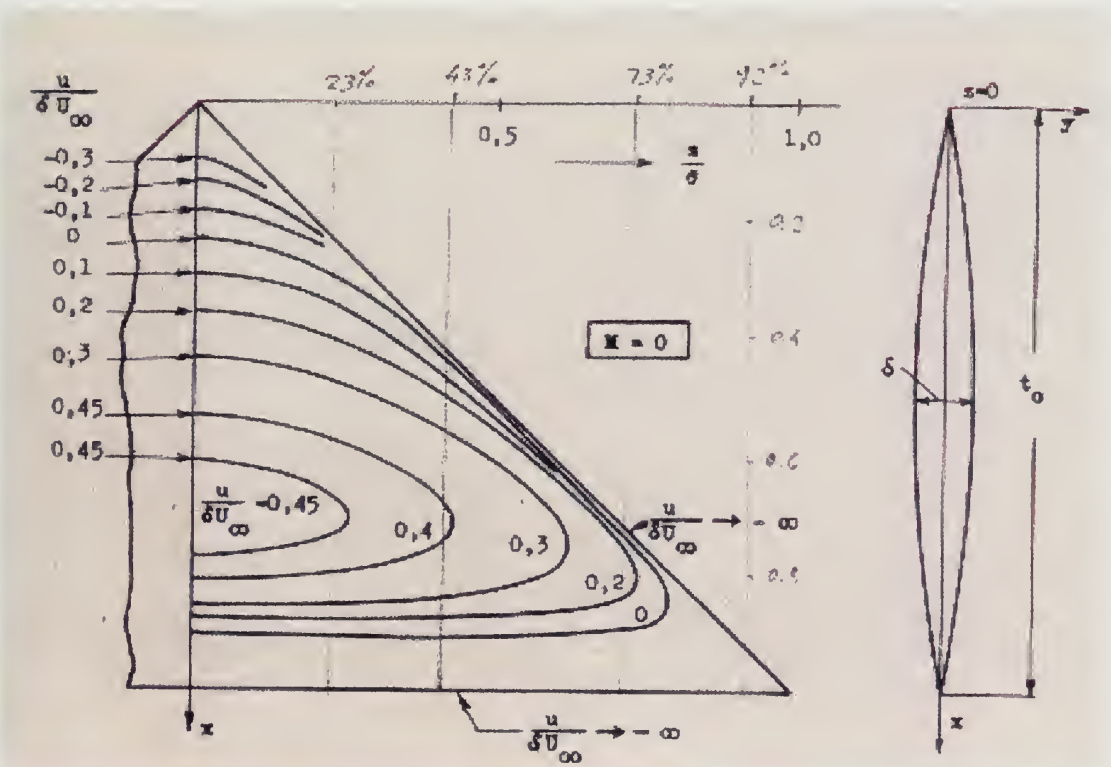

Figure 4.4 Approximate Linear Theory [Ref. 9] M_∞= 0

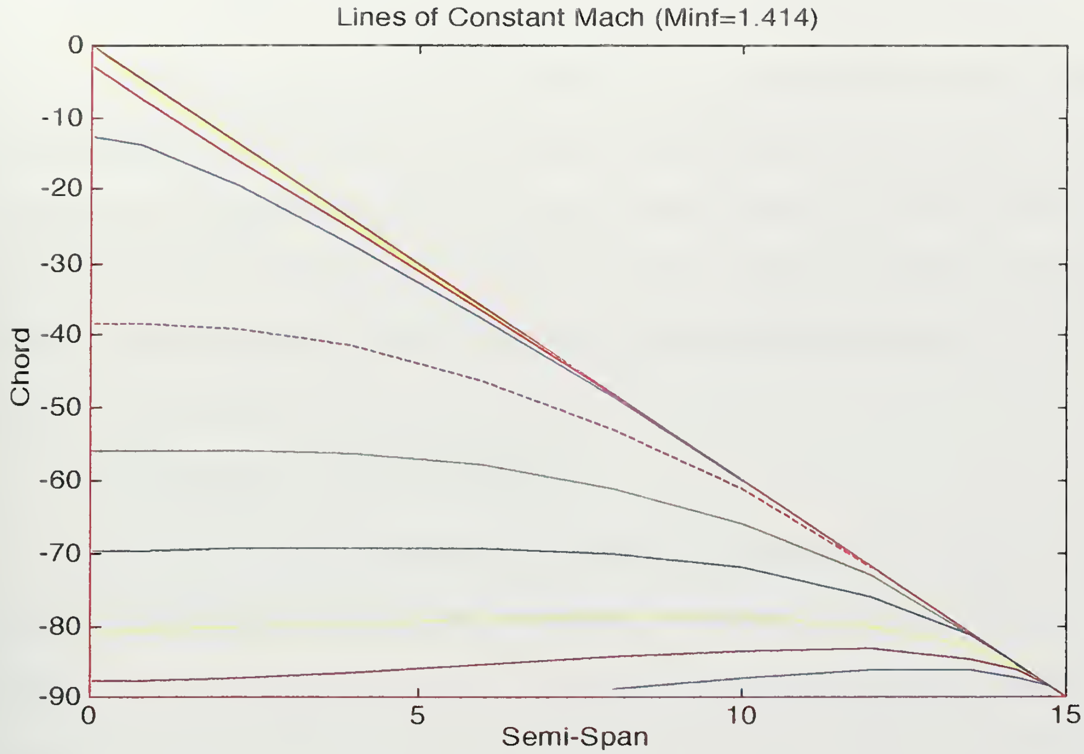

Figure 4.5 A502i Mach Contour Plot (M_∞=1.414)

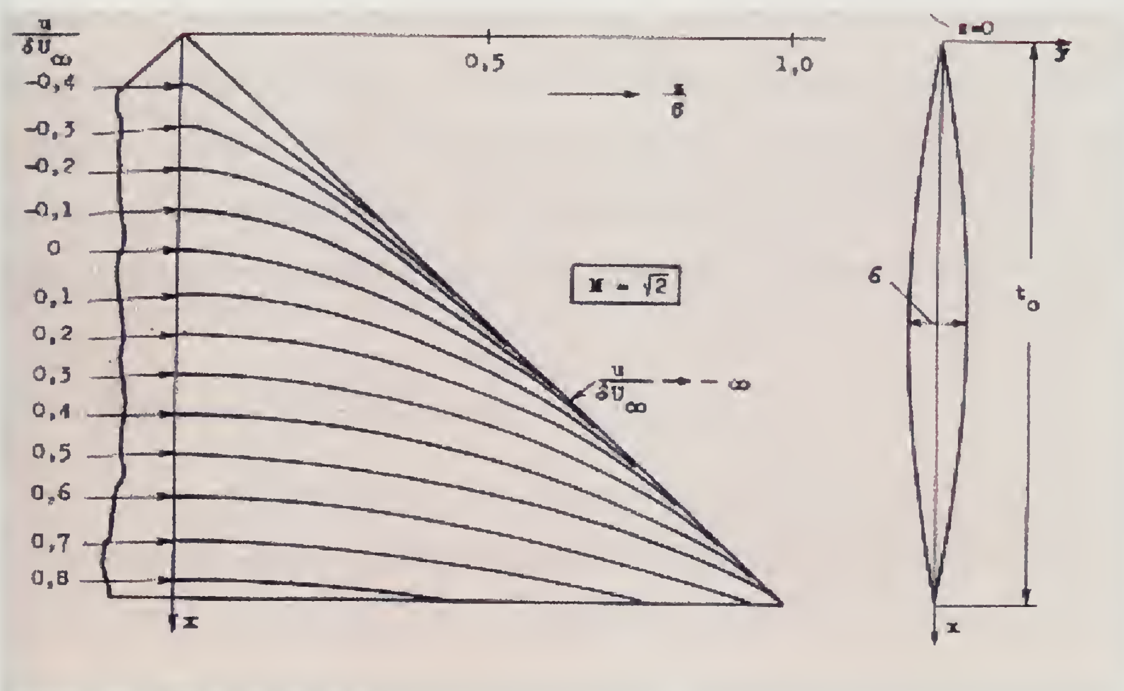

Figure 4.6 Approximate Linear Theory [Ref. 9] M_∞=1.414

C. GBU-24 FREE-STREAM (NO CANARDS) DISCUSSION

A free-stream measurement of separation forces on the GBU-24, without canards, was conducted in a wind tunnel for various Mach numbers from .8 to 1.2 [Ref. 7]. Since A502i uses linear potential theory, the model of the GBU-24, without canards, was evaluated at both Mach .8 and 1.2, avoiding the transonic regime, to ascertain the accuracy of the code with the given geometry. Normal forces and pitching moments for both cases are plotted and compared to the wind tunnel data.

1. Subsonic Case (M_∞=0.8)

The GBU-24 model, without the canards, was run for angles of attack varying from -10 to +10 degrees in two degree increments. Values much higher than that ran into wake modelling problems as the wake's angle relative to the free-stream was getting large enough that results would become questionable, and remodelling the wake was too difficult for such a complex geometry. The results of the A502i analysis are displayed in Figures 4.7 and 4.8. For angles of attack between -4 and +4 degrees, A502i does a good job of predicting the separation forces. The pitching moment, which happens to be unstable without the canards, is approximately linear over the -4 to +4 degree range and is the limiting factor to the models accuracy. The normal force is approximately linear over a wider range, and A502i does a good job of predicting the normal forces from -6 to +6 degrees.

2. Supersonic Case (M_∞=1.2)

The results for the subsonic case demonstrated that the effective range of angle of attack that A502i needed to explore was from -6 to +6 degrees. Figures 4.9 and 4.10 plot the comparison of wind tunnel data versus A502i results for pitching moment and normal force. The results for the supersonic case are slightly better than that of the subsonic case. The actual pitching moment of the GBU-24 is approximately linear over a wider angle of

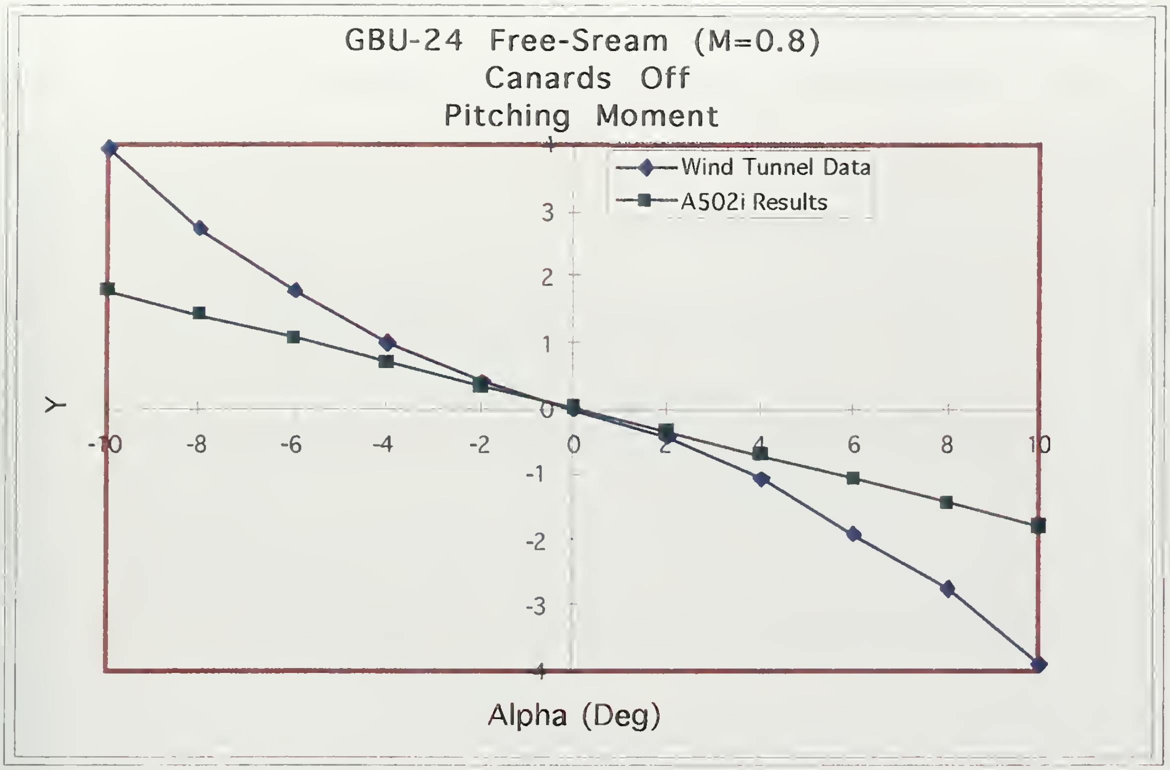

Figure 4.7 Comparison of Pitching Moments

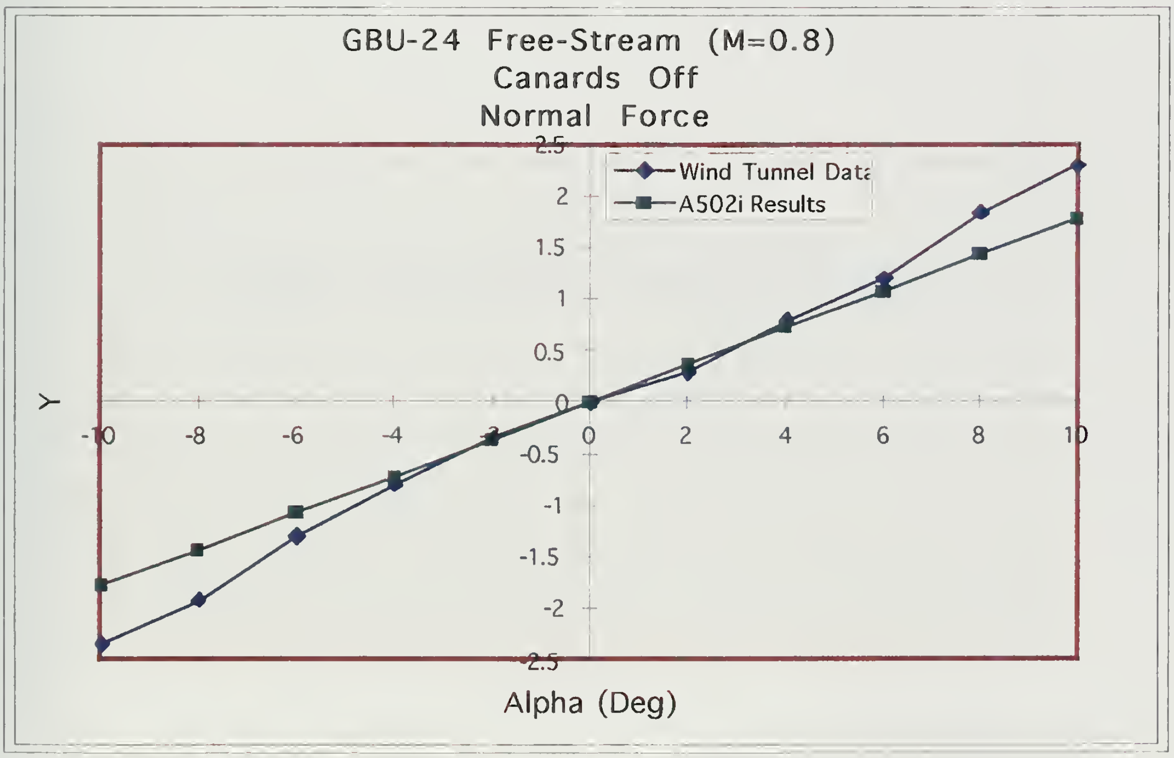

Figure 4.8 Comparison of Normal Forces

attack region, but fluctuations in the data at -6 and +6 degrees means that the model is still only viable from -4 to +4 degrees. The normal force line is nearly linear from -10 to +10 degrees and extrapolating the A502i results out to 10 degrees would still yield good predictions.

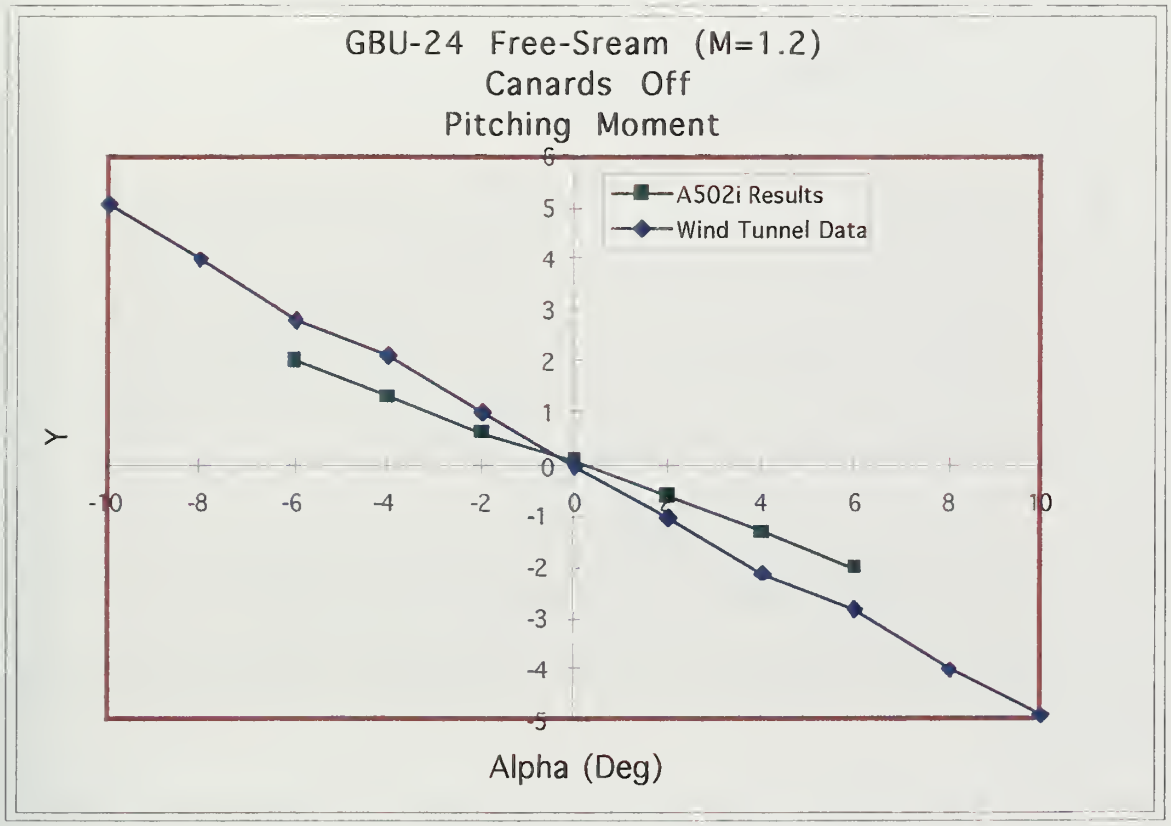

Figure 4.9 Comparison of Pitching Moments

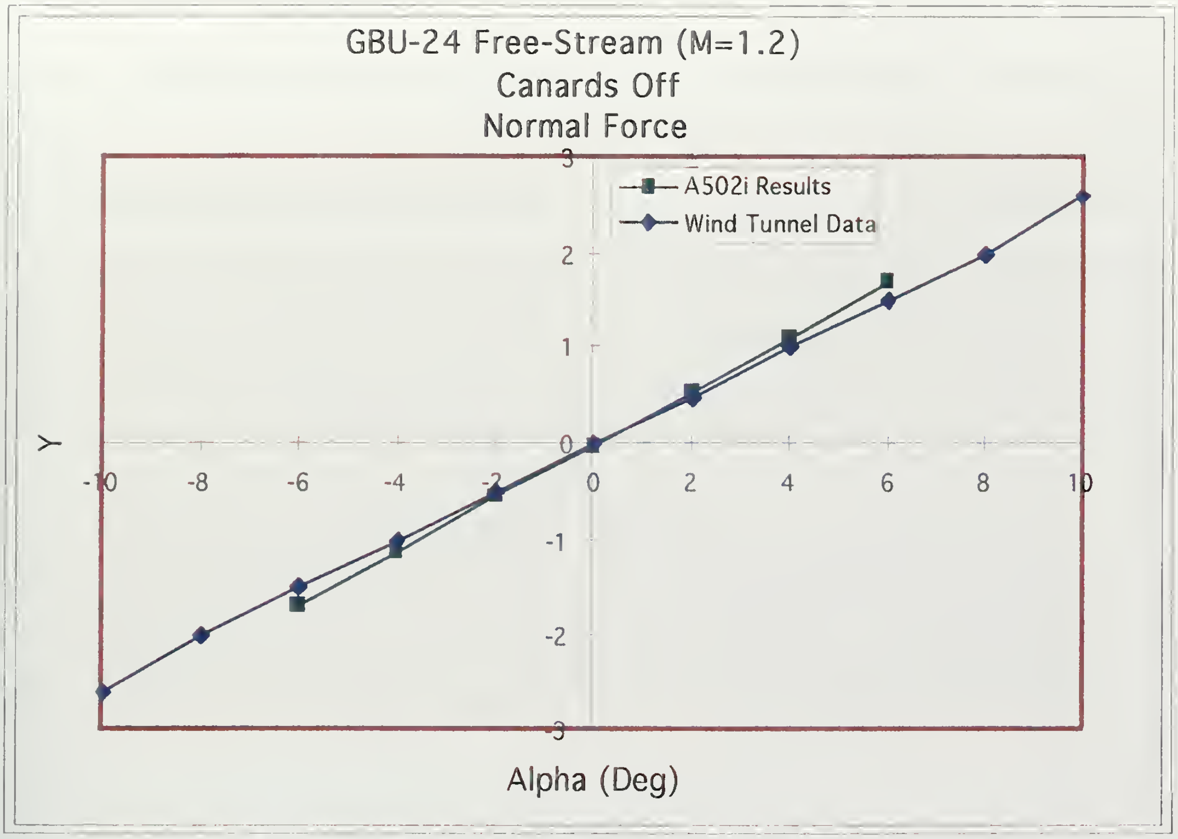

Figure 4.10 Comparison of Normal Forces

D. GBU-24 FREE-STREAM (WITH CANARDS) DISCUSSION

As in the case with no canards, free-stream measurements of the separation forces on GBU-24 were taken from Mach .8 to 1.2 in a wind tunnel [Ref. 7]. Again, due to the limitations of linear theory inherent in the code, an analysis was done for Mach numbers of .8 and 1.2 to minimize transonic effects. Even with the more complex geometry, A502i does an accurate job of predicting the separation forces over the range of angles of attack that are approximately linear.

1. Subsonic Case (M_∞=0.8)

The GBU-24 model, with canards, was run in two degree increments of angle of attack from -10 to +10. The wake modelling limitation, as well as reviewing the data from the wind tunnel measurements [Ref. 7] showed the non-linearity of the separation forces at

the higher values of angle of attack, precluded any attempts to predict forces beyond the aforementioned angle of attack interval. The results of the A502i analysis are displayed in Figures 4.11 and 4.12. The addition of the canards makes the pitching moment stable, but linear over a smaller region than without the canards. A502i gave accurate results from -2 to +2 degrees angle of attack when predicting pitching moment. The prediction of normal forces fared better, showing accurate results from -3 to +3 degrees angle of attack.

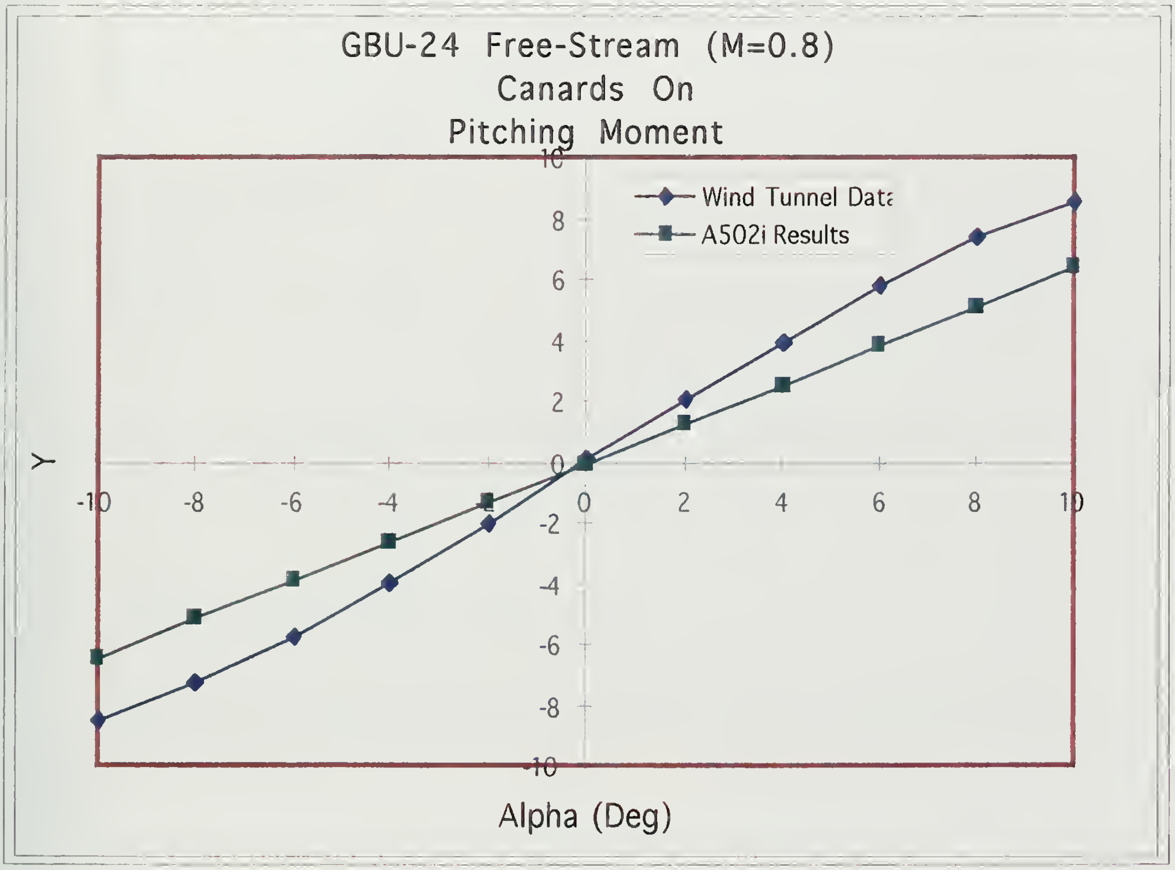

Figure 4.11 Comparison of Pitching Moments

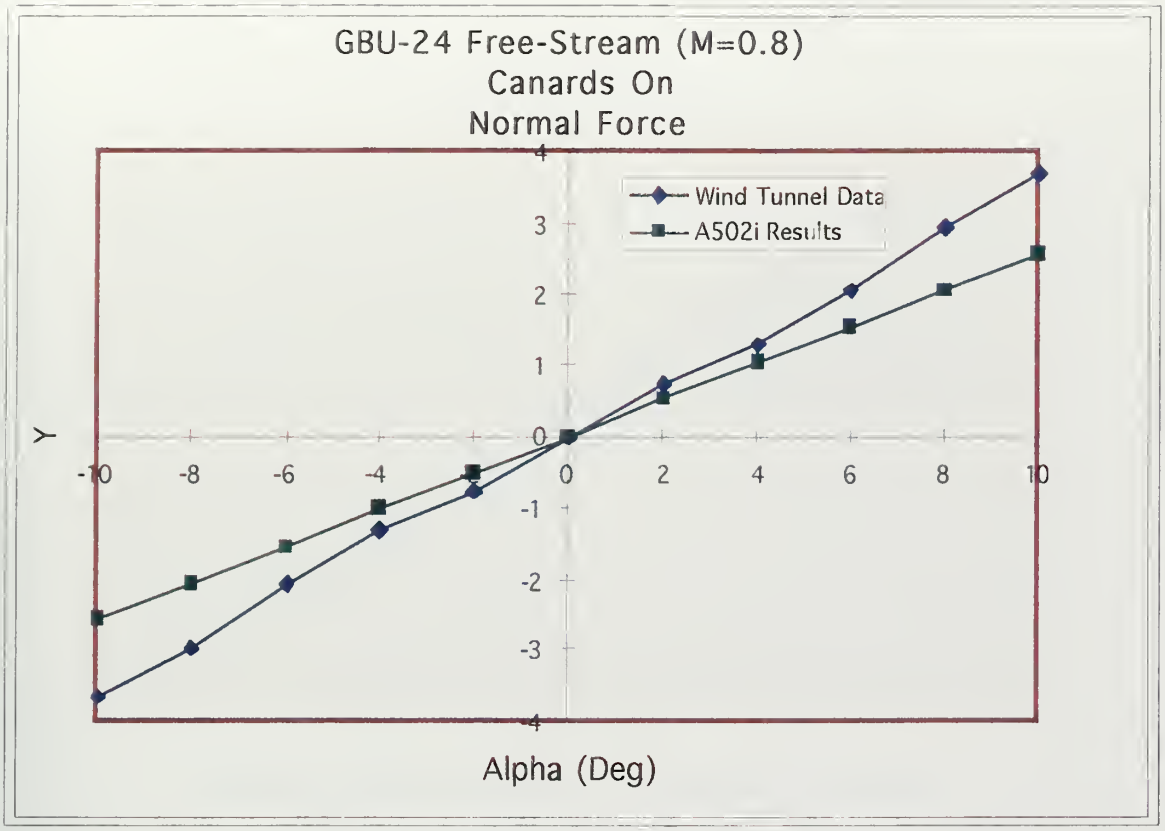

Figure 4.12 Comparison of Normal Forces

2. Supersonic Case (M_∞=1.2)

As in the case with no canards, the region of accuracy, with the model used, was assumed to be less than + or - 10 degrees angle of attack. Cases were run from -6 to +6 degrees angle of attack in two degree increments. A comparison of A502i results with wind tunnel data is shown in Figures 4.13 and 4.14. For both the pitching moment and the normal force, A502i does a much better job of prediction then when subsonic. The wind tunnel data is nearly linear in both pitch moment and normal force from -8 to +8 degrees angle of attack. Extrapolating the A502i data out to + or - 8 degrees angle of attack, shows excellent agreement with the wind tunnel data.

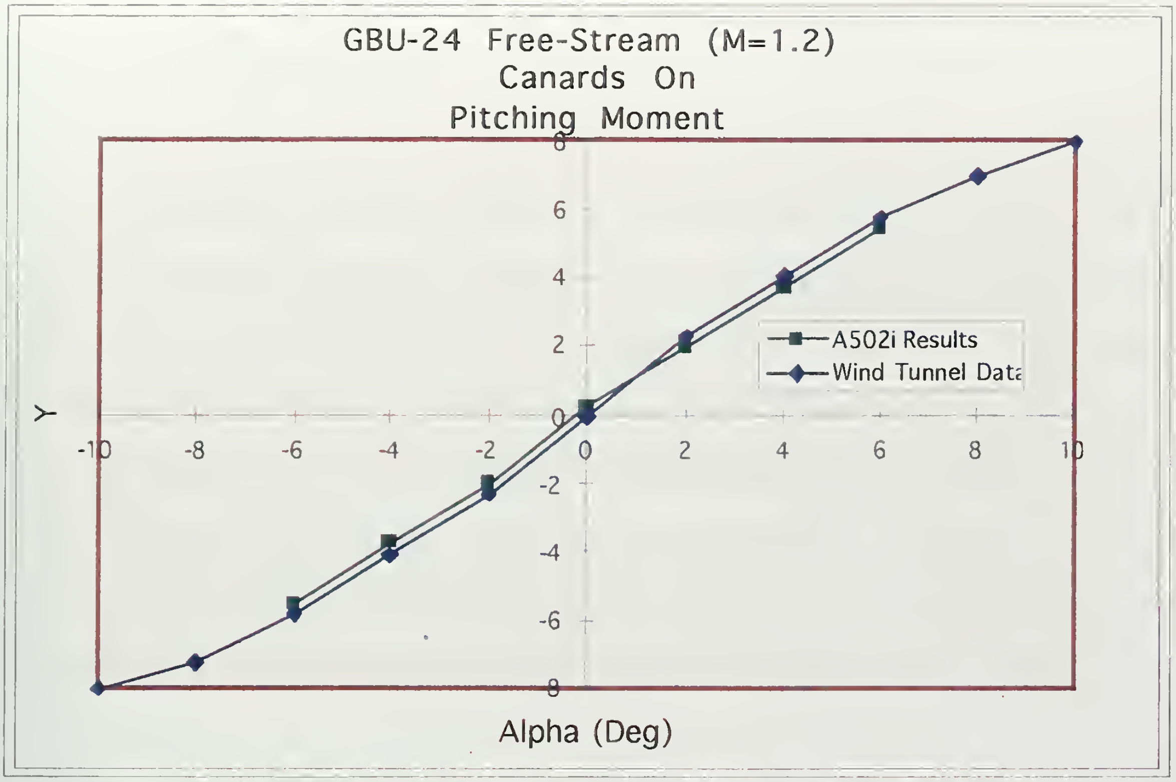

Figure 4.13 Comparison of Pitching Moments

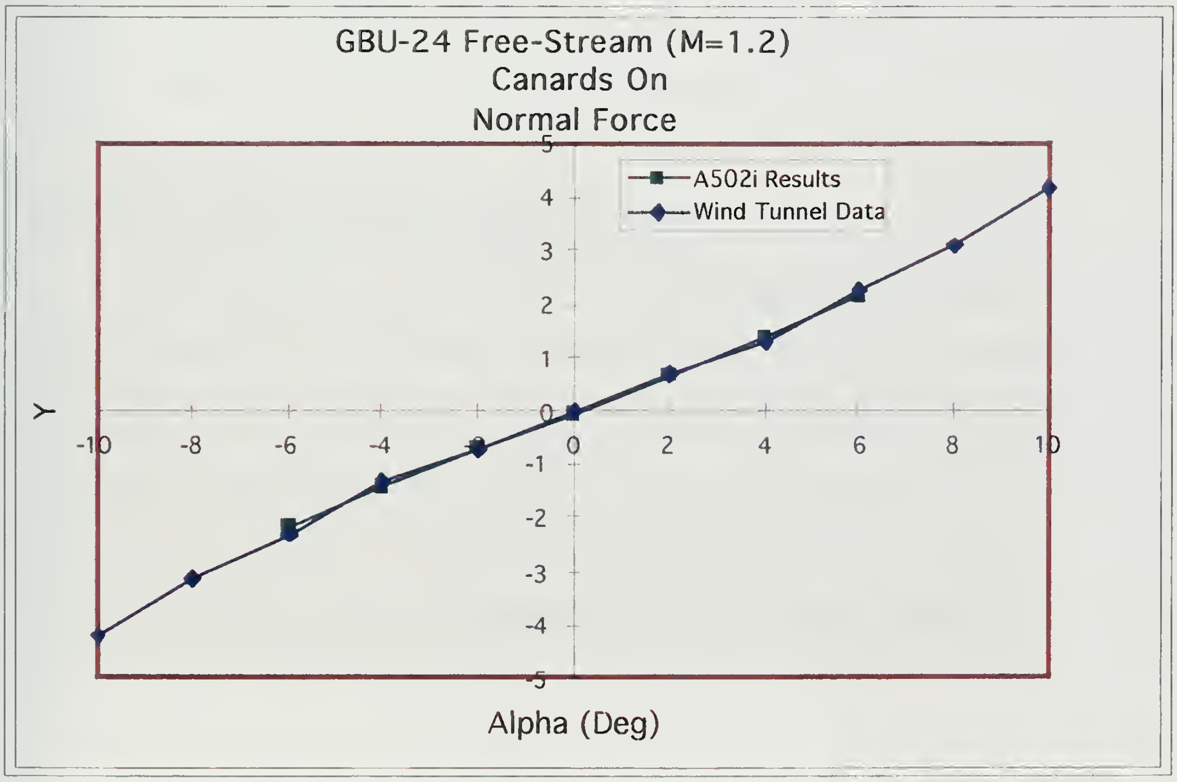

Figure 4.14 Comparison of Normal Forces

E. F-14 DISCUSSION

The GBU-24, without canards was located at station 3 of the F-14 via the NAVSEP code. In the process of running a solution, the combined geometries were found to have a total of 150 networks (A502i's maximum). The combined geometry had about 4,000 panels, far short of the 20,000 panel maximum, so there was room for more detailed modelling, but there was not a chance to insert the GBU-24, with canards, into the F-14's flow field and analyze the forces on the bomb. The geometry with the canardless bomb ran to a solution that appeared to be valid, so there is a high degree of confidence that if the number of networks could be reduced to allow the GBU-24, with canards, to be inserted into the F-14 flow field, the code would yield accurate predictions at small angles of attack on the forward stations. To reduce the total number of networks by combining existing networks would have required a large time investment and the use of MACGS, which the department currently does not possess, the two reasons why it was not done. Figure 4.15 shows a Mach distribution of the solution of the canardless bomb and F-14 at Mach = 0.8 and 0 degrees angle of attack

F. POST-PROCESSING DISCUSSION

The Mach values for the subsonic case of the GBU-24, with canards, at 4 degrees angle of attack, were extracted from the ft13 file. These values, used in conjunction with RAID are shown in Figures 4.16 and 4.17. The color distribution over the nose in Figure 4.16 indicates that the bomb is at an angle of attack, and scanning the rest of the model showed no discontinuous solutions, which is generally represented in A502i by a Mach value of 0 or 1,000. The visual representation is a quick way of telling if A502i ran an accurate solution. The only other way is to individually check the Mach or Cp values of each panel in the ft13 file or the arbitrarily named output file. The other point of interest in Figure 4.16 is the lack of panel density along the mid-section of the bomb. The goal, in the

[illegible]

case of stores separation prediction, is to have as simple a model as possible that still gives accurate predictions. The fewer the number of panels, the shorter the run time. The fact that A502i is a higher order panel method allows the luxury of using fewer panels. Figure 4.17 highlights the approach used to take into account separation effects as discussed on page 16.

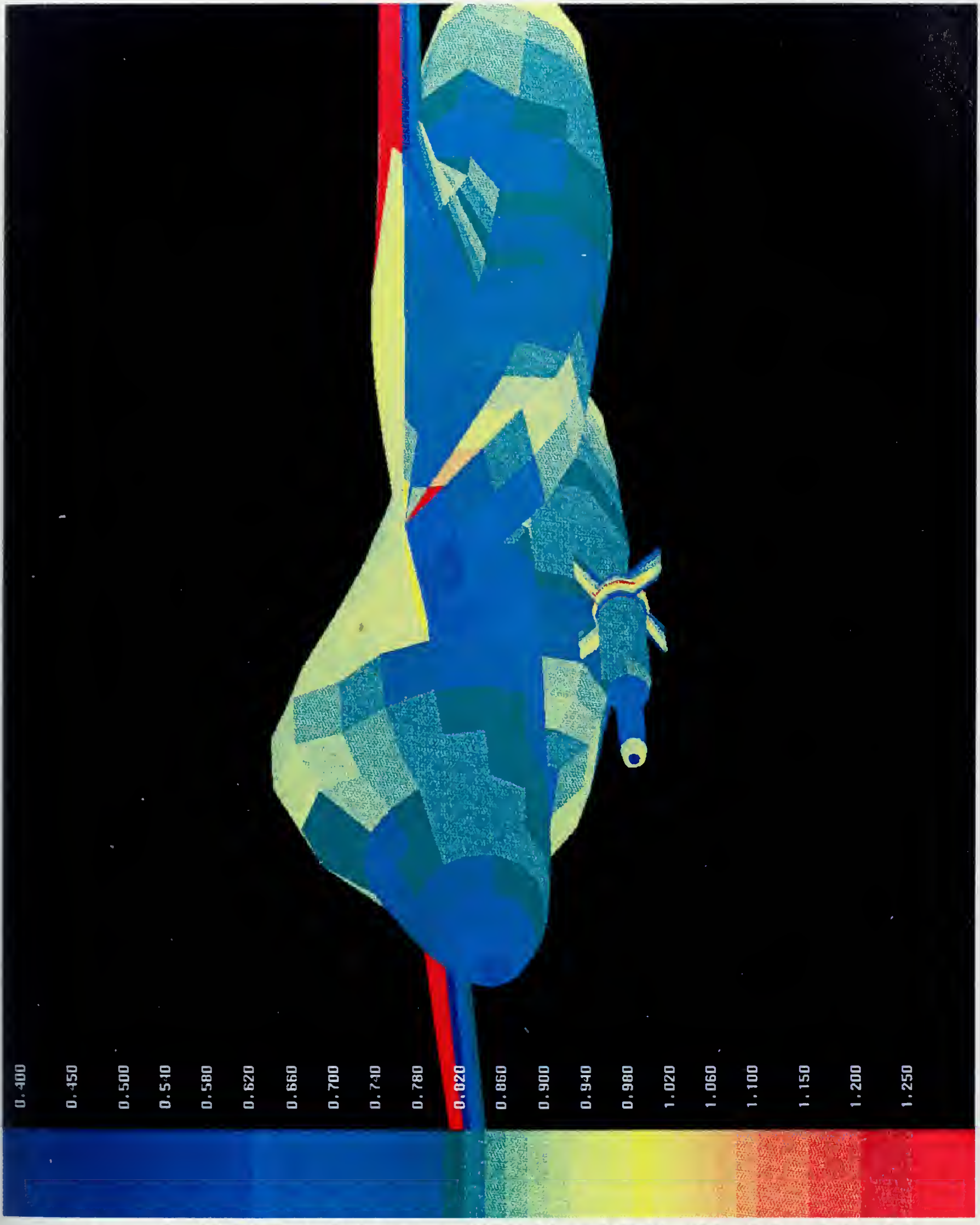

Figure 4.15 Mach Distribution over GBU-24 and F-14 (M_∞=0.8, alpha=0°)

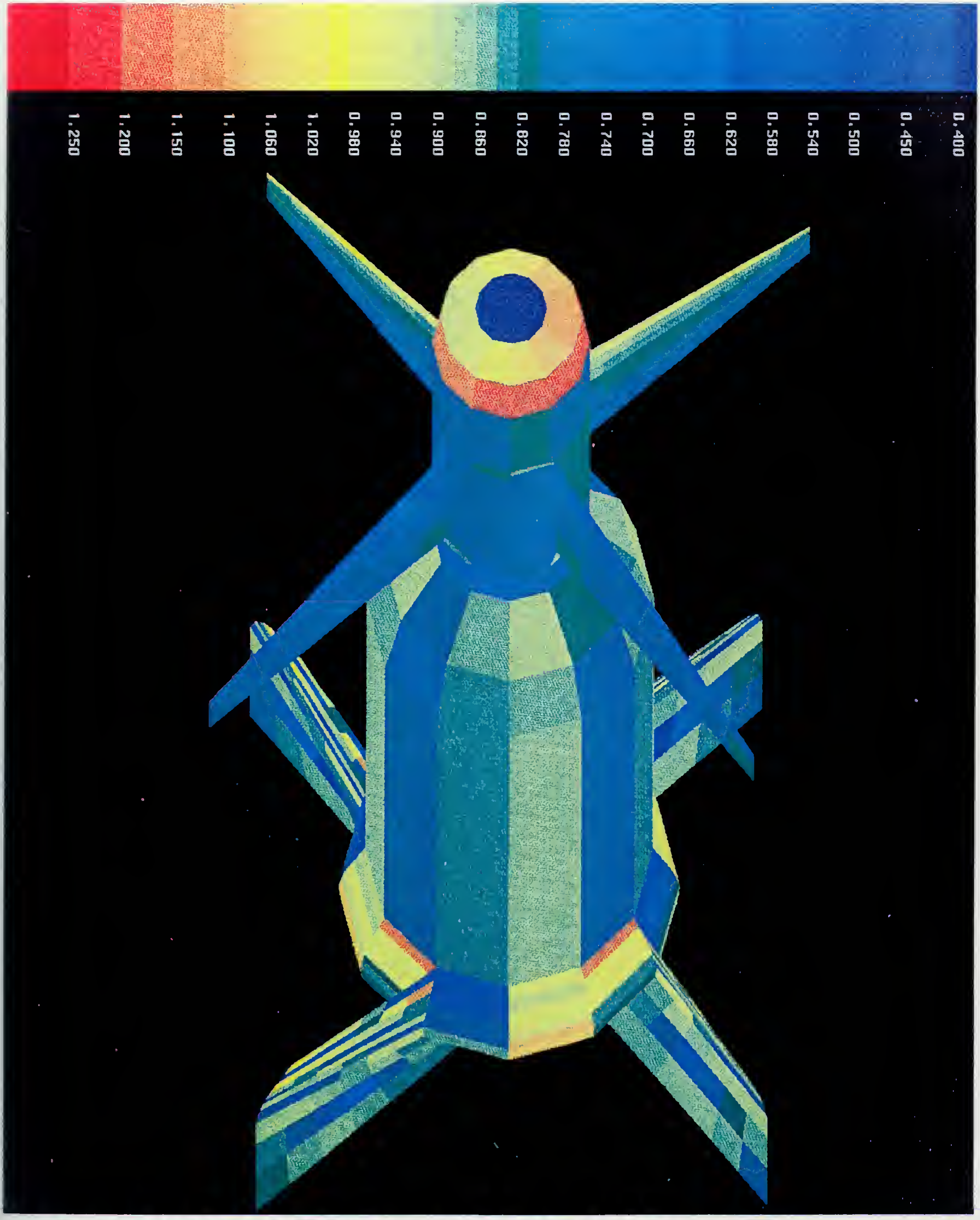

Figure 4.16 Mach Distribution over GBU-24 (M_∞=0.8, alpha=4°)

Figure 4.17 Mach Distribution over GBU-24 (M_∞=0.8, alpha=4°)

V. SUMMARY AND CONCLUSIONS

The main goal of this analysis is to determine the accuracy of A502i on both simple geometries and complex geometries. To accomplish this, A502i is compared with results available from linear theory and wind tunnel experiments. This allows conclusions to be drawn on the capabilities as well as the limitations of A502i.

In general, A502i can accurately predict flow properties, forces and moments on simple and complex geometries at low angles of attack. The predictions are valid over a wide Mach range, from 0 up to and including 0.8 and from 1.2 and above. The supersonic solutions are available due to A502i's higher order capabilities.

The limitations of A502i are consistent with most panel methods. A502i cannot predict flow dominated by viscous, separated or transonic effects. It cannot predict flow with different total pressures, such as flow properties inside a jet plume or a propeller slipstream swirl. The biggest shortcoming of A502i is its inability to handle unsteady cases and automatically determine wake shapes.

Experience or knowledge of the flow properties around the geometry being tested is important in building an accurate model. An accurate model may not be physically accurate. Flight test results revealed a yawing moment on the GBU-24 that was not discovered in wind tunnel experiments when the bomb was carried on an aft station. The yawing moment may be caused by the fact that the canards are not fixed, but spring-damped. A502i predictions would not be accurate without inputting a moment to simulate the deflection of the canards, since the canards are fixed by the geometry. A502i, while a powerful tool in terms of cost savings and time, cannot completely substitute for wind tunnel experiments and flight tests, as constructing a complex geometry to exact physical specifications will probably not yield accurate predictions.

APPENDIX A. GBU-24 OUPUT FILE (INPUT FILE PORTION)


```
 ****************************************************************************************************

   dynamic memory management initialization

   max no. levels          15   max no. arrays        200   maximum scratch storage     900000   total storage provided  900000
     addr(maplev)           0      addr(maplws)          0     addr(scratch storage)          1

 ****************************************************************************************************
  wopen call on unit    1  blocks:    10   status:     0
  wopen call on unit    2  blocks:    10   status:     0
  wopen call on unit    3  blocks:    10   status:     0
1

 ****************************************************************************
 *                                                                          *
 *                    a502 - pan-air technology program                     *
 *                                                                          *
 *              potential flow about arbitrary configurations               *
 *              version id = ht2 (12 feb 92) boeing ver i00                 *
 *                                                                          *
 *                                07-Mar-9                                  *
 *                                                                          *
 *                                                                          *
 * GBU-24 FREESTREAM M=0.8
 * $SOLUTION
 *                                                                          *
 *                                                                          *
 *                                                                          *
 ****************************************************************************
1
0*b*input-da




                      - list of a502 input data cards -
     1 $TITLE
     2 GBU-24 FREESTREAM M=0.8
     3 $SOLUTION
     4 $SYMMETRY
     5 = MISYMM   MJSYMM
     6 0.         0.
     7 $MACH NUMBER
     8 =AMACH
     9 .8
    10 $CASES
    11 =NCASE
    12 1.
    13 $ANGLES-OF-ATTACK
    14 =ALPC
    15 2.
    16 =ALPHA(1)
```

```
2.
$PRINTOUT OPTIONS
=ISINGS   IGEOMP    ISINGP    ICONTP    IBCONP    IEDGEP
0.        0.        0.        1.        0.        0.
=IPRAIC   NEXDGN    IOUTPR    IFMCPR
0.        0.        0.        0.
$REFERENCES FOR ACCUMULATED FORCES AND MOMENTS
=XREF     YREF      ZREF      NREF
100.716   0.0       0.0       1.
=SREF     BREF      CREF      DREF
165.1248  1.0       14.496    14.496
$POINTS NETWORK =    ZCAN4
1.0
2.0
       9.0       9.0
    45.236     3.138    -2.324    42.548     3.138    -2.324
    39.859     3.138    -2.324    37.171     3.138    -2.324
    34.483     3.138    -2.324    31.795     3.138    -2.324
    29.107     3.138    -2.324    26.418     3.138    -2.324
    23.730     3.138    -2.324
    45.183     4.642    -3.583    42.732     4.642    -3.582
    40.281     4.642    -3.582    37.830     4.642    -3.582
    35.380     4.642    -3.581    32.929     4.642    -3.581
    30.478     4.642    -3.581    28.027     4.642    -3.580
    25.576     4.642    -3.580
    45.130     6.146    -4.841    42.917     6.146    -4.840
    40.703     6.146    -4.840    38.489     6.146    -4.839
    36.276     6.146    -4.839    34.063     6.146    -4.838
    31.849     6.146    -4.837    29.635     6.146    -4.837
    27.422     6.145    -4.836
    45.077     7.650    -6.100    43.101     7.650    -6.099
    41.125     7.650    -6.098    39.149     7.650    -6.097
    37.173     7.650    -6.096    35.196     7.650    -6.095
    33.220     7.650    -6.094    31.244     7.649    -6.093
    29.268     7.649    -6.092
    45.025     9.155    -7.358    43.286     9.155    -7.357
    41.547     9.154    -7.355    39.808     9.154    -7.354
    38.069     9.154    -7.353    36.330     9.154    -7.352
    34.591     9.153    -7.350    32.853     9.153    -7.349
    31.114     9.153    -7.348
    44.972    10.659    -8.616    43.470    10.659    -8.615
    41.969    10.659    -8.613    40.467    10.658    -8.612
    38.966    10.658    -8.610    37.464    10.658    -8.608
    35.963    10.658    -8.607    34.461    10.657    -8.605
    32.959    10.657    -8.603
    44.919    12.163    -9.875    43.655    12.163    -9.873
    42.390    12.163    -9.871    41.126    12.162    -9.869
    39.862    12.162    -9.867    38.598    12.162    -9.865
    37.334    12.161    -9.863    36.069    12.161    -9.861
    34.805    12.161    -9.859
    44.866    13.668   -11.133    43.839    13.667   -11.131
    42.812    13.667   -11.129    41.785    13.667   -11.127
    40.759    13.666   -11.124    39.732    13.666   -11.122
    38.705    13.665   -11.120    37.678    13.665   -11.117
    36.651    13.665   -11.115
    44.813    15.172   -12.392    44.024    15.172   -12.389
    43.234    15.171   -12.387    42.445    15.171   -12.384
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      41.655    15.170    -12.381     40.866    15.170    -12.379
      40.076    15.169    -12.376     39.287    15.169    -12.374
      38.497    15.168    -12.371
$POINTS NETWORK =     ZCAN3
1.0
2.0
         9.0       9.0
      45.236    -2.324     -3.138     42.548    -2.324     -3.138
      39.859    -2.324     -3.138     37.171    -2.324     -3.138
      34.483    -2.324     -3.138     31.795    -2.324     -3.138
      29.107    -2.324     -3.138     26.418    -2.324     -3.138
      23.730    -2.324     -3.138
      45.183    -3.583     -4.642     42.732    -3.582     -4.642
      40.281    -3.582     -4.642     37.830    -3.582     -4.642
      35.380    -3.581     -4.642     32.929    -3.581     -4.642
      30.478    -3.581     -4.642     28.027    -3.580     -4.642
      25.576    -3.580     -4.642
      45.130    -4.841     -6.146     42.917    -4.840     -6.146
      40.703    -4.840     -6.146     38.489    -4.839     -6.146
      36.276    -4.839     -6.146     34.063    -4.838     -6.146
      31.849    -4.837     -6.146     29.635    -4.837     -6.146
      27.422    -4.836     -6.145
      45.077    -6.100     -7.650     43.101    -6.099     -7.650
      41.125    -6.098     -7.650     39.149    -6.097     -7.650
      37.173    -6.096     -7.650     35.196    -6.095     -7.650
      33.220    -6.094     -7.650     31.244    -6.093     -7.649
      29.268    -6.092     -7.649
      45.025    -7.358     -9.155     43.286    -7.357     -9.155
      41.547    -7.355     -9.154     39.808    -7.354     -9.154
      38.069    -7.353     -9.154     36.330    -7.352     -9.154
      34.591    -7.350     -9.153     32.853    -7.349     -9.153
      31.114    -7.348     -9.153
      44.972    -8.616    -10.659     43.470    -8.615    -10.659
      41.969    -8.613    -10.659     40.467    -8.612    -10.658
      38.966    -8.610    -10.658     37.464    -8.608    -10.658
      35.963    -8.607    -10.658     34.461    -8.605    -10.657
      32.959    -8.603    -10.657
      44.919    -9.875    -12.163     43.655    -9.873    -12.163
      42.390    -9.871    -12.163     41.126    -9.869    -12.162
      39.862    -9.867    -12.162     38.598    -9.865    -12.162
      37.334    -9.863    -12.161     36.069    -9.861    -12.161
      34.805    -9.859    -12.161
      44.866   -11.133    -13.668     43.839   -11.131    -13.667
      42.812   -11.129    -13.667     41.785   -11.127    -13.667
      40.759   -11.124    -13.666     39.732   -11.122    -13.666
      38.705   -11.120    -13.665     37.678   -11.117    -13.665
      36.651   -11.115    -13.665
      44.813   -12.392    -15.172     44.024   -12.389    -15.172
      43.234   -12.387    -15.171     42.445   -12.384    -15.171
      41.655   -12.381    -15.170     40.866   -12.379    -15.170
      40.076   -12.376    -15.169     39.287   -12.374    -15.169
      38.497   -12.371    -15.168
$POINTS NETWORK =     ZCAN1
1.0
2.0
         9.0       9.0
      45.236     2.324      3.138     42.548     2.324      3.138
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     39.859    2.324    3.138   37.171    2.324    3.138
     34.483    2.324    3.138   31.795    2.324    3.138
     29.107    2.324    3.138   26.418    2.324    3.138
     23.730    2.324    3.138
     45.183    3.583    4.642   42.732    3.582    4.642
     40.281    3.582    4.642   37.830    3.582    4.642
     35.380    3.581    4.642   32.929    3.581    4.642
     30.478    3.581    4.642   28.027    3.580    4.642
     25.576    3.580    4.642
     45.130    4.841    6.146   42.917    4.840    6.146
     40.703    4.840    6.146   38.489    4.839    6.146
     36.276    4.839    6.146   34.063    4.838    6.146
     31.849    4.837    6.146   29.635    4.837    6.146
     27.422    4.836    6.145
     45.077    6.100    7.650   43.101    6.099    7.650
     41.125    6.098    7.650   39.149    6.097    7.650
     37.173    6.096    7.650   35.196    6.095    7.650
     33.220    6.094    7.650   31.244    6.093    7.649
     29.268    6.092    7.649
     45.025    7.358    9.155   43.286    7.357    9.155
     41.547    7.355    9.154   39.808    7.354    9.154
     38.069    7.353    9.154   36.330    7.352    9.154
     34.591    7.350    9.153   32.853    7.349    9.153
     31.114    7.348    9.153
     44.972    8.616   10.659   43.470    8.615   10.659
     41.969    8.613   10.659   40.467    8.612   10.658
     38.966    8.610   10.658   37.464    8.608   10.658
     35.963    8.607   10.658   34.461    8.605   10.657
     32.959    8.603   10.657
     44.919    9.875   12.163   43.655    9.873   12.163
     42.390    9.871   12.163   41.126    9.869   12.162
     39.862    9.867   12.162   38.598    9.865   12.162
     37.334    9.863   12.161   36.069    9.861   12.161
     34.805    9.859   12.161
     44.866   11.133   13.668   43.839   11.131   13.667
     42.812   11.129   13.667   41.785   11.127   13.667
     40.759   11.124   13.666   39.732   11.122   13.666
     38.705   11.120   13.665   37.678   11.117   13.665
     36.651   11.115   13.665
     44.813   12.392   15.172   44.024   12.389   15.172
     43.234   12.387   15.171   42.445   12.384   15.171
     41.655   12.382   15.170   40.866   12.379   15.170
     40.076   12.376   15.169   39.287   12.374   15.169
     38.497   12.371   15.168
 $POINTS NETWORK =    ZCAN2
 1.0
 2.0
        9.0      9.0
     45.236   -3.138    2.324   42.548   -3.138    2.324
     39.859   -3.138    2.324   37.171   -3.138    2.324
     34.483   -3.138    2.324   31.795   -3.138    2.324
     29.107   -3.138    2.324   26.418   -3.138    2.324
     23.730   -3.138    2.324
     45.183   -4.642    3.583   42.732   -4.642    3.582
     40.281   -4.642    3.582   37.830   -4.642    3.582
     35.380   -4.642    3.581   32.929   -4.642    3.581
     30.478   -4.642    3.581   28.027   -4.642    3.580
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     25.576    -4.642     3.580
     45.130    -6.146     4.841    42.917    -6.146     4.840
     40.703    -6.146     4.840    38.489    -6.146     4.839
     36.276    -6.146     4.839    34.063    -6.146     4.838
     31.849    -6.146     4.837    29.635    -6.146     4.837
     27.422    -6.145     4.836
     45.077    -7.650     6.100    43.101    -7.650     6.099
     41.125    -7.650     6.098    39.149    -7.650     6.097
     37.173    -7.650     6.096    35.196    -7.650     6.095
     33.220    -7.650     6.094    31.244    -7.649     6.093
     29.268    -7.649     6.092
     45.025    -9.155     7.358    43.286    -9.155     7.357
     41.547    -9.154     7.355    39.808    -9.154     7.354
     38.069    -9.154     7.353    36.330    -9.154     7.352
     34.591    -9.153     7.350    32.853    -9.153     7.349
     31.114    -9.153     7.348
     44.972   -10.659     8.616    43.470   -10.659     8.615
     41.969   -10.659     8.613    40.467   -10.658     8.612
     38.966   -10.658     8.610    37.464   -10.658     8.608
     35.963   -10.658     8.607    34.461   -10.657     8.605
     32.959   -10.657     8.603
     44.919   -12.163     9.875    43.655   -12.163     9.873
     42.390   -12.163     9.871    41.126   -12.162     9.869
     39.862   -12.162     9.867    38.598   -12.162     9.865
     37.334   -12.161     9.863    36.069   -12.161     9.861
     34.805   -12.161     9.859
     44.866   -13.668    11.133    43.839   -13.667    11.131
     42.812   -13.667    11.129    41.785   -13.667    11.127
     40.759   -13.666    11.124    39.732   -13.666    11.122
     38.705   -13.665    11.120    37.678   -13.665    11.117
     36.651   -13.665    11.115
     44.813   -15.172    12.392    44.024   -15.172    12.389
     43.234   -15.171    12.387    42.445   -15.171    12.384
     41.655   -15.170    12.382    40.866   -15.170    12.379
     40.076   -15.169    12.376    39.287   -15.169    12.374
     38.497   -15.168    12.371
$POINTS NETWORK =     ZNOSF
1.0
1.0
        4.0      13.0
      8.499     0.000     3.999     2.498     0.000     3.564
      0.482     0.000     1.853     0.000     0.000     0.000
      8.499     1.995     3.465     2.498     1.778     3.088
      0.482     0.924     1.605     0.000     0.000     0.000
      8.499     3.463     2.007     2.498     3.086     1.788
      0.482     1.604     0.930     0.000     0.000     0.000
      8.499     3.999     0.000     2.498     3.565     0.000
      0.482     1.853     0.000     0.000     0.000     0.000
      8.499     3.463    -2.007     2.498     3.086    -1.789
      0.482     1.604    -0.930     0.000     0.000     0.000
      8.499     2.007    -3.463     2.498     1.789    -3.087
      0.482     0.930    -1.604     0.000     0.000     0.000
      8.499     0.000    -4.000     2.498     0.000    -3.565
      0.482     0.000    -1.853     0.000     0.000     0.000
      8.499    -2.007    -3.463     2.498    -1.788    -3.086
      0.482    -0.930    -1.604     0.000     0.000     0.000
      8.499    -3.463    -2.007     2.498    -3.086    -1.789
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      0.482    -1.604    -0.930     0.000     0.000     0.000
      8.499    -3.999     0.000     2.498    -3.565     0.000
      0.482    -1.853     0.000     0.000     0.000     0.000
      8.499    -3.463     2.007     2.498    -3.086     1.788
      0.482    -1.604     0.930     0.000     0.000     0.000
      8.499    -1.995     3.464     2.498    -1.778     3.088
      0.482    -0.924     1.605     0.000     0.000     0.000
      8.499     0.000     3.999     2.498     0.000     3.565
      0.482     0.000     1.853     0.000     0.000     0.000
$POINTS NETWORK =  ZNOSAFT
1.0
1.0
       13.0       2.0
      8.499     0.000     3.999     8.499     1.995     3.465
      8.499     3.463     2.007     8.499     3.999     0.000
      8.499     3.463    -2.007     8.499     2.007    -3.463
      8.499     0.000    -4.000     8.499    -2.007    -3.463
      8.499    -3.463    -2.007     8.499    -3.999     0.000
      8.499    -3.463     2.007     8.499    -1.995     3.464
      8.499     0.000     3.999
     21.730     0.000     3.999    21.730     1.995     3.465
     21.730     3.463     2.007    21.730     3.999     0.000
     21.730     3.463    -2.007    21.730     2.007    -3.463
     21.730     0.000    -4.000    21.730    -2.007    -3.463
     21.730    -3.463    -2.007    21.730    -3.999     0.000
     21.730    -3.463     2.007    21.730    -1.995     3.465
     21.730     0.000     3.999
$POINTS NETWORK = ZCANFWD1
1.0
1.0
        3.0      13.0
     23.730    -3.138     2.324    22.730    -3.300     2.165
     21.730    -3.463     2.007
     23.730    -1.995     3.465    22.730    -1.995     3.465
     21.730    -1.995     3.465
     23.730     0.000     4.000    22.730     0.000     4.000
     21.730     0.000     3.999
     23.730     2.324     3.138    22.730     2.159     3.301
     21.730     1.995     3.465
     23.730     3.463     2.007    22.730     3.463     2.007
     21.730     3.463     2.007
     23.730     4.000     0.000    22.730     4.000     0.000
     21.730     3.999     0.000
     23.730     3.138    -2.324    22.730     3.301    -2.166
     21.730     3.463    -2.007
     23.730     2.007    -3.464    22.730     2.007    -3.464
     21.730     2.007    -3.463
     23.730     0.000    -4.000    22.730     0.000    -4.000
     21.730     0.000    -4.000
     23.730    -2.324    -3.138    22.730    -2.165    -3.301
     21.730    -2.007    -3.463
     23.730    -3.463    -2.007    22.730    -3.463    -2.007
     21.730    -3.463    -2.007
     23.730    -4.000     0.000    22.730    -4.000     0.000
     21.730    -3.999     0.000
     23.730    -3.138     2.324    22.730    -3.300     2.165
     21.730    -3.463     2.007
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$POINTS NETWORK =    BODCAN1
1.
1.        0.        0.        0.        1.
4.        2.
    23.730     2.324     3.138    23.730     0.000     4.000
    23.730    -1.995     3.465    23.730    -3.138     2.324
    45.236     2.324     3.138    45.236     0.000     4.000
    45.236    -1.995     3.465    45.236    -3.138     2.324
$POINTS NETWORK =    BODCAN2
1.
1.        0.        0.        0.        1.
4.        2.
    23.730    -3.138     2.324    23.730    -4.000     0.000
    23.730    -3.463    -2.007    23.730    -2.324    -3.138
    45.236    -3.138     2.324    45.236    -4.000     0.000
    45.236    -3.463    -2.007    45.236    -2.324    -3.138
$POINTS NETWORK =    BODCAN3
1.
1.        0.        0.        0.        1.
4.        2.
    23.730    -2.324    -3.138    23.730     0.000    -4.000
    23.730     2.007    -3.464    23.730     3.138    -2.324
    45.236    -2.324    -3.138    45.236     0.000    -4.000
    45.236     2.007    -3.464    45.236     3.138    -2.324
$POINTS NETWORK =    BODCAN4
1.
1.        0.        0.        0.        1.
4.        2.
    23.730     3.138    -2.324    23.730     4.000     0.000
    23.730     3.463     2.007    23.730     2.324     3.138
    45.236     3.138    -2.324    45.236     4.000     0.000
    45.236     3.463     2.007    45.236     2.324     3.138
$POINTS NETWORK = ZCANAFT1
1.0
1.0       0.        0.        0.        1.
       3.0      13.0
    47.236    -3.463     2.007    46.236    -3.300     2.165
    45.236    -3.138     2.324
    47.236    -4.000     0.000    45.236    -4.000     0.000
    45.236    -4.000     0.000
    47.236    -3.463    -2.007    46.236    -3.463    -2.007
    45.236    -3.463    -2.007
    47.236    -2.007    -3.464    46.236    -2.166    -3.301
    45.236    -2.324    -3.138
    47.236     0.000    -4.000    46.236     0.000    -4.000
    45.236     0.000    -4.000
    47.236     2.007    -3.464    46.236     2.007    -3.464
    45.236     2.007    -3.464
    47.236     3.464    -2.007    46.236     3.301    -2.166
    45.236     3.138    -2.324
    47.236     4.000     0.000    46.236     4.000     0.000
    45.236     4.000     0.000
    47.236     3.463     2.007    46.236     3.463     2.007
    45.236     3.463     2.007
    47.236     1.995     3.465    46.236     2.159     3.301
    45.236     2.324     3.138
    47.236     0.000     4.000    46.236     0.000     4.000
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     45.236     0.000     4.000
     47.236    -1.995     3.465    46.236    -1.995     3.465
     45.236    -1.995     3.465
     47.236    -3.463     2.007    46.236    -3.300     2.165
     45.236    -3.138     2.324
$POINTS NETWORK = ZCANAFT2
1.0
1.0        0.        0.        0.        1.
       13.0       2.0
     53.318     0.000     4.000    53.318     1.995     3.465
     53.318     3.463     2.007    53.318     4.000    -0.001
     53.318     3.464    -2.008    53.318     2.007    -3.464
     53.318     0.000    -4.000    53.318    -2.007    -3.464
     53.318    -3.463    -2.007    53.318    -4.000    -0.001
     53.318    -3.463     2.007    53.318    -1.995     3.465
     53.318     0.000     4.000
     47.236     0.000     4.000    47.236     1.995     3.465
     47.236     3.463     2.007    47.236     4.000     0.000
     47.236     3.464    -2.007    47.236     2.007    -3.464
     47.236     0.000    -4.000    47.236    -2.007    -3.464
     47.236    -3.463    -2.007    47.236    -4.000     0.000
     47.236    -3.463     2.007    47.236    -1.995     3.465
     47.236     0.000     4.000
$POINTS NETWORK =    ZBOD2
1.0
1.0
        4.0      13.0
    132.459    -3.616     6.281    71.254    -3.616     6.281
     61.785    -3.167     5.500    53.318    -1.995     3.465
    132.459     0.000     7.250    71.254     0.000     7.250
     61.785     0.000     6.349    53.318     0.000     4.000
    132.459     3.616     6.281    71.254     3.616     6.281
     61.785     3.166     5.499    53.318     1.995     3.465
    132.459     6.278     3.638    71.254     6.278     3.638
     61.785     5.497     3.186    53.318     3.463     2.007
    132.459     7.251     0.000    71.254     7.250     0.000
     61.785     6.349     0.000    53.318     4.000    -0.001
    132.459     6.279    -3.638    71.254     6.278    -3.638
     61.785     5.498    -3.186    53.318     3.464    -2.008
    132.459     3.639    -6.278    71.254     3.638    -6.279
     61.785     3.186    -5.498    53.318     2.007    -3.464
    132.459     0.001    -7.251    71.254     0.000    -7.250
     61.785     0.001    -6.349    53.318     0.000    -4.000
    132.459    -3.638    -6.279    71.254    -3.638    -6.279
     61.785    -3.185    -5.498    53.318    -2.007    -3.464
    132.459    -6.278    -3.639    71.254    -6.278    -3.638
     61.785    -5.497    -3.186    53.318    -3.463    -2.007
    132.459    -7.250    -0.001    71.254    -7.250     0.000
     61.785    -6.349    -0.001    53.318    -4.000    -0.001
    132.459    -6.278     3.638    71.254    -6.278     3.638
     61.785    -5.497     3.185    53.318    -3.463     2.007
    132.459    -3.616     6.281    71.254    -3.616     6.281
     61.785    -3.167     5.500    53.318    -1.995     3.465
$POINTS NETWORK =    ZBODA4
1.0
1.0
        4.0      11.0
```

```
     132.459    -6.278    -3.639   132.459    -7.250    -0.000
     132.459    -6.278     3.638   132.459    -3.616     6.281
     134.175    -6.549    -3.796   134.175    -7.564    -0.000
     134.175    -6.549     3.795   134.175    -3.773     6.552
     135.865    -6.816    -3.951   135.865    -7.872     0.000
     135.865    -6.817     3.950   135.865    -3.927     6.820
     137.500    -7.075    -4.100   137.500    -8.171     0.000
     137.500    -7.075     4.100   137.500    -4.076     7.078
     138.947    -7.239    -4.196   138.947    -8.361     0.000
     138.947    -7.240     4.195   138.947    -4.170     7.243
     140.100    -7.341    -4.254   140.100    -8.479     0.000
     140.100    -7.341     4.254   140.100    -4.229     7.344
     141.551    -7.469    -4.328   141.551    -8.626     0.000
     141.551    -7.469     4.328   141.551    -4.302     7.472
     143.975    -7.420    -4.300   143.975    -8.569     0.000
     143.975    -7.420     4.299   143.975    -4.274     7.423
     148.235    -6.650    -3.854   148.235    -7.680     0.000
     148.235    -6.649     3.853   148.235    -3.830     6.652
     153.934    -5.619    -3.257   153.934    -6.489     0.000
     153.934    -5.619     3.256   153.934    -3.237     5.621
     160.353    -4.457    -2.584   160.353    -5.148    -0.000
     160.353    -4.457     2.583   160.353    -2.568     4.459
$POINTS NETWORK =    ZBODA3
1.0
1.0
         4.0      11.0
     132.459     3.639    -6.278   132.459     0.000    -7.251
     132.459    -3.638    -6.279   132.459    -6.278    -3.639
     134.175     3.796    -6.550   134.175     0.000    -7.564
     134.175    -3.795    -6.550   134.175    -6.549    -3.796
     135.865     3.951    -6.817   135.865     0.000    -7.873
     135.865    -3.950    -6.817   135.865    -6.816    -3.951
     137.500     4.100    -7.076   137.500     0.000    -8.172
     137.500    -4.100    -7.076   137.500    -7.075    -4.100
     138.947     4.195    -7.240   138.947     0.000    -8.361
     138.947    -4.195    -7.240   138.947    -7.239    -4.196
     140.100     4.254    -7.341   140.100     0.000    -8.479
     140.100    -4.254    -7.341   140.100    -7.341    -4.254
     141.551     4.328    -7.469   141.551     0.000    -8.626
     141.551    -4.328    -7.469   141.551    -7.469    -4.328
     143.975     4.300    -7.420   143.975     0.000    -8.569
     143.975    -4.300    -7.420   143.975    -7.420    -4.300
     148.235     3.853    -6.650   148.235     0.000    -7.680
     148.235    -3.853    -6.650   148.235    -6.650    -3.854
     153.934     3.256    -5.619   153.934     0.000    -6.489
     153.934    -3.256    -5.619   153.934    -5.619    -3.257
     160.353     2.584    -4.458   160.353     0.000    -5.148
     160.353    -2.583    -4.458   160.353    -4.457    -2.584
$POINTS NETWORK =    ZBODA2
1.0
1.0
         4.0      11.0
     132.459     6.278     3.638   132.459     7.251     0.000
     132.459     6.279    -3.638   132.459     3.639    -6.278
     134.175     6.550     3.795   134.175     7.564     0.000
     134.175     6.550    -3.796   134.175     3.796    -6.550
     135.865     6.817     3.950   135.865     7.873     0.000
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  135.865     6.817    -3.950   135.865     3.951    -6.817
  137.500     7.075     4.100   137.500     8.172     0.000
  137.500     7.075    -4.100   137.500     4.100    -7.076
  138.947     7.240     4.195   138.947     8.361     0.000
  138.947     7.239    -4.196   138.947     4.195    -7.240
  140.100     7.341     4.254   140.100     8.479     0.000
  140.100     7.341    -4.254   140.100     4.254    -7.341
  141.551     7.469     4.328   141.551     8.626     0.000
  141.551     7.469    -4.328   141.551     4.328    -7.469
  143.975     7.420     4.300   143.975     8.569     0.000
  143.975     7.420    -4.300   143.975     4.300    -7.420
  148.235     6.649     3.853   148.235     7.680     0.000
  148.235     6.649    -3.853   148.235     3.853    -6.650
  153.934     5.618     3.256   153.934     6.489     0.000
  153.934     5.619    -3.256   153.934     3.256    -5.619
  160.353     4.457     2.583   160.353     5.148     0.000
  160.353     4.457    -2.583   160.353     2.584    -4.458
$POINTS NETWORK =     ZFIN2
1.0
2.0
     11.0       7.0
  132.459     6.278     3.638   134.176     6.550     3.795
  135.865     6.817     3.950   137.500     7.075     4.100
  138.948     7.240     4.195   140.101     7.341     4.254
  141.551     7.469     4.328   143.975     7.420     4.300
  148.235     6.649     3.853   153.934     5.618     3.256
  160.353     4.457     2.583
  132.480     7.119     4.856   133.996     7.408     5.052
  135.495     7.695     5.246   136.960     7.975     5.436
  138.272     8.147     5.552   139.314     8.249     5.619
  140.676     8.382     5.708   143.055     8.379     5.718
  147.477     7.746     5.351   153.507     6.882     4.850
  160.341     5.903     4.283
  132.502     7.960     6.074   133.818     8.267     6.307
  135.128     8.572     6.540   136.422     8.874     6.770
  137.598     9.055     6.907   138.530     9.156     6.983
  139.801     9.294     7.086   142.132     9.335     7.134
  146.713     8.835     6.844   153.075     8.140     6.441
  160.328     7.348     5.983
  132.523     8.801     7.291   133.642     9.125     7.562
  134.763     9.448     7.833   135.885     9.773     8.104
  136.926     9.962     8.261   137.749    10.062     8.344
  138.929    10.205     8.462   141.207    10.288     8.548
  145.945     9.917     8.333   152.641     9.394     8.030
  160.316     8.794     7.682
  132.544     9.642     8.508   133.469     9.982     8.815
  134.402    10.324     9.123   135.350    10.671     9.437
  136.255    10.869     9.615   136.970    10.966     9.702
  138.059    11.115     9.835   140.281    11.238     9.960
  145.175    10.994     9.819   152.205    10.643     9.616
  160.303    10.239     9.382
  132.566    10.484     9.726   133.301    10.838    10.066
  134.047    11.198    10.413   134.817    11.569    10.770
  135.587    11.775    10.968   136.195    11.869    11.058
  137.190    12.023    11.206   139.354    12.185    11.371
  144.403    12.065    11.301   151.768    11.888    11.199
  160.291    11.685    11.081
```

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  132.587    11.325    10.943   133.137    11.695    11.318
  133.701    12.073    11.702   134.288    12.467    12.102
  134.924    12.681    12.320   135.424    12.769    12.410
  136.323    12.929    12.574   138.428    13.131    12.781
  143.632    13.131    12.781   151.331    13.130    12.781
  160.278    13.130    12.781
$POINTS NETWORK =    ZFIN4
1.0
2.0
     11.0       7.0
  132.459    -6.278    -3.639   134.175    -6.549    -3.796
  135.865    -6.816    -3.951   137.500    -7.075    -4.100
  138.947    -7.239    -4.196   140.100    -7.341    -4.254
  141.551    -7.469    -4.328   143.975    -7.420    -4.300
  148.235    -6.650    -3.854   153.934    -5.619    -3.257
  160.353    -4.457    -2.584
  132.480    -7.119    -4.856   133.996    -7.408    -5.052
  135.495    -7.695    -5.246   136.960    -7.975    -5.436
  138.272    -8.147    -5.552   139.314    -8.249    -5.619
  140.676    -8.382    -5.708   143.055    -8.379    -5.718
  147.477    -7.746    -5.351   153.507    -6.882    -4.850
  160.341    -5.903    -4.283
  132.502    -7.960    -6.074   133.818    -8.267    -6.307
  135.128    -8.572    -6.540   136.422    -8.874    -6.770
  137.598    -9.055    -6.907   138.530    -9.156    -6.983
  139.801    -9.294    -7.086   142.132    -9.335    -7.134
  146.713    -8.835    -6.844   153.075    -8.140    -6.441
  160.328    -7.348    -5.983
  132.523    -8.801    -7.291   133.642    -9.125    -7.562
  134.763    -9.448    -7.833   135.885    -9.773    -8.104
  136.926    -9.962    -8.261   137.749   -10.062    -8.344
  138.929   -10.205    -8.462   141.207   -10.288    -8.548
  145.945    -9.917    -8.333   152.641    -9.394    -8.030
  160.316    -8.794    -7.682
  132.544    -9.642    -8.508   133.469    -9.982    -8.815
  134.402   -10.324    -9.123   135.350   -10.671    -9.437
  136.255   -10.869    -9.615   136.970   -10.966    -9.702
  138.059   -11.115    -9.835   140.281   -11.238    -9.960
  145.175   -10.994    -9.819   152.205   -10.643    -9.616
  160.303   -10.239    -9.382
  132.566   -10.484    -9.726   133.301   -10.838   -10.066
  134.047   -11.198   -10.413   134.817   -11.569   -10.770
  135.587   -11.775   -10.968   136.195   -11.869   -11.058
  137.190   -12.023   -11.206   139.354   -12.185   -11.371
  144.403   -12.065   -11.301   151.768   -11.888   -11.199
  160.291   -11.685   -11.081
  132.587   -11.325   -10.943   133.137   -11.695   -11.318
  133.701   -12.073   -11.702   134.288   -12.467   -12.102
  134.924   -12.681   -12.320   135.424   -12.769   -12.410
  136.323   -12.929   -12.574   138.428   -13.131   -12.781
  143.632   -13.131   -12.781   151.331   -13.130   -12.781
  160.278   -13.130   -12.781
$POINTS NETWORK =    ZFIN3
1.0
2.0
     11.0       7.0
  132.459     3.639    -6.278   134.175     3.796    -6.550
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   135.865     3.951    -6.817   137.500     4.100    -7.076
   138.947     4.195    -7.240   140.100     4.254    -7.341
   141.551     4.328    -7.469   143.975     4.300    -7.420
   148.235     3.853    -6.650   153.934     3.256    -5.619
   160.353     2.584    -4.458
   132.480     4.856    -7.119   133.996     5.052    -7.408
   135.495     5.246    -7.695   136.960     5.436    -7.975
   138.272     5.552    -8.147   139.314     5.619    -8.249
   140.676     5.708    -8.382   143.055     5.718    -8.379
   147.477     5.351    -7.746   153.507     4.850    -6.882
   160.341     4.283    -5.903
   132.502     6.074    -7.960   133.818     6.307    -8.267
   135.128     6.540    -8.572   136.422     6.770    -8.874
   137.598     6.907    -9.055   138.530     6.983    -9.156
   139.801     7.086    -9.294   142.132     7.134    -9.335
   146.713     6.844    -8.835   153.075     6.441    -8.140
   160.328     5.983    -7.348
   132.523     7.291    -8.801   133.642     7.562    -9.125
   134.763     7.833    -9.448   135.885     8.104    -9.773
   136.926     8.261    -9.962   137.749     8.344   -10.062
   138.929     8.462   -10.205   141.207     8.548   -10.288
   145.945     8.333    -9.917   152.641     8.030    -9.394
   160.316     7.682    -8.794
   132.544     8.508    -9.642   133.469     8.815    -9.982
   134.402     9.123   -10.324   135.350     9.437   -10.671
   136.255     9.615   -10.869   136.970     9.702   -10.966
   138.059     9.835   -11.115   140.281     9.960   -11.238
   145.175     9.819   -10.994   152.205     9.616   -10.643
   160.303     9.382   -10.239
   132.566     9.726   -10.484   133.301    10.066   -10.838
   134.047    10.413   -11.198   134.817    10.770   -11.569
   135.587    10.968   -11.775   136.195    11.058   -11.869
   137.190    11.206   -12.023   139.354    11.371   -12.185
   144.403    11.301   -12.065   151.768    11.199   -11.888
   160.291    11.081   -11.685
   132.587    10.943   -11.325   133.137    11.318   -11.695
   133.701    11.702   -12.073   134.288    12.102   -12.467
   134.924    12.320   -12.681   135.424    12.410   -12.769
   136.323    12.574   -12.929   138.428    12.781   -13.131
   143.632    12.781   -13.131   151.331    12.781   -13.130
   160.278    12.781   -13.130
$POINTS NETWORK =    ZBODA1
1.0
1.0
       4.0      11.0
   132.459    -3.616     6.281   132.459     0.000     7.250
   132.459     3.616     6.281   132.459     6.278     3.638
   134.175    -3.773     6.552   134.175     0.000     7.563
   134.175     3.773     6.552   134.175     6.550     3.795
   135.865    -3.927     6.820   135.865     0.000     7.872
   135.865     3.927     6.820   135.865     6.817     3.950
   137.500    -4.076     7.078   137.500     0.000     8.170
   137.500     4.076     7.078   137.500     7.075     4.100
   138.947    -4.170     7.243   138.947     0.000     8.360
   138.947     4.170     7.243   138.947     7.240     4.195
   140.100    -4.229     7.344   140.100     0.000     8.477
   140.100     4.229     7.344   140.100     7.341     4.254
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  141.551   -4.302    7.472  141.551    0.000    8.625
  141.551    4.302    7.472  141.551    7.469    4.328
  143.975   -4.274    7.423  143.975    0.000    8.568
  143.975    4.274    7.423  143.975    7.420    4.300
  148.235   -3.830    6.652  148.235    0.000    7.679
  148.235    3.830    6.652  148.235    6.649    3.853
  153.934   -3.237    5.621  153.934    0.000    6.488
  153.934    3.236    5.621  153.934    5.618    3.256
  160.353   -2.568    4.459  160.353    0.000    5.147
  160.353    2.568    4.460  160.353    4.457    2.583
$POINTS NETWORK =    ZFIN1
1.0
2.0
     11.0      7.0
  132.459   -3.616    6.281  134.176   -3.773    6.552
  135.865   -3.927    6.820  137.500   -4.076    7.078
  138.948   -4.170    7.243  140.101   -4.229    7.344
  141.551   -4.302    7.472  143.975   -4.274    7.423
  148.235   -3.830    6.652  153.934   -3.237    5.621
  160.353   -2.568    4.459
  132.480   -4.856    7.119  133.996   -5.052    7.408
  135.495   -5.246    7.695  136.960   -5.436    7.975
  138.272   -5.552    8.147  139.314   -5.619    8.249
  140.676   -5.708    8.382  143.055   -5.718    8.379
  147.477   -5.351    7.746  153.507   -4.850    6.882
  160.341   -4.283    5.903
  132.502   -6.074    7.960  133.818   -6.307    8.267
  135.128   -6.540    8.572  136.422   -6.770    8.874
  137.598   -6.907    9.055  138.530   -6.983    9.156
  139.801   -7.086    9.294  142.132   -7.134    9.335
  146.713   -6.844    8.835  153.075   -6.441    8.140
  160.328   -5.983    7.348
  132.523   -7.291    8.801  133.642   -7.562    9.125
  134.763   -7.833    9.448  135.885   -8.104    9.773
  136.926   -8.261    9.962  137.749   -8.344   10.062
  138.929   -8.462   10.205  141.207   -8.548   10.288
  145.945   -8.333    9.917  152.641   -8.030    9.394
  160.316   -7.682    8.794
  132.544   -8.508    9.642  133.469   -8.815    9.982
  134.402   -9.123   10.324  135.350   -9.437   10.671
  136.255   -9.615   10.869  136.970   -9.702   10.966
  138.059   -9.835   11.115  140.281   -9.960   11.238
  145.175   -9.819   10.994  152.205   -9.616   10.643
  160.303   -9.382   10.239
  132.566   -9.726   10.484  133.301  -10.066   10.838
  134.047  -10.413   11.198  134.817  -10.770   11.569
  135.587  -10.968   11.775  136.195  -11.058   11.869
  137.190  -11.206   12.023  139.354  -11.371   12.185
  144.403  -11.301   12.065  151.768  -11.199   11.888
  160.291  -11.081   11.685
  132.587  -10.943   11.325  133.137  -11.318   11.695
  133.701  -11.702   12.073  134.288  -12.102   12.467
  134.924  -12.320   12.681  135.424  -12.410   12.769
  136.323  -12.574   12.929  138.428  -12.781   13.131
  143.632  -12.781   13.131  151.331  -12.781   13.130
  160.278  -12.781   13.130
$POINTS NETWORK =     ZEND
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1.0
5.0        0.         0.         0.         0.
      13.0       2.0
   160.353    -2.568     4.459   160.353     0.000     5.148
   160.353     2.568     4.460   160.353     4.457     2.583
   160.353     5.148     0.000   160.353     4.457    -2.583
   160.353     2.584    -4.458   160.353     0.000    -5.148
   160.353    -2.583    -4.458   160.353    -4.457    -2.584
   160.353    -5.148    -0.001   160.353    -4.457     2.583
   160.353    -2.568     4.459
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000   160.350     0.000     0.000
   160.350     0.000     0.000
$POINTS NETWORK = ZFINWAK2
1.0
18.0       0.         0.         0.         1.
       7.0       2.0
   160.353     4.457     2.583   160.341     5.903     4.283
   160.328     7.348     5.983   160.316     8.794     7.682
   160.303    10.239     9.382   160.291    11.685    11.081
   160.278    13.130    12.781
  1160.353     4.457     2.583  1160.341     5.903     4.283
  1160.328     7.348     5.983  1160.316     8.794     7.682
  1160.303    10.239     9.382  1160.291    11.685    11.081
  1160.278    13.130    12.781
$POINTS NETWORK = ZFINWAK1
1.0
18.0       0.         0.         0.         1.
       7.0       2.0
   160.353    -2.568     4.459   160.341    -4.283     5.903
   160.328    -5.983     7.348   160.316    -7.682     8.794
   160.303    -9.382    10.239   160.291   -11.081    11.685
   160.278   -12.781    13.130
  1160.353    -2.568     4.459  1160.341    -4.283     5.903
  1160.328    -5.983     7.348  1160.316    -7.682     8.794
  1160.303    -9.382    10.239  1160.291   -11.081    11.685
  1160.278   -12.781    13.130
$POINTS NETWORK = ZFINWAK4
1.0
18.0       0.         0.         0.         1.
       7.0       2.0
   160.353    -4.457    -2.584   160.341    -5.903    -4.283
   160.328    -7.348    -5.983   160.316    -8.794    -7.682
   160.303   -10.239    -9.382   160.291   -11.685   -11.081
   160.278   -13.130   -12.781
  1160.353    -4.457    -2.584  1160.341    -5.903    -4.283
  1160.328    -7.348    -5.983  1160.316    -8.794    -7.682
  1160.303   -10.239    -9.382  1160.291   -11.685   -11.081
  1160.278   -13.130   -12.781
$POINTS NETWORK = ZFINWAK3
1.0
18.0       0.         0.         0.         1.
       7.0       2.0
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  160.353     2.584    -4.458   160.341     4.283    -5.903
  160.328     5.983    -7.348   160.316     7.682    -8.794
  160.303     9.382   -10.239   160.291    11.081   -11.685
  160.278    12.781   -13.130
 1160.353     2.584    -4.458  1160.341     4.283    -5.903
 1160.328     5.983    -7.348  1160.316     7.682    -8.794
 1160.303     9.382   -10.239  1160.291    11.081   -11.685
 1160.278    12.781   -13.130
$POINTS NETWORK = ZCNBDWK1
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18.0        1.        0.        0.        1.
      9.0      16.0
   45.236    -3.138     2.324    45.183    -4.642     3.583
   45.130    -6.146     4.841    45.077    -7.650     6.100
   45.025    -9.155     7.358    44.972   -10.659     8.616
   44.919   -12.163     9.875    44.866   -13.668    11.133
   44.813   -15.172    12.392
   53.318    -3.463     2.007    53.265    -4.967     3.265
   53.212    -6.471     4.523    53.160    -7.976     5.782
   53.107    -9.480     7.040    53.054   -10.984     8.299
   53.001   -12.489     9.557    52.948   -13.993    10.816
   52.896   -15.497    12.074
   61.785    -5.497     3.185    61.732    -7.001     4.444
   61.679    -8.505     5.702    61.627   -10.010     6.960
   61.574   -11.514     8.219    61.521   -13.018     9.477
   61.468   -14.523    10.736    61.415   -16.027    11.994
   61.362   -17.531    13.253
   71.254    -6.278     3.638    71.201    -7.782     4.896
   71.148    -9.286     6.155    71.096   -10.790     7.413
   71.043   -12.295     8.672    70.990   -13.799     9.930
   70.937   -15.303    11.189    70.884   -16.808    12.447
   70.831   -18.312    13.705
  132.459    -6.278     3.638   132.406    -7.782     4.896
  132.353    -9.286     6.155   132.301   -10.791     7.413
  132.248   -12.295     8.672   132.195   -13.799     9.930
  132.142   -15.304    11.189   132.089   -16.808    12.447
  132.036   -18.312    13.705
  134.175    -6.549     3.795   134.122    -8.054     5.054
  134.070    -9.558     6.312   134.017   -11.062     7.570
  133.964   -12.566     8.829   133.911   -14.071    10.087
  133.858   -15.575    11.346   133.806   -17.079    12.604
  133.753   -18.583    13.863
  135.865    -6.817     3.950   135.812    -8.321     5.208
  135.759    -9.825     6.467   135.706   -11.329     7.725
  135.653   -12.834     8.984   135.600   -14.338    10.242
  135.548   -15.842    11.501   135.495   -17.347    12.759
  135.442   -18.851    14.018
  137.500    -7.075     4.100   137.447    -8.580     5.358
  137.394   -10.084     6.617   137.341   -11.588     7.875
  137.288   -13.092     9.134   137.236   -14.597    10.392
  137.183   -16.101    11.651   137.130   -17.605    12.909
  137.077   -19.109    14.168
  138.947    -7.240     4.195   138.895    -8.744     5.454
  138.842   -10.248     6.712   138.789   -11.752     7.971
  138.736   -13.257     9.229   138.683   -14.761    10.488
  138.631   -16.265    11.746   138.578   -17.770    13.004
  138.525   -19.274    14.263
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     140.100    -7.341     4.254   140.048    -8.845     5.512
     139.995   -10.350     6.771   139.942   -11.854     8.029
     139.889   -13.358     9.288   139.836   -14.863    10.546
     139.784   -16.367    11.805   139.731   -17.871    13.063
     139.678   -19.375    14.322
     141.551    -7.469     4.328   141.498    -8.973     5.586
     141.445   -10.477     6.845   141.393   -11.981     8.103
     141.340   -13.486     9.362   141.287   -14.990    10.620
     141.234   -16.494    11.879   141.181   -17.999    13.137
     141.129   -19.503    14.396
     143.975    -7.420     4.299   143.923    -8.924     5.558
     143.870   -10.428     6.816   143.817   -11.933     8.075
     143.764   -13.437     9.333   143.711   -14.941    10.592
     143.658   -16.445    11.850   143.606   -17.950    13.109
     143.553   -19.454    14.367
     148.235    -6.649     3.853   148.182    -8.154     5.111
     148.129    -9.658     6.370   148.076   -11.162     7.628
     148.023   -12.667     8.887   147.971   -14.171    10.145
     147.918   -15.675    11.404   147.865   -17.179    12.662
     147.812   -18.684    13.921
     153.934    -5.619     3.256   153.881    -7.123     4.514
     153.828    -8.627     5.773   153.776   -10.131     7.031
     153.723   -11.636     8.290   153.670   -13.140     9.548
     153.617   -14.644    10.806   153.564   -16.149    12.065
     153.512   -17.653    13.323
     160.353    -4.457     2.583   160.301    -5.962     3.841
     160.248    -7.466     5.100   160.195    -8.970     6.358
     160.142   -10.475     7.617   160.089   -11.979     8.875
     160.036   -13.483    10.134   159.984   -14.987    11.392
     159.931   -16.492    12.651
    1160.353    -4.457     2.583  1160.301    -5.962     3.841
    1160.248    -7.466     5.100  1160.195    -8.970     6.358
    1160.142   -10.475     7.617  1160.089   -11.979     8.875
    1160.036   -13.483    10.134  1159.984   -14.987    11.392
    1159.931   -16.492    12.651
$POINTS NETWORK = ZCNBDWK2
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18.0      1.        0.        0.        1.
       9.0      16.0
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      45.130    -4.841    -6.146    45.077    -6.100    -7.650
      45.025    -7.358    -9.155    44.972    -8.616   -10.659
      44.919    -9.875   -12.163    44.866   -11.133   -13.668
      44.813   -12.392   -15.172
      53.318    -2.007    -3.463    53.265    -3.265    -4.967
      53.212    -4.523    -6.471    53.160    -5.782    -7.976
      53.107    -7.040    -9.480    53.054    -8.299   -10.984
      53.001    -9.557   -12.489    52.948   -10.816   -13.993
      52.896   -12.074   -15.497
      61.785    -3.185    -5.497    61.732    -4.444    -7.001
      61.679    -5.702    -8.505    61.627    -6.960   -10.010
      61.574    -8.219   -11.514    61.521    -9.477   -13.018
      61.468   -10.736   -14.523    61.415   -11.994   -16.027
      61.362   -13.253   -17.531
      71.254    -3.638    -6.278    71.201    -4.896    -7.782
      71.148    -6.155    -9.286    71.096    -7.413   -10.790
      71.043    -8.672   -12.295    70.990    -9.930   -13.799
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872	70.937	-11.189	-15.303	70.884	-12.447	-16.808
873	70.831	-13.705	-18.312			
874	132.459	-3.638	-6.278	132.406	-4.896	-7.782
875	132.353	-6.155	-9.286	132.301	-7.413	-10.791
876	132.248	-8.672	-12.295	132.195	-9.930	-13.799
877	132.142	-11.189	-15.304	132.089	-12.447	-16.808
878	132.036	-13.705	-18.312			
879	134.175	-3.795	-6.549	134.122	-5.054	-8.054
880	134.070	-6.312	-9.558	134.017	-7.570	-11.062
881	133.964	-8.829	-12.566	133.911	-10.087	-14.071
882	133.858	-11.346	-15.575	133.806	-12.604	-17.079
883	133.753	-13.863	-18.583			
884	135.865	-3.950	-6.817	135.812	-5.208	-8.321
885	135.759	-6.467	-9.825	135.706	-7.725	-11.329
886	135.653	-8.984	-12.834	135.600	-10.242	-14.338
887	135.548	-11.501	-15.842	135.495	-12.759	-17.347
888	135.442	-14.018	-18.851			
889	137.500	-4.100	-7.075	137.447	-5.358	-8.580
890	137.394	-6.617	-10.084	137.341	-7.875	-11.588
891	137.288	-9.134	-13.092	137.236	-10.392	-14.597
892	137.183	-11.651	-16.101	137.130	-12.909	-17.605
893	137.077	-14.168	-19.109			
894	138.947	-4.195	-7.240	138.895	-5.454	-8.744
895	138.842	-6.712	-10.248	138.789	-7.971	-11.752
896	138.736	-9.229	-13.257	138.683	-10.488	-14.761
897	138.631	-11.746	-16.265	138.578	-13.004	-17.770
898	138.525	-14.263	-19.274			
899	140.100	-4.254	-7.341	140.048	-5.512	-8.845
900	139.995	-6.771	-10.350	139.942	-8.029	-11.854
901	139.889	-9.288	-13.358	139.836	-10.546	-14.863
902	139.784	-11.805	-16.367	139.731	-13.063	-17.871
903	139.678	-14.322	-19.375			
904	141.551	-4.328	-7.469	141.498	-5.586	-8.973
905	141.445	-6.845	-10.477	141.393	-8.103	-11.981
906	141.340	-9.362	-13.486	141.287	-10.620	-14.990
907	141.234	-11.879	-16.494	141.181	-13.137	-17.999
908	141.129	-14.396	-19.503			
909	143.975	-4.299	-7.420	143.923	-5.558	-8.924
910	143.870	-6.816	-10.428	143.817	-8.075	-11.933
911	143.764	-9.333	-13.437	143.711	-10.592	-14.941
912	143.658	-11.850	-16.445	143.606	-13.109	-17.950
913	143.553	-14.367	-19.454			
914	148.235	-3.853	-6.649	148.182	-5.111	-8.154
915	148.129	-6.370	-9.658	148.076	-7.628	-11.162
916	148.023	-8.887	-12.667	147.971	-10.145	-14.171
917	147.918	-11.404	-15.675	147.865	-12.662	-17.179
918	147.812	-13.921	-18.684			
919	153.934	-3.256	-5.619	153.881	-4.514	-7.123
920	153.828	-5.773	-8.627	153.776	-7.031	-10.131
921	153.723	-8.290	-11.636	153.670	-9.548	-13.140
922	153.617	-10.806	-14.644	153.564	-12.065	-16.149
923	153.512	-13.323	-17.653			
924	160.353	-2.583	-4.457	160.301	-3.841	-5.962
925	160.248	-5.100	-7.466	160.195	-6.358	-8.970
926	160.142	-7.617	-10.475	160.089	-8.875	-11.979
927	160.036	-10.134	-13.483	159.984	-11.392	-14.987
928	159.931	-12.651	-16.492			

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 1160.353    -2.583    -4.457  1160.301    -3.841    -5.962
 1160.248    -5.100    -7.466  1160.195    -6.358    -8.970
 1160.142    -7.617   -10.475  1160.089    -8.875   -11.979
 1160.036   -10.134   -13.483  1159.984   -11.392   -14.987
 1159.931   -12.651   -16.492
$POINTS NETWORK = ZCNBDWK3
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        9.0      16.0
   45.236     3.138    -2.324    45.183     4.642    -3.583
   45.130     6.146    -4.841    45.077     7.650    -6.100
   45.025     9.155    -7.358    44.972    10.659    -8.616
   44.919    12.163    -9.875    44.866    13.668   -11.133
   44.813    15.172   -12.392
   53.318     3.463    -2.007    53.265     4.967    -3.265
   53.212     6.471    -4.523    53.160     7.976    -5.782
   53.107     9.480    -7.040    53.054    10.984    -8.299
   53.001    12.489    -9.557    52.948    13.993   -10.816
   52.896    15.497   -12.074
   61.785     5.497    -3.185    61.732     7.001    -4.444
   61.679     8.505    -5.702    61.627    10.010    -6.960
   61.574    11.514    -8.219    61.521    13.018    -9.477
   61.468    14.523   -10.736    61.415    16.027   -11.994
   61.362    17.531   -13.253
   71.254     6.278    -3.638    71.201     7.782    -4.896
   71.148     9.286    -6.155    71.096    10.790    -7.413
   71.043    12.295    -8.672    70.990    13.799    -9.930
   70.937    15.303   -11.189    70.884    16.808   -12.447
   70.831    18.312   -13.705
  132.459     6.278    -3.638   132.406     7.782    -4.896
  132.353     9.286    -6.155   132.301    10.791    -7.413
  132.248    12.295    -8.672   132.195    13.799    -9.930
  132.142    15.304   -11.189   132.089    16.808   -12.447
  132.036    18.312   -13.705
  134.175     6.549    -3.795   134.122     8.054    -5.054
  134.070     9.558    -6.312   134.017    11.062    -7.570
  133.964    12.566    -8.829   133.911    14.071   -10.087
  133.858    15.575   -11.346   133.806    17.079   -12.604
  133.753    18.583   -13.863
  135.865     6.817    -3.950   135.812     8.321    -5.208
  135.759     9.825    -6.467   135.706    11.329    -7.725
  135.653    12.834    -8.984   135.600    14.338   -10.242
  135.548    15.842   -11.501   135.495    17.347   -12.759
  135.442    18.851   -14.018
  137.500     7.075    -4.100   137.447     8.580    -5.358
  137.394    10.084    -6.617   137.341    11.588    -7.875
  137.288    13.092    -9.134   137.236    14.597   -10.392
  137.183    16.101   -11.651   137.130    17.605   -12.909
  137.077    19.109   -14.168
  138.947     7.240    -4.195   138.895     8.744    -5.454
  138.842    10.248    -6.712   138.789    11.752    -7.971
  138.736    13.257    -9.229   138.683    14.761   -10.488
  138.631    16.265   -11.746   138.578    17.770   -13.004
  138.525    19.274   -14.263
  140.100     7.341    -4.254   140.048     8.845    -5.512
  139.995    10.350    -6.771   139.942    11.854    -8.029
  139.889    13.358    -9.288   139.836    14.863   -10.546
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     139.784    16.367   -11.805   139.731    17.871   -13.063
     139.678    19.375   -14.322
     141.551     7.469    -4.328   141.498     8.973    -5.586
     141.445    10.477    -6.845   141.393    11.981    -8.103
     141.340    13.486    -9.362   141.287    14.990   -10.620
     141.234    16.494   -11.879   141.181    17.999   -13.137
     141.129    19.503   -14.396
     143.975     7.420    -4.299   143.923     8.924    -5.558
     143.870    10.428    -6.816   143.817    11.933    -8.075
     143.764    13.437    -9.333   143.711    14.941   -10.592
     143.658    16.445   -11.850   143.606    17.950   -13.109
     143.553    19.454   -14.367
     148.235     6.649    -3.853   148.182     8.154    -5.111
     148.129     9.658    -6.370   148.076    11.162    -7.628
     148.023    12.667    -8.887   147.971    14.171   -10.145
     147.918    15.675   -11.404   147.865    17.179   -12.662
     147.812    18.684   -13.921
     153.934     5.619    -3.256   153.881     7.123    -4.514
     153.828     8.627    -5.773   153.776    10.131    -7.031
     153.723    11.636    -8.290   153.670    13.140    -9.548
     153.617    14.644   -10.806   153.564    16.149   -12.065
     153.512    17.653   -13.323
     160.353     4.457    -2.583   160.301     5.962    -3.841
     160.248     7.466    -5.100   160.195     8.970    -6.358
     160.142    10.475    -7.617   160.089    11.979    -8.875
     160.036    13.483   -10.134   159.984    14.987   -11.392
     159.931    16.492   -12.651
    1160.353     4.457    -2.583  1160.301     5.962    -3.841
    1160.248     7.466    -5.100  1160.195     8.970    -6.358
    1160.142    10.475    -7.617  1160.089    11.979    -8.875
    1160.036    13.483   -10.134  1159.984    14.987   -11.392
    1159.931    16.492   -12.651
$POINTS NETWORK = ZCNBDWK4
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        9.0     16.0
      45.236     2.324     3.138    45.183     3.583     4.642
      45.130     4.841     6.146    45.077     6.100     7.650
      45.025     7.358     9.155    44.972     8.616    10.659
      44.919     9.875    12.163    44.866    11.133    13.668
      44.813    12.392    15.172
      53.318     2.007     3.463    53.265     3.265     4.967
      53.212     4.523     6.471    53.160     5.782     7.976
      53.107     7.040     9.480    53.054     8.299    10.984
      53.001     9.557    12.489    52.948    10.816    13.993
      52.896    12.074    15.497
      61.785     3.185     5.497    61.732     4.444     7.001
      61.679     5.702     8.505    61.627     6.960    10.010
      61.574     8.219    11.514    61.521     9.477    13.018
      61.468    10.736    14.523    61.415    11.994    16.027
      61.362    13.253    17.531
      71.254     3.638     6.278    71.201     4.896     7.782
      71.148     6.155     9.286    71.096     7.413    10.790
      71.043     8.672    12.295    70.990     9.930    13.799
      70.937    11.189    15.303    70.884    12.447    16.808
      70.831    13.705    18.312
     132.459     3.638     6.278   132.406     4.896     7.782
```

1043	132.353	6.155	9.286	132.301	7.413	10.791
1044	132.248	8.672	12.295	132.195	9.930	13.799
1045	132.142	11.189	15.304	132.089	12.447	16.808
1046	132.036	13.705	18.312			
1047	134.175	3.795	6.549	134.122	5.054	8.054
1048	134.070	6.312	9.558	134.017	7.570	11.062
1049	133.964	8.829	12.566	133.911	10.087	14.071
1050	133.858	11.346	15.575	133.806	12.604	17.079
1051	133.753	13.863	18.583			
1052	135.865	3.950	6.817	135.812	5.208	8.321
1053	135.759	6.467	9.825	135.706	7.725	11.329
1054	135.653	8.984	12.834	135.600	10.242	14.338
1055	135.548	11.501	15.842	135.495	12.759	17.347
1056	135.442	14.018	18.851			
1057	137.500	4.100	7.075	137.447	5.358	8.580
1058	137.394	6.617	10.084	137.341	7.875	11.588
1059	137.288	9.134	13.092	137.236	10.392	14.597
1060	137.183	11.651	16.101	137.130	12.909	17.605
1061	137.077	14.168	19.109			
1062	138.947	4.195	7.240	138.895	5.454	8.744
1063	138.842	6.712	10.248	138.789	7.971	11.752
1064	138.736	9.229	13.257	138.683	10.488	14.761
1065	138.631	11.746	16.265	138.578	13.004	17.770
1066	138.525	14.263	19.274			
1067	140.100	4.254	7.341	140.048	5.512	8.845
1068	139.995	6.771	10.350	139.942	8.029	11.854
1069	139.889	9.288	13.358	139.836	10.546	14.863
1070	139.784	11.805	16.367	139.731	13.063	17.871
1071	139.678	14.322	19.375			
1072	141.551	4.328	7.469	141.498	5.586	8.973
1073	141.445	6.845	10.477	141.393	8.103	11.981
1074	141.340	9.362	13.486	141.287	10.620	14.990
1075	141.234	11.879	16.494	141.181	13.137	17.999
1076	141.129	14.396	19.503			
1077	143.975	4.299	7.420	143.923	5.558	8.924
1078	143.870	6.816	10.428	143.817	8.075	11.933
1079	143.764	9.333	13.437	143.711	10.592	14.941
1080	143.658	11.850	16.445	143.606	13.109	17.950
1081	143.553	14.367	19.454			
1082	148.235	3.853	6.649	148.182	5.111	8.154
1083	148.129	6.370	9.658	148.076	7.628	11.162
1084	148.023	8.887	12.667	147.971	10.145	14.171
1085	147.918	11.404	15.675	147.865	12.662	17.179
1086	147.812	13.921	18.684			
1087	153.934	3.256	5.619	153.881	4.514	7.123
1088	153.828	5.773	8.627	153.776	7.031	10.131
1089	153.723	8.290	11.636	153.670	9.548	13.140
1090	153.617	10.806	14.644	153.564	12.065	16.149
1091	153.512	13.323	17.653			
1092	160.353	2.583	4.457	160.301	3.841	5.962
1093	160.248	5.100	7.466	160.195	6.358	8.970
1094	160.142	7.617	10.475	160.089	8.875	11.979
1095	160.036	10.134	13.483	159.984	11.392	14.987
1096	159.931	12.651	16.492			
1097	1160.353	2.583	4.457	1160.301	3.841	5.962
1098	1160.248	5.100	7.466	1160.195	6.358	8.970
1099	1160.142	7.617	10.475	1160.089	8.875	11.979

```
  1100   1160.036    10.134    13.483  1159.984    11.392    14.987
  1101   1159.931    12.651    16.492
  1102 $POINTS NETWORK =  ZBODWAK
  1103 1.0
  1104 18.        1.                          1.
  1105       13.0       2.0
  1106    160.353    -2.568     4.459   160.353     0.000     5.148
  1107    160.353     2.568     4.460   160.353     4.457     2.583
  1108    160.353     5.148     0.000   160.353     4.457    -2.583
  1109    160.353     2.584    -4.458   160.353     0.000    -5.148
  1110    160.353    -2.583    -4.458   160.353    -4.457    -2.584
  1111    160.353    -5.148    -0.001   160.353    -4.457     2.583
  1112    160.353    -2.568     4.459
  1113   1160.353    -2.568     4.459  1160.353     0.000     5.148
  1114   1160.353     2.568     4.460  1160.353     4.457     2.583
  1115   1160.353     5.148     0.000  1160.353     4.457    -2.583
  1116   1160.353     2.584    -4.458  1160.353     0.000    -5.148
  1117   1160.353    -2.583    -4.458  1160.353    -4.457    -2.584
  1118   1160.353    -5.148    -0.001  1160.353    -4.457     2.583
  1119   1160.353    -2.568     4.459
  1120 $END
1

                                    record of input processing


  $TIT
  $SYM
  $MAC
  $CAS
  $ANG
  $PRI
  $REF
  $POI
      kn,kt              1           2
     network # being processed   1     9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
      kn,kt              1           2
     network # being processed   2     9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
      kn,kt              1           2
     network # being processed   3     9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
      kn,kt              1           2
     network # being processed   4     9.0000    9.0000    0.0000    0.0000    0.0000    0.0000

  $POI
      kn,kt              1           1
     network # being processed   5     4.0000   13.0000    0.0000    0.0000    0.0000    0.0000

  $POI
      kn,kt              1           1
     network # being processed   6    13.0000    2.0000    0.0000    0.0000    0.0000    0.0000
```

APPENDIX B. GBU-24 OUPUT FILE (EDGE ANALYSIS)

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Mar 7 1996 13:51 **results** Page 58

abutment	nw-ident	ntd	knet.edge	nw-ident	ntd	knet.edge	
1		12	1.1-		18	30.1+	
		18	30.1-		12	1.1+	
2		12	1.2-		12	1.2+	probable error: unabutted free edge
3		12	1.3-		12	1.3+	probable error: unabutted free edge
4		12	10.2-		12	11.4-	
		12	11.4+		12	1.4+	
		12	1.4-		12	10.2+	
5		12	2.1-		18	29.1+	
		18	29.1-		12	2.1+	
6		12	2.2-		12	2.2+	probable error: unabutted free edge
7		12	2.3-		12	2.3+	probable error: unabutted free edge
8		12	9.2-		12	10.4-	
		12	10.4+		12	2.4+	
		12	2.4-		12	9.2+	
9		12	3.1-		18	31.1+	
		18	31.1-		12	3.1+	
10		12	3.2-		12	3.2+	probable error: unabutted free edge
11		12	3.3-		12	3.3+	probable error: unabutted free edge
12		12	11.2-		12	8.4-	
		12	8.4+		12	3.4+	
		12	3.4-		12	11.2+	
13		12	4.1-		18	28.1+	
		18	28.1-		12	4.1+	
14		12	4.2-		12	4.2+	probable error: unabutted free edge
15		12	4.3-		12	4.3+	probable error: unabutted free edge
16		12	8.2-		12	9.4-	
		12	9.4+		12	4.4+	
		12	4.4-		12	8.2+	
17		12	6.4+		12	5.1+	
		12	5.1-		12	6.4-	
18		12	5.4+		12	5.2+	
		12	5.2-		12	5.4-	
19		12	6.3+		12	6.1+	
		12	6.1-		12	6.3-	
20		12	7.3+		12	6.2+	
		12	6.2-		12	7.3-	
21		12	7.3+		12	6.2+	
		12	6.2-		12	7.3-	
22		12	8.1+		12	7.1+	
		12	7.1-		12	8.1-	
23		12	7.1-		12	11.1-	
		12	11.1+		12	7.1+	
24		12	10.1+		12	7.1+	
		12	7.1-		12	10.1-	
25		12	9.1+		12	7.1+	
		12	7.1-		12	9.1-	
26		12	7.4+		12	7.2+	
		12	7.2-		12	7.4-	
27		12	12.2+		12	8.3+	
		12	8.3-		12	12.2-	
28		12	12.2+		12	9.3+	
		12	9.3-		12	12.2-	
29		12	12.2+		12	10.3+	
		12	10.3-		12	12.2-	
30		12	11.3-		12	12.2-	
		12	12.2+		12	11.3+	

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31	12	12.3+	12	12.1+	
	12	12.1-	12	12.3-	
32	12	13.3+	12	12.4+	
	12	12.4-	12	13.3-	
33	12	13.3+	12	12.4+	
	12	12.4-	12	13.3-	
34	12	13.1-	12	14.3-	
	12	14.3+	12	13.1+	
35	12	13.1-	12	14.3-	
	12	14.3+	12	13.1+	
36	12	13.4+	12	13.2+	
	12	13.2-	12	13.4-	
37	12	14.1-	12	21.4-	
	12	21.4+	12	14.1+	
38	12	14.1-	12	17.4-	
	12	17.4+	12	14.1+	
39	12	14.1-	12	16.4-	
	12	16.4+	12	14.1+	
40	12	14.1-	12	15.4-	
	12	15.4+	12	14.1+	
41	12	14.4+	12	14.2+	
	12	14.2-	12	14.4-	
42	12	16.3+	12	19.4-	
	12	19.4+	12	15.1+	
	12	15.1-	12	16.3-	
43	12	23.4+	18	32.1+	
	18	32.1-	12	15.2+	
•	12	15.2-	12	23.4-	
44	12	21.1+	12	22.4+	
	12	22.4-	12	15.3+	
	12	15.3-	12	21.1-	
45	12	17.3+	12	20.4-	
	12	20.4+	12	16.1+	
	12	16.1-	12	17.3-	
46	12	23.4+	18	32.1+	
	18	32.1-	12	16.2+	
	12	16.2-	12	23.4-	
47	12	21.3+	12	18.4-	
	12	18.4+	12	17.1+	
	12	17.1-	12	21.3-	
48	12	23.4+	18	32.1+	
	18	32.1-	12	17.2+	
	12	17.2-	12	23.4-	
49	12	18.1-	12	18.1+	probable error: unabutted free edge
50	12	18.2-	12	18.2+	probable error: unabutted free edge
51	12	18.3-	18	24.1-	
	18	24.1+	12	18.3+	
52	12	19.1-	12	19.1+	probable error: unabutted free edge
53	12	19.2-	12	19.2+	probable error: unabutted free edge
54	12	19.3-	18	26.1-	
	18	26.1+	12	19.3+	
55	12	20.1-	12	20.1+	probable error: unabutted free edge
56	12	20.2-	12	20.2+	probable error: unabutted free edge
57	12	20.3-	18	27.1-	
	18	27.1+	12	20.3+	
58	12	23.4+	18	32.1+	
	18	32.1-	12	21.2+	

	12	21.2-	12	23.4-	
59	12	22.1-	12	22.1+	probable error: unabutted free edge
60	12	22.2-	12	22.2+	probable error: unabutted free edge
61	12	22.3-	18	25.1-	
	18	25.1+	12	22.3+	
62	12	23.1-	12	23.3-	
	12	23.3+	12	23.1+	
63	18	24.2-	18	24.2+	
64	18	24.3-	18	24.3+	
65	18	24.4-	18	24.4+	
66	18	25.2-	18	25.2+	
67	18	25.3-	18	25.3+	
68	18	32.2+	18	32.4+	
	18	32.4-	18	25.4+	
	18	25.4-	18	32.2-	
69	18	26.2-	18	26.2+	
70	18	26.3-	18	26.3+	
71	18	26.4-	18	26.4+	
72	18	27.2-	18	27.2+	
73	18	27.3-	18	27.3+	
74	18	27.4-	18	27.4+	
75	18	28.2-	18	28.2+	
76	18	28.3-	18	28.3+	
77	18	28.4-	18	28.4+	
78	18	29.2-	18	29.2+	
79	18	29.3-	18	29.3+	
80	18	29.4-	18	29.4+	
81	18	30.2-	18	30.2+	
82	18	30.3-	18	30.3+	
83	18	30.4-	18	30.4+	
84	18	31.2-	18	31.2+	
85	18	31.3-	18	31.3+	
86	18	31.4-	18	31.4+	
87	18	32.3-	18	32.3+	

surfaces associated with various regions of the configuration

region	nw-id	nw-name	dblt-type	surface	material		r/ctr	
1	1		analysis	upper	air	75.546633	0.341333	-0.739267
	1		analysis	lower	air			
	2		analysis	upper	air			
	2		analysis	lower	air			
	3		analysis	upper	air			
	3		analysis	lower	air			
	4		analysis	upper	air			
	4		analysis	lower	air			
	5		analysis	upper	air			
	6		analysis	upper	air			
	7		analysis	upper	air			
	8		analysis	upper	air			
	9		analysis	upper	air			
	10		analysis	upper	air			
	11		analysis	upper	air			
	12		analysis	upper	air			
	13		analysis	upper	air			
	14		analysis	upper	air			
	15		analysis	upper	air			

```
            16              analysis      upper    air
            17              analysis      upper    air
            18              analysis      upper    air
            18              analysis      lower    air
            19              analysis      upper    air
            19              analysis      lower    air
            20              analysis      upper    air
            20              analysis      lower    air
            21              analysis      upper    air
            22              analysis      upper    air
            22              analysis      lower    air
            24              nt=18 wake    upper    air
            24              nt=18 wake    lower    air
            25              nt=18 wake    upper    air
            25              nt=18 wake    lower    air
            26              nt=18 wake    upper    air
            26              nt=18 wake    lower    air
            27              nt=18 wake    upper    air
            27              nt=18 wake    lower    air
            28              nt=18 wake    upper    air
            28              nt=18 wake    lower    air
            29              nt=18 wake    upper    air
            29              nt=18 wake    lower    air
            30              nt=18 wake    upper    air
            30              nt=18 wake    lower    air
            31              nt=18 wake    upper    air
            31              nt=18 wake    lower    air
            32              nt=18 wake    lower    air

      2      5              analysis      lower    air         68.013867     0.854933    -1.775733
             6              analysis      lower    air
             7              analysis      lower    air
             8              analysis      lower    air
             9              analysis      lower    air
            10              analysis      lower    air
            11              analysis      lower    air
            12              analysis      lower    air
            13              analysis      lower    air
            14              analysis      lower    air
            15              analysis      lower    air
            16              analysis      lower    air
            17              analysis      lower    air
            21              analysis      lower    air
            23              analysis      lower    air

      3     23              analysis      upper    air        160.353000     2.584000    -4.458000
            32              nt=18 wake    upper    air

 0*b*extra-cp


 0 *****  summary of extra control points  *****

        nw   edge   point   row   col     fine grid location
    1.   6     2      11     11     2       21     3
    2.   7     1       4      1     4        1     7
    3.   7     1       7      1     7        1    13
```

```
     4.   7     1      10    1    10        1    19
     5.   7     3      11    3     3        5     5
     6.  12     2       4    4     3        7     5
     7.  12     2       7    7     3       13     5
     8.  12     2      10   10     3       19     5
     9.  12     4       3   11     1       21     1
    10.  13     1      12    1    12        1    23
    11.  13     3       3    2    11        3    21
    12.  14     1       4    1     4        1     7
    13.  14     1       7    1     7        1    13
    14.  14     1      10    1    10        1    19
    15.  14     3      12    4     2        7     3
    16.  23     4       4   10     1       19     1
    17.  23     4       7    7     1       13     1
    18.  23     4      10    4     1        7     1
    19.  32     1       4    1     4        1     7
    20.  32     1       7    1     7        1    13
    21.  32     1      10    1    10        1    19
0*e*extra-cp
0*b*extra-vp


0 *****   summary of extra v-parameter points   *****

         nw   edge  point  row  col     fine grid location
     1.   6     2      11   11     2       21     3
     2.   7     1       4    1     4        1     7
     3.   7     1       7    1     7        1    13
     4.   7     1      10    1    10        1    19
     5.   7     3      11    3     3        5     5
     6.  12     2       4    4     3        7     5
     7.  12     2       7    7     3       13     5
     8.  12     2      10   10     3       19     5
     9.  12     4       3   11     1       21     1
    10.  13     1      12    1    12        1    23
    11.  13     3       3    2    11        3    21
    12.  14     1       4    1     4        1     7
    13.  14     1       7    1     7        1    13
    14.  14     1      10    1    10        1    19
    15.  14     3      12    4     2        7     3
    16.  23     4       4   10     1       19     1
    17.  23     4       7    7     1       13     1
    18.  23     4      10    4     1        7     1
    19.  32     1       4    1     4        1     7
    20.  32     1       7    1     7        1    13
    21.  32     1      10    1    10        1    19
0*e*extra-vp
0*b*abutment
1                                  abutment summary


0abutment #    1
                  dblt edge                                starts at ai #    1       ends at ai #    2
  nw.edge   nw/id  type type   matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.1              12    4                             1    2    3    4    5    6    7    8    9
  30.1              18    5    mu-match                 1    2    3    4    5    6    7    8    9
0abutment #    2    doublet strength matched to zero along this abutment                                   ***  warning  **
```

```
*
                 dblt edge                        starts at ai #   2      ends at ai #   3
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.2            12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #   3    doublet strength matched to zero along this abutment                                 ***  warning  **
*
                 dblt edge                        starts at ai #   3      ends at ai #   4
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.3            12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #   4
                 dblt edge                        starts at ai #   1      ends at ai #   4
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   1.4            12    4   mu-match                 1   2   3   4   5   6   7   8   9
  10.2            12    4                            1   0   0   0   0   0   0   0   2
  11.4            12    4                            2   0   0   0   0   0   0   0   1
0abutment #   5
                 dblt edge                        starts at ai #   5      ends at ai #   6
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.1            12    4                            1   2   3   4   5   6   7   8   9
  29.1            18    5   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #   6    doublet strength matched to zero along this abutment                                 ***  warning  **
*
                 dblt edge                        starts at ai #   6      ends at ai #   7
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.2            12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #   7    doublet strength matched to zero along this abutment                                 ***  warning  **
*
                 dblt edge                        starts at ai #   7      ends at ai #   8
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.3            12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #   8
                 dblt edge                        starts at ai #   5      ends at ai #   8
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   2.4            12    4   mu-match                 1   2   3   4   5   6   7   8   9
   9.2            12    4                            1   0   0   0   0   0   0   0   2
  10.4            12    4                            2   0   0   0   0   0   0   0   1
0abutment #   9
                 dblt edge                        starts at ai #   9      ends at ai #  10
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.1            12    4                            1   2   3   4   5   6   7   8   9
  31.1            18    5   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #  10    doublet strength matched to zero along this abutment                                 ***  warning  **
*
                 dblt edge                        starts at ai #  10      ends at ai #  11
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.2            12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #  11    doublet strength matched to zero along this abutment                                 ***  warning  **
*
                 dblt edge                        starts at ai #  11      ends at ai #  12
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.3            12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #  12
                 dblt edge                        starts at ai #  12      ends at ai #   9
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   3.4            12    4   mu-match                 1   2   3   4   5   6   7   8   9
   8.4            12    4                            2   0   0   0   0   0   0   0   1
  11.2            12    4                            1   0   0   0   0   0   0   0   2
```

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0abutment #  13
                  dblt edge                         starts at ai #  13      ends at ai #  14
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   4.1             12    4                            1   2   3   4   5   6   7   8   9
  28.1             18    5   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #  14    doublet strength matched to zero along this abutment                           *** warning **
*
                  dblt edge                         starts at ai #  14      ends at ai #  15
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   4.2             12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #  15    doublet strength matched to zero along this abutment                           *** warning **
*
                  dblt edge                         starts at ai #  15      ends at ai #  16
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   4.3             12    4   mu-match                 1   2   3   4   5   6   7   8   9
0abutment #  16
                  dblt edge                         starts at ai #  13      ends at ai #  16
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   4.4             12    4   mu-match                 1   2   3   4   5   6   7   8   9
   8.2             12    4                            1   0   0   0   0   0   0   0   2
   9.4             12    4                            2   0   0   0   0   0   0   0   1
0abutment #  17
                  dblt edge                         starts at ai #  17      ends at ai #  17
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   5.1             12    4                            1   2   3   4   5   6   7   8   9  10  11  12  13
   6.4             12    4   mu-match                13  12  11  10   9   8   7   6   5   4   3   2   1
0abutment #  18
                  dblt edge                         starts at ai #  18      ends at ai #  17
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   5.2             12    4   mu-match                 1  -2   3   4
   5.4             12    4                            4  -3   2   1
0abutment #  19
                  dblt edge                         starts at ai #  19      ends at ai #  17
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   6.1             12    4   mu-match                 1   2
   6.3             12    4                            2   1
0abutment #  20
                  dblt edge                         starts at ai #  20      ends at ai #  19
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   6.2             12    4                            1   2   3   4   5   6   7   8   9  10  11
   7.3             12    4   mu-match                11  10   9   8   7   6   5   4   3   2   1
0abutment #  21
                  dblt edge                         starts at ai #  19      ends at ai #  20
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   6.2             12    4                           11  12  13
   7.3             12    4   mu-match                13  12  11
0abutment #  22
                  dblt edge                         starts at ai #  12      ends at ai #  16
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   7.1             12    4                            1   2   3   4
   8.1             12    4   mu-match                 4   3   2   1
0abutment #  23
                  dblt edge                         starts at ai #   4      ends at ai #  12
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   7.1             12    4                            4   5   6   7
  11.1             12    4   mu-match                 4   3   2   1
0abutment #  24
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                  dblt edge                         starts at ai #   8      ends at ai #   4
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
   7.1             12    4                             7   8   9  10
  10.1             12    4   mu-match                  4   3   2   1
0abutment #  25
                  dblt edge                         starts at ai #  16      ends at ai #   8
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
   7.1             12    4                            10  11  12  13
   9.1             12    4   mu-match                  4   3   2   1
0abutment #  26
                  dblt edge                         starts at ai #  20      ends at ai #  16
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
   7.2             12    4   mu-match                  1   2   3
   7.4             12    4                             3   2   1
0abutment #  27
                  dblt edge                         starts at ai #   9      ends at ai #  13
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
   8.3             12    4                             1   2   3   4
  12.2             12    4   mu-match                 13  12  11  10
0abutment #  28
                  dblt edge                         starts at ai #  13      ends at ai #   5
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
   9.3             12    4                             1   2   3   4
  12.2             12    4   mu-match                  4   3   2   1
0abutment #  29
                  dblt edge                         starts at ai #   5      ends at ai #   1
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  10.3             12    4                             1   2   3   4
  12.2             12    4   mu-match                  7   6   5   4
0abutment #  30
                  dblt edge                         starts at ai #   1      ends at ai #   9
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  11.3             12    4                             1   2   3   4
  12.2             12    4   mu-match                 10   9   8   7
0abutment #  31
                  dblt edge                         starts at ai #  13      ends at ai #  21
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  12.1             12    4                             1   2   3
  12.3             12    4   mu-match                  3   2   1
0abutment #  32
                  dblt edge                         starts at ai #  22      ends at ai #  21
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  12.4             12    4                             1   2   3
  13.3             12    4   mu-match                  3   2   1
0abutment #  33
                  dblt edge                         starts at ai #  21      ends at ai #  22
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  12.4             12    4                             3   4   5   6   7   8   9  10  11  12  13
  13.3             12    4   mu-match                 13  12  11  10   9   8   7   6   5   4   3
0abutment #  34
                  dblt edge                         starts at ai #  24      ends at ai #  23
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  13.1             12    4                             1   2   3   4   5   6   7   8   9  10  11  12
  14.3             12    4   mu-match                 12  11  10   9   8   7   6   5   4   3   2   1
0abutment #  35
                  dblt edge                         starts at ai #  23      ends at ai #  24
  nw.edge  nw/id  type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
```

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   13.1              12    4                                     12  13
   14.3              12    4   mu-match                          13  12
 0abutment #  36
                    dblt  edge                                 starts at ai #  22      ends at ai #  23
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   13.2              12    4   mu-match                           1   2
   13.4              12    4                                      2   1
 0abutment #  37
                    dblt  edge                                 starts at ai #  26      ends at ai #  25
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   14.1              12    4                                      1   2   3   4
   21.4              12    4   mu-match                           4   3   2   1
 0abutment #  38
                    dblt  edge                                 starts at ai #  27      ends at ai #  26
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   14.1              12    4                                      4   5   6   7
   17.4              12    4   mu-match                           4   3   2   1
 0abutment #  39
                    dblt  edge                                 starts at ai #  28      ends at ai #  27
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   14.1              12    4                                      7  -8   9  10
   16.4              12    4   mu-match                           4  -3   2   1
 0abutment #  40
                    dblt  edge                                 starts at ai #  25      ends at ai #  28
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   14.1              12    4                                     10 -11  12  13
   15.4              12    4   mu-match                           4  -3   2   1
 0abutment #  41
                    dblt  edge                                 starts at ai #  24      ends at ai #  25
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   14.2              12    4                                      1   2   3   4
   14.4              12    4   mu-match                           4   3   2   1
 0abutment #  42
                    dblt  edge                                 starts at ai #  29      ends at ai #  28
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   15.1              12    4   mu-match                           1   2   3   4   5   6   7   8   9  10  11
   16.3              12    4                                     11  10   9   8   7   6   5   4   3   2   1
   19.4              12    4                                     11  10   9   8   7   6   5   4   3   2   1
 0abutment #  43
                    dblt  edge                                 starts at ai #  29      ends at ai #  30
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   15.2              12    4                                      1  -2   3   4
   23.4              12    4                                      4  -3   2   1
   32.1              18    5   mu-match                          10 -11  12  13
 0abutment #  44
                    dblt  edge                                 starts at ai #  30      ends at ai #  25
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   15.3              12    4                                      1   2   3   4   5  -6  -7   8   9 -10  11
   21.1              12    4   mu-match                          11  10   9   8   7  -6  -5   4   3  -2   1
   22.4              12    4                                      1   2   3   4   5  -6  -7   8   9 -10  11
 0abutment #  45
                    dblt  edge                                 starts at ai #  31      ends at ai #  27
   nw.edge   nw/id  type  type   matching   kutta-fl           corresponding edge points ( minus (-) indicates point moved by $eat
   16.1              12    4                                      1   2   3   4   5   6   7   8   9  10  11
   17.3              12    4   mu-match                          11  10   9   8   7   6   5   4   3   2   1
   20.4              12    4                                     11  10   9   8   7   6   5   4   3   2   1
 0abutment #  46
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                  dblt edge                               starts at ai #  31      ends at ai #  29
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   16.2            12    4                            1   2   3   4
   23.4            12    4                            7   6   5   4
   32.1            18    5   mu-match                 7   8   9  10
0abutment #  47
                  dblt edge                               starts at ai #  32      ends at ai #  26
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   17.1            12    4                            1  -2   3   4  -5  -6   7   8   9  10  11
   18.4            12    4                           11 -10   9   8  -7  -6   5   4   3   2   1
   21.3            12    4   mu-match                11 -10   9   8  -7  -6   5   4   3   2   1
0abutment #  48
                  dblt edge                               starts at ai #  32      ends at ai #  31
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   17.2            12    4                            1   2   3   4
   23.4            12    4                           10   9   8   7
   32.1            18    5   mu-match                 4   5   6   7
0abutment #  49    doublet strength matched to zero along this abutment                            ***  warning  **
*
                  dblt edge                               starts at ai #  26      ends at ai #  33
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   18.1            12    4   mu-match                 1   2   3   4   5   6   7
0abutment #  50    doublet strength matched to zero along this abutment                            ***  warning  **
*
                  dblt edge                               starts at ai #  33      ends at ai #  34
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   18.2            12    4   mu-match                 1   2   3   4   5   6   7   8   9  10  11
0abutment #  51
                  dblt edge                               starts at ai #  32      ends at ai #  34
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   18.3            12    4   vor-mtch                 1   2   3   4   5   6   7
   24.1            18    5   mu-match  vor-mtch       7   6   5   4   3   2   1
0abutment #  52    doublet strength matched to zero along this abutment                            ***  warning  **
*
                  dblt edge                               starts at ai #  28      ends at ai #  35
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   19.1            12    4   mu-match                 1   2   3   4   5   6   7
0abutment #  53    doublet strength matched to zero along this abutment                            ***  warning  **
*
                  dblt edge                               starts at ai #  35      ends at ai #  36
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   19.2            12    4   mu-match                 1   2   3   4   5   6   7   8   9  10  11
0abutment #  54
                  dblt edge                               starts at ai #  29      ends at ai #  36
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   19.3            12    4   vor-mtch                 1   2   3   4   5   6   7
   26.1            18    5   mu-match  vor-mtch       7   6   5   4   3   2   1
0abutment #  55    doublet strength matched to zero along this abutment                            ***  warning  **
*
                  dblt edge                               starts at ai #  27      ends at ai #  37
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   20.1            12    4   mu-match                 1   2   3   4   5   6   7
0abutment #  56    doublet strength matched to zero along this abutment                            ***  warning  **
*
                  dblt edge                               starts at ai #  37      ends at ai #  38
  nw.edge  nw/id  type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
   20.2            12    4   mu-match                 1   2   3   4   5   6   7   8   9  10  11
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0abutment #  57
                 dblt edge                           starts at ai #  31      ends at ai #  38
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  20.3            12    4   vor-mtch                  1   2   3   4   5   6   7
  27.1            18    5   mu-match  vor-mtch        7   6   5   4   3   2   1
0abutment #  58
                 dblt edge                           starts at ai #  30      ends at ai #  32
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  21.2            12    4                             1  -2   3   4
  23.4            12    4                            13 -12  11  10
  32.1            18    5   mu-match                  1  -2   3   4
0abutment #  59   doublet strength matched to zero along this abutment                                *** warning **
*
                 dblt edge                           starts at ai #  25      ends at ai #  39
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  22.1            12    4   mu-match                  1   2   3   4   5   6   7
0abutment #  60   doublet strength matched to zero along this abutment                                *** warning **
*
                 dblt edge                           starts at ai #  39      ends at ai #  40
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  22.2            12    4   mu-match                  1   2   3   4   5   6   7   8   9  10  11
0abutment #  61
                 dblt edge                           starts at ai #  30      ends at ai #  40
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  22.3            12    4   vor-mtch                  1   2   3   4   5   6   7
  25.1            18    5   mu-match  vor-mtch        7   6   5   4   3   2   1
0abutment #  62
                 dblt edge                           starts at ai #  41      ends at ai #  30
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  23.1            12    4   mu-match                  1   2
  23.3            12    4                             2   1
0abutment #  63   wake side edge left unabutted                                                        *** warning **
*
                 dblt edge                           starts at ai #  34      ends at ai #  42
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  24.2            18    2                             1   2
0abutment #  64   wake trailing edge unabutted.  wake filaments will be added                  *** gentle reminder **
*
                 dblt edge                           starts at ai #  42      ends at ai #  43
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  24.3            18    2                             1   2   3   4   5   6   7
0abutment #  65   wake side edge left unabutted                                                        *** warning **
*
                 dblt edge                           starts at ai #  43      ends at ai #  32
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  24.4            18    2                             1   2
0abutment #  66   wake side edge left unabutted                                                        *** warning **
*
                 dblt edge                           starts at ai #  40      ends at ai #  44
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  25.2            18    2                             1   2
0abutment #  67   wake trailing edge unabutted.  wake filaments will be added                  *** gentle reminder **
*
                 dblt edge                           starts at ai #  44      ends at ai #  45
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  25.3            18    2                             1   2   3   4   5   6   7
0abutment #  68
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                   dblt edge                         starts at ai #  45      ends at ai #  30
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  25.4              18    2                            1   2
  32.2              18    2                            2   1
  32.4              18    2                            1   2
0abutment #  69     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #  36      ends at ai #  46
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  26.2              18    2                            1   2
0abutment #  70     wake trailing edge unabutted.   wake filaments will be added                        *** gentle reminder **
*
                   dblt edge                         starts at ai #  46      ends at ai #  47
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  26.3              18    2                            1   2   3   4   5   6   7
0abutment #  71     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #  47      ends at ai #  29
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  26.4              18    2                            1   2
0abutment #  72     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #  38      ends at ai #  48
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  27.2              18    2                            1   2
0abutment #  73     wake trailing edge unabutted.   wake filaments will be added                        *** gentle reminder **
*
                   dblt edge                         starts at ai #  48      ends at ai #  49
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  27.3              18    2                            1   2   3   4   5   6   7
0abutment #  74     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #  49      ends at ai #  31
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  27.4              18    2                            1   2
0abutment #  75     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #  14      ends at ai #  50
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  28.2              18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  76     wake trailing edge unabutted.   wake filaments will be added                        *** gentle reminder **
*
                   dblt edge                         starts at ai #  50      ends at ai #  51
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  28.3              18    2                            1   2   3   4   5   6   7   8   9
0abutment #  77     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #  51      ends at ai #  13
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  28.4              18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  78     wake side edge left unabutted                                                          ***  warning  **
*
                   dblt edge                         starts at ai #   6      ends at ai #  52
  nw.edge  nw/id   type type  matching  kutta-fl     corresponding edge points ( minus (-) indicates point moved by $eat
  29.2              18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  79     wake trailing edge unabutted.   wake filaments will be added                        *** gentle reminder **
*
```

```
                 dblt edge                        starts at ai #  52      ends at ai #  53
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  29.3            18    2                            1   2   3   4   5   6   7   8   9
0abutment #  80    wake side edge left unabutted                                                        ***  warning  **
*
                 dblt edge                        starts at ai #  53      ends at ai #   5
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  29.4            18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  81    wake side edge left unabutted                                                        ***  warning  **
*
                 dblt edge                        starts at ai #   2      ends at ai #  54
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  30.2            18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  82    wake trailing edge unabutted.  wake filaments will be added                      *** gentle reminder **
*
                 dblt edge                        starts at ai #  54      ends at ai #  55
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  30.3            18    2                            1   2   3   4   5   6   7   8   9
0abutment #  83    wake side edge left unabutted                                                        ***  warning  **
*
                 dblt edge                        starts at ai #  55      ends at ai #   1
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  30.4            18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  84    wake side edge left unabutted                                                        ***  warning  **
*
                 dblt edge                        starts at ai #  10      ends at ai #  56
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  31.2            18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  85    wake trailing edge unabutted.  wake filaments will be added                      *** gentle reminder **
*
                 dblt edge                        starts at ai #  56      ends at ai #  57
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  31.3            18    2                            1   2   3   4   5   6   7   8   9
0abutment #  86    wake side edge left unabutted                                                        ***  warning  **
*
                 dblt edge                        starts at ai #  57      ends at ai #   9
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  31.4            18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
0abutment #  87    wake trailing edge unabutted.  wake filaments will be added                      *** gentle reminder **
*
                 dblt edge                        starts at ai #  45      ends at ai #  45
  nw.edge  nw/id type type  matching  kutta-fl    corresponding edge points ( minus (-) indicates point moved by $eat
  32.3            18    2                            1   2   3   4   5   6   7   8   9  10  11  12  13
0*e*abutment
0*b*nwedgmov
1          *****  movement of network edge points  *****
  nw.edge       motion
  dz(max)        dz(i)


   5.2       ** .lt. eps **      tolerance =   0.1911E-02
   0.50E-03    0.000000    0.000500    0.000000    0.000000
   1 orig x    8.499000    2.498000    0.482000    0.000000
          y    0.000000    0.000000    0.000000    0.000000
          z    3.999000    3.565000    1.853000    0.000000
    moved x    8.499000    2.498000    0.482000    0.000000
          y    0.000000    0.000000    0.000000    0.000000
```

APPENDIX C. GBU-24 OUTPUT FILE (UNIT NORMALS)


```
  nwltrf/in             9
        1.        24          25          26          27          28          29          30          31          32



  =====  summary of networks for trefftz plane analysis  =====

    nw   network-id
   ---   ----------
 nwltrf/out             9
        1.        24          25          26          27          28          29          30          31          32

   24
   25
   26
   27
   28
   29
   30
   31
   32

   t/abtidn     2.099325
 abtcal/anl     0.000034
0*e*libgeoab
0 control points for network :   1
    jc  jc/naive          zc                                 znc                        nw panel.sp jzc ifn jfn izdc abut fseg  ta
u
     1    1   45.090395   3.246673   -2.414971   0.000000   0.641888   0.766799    1     1.1    1   1   1    1    1    1 0.0
000
     2    2   43.834818   3.232000   -2.402644   0.000149   0.641734   0.766927    1     1.8    2   2   1    4    4    4 0.9
375
     3    3   41.158462   3.232000   -2.402625   0.000000   0.641588   0.767049    1     2.8    3   4   1    4    4    4 0.8
125
     4    4   38.481511   3.232000   -2.402625   0.000000   0.641588   0.767049    1     3.8    4   6   1    4    4    4 0.6
875
     5    5   35.804544   3.232000   -2.402580   0.000149   0.641392   0.767213    1     4.8    5   8   1    4    4    4 0.5
625
     6    6   33.127182   3.232000   -2.402562   0.000000   0.641288   0.767301    1     5.8    6  10   1    4    4    4 0.4
375
     7    7   30.449590   3.232000   -2.402562   0.000000   0.641288   0.767301    1     6.8    7  12   1    4    4    4 0.3
125
     8    8   27.771476   3.232000   -2.402515   0.000149   0.641050   0.767499    1     7.8    8  14   1    4    4    4 0.1
875
     9    9   25.093237   3.230462   -2.401216   0.000000   0.640987   0.767552    1     8.8    9  16   1    4    4    4 0.0
625
    10   10   24.013415   3.231929   -2.402441   0.000000   0.640987   0.767552    1     8.4   10  17   1    5    3    3 1.0
000
    11   11   45.085496   3.858495   -2.927114   0.000149   0.641734   0.766927    1     1.5   11   1   2   -1    0    1 0.0
625
    12   12   43.930127   3.885736   -2.949683   0.000149   0.641734   0.766927    1     1.5   12   2   2    0    0    0 0.0
000
    13   13   41.359743   3.885756   -2.949450   0.000000   0.641588   0.767049    1     2.5   13   4   2    0    0    0 0.0
000
    14   14   38.789418   3.885803   -2.949489   0.000000   0.641588   0.767049    1     3.5   14   6   2    0    0    0 0.0
000
    15   15   36.219655   3.885870   -2.949298   0.000149   0.641392   0.767213    1     4.5   15   8   2    0    0    0 0.0
```

APPENDIX D. GBU-24 OUTPUT FILE (SOLUTION DATA)

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```
    pic counts                                panel/source  panel/doublet   block/source  block/doublet

    no influence                                      0             0              0              0
    monopole far field                           140654        614894              0              0
    dipole far field                              68550        341612              0              0
    quadrupole far field                          35875        148773              0              0
    one sub-panel intermediate field              32254        120038              0              0
    two sub-panel intermediate field              25193        141840              0              0
    eight sub-panel near field                     1890          6943              0              0



                    influence coefficient generation i/o count
   ncalg=        0   nwrdg=          0   ncalt=        0   nwrdt=           0
    n56chg:          4
        1.          0       16313      112589       16313

0logical flags for cp/2 iteration:
        F = bkprnt, print flag for solver statistics
  wopen call on unit   19  blocks:   100   status:     0
0
                ***********************************
                *                                 *
                *       condition indicators      *
                *                                 *
                *  uniform solution 0.257794E-12  *
                *                                 *
                ***********************************
1
0*b*solution
                                                  simultaneous solution number    1


 mach number =   0.80000    angle of attack =   2.00000    sideslip angle =   0.00000    freestream speed =   1.00000
 compressibility factor =   0.60000   compressibility angle of attack =   2.00000   compressibility angle of sideslip =   0.000
00
 freestream velocity = (   0.99939,   0.00000,   0.03490)    compressibility direction = (   0.99939,   0.00000,   0.03490)
1
    network id:          index:   1    source type =  0    doublet type = 12      number rows =   8    number columns =   8

  jc   ip        x          y          z          d0         dx          dy          dz          s0         anx         any         a
nz
  lmachu        wxu        wyu        wzu        pheu       vxu         vyu         vzu         cplinu      cpslnu      cp2ndu      cpi
snu
  lmachl        wxl        wyl        wzl        phel       vxl         vyl         vzl         cplinl      cpslnl      cp2ndl      cpi
snl
     wnu        wnl        pwnu       pwnl       vtu        vtl         pvtu        pvtl        cplind      cpslnd      cp2ndd      cpi
snd

   12     1   43.9301     3.8857    -2.9497     0.4701    -0.0365      0.1604     -0.1352      0.0000      0.0000      0.0196      0
.0234
     0.7580     0.9818     0.0789    -0.0662    -0.6205     0.9443      0.0789     -0.0675      0.1172      0.1009      0.0997      0
```

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.0990												
	0.7889	0.9920	-0.0815	0.0680	-1.0905	0.9809	-0.0815	0.0676	0.0348	0.0270	0.0269	0
.0268												
	0.0000	0.0000	-0.0269	-0.0269	0.9500	0.9866	0.1377	0.0856	0.0825	0.0739	0.0728	0
.0722												
13	2	41.3597	3.8858	-2.9495	0.5707	-0.0349	0.0896	-0.0757	0.0000	0.0000	0.0196	0
.0234												
	0.7630	0.9851	0.0430	-0.0360	-0.4911	0.9554	0.0430	-0.0370	0.0930	0.0862	0.0854	0
.0851												
	0.7932	0.9960	-0.0465	0.0389	-1.0617	0.9903	-0.0465	0.0387	0.0179	0.0157	0.0157	0
.0157												
	0.0000	0.0000	-0.0268	-0.0268	0.9571	0.9921	0.0905	0.0392	0.0750	0.0704	0.0697	0
.0694												
14	3	38.7894	3.8858	-2.9495	0.6353	-0.0168	0.0389	-0.0330	0.0000	0.0000	0.0196	0
.0234												
	0.7731	0.9896	0.0174	-0.0145	-0.3976	0.9691	0.0174	-0.0152	0.0641	0.0614	0.0610	0
.0609												
	0.7878	0.9949	-0.0216	0.0181	-1.0330	0.9859	-0.0216	0.0177	0.0281	0.0274	0.0273	0
.0273												
	0.0000	0.0000	-0.0268	-0.0268	0.9694	0.9863	0.0546	0.0146	0.0359	0.0340	0.0337	0
.0336												
15	4	36.2197	3.8859	-2.9493	0.6558	0.0012	0.0043	-0.0036	0.0000	0.0000	0.0196	0
.0234												
	0.7824	0.9932	-0.0004	0.0002	-0.3345	0.9801	-0.0004	-0.0003	0.0410	0.0398	0.0397	0
.0396												
	0.7814	0.9927	-0.0048	0.0038	-0.9903	0.9790	-0.0048	0.0033	0.0431	0.0421	0.0419	0
.0419												
	0.0000	0.0000	-0.0269	-0.0269	0.9801	0.9790	0.0294	0.0263	-0.0021	-0.0023	-0.0023	-0
.0023												
16	5	33.6500	3.8860	-2.9491	0.6287	0.0201	-0.0166	0.0143	0.0000	0.0000	0.0196	0
.0234												
	0.7916	0.9967	-0.0114	0.0095	-0.2984	0.9905	-0.0114	0.0093	0.0196	0.0189	0.0188	0
.0188												
	0.7739	0.9898	0.0051	-0.0043	-0.9271	0.9704	0.0051	-0.0050	0.0608	0.0592	0.0589	0
.0589												
	0.0000	0.0000	-0.0268	-0.0268	0.9906	0.9704	0.0118	0.0414	-0.0411	-0.0404	-0.0401	-0
.0400												
17	6	31.0801	3.8861	-2.9492	0.5518	0.0400	-0.0253	0.0220	0.0000	0.0000	0.0196	0
.0234												
	0.8008	1.0003	-0.0168	0.0140	-0.2883	1.0005	-0.0168	0.0140	-0.0008	-0.0015	-0.0015	-0
.0015												
	0.7654	0.9863	0.0085	-0.0071	-0.8401	0.9606	0.0085	-0.0080	0.0806	0.0788	0.0782	0
.0782												
	0.0000	0.0000	-0.0268	-0.0268	1.0007	0.9606	0.0012	0.0516	-0.0814	-0.0803	-0.0797	-0
.0797												
18	7	28.5100	3.8862	-2.9490	0.4202	0.0661	-0.0279	0.0248	0.0000	0.0000	0.0196	0
.0234												
	0.8131	1.0051	-0.0197	0.0162	-0.3060	1.0140	-0.0197	0.0166	-0.0280	-0.0287	-0.0288	-0
.0288												
	0.7545	0.9818	0.0082	-0.0070	-0.7263	0.9479	0.0082	-0.0082	0.1060	0.1042	0.1032	0
.1031												

```
     0.0000     0.0000    -0.0269    -0.0269     1.0143     0.9479     0.0150     0.0617    -0.1339    -0.1329    -0.1320    -0
.1318

   19      8    25.9399     3.8863    -2.9489     0.2091     0.1259    -0.0564     0.0500     0.0000     0.0000     0.0195     0
.0234
     0.8428     1.0159    -0.0363     0.0303    -0.3655     1.0449    -0.0363     0.0313    -0.0908    -0.0921    -0.0929    -0
.0928
     0.7307     0.9716     0.0201    -0.0168    -0.5745     0.9190     0.0201    -0.0186     0.1644     0.1614     0.1589     0
.1585
     0.0000     0.0000    -0.0268    -0.0268     1.0460     0.9194     0.0522     0.0945    -0.2551    -0.2535    -0.2518    -0
.2513

   22      9    43.9956     5.3899    -4.2081     0.6121    -0.0103     0.0309    -0.0261     0.0000     0.0000     0.0178     0
.0212
     0.7641     0.9858     0.0114    -0.0099    -0.5134     0.9589     0.0114    -0.0109     0.0841     0.0820     0.0813     0
.0812
     0.7731     0.9890    -0.0195     0.0159    -1.1255     0.9693    -0.0195     0.0152     0.0616     0.0609     0.0605     0
.0605
     0.0000     0.0000    -0.0271    -0.0271     0.9591     0.9696     0.0555     0.0302     0.0225     0.0211     0.0208     0
.0207

   23     10    41.6628     5.3899    -4.2076     0.6418    -0.0113     0.0155    -0.0132     0.0000     0.0000     0.0178     0
.0212
     0.7708     0.9885     0.0025    -0.0021    -0.4271     0.9668     0.0025    -0.0028     0.0678     0.0664     0.0660     0
.0660
     0.7807     0.9923    -0.0130     0.0109    -1.0689     0.9781    -0.0130     0.0104     0.0442     0.0435     0.0433     0
.0433
     0.0000     0.0000    -0.0268    -0.0268     0.9668     0.9783     0.0418     0.0220     0.0236     0.0230     0.0227     0
.0227
1
   network id:            index:   1    source type =  0    doublet type = 12     number rows =   8   number columns =   8

  jc   ip          x          y          z         d0         dx         dy         dz         s0        anx        any          a
nz
  lmachu         wxu        wyu        wzu       pheu        vxu        vyu        vzu     cplinu     cpslnu     cp2ndu        cpi
snu
  lmachl         wxl        wyl        wzl       phel        vxl        vyl        vzl     cplinl     cpslnl     cp2ndl        cpi
snl
     wnu         wnl       pwnu       pwnl        vtu        vtl       pvtu       pvtl     cplind     cpslnd     cp2ndd        cpi
snd

   24     11    39.3297     5.3900    -4.2074     0.6593    -0.0025     0.0030    -0.0026     0.0000     0.0000     0.0178     0
.0212
     0.7787     0.9917    -0.0043     0.0034    -0.3620     0.9760    -0.0043     0.0028     0.0490     0.0480     0.0478     0
.0478
     0.7810     0.9925    -0.0073     0.0059    -1.0213     0.9785    -0.0073     0.0054     0.0438     0.0429     0.0427     0
.0427
     0.0000     0.0000    -0.0269    -0.0269     0.9760     0.9786     0.0291     0.0247     0.0053     0.0052     0.0051     0
.0051

   25     12    36.9972     5.3901    -4.2069     0.6518     0.0096    -0.0072     0.0063     0.0000     0.0000     0.0178     0
.0212
     0.7863     0.9946    -0.0095     0.0077    -0.3185     0.9844    -0.0095     0.0073     0.0318     0.0310     0.0309     0
.0309
     0.7778     0.9913    -0.0022     0.0017    -0.9703     0.9749    -0.0022     0.0011     0.0514     0.0503     0.0500     0
.0500
     0.0000     0.0000    -0.0269    -0.0269     0.9845     0.9749     0.0182     0.0316    -0.0196    -0.0193    -0.0192    -0
```

```
.0191

  26     13    34.6651    5.3901   -4.2065    0.6136    0.0236   -0.0160    0.0139    0.0000    0.0000    0.0178    0
.0212
    0.7937    0.9975   -0.0143    0.0117   -0.2934    0.9928   -0.0143    0.0116    0.0149    0.0141    0.0141    0
.0141
    0.7728    0.9893    0.0017   -0.0016   -0.9070    0.9692    0.0017   -0.0023    0.0630    0.0617    0.0613    0
.0613
    0.0000    0.0000   -0.0269   -0.0269    0.9929    0.9692    0.0077    0.0393   -0.0481   -0.0475   -0.0472   -0
.0472

  27     14    32.3324    5.3902   -4.2061    0.5403    0.0398   -0.0247    0.0216    0.0000    0.0000    0.0177    0
.0212
    0.8018    1.0006   -0.0194    0.0160   -0.2881    1.0016   -0.0194    0.0160   -0.0031   -0.0038   -0.0038   -0
.0038
    0.7665    0.9867    0.0053   -0.0047   -0.8284    0.9618    0.0053   -0.0055    0.0780    0.0764    0.0759    0
.0758
    0.0000    0.0000   -0.0269   -0.0269    1.0019    0.9618    0.0036    0.0481   -0.0810   -0.0802   -0.0797   -0
.0796

  28     15    29.9996    5.3903   -4.2057    0.4231    0.0656   -0.0397    0.0347    0.0000    0.0000    0.0177    0
.0212
    0.8146    1.0054   -0.0279    0.0231   -0.3068    1.0152   -0.0279    0.0234   -0.0308   -0.0317   -0.0318   -0
.0318
    0.7561    0.9825    0.0119   -0.0101   -0.7299    0.9496    0.0119   -0.0113    0.1027    0.1006    0.0996    0
.0995
    0.0000    0.0000   -0.0270   -0.0270    1.0159    0.9498    0.0211    0.0630   -0.1335   -0.1323   -0.1314   -0
.1313

  29     16    27.6671    5.3902   -4.2053    0.2271    0.1435   -0.0939    0.0817    0.0000    0.0000    0.0177    0
.0212
    0.8544    1.0192   -0.0565    0.0472   -0.3662    1.0551   -0.0565    0.0485   -0.1124   -0.1157   -0.1169   -0
.1166
    0.7257    0.9693    0.0373   -0.0312   -0.5933    0.9116    0.0373   -0.0333    0.1801    0.1745    0.1716    0
.1709
    0.0000    0.0000   -0.0268   -0.0268    1.0578    0.9130    0.0763    0.1137   -0.2925   -0.2902   -0.2884   -0
.2875

  32     17    44.0611    6.8941   -5.4668    0.6451   -0.0028    0.0028   -0.0024    0.0000    0.0000    0.0160    0
.0191
    0.7693    0.9878   -0.0034    0.0023   -0.4654    0.9651   -0.0034    0.0016    0.0708    0.0697    0.0693    0
.0692
    0.7717    0.9887   -0.0062    0.0047   -1.1105    0.9679   -0.0062    0.0040    0.0651    0.0641    0.0638    0
.0637
    0.0000    0.0000   -0.0271   -0.0271    0.9652    0.9679    0.0391    0.0349    0.0057    0.0056    0.0055    0
.0055

  33     18    41.9658    6.8941   -5.4660    0.6518   -0.0021   -0.0022    0.0018    0.0000    0.0000    0.0160    0
.0191
    0.7750    0.9901   -0.0073    0.0058   -0.4002    0.9717   -0.0073    0.0052    0.0574    0.0565    0.0562    0
.0562
    0.7768    0.9909   -0.0050    0.0040   -1.0521    0.9738   -0.0050    0.0034    0.0534    0.0524    0.0521    0
.0521
    0.0000    0.0000   -0.0269   -0.0269    0.9717    0.9738    0.0308    0.0304    0.0041    0.0041    0.0041    0
.0041

  34     19    39.8703    6.8942   -5.4653    0.6513    0.0039   -0.0078    0.0066    0.0000    0.0000    0.0160    0
```

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.0191
      0.7814     0.9926    -0.0109     0.0086    -0.3496     0.9789    -0.0109     0.0082     0.0428     0.0420     0.0418      0
.0418
      0.7779     0.9913    -0.0031     0.0021    -1.0010     0.9750    -0.0031     0.0016     0.0511     0.0500     0.0498      0
.0498
      0.0000     0.0000    -0.0271    -0.0271     0.9790     0.9750     0.0223     0.0309    -0.0083    -0.0081    -0.0080     -0
.0080

   35     20    37.7751     6.8943    -5.4646     0.6334     0.0137    -0.0133     0.0115     0.0000     0.0000     0.0159      0
.0191
      0.7881     0.9952    -0.0140     0.0115    -0.3148     0.9864    -0.0140     0.0112     0.0275     0.0268     0.0267      0
.0267
      0.7759     0.9906    -0.0007     0.0004    -0.9483     0.9728    -0.0007    -0.0003     0.0557     0.0545     0.0542      0
.0542
      0.0000     0.0000    -0.0270    -0.0270     0.9866     0.9728     0.0137     0.0345    -0.0281    -0.0277    -0.0275     -0
.0275
1
    network id:          index:   1   source type =  0   doublet type = 12     number rows =   8   number columns =   8

  jc   ip         x          y          z         d0         dx         dy         dz         s0        anx        any      a
nz
  lmachu         wxu        wyu        wzu        pheu       vxu        vyu        vzu       cplinu     cpslnu     cp2ndu    cpi
snu
  lmachl         wxl        wyl        wzl        phel       vxl        vyl        vzl       cplinl     cpslnl     cp2ndl    cpi
snl
     wnu         wnl        pwnu       pwnl       vtu        vtl        pvtu       pvtl      cplind     cpslnd     cp2ndd    cpi
snd

   36     21    35.6799     6.8943    -5.4639     0.5927     0.0260    -0.0197     0.0170     0.0000     0.0000     0.0159      0
.0191
      0.7952     0.9980    -0.0179     0.0144    -0.2957     0.9943    -0.0179     0.0143     0.0117     0.0109     0.0109      0
.0109
      0.7720     0.9890     0.0018    -0.0020    -0.8884     0.9683     0.0018    -0.0027     0.0648     0.0635     0.0631      0
.0631
      0.0000     0.0000    -0.0271    -0.0271     0.9945     0.9683     0.0051     0.0402    -0.0532    -0.0526    -0.0522     -0
.0522

   37     22    33.5845     6.8944    -5.4630     0.5225     0.0419    -0.0284     0.0247     0.0000     0.0000     0.0159      0
.0191
      0.8034     1.0011    -0.0229     0.0186    -0.2942     1.0033    -0.0229     0.0187    -0.0066    -0.0074    -0.0074     -0
.0074
      0.7661     0.9866     0.0055    -0.0051    -0.8167     0.9614     0.0055    -0.0060     0.0788     0.0772     0.0766      0
.0766
      0.0000     0.0000    -0.0271    -0.0271     1.0037     0.9614     0.0081     0.0487    -0.0854    -0.0846    -0.0840     -0
.0839

   38     23    31.4892     6.8943    -5.4624     0.4118     0.0690    -0.0454     0.0395     0.0000     0.0000     0.0159      0
.0191
      0.8171     1.0062    -0.0320     0.0267    -0.3148     1.0177    -0.0320     0.0271    -0.0360    -0.0371    -0.0373     -0
.0372
      0.7554     0.9822     0.0133    -0.0112    -0.7266     0.9487     0.0133    -0.0124     0.1046     0.1023     0.1013      0
.1012
      0.0000     0.0000    -0.0268    -0.0268     1.0186     0.9489     0.0268     0.0649    -0.1406    -0.1394    -0.1386     -0
.1384

   39     24    29.3942     6.8939    -5.4617     0.2250     0.1566    -0.1066     0.0926     0.0000     0.0000     0.0159      0
.0191
```

	0.8624	1.0217	-0.0639	0.0531	-0.3754	1.0626	-0.0639	0.0545	-0.1277	-0.1320	-0.1335	-0
.1332												
	0.7214	0.9673	0.0427	-0.0359	-0.6004	0.9059	0.0427	-0.0380	0.1919	0.1852	0.1819	0
.1810												
	0.0000	0.0000	-0.0270	-0.0270	1.0659	0.9077	0.0883	0.1227	-0.3195	-0.3172	-0.3154	-0
.3142												
42	25	44.1269	8.3988	-6.7254	0.6354	0.0002	-0.0095	0.0080	0.0000	0.0000	0.0142	0
.0169												
	0.7726	0.9890	-0.0100	0.0078	-0.4399	0.9689	-0.0100	0.0071	0.0628	0.0620	0.0616	0
.0616												
	0.7725	0.9891	-0.0005	-0.0002	-1.0752	0.9688	-0.0005	-0.0009	0.0637	0.0625	0.0621	0
.0621												
	0.0000	0.0000	-0.0272	-0.0272	0.9690	0.9688	0.0321	0.0380	-0.0009	-0.0005	-0.0005	-0
.0005												
43	26	42.2688	8.3986	-6.7242	0.6339	0.0024	-0.0117	0.0098	0.0000	0.0000	0.0141	0
.0169												
	0.7777	0.9910	-0.0125	0.0099	-0.3885	0.9747	-0.0125	0.0093	0.0512	0.0504	0.0502	0
.0501												
	0.7756	0.9904	-0.0008	0.0001	-1.0224	0.9723	-0.0008	-0.0005	0.0566	0.0554	0.0551	0
.0551												
	0.0000	0.0000	-0.0272	-0.0272	0.9748	0.9723	0.0256	0.0349	-0.0054	-0.0050	-0.0049	-0
.0049												
44	27	40.4108	8.3984	-6.7230	0.6254	0.0075	-0.0148	0.0126	0.0000	0.0000	0.0141	0
.0169												
	0.7831	0.9932	-0.0150	0.0120	-0.3482	0.9808	-0.0150	0.0116	0.0388	0.0381	0.0380	0
.0379												
	0.7764	0.9908	-0.0002	-0.0004	-0.9737	0.9733	-0.0002	-0.0010	0.0547	0.0535	0.0533	0
.0532												
	0.0000	0.0000	-0.0272	-0.0272	0.9810	0.9733	0.0189	0.0347	-0.0159	-0.0154	-0.0153	-0
.0153												
45	28	38.5529	8.3985	-6.7221	0.6045	0.0161	-0.0183	0.0156	0.0000	0.0000	0.0141	0
.0169												
	0.7892	0.9956	-0.0174	0.0140	-0.3198	0.9876	-0.0174	0.0137	0.0251	0.0244	0.0243	0
.0243												
	0.7748	0.9901	0.0009	-0.0013	-0.9243	0.9715	0.0009	-0.0019	0.0584	0.0571	0.0568	0
.0567												
	0.0000	0.0000	-0.0272	-0.0272	0.9878	0.9715	0.0118	0.0370	-0.0332	-0.0327	-0.0324	-0
.0324												
46	29	36.6947	8.3986	-6.7211	0.5641	0.0281	-0.0236	0.0203	0.0000	0.0000	0.0141	0
.0169												
	0.7962	0.9983	-0.0206	0.0167	-0.3050	0.9954	-0.0206	0.0166	0.0093	0.0086	0.0086	0
.0086												
	0.7711	0.9887	0.0029	-0.0030	-0.8690	0.9672	0.0029	-0.0037	0.0670	0.0656	0.0652	0
.0651												
	0.0000	0.0000	-0.0272	-0.0272	0.9957	0.9672	0.0057	0.0420	-0.0576	-0.0570	-0.0566	-0
.0565												
47	30	34.8366	8.3984	-6.7200	0.4978	0.0443	-0.0322	0.0279	0.0000	0.0000	0.0141	0
.0169												
	0.8049	1.0016	-0.0256	0.0208	-0.3059	1.0048	-0.0256	0.0209	-0.0098	-0.0106	-0.0106	-0
.0106												
	0.7653	0.9863	0.0066	-0.0061	-0.8037	0.9604	0.0066	-0.0070	0.0808	0.0791	0.0785	0

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.0784
      0.0000     0.0000    -0.0272    -0.0272     1.0053     0.9605     0.0120     0.0503    -0.0905    -0.0897    -0.0891    -0
.0891
1
    network id:            index:   1   source type =  0    doublet type = 12     number rows =   8   number columns =   8

  jc   ip          x          y          z          d0         dx         dy         dz         s0         anx        any          a
nz
  lmachu          wxu        wyu        wzu        pheu       vxu        vyu        vzu        cplinu     cpslnu     cp2ndu      cpi
snu
  lmachl          wxl        wyl        wzl        phel       vxl        vyl        vzl        cplinl     cpslnl     cp2ndl      cpi
snl
     wnu          wnl        pwnu       pwnl       vtu        vtl        pvtu       pvtl       cplind     cpslnd     cp2ndd      cpi
snd

   48    31    32.9791     8.3980    -6.7188     0.3938     0.0734    -0.0501     0.0435     0.0000     0.0000     0.0141      0
.0169
      0.8197     1.0071    -0.0352     0.0291    -0.3278     1.0203    -0.0352     0.0295    -0.0415    -0.0428    -0.0429     -0
.0429
      0.7540     0.9816     0.0149    -0.0128    -0.7216     0.9469     0.0149    -0.0140     0.1082     0.1058     0.1047      0
.1046
      0.0000     0.0000    -0.0270    -0.0270     1.0214     0.9472     0.0315     0.0677    -0.1497    -0.1486    -0.1477     -0
.1475

   49    32    31.1216     8.3979    -6.7179     0.2164     0.1693    -0.1168     0.1013     0.0000     0.0000     0.0141      0
.0169
      0.8697     1.0241    -0.0695     0.0574    -0.3883     1.0693    -0.0695     0.0590    -0.1415    -0.1468    -0.1486     -0
.1481
      0.7171     0.9653     0.0473    -0.0400    -0.6047     0.9000     0.0473    -0.0423     0.2040     0.1963     0.1926      0
.1915
      0.0000     0.0000    -0.0272    -0.0272     1.0732     0.9023     0.0981     0.1312    -0.3455    -0.3431    -0.3411     -0
.3396

   52    33    44.1925     9.9036    -7.9837     0.5979     0.0014    -0.0196     0.0165     0.0000     0.0000     0.0123      0
.0148
      0.7754     0.9900    -0.0154     0.0123    -0.4289     0.9720    -0.0154     0.0116     0.0564     0.0557     0.0554      0
.0554
      0.7741     0.9899     0.0042    -0.0041    -1.0269     0.9705     0.0042    -0.0048     0.0604     0.0589     0.0586      0
.0585
      0.0000     0.0000    -0.0272    -0.0272     0.9722     0.9706     0.0276     0.0407    -0.0040    -0.0032    -0.0032     -0
.0032

   53    34    42.5718     9.9034    -7.9822     0.5938     0.0046    -0.0206     0.0173     0.0000     0.0000     0.0123      0
.0148
      0.7797     0.9918    -0.0174     0.0136    -0.3883     0.9769    -0.0174     0.0131     0.0465     0.0457     0.0455      0
.0455
      0.7756     0.9905     0.0032    -0.0036    -0.9821     0.9723     0.0032    -0.0043     0.0568     0.0553     0.0550      0
.0550
      0.0000     0.0000    -0.0275    -0.0275     0.9772     0.9724     0.0225     0.0386    -0.0103    -0.0096    -0.0095     -0
.0095

   54    35    40.9511     9.9029    -7.9807     0.5827     0.0091    -0.0221     0.0187     0.0000     0.0000     0.0123      0
.0148
      0.7842     0.9935    -0.0189     0.0154    -0.3562     0.9820    -0.0189     0.0150     0.0362     0.0355     0.0354      0
.0354
      0.7761     0.9907     0.0033    -0.0031    -0.9389     0.9729     0.0033    -0.0037     0.0557     0.0543     0.0540      0
.0540
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      0.0000      0.0000     -0.0271     -0.0271      0.9822      0.9729      0.0175      0.0380     -0.0195     -0.0188     -0.0186     -0
.0186

    55    36     39.3304      9.9027     -7.9795      0.5632      0.0167     -0.0239      0.0204      0.0000      0.0000      0.0123      0
.0148
      0.7896      0.9957     -0.0208      0.0164     -0.3323      0.9879     -0.0208      0.0162      0.0242      0.0234      0.0234      0
.0234
      0.7747      0.9901      0.0031     -0.0035     -0.8956      0.9713      0.0031     -0.0042      0.0589      0.0575      0.0571      0
.0571
      0.0000      0.0000     -0.0275     -0.0275      0.9883      0.9713      0.0121      0.0393     -0.0347     -0.0340     -0.0338     -0
.0337

    56    37     37.7098      9.9028     -7.9781      0.5269      0.0293     -0.0281      0.0241      0.0000      0.0000      0.0123      0
.0148
      0.7969      0.9985     -0.0235      0.0187     -0.3200      0.9960     -0.0235      0.0186      0.0080      0.0071      0.0071      0
.0071
      0.7707      0.9885      0.0046     -0.0047     -0.8469      0.9667      0.0046     -0.0055      0.0682      0.0667      0.0662      0
.0662
      0.0000      0.0000     -0.0275     -0.0275      0.9964      0.9667      0.0083      0.0440     -0.0603     -0.0595     -0.0591     -0
.0591

    57    38     36.0892      9.9027     -7.9767      0.4661      0.0467     -0.0362      0.0313      0.0000      0.0000      0.0123      0
.0148
      0.8062      1.0021     -0.0281      0.0228     -0.3224      1.0060     -0.0281      0.0229     -0.0124     -0.0134     -0.0134     -0
.0134
      0.7644      0.9859      0.0082     -0.0075     -0.7885      0.9593      0.0082     -0.0084      0.0831      0.0812      0.0806      0
.0805
      0.0000      0.0000     -0.0273     -0.0273      1.0067      0.9594      0.0154      0.0525     -0.0955     -0.0946     -0.0940     -0
.0939

    58    39     34.4689      9.9023     -7.9753      0.3703      0.0782     -0.0549      0.0476      0.0000      0.0000      0.0123      0
.0148
      0.8222      1.0079     -0.0380      0.0311     -0.3443      1.0229     -0.0380      0.0316     -0.0467     -0.0482     -0.0484     -0
.0484
      0.7521      0.9808      0.0169     -0.0148     -0.7146      0.9447      0.0169     -0.0160      0.1128      0.1101      0.1090      0
.1088
      0.0000      0.0000     -0.0273     -0.0273      1.0241      0.9450      0.0359      0.0712     -0.1595     -0.1583     -0.1574     -0
.1571

    59    40     32.8484      9.9021     -7.9739      0.2042      0.1828     -0.1270      0.1100      0.0000      0.0000      0.0123      0
.0148
      0.8773      1.0265     -0.0749      0.0615     -0.4030      1.0762     -0.0749      0.0632     -0.1555     -0.1618     -0.1640     -0
.1634
      0.7122      0.9630      0.0522     -0.0444     -0.6072      0.8934      0.0522     -0.0468      0.2175      0.2087      0.2045      0
.2032
      0.0000      0.0000     -0.0275     -0.0275      1.0807      0.8962      0.1078      0.1406     -0.3731     -0.3705     -0.3684     -0
.3666
1
   network id:          index:   1    source type =  0    doublet type = 12      number rows =   8    number columns =   8

  jc   ip          x           y           z          d0          dx          dy          dz          s0         anx         any          a
nz
  lmachu         wxu         wyu         wzu        pheu         vxu         vyu         vzu      cplinu      cpslnu      cp2ndu        cpi
snu
  lmachl         wxl         wyl         wzl        phel         vxl         vyl         vzl      cplinl      cpslnl      cp2ndl        cpi
snl
     wnu         wnl        pwnu        pwnl         vtu         vtl        pvtu        pvtl      cplind      cpslnd      cp2ndd        cpi
```

```
snd

  62      41     44.2579    11.4079    -9.2422     0.5332     0.0019    -0.0316     0.0265     0.0000     0.0000     0.0105     0
.0126
     0.7779     0.9909    -0.0220     0.0173    -0.4324     0.9746    -0.0220     0.0168     0.0508     0.0500     0.0497     0
.0497
     0.7761     0.9908     0.0096    -0.0091    -0.9657     0.9728     0.0096    -0.0097     0.0564     0.0544     0.0541     0
.0540
     0.0000     0.0000    -0.0276    -0.0276     0.9750     0.9729     0.0253     0.0447    -0.0056    -0.0044    -0.0043    -0
.0043

  63      42     42.8745    11.4079    -9.2404     0.5290     0.0052    -0.0318     0.0267     0.0000     0.0000     0.0105     0
.0126
     0.7814     0.9923    -0.0235     0.0182    -0.4007     0.9786    -0.0235     0.0177     0.0428     0.0420     0.0418     0
.0418
     0.7767     0.9910     0.0083    -0.0084    -0.9297     0.9734     0.0083    -0.0090     0.0550     0.0530     0.0528     0
.0527
     0.0000     0.0000    -0.0279    -0.0279     0.9790     0.9735     0.0219     0.0432    -0.0122    -0.0111    -0.0110    -0
.0109

  64      43     41.4910    11.4075    -9.2387     0.5189     0.0087    -0.0320     0.0269     0.0000     0.0000     0.0105     0
.0126
     0.7848     0.9936    -0.0240     0.0196    -0.3750     0.9824    -0.0240     0.0192     0.0350     0.0342     0.0341     0
.0341
     0.7769     0.9911     0.0080    -0.0071    -0.8939     0.9738     0.0080    -0.0077     0.0542     0.0524     0.0521     0
.0521
     0.0000     0.0000    -0.0271    -0.0271     0.9829     0.9738     0.0189     0.0421    -0.0192    -0.0182    -0.0180    -0
.0180

  65      44     40.1079    11.4070    -9.2370     0.5042     0.0150    -0.0326     0.0276     0.0000     0.0000     0.0105     0
.0126
     0.7893     0.9954    -0.0255     0.0199    -0.3543     0.9874    -0.0255     0.0196     0.0250     0.0241     0.0241     0
.0241
     0.7757     0.9906     0.0071    -0.0073    -0.8584     0.9724     0.0071    -0.0080     0.0570     0.0552     0.0549     0
.0549
     0.0000     0.0000    -0.0279    -0.0279     0.9879     0.9724     0.0154     0.0426    -0.0320    -0.0311    -0.0308    -0
.0308

  66      45     38.7248    11.4071    -9.2351     0.4755     0.0279    -0.0352     0.0300     0.0000     0.0000     0.0105     0
.0126
     0.7965     0.9982    -0.0275     0.0215    -0.3428     0.9954    -0.0275     0.0214     0.0090     0.0080     0.0080     0
.0080
     0.7714     0.9888     0.0077    -0.0079    -0.8183     0.9674     0.0077    -0.0086     0.0669     0.0651     0.0647     0
.0646
     0.0000     0.0000    -0.0279    -0.0279     0.9960     0.9675     0.0131     0.0465    -0.0579    -0.0570    -0.0566    -0
.0566

  67      46     37.3418    11.4069    -9.2334     0.4248     0.0469    -0.0415     0.0357     0.0000     0.0000     0.0105     0
.0126
     0.8064     1.0020    -0.0309     0.0250    -0.3443     1.0061    -0.0309     0.0251    -0.0127    -0.0138    -0.0138    -0
.0138
     0.7644     0.9859     0.0106    -0.0096    -0.7691     0.9593     0.0106    -0.0106     0.0834     0.0814     0.0807     0
.0806
     0.0000     0.0000    -0.0274    -0.0274     1.0069     0.9594     0.0187     0.0548    -0.0962    -0.0952    -0.0945    -0
.0944

  68      47     35.9585    11.4065    -9.2317     0.3406     0.0821    -0.0598     0.0517     0.0000     0.0000     0.0105     0
```

```
.0126
     0.8242     1.0086    -0.0408     0.0328    -0.3642     1.0248    -0.0408     0.0334    -0.0507    -0.0524    -0.0526     -0
.0526
     0.7506     0.9801     0.0190    -0.0170    -0.7048     0.9427     0.0190    -0.0183     0.1170     0.1140     0.1127      0
.1125
     0.0000     0.0000    -0.0277    -0.0277     1.0262     0.9431     0.0396     0.0747    -0.1677    -0.1664    -0.1654     -0
.1651

   69    48    34.5750    11.4064    -9.2298     0.1888     0.1978    -0.1381     0.1195     0.0000     0.0000     0.0105      0
.0126
     0.8855     1.0291    -0.0806     0.0657    -0.4193     1.0836    -0.0806     0.0676    -0.1707    -0.1780    -0.1807     -0
.1799
     0.7067     0.9604     0.0575    -0.0493    -0.6081     0.8859     0.0575    -0.0519     0.2330     0.2228     0.2179      0
.2164
     0.0000     0.0000    -0.0279    -0.0279     1.0887     0.8892     0.1182     0.1511    -0.4036    -0.4009    -0.3986     -0
.3962

   72    49    44.3232    12.9125   -10.5007     0.4285     0.0014    -0.0546     0.0457     0.0000     0.0000     0.0087      0
.0104
     0.7803     0.9914    -0.0341     0.0272    -0.4570     0.9768    -0.0341     0.0267     0.0458     0.0446     0.0444      0
.0444
     0.7788     0.9919     0.0204    -0.0185    -0.8854     0.9753     0.0204    -0.0190     0.0519     0.0486     0.0484      0
.0483
     0.0000     0.0000    -0.0278    -0.0278     0.9777     0.9757     0.0308     0.0557    -0.0060    -0.0040    -0.0040     -0
.0039

   73    50    43.1771    12.9122   -10.4987     0.4256     0.0040    -0.0545     0.0457     0.0000     0.0000     0.0087      0
.0104
     0.7828     0.9924    -0.0352     0.0277    -0.4325     0.9795    -0.0352     0.0272     0.0403     0.0390     0.0389      0
.0388
     0.7789     0.9920     0.0193    -0.0179    -0.8581     0.9755     0.0193    -0.0184     0.0515     0.0484     0.0481      0
.0481
     0.0000     0.0000    -0.0281    -0.0281     0.9805     0.9759     0.0297     0.0545    -0.0112    -0.0093    -0.0093     -0
.0092
1
   network id:            index:   1    source type =  0    doublet type = 12      number rows =   8    number columns =   8

  jc   ip        x          y          z          d0         dx         dy         dz         s0         anx        any         a
nz
  lmachu        wxu        wyu        wzu        pheu       vxu        vyu        vzu        cplinu     cpslnu     cp2ndu      cpi
snu
  lmachl        wxl        wyl        wzl        phel       vxl        vyl        vzl        cplinl     cpslnl     cp2ndl      cpi
snl
     wnu        wnl        pwnu       pwnl       vtu        vtl        pvtu       pvtl       cplind     cpslnd     cp2ndd      cpi
snd

   74    51    42.0309    12.9120   -10.4967     0.4194     0.0065    -0.0537     0.0450     0.0000     0.0000     0.0087      0
.0104
     0.7852     0.9934    -0.0354     0.0282    -0.4115     0.9822    -0.0354     0.0278     0.0348     0.0335     0.0334      0
.0333
     0.7790     0.9920     0.0183    -0.0167    -0.8309     0.9757     0.0183    -0.0172     0.0509     0.0480     0.0477      0
.0477
     0.0000     0.0000    -0.0278    -0.0278     0.9833     0.9760     0.0284     0.0530    -0.0162    -0.0145    -0.0144     -0
.0144

   75    52    40.8853    12.9116   -10.4945     0.4102     0.0110    -0.0534     0.0448     0.0000     0.0000     0.0087      0
.0104
```

```
     0.7885    0.9947   -0.0361    0.0283   -0.3936    0.9859   -0.0361    0.0280    0.0275    0.0262    0.0261     0
.0261
     0.7782    0.9917    0.0172   -0.0162   -0.8038    0.9748    0.0172   -0.0168    0.0527    0.0498    0.0495     0
.0495
     0.0000    0.0000   -0.0282   -0.0282    0.9869    0.9751    0.0269    0.0524   -0.0252   -0.0236   -0.0234    -0
.0234

   76    53   39.7398   12.9114  -10.4924    0.3929    0.0211   -0.0536    0.0452    0.0000    0.0000    0.0087     0
.0104
     0.7941    0.9969   -0.0368    0.0290   -0.3813    0.9921   -0.0368    0.0288    0.0150    0.0136    0.0135     0
.0135
     0.7749    0.9903    0.0168   -0.0157   -0.7742    0.9711    0.0168   -0.0164    0.0602    0.0574    0.0571     0
.0570
     0.0000    0.0000   -0.0281   -0.0281    0.9932    0.9713    0.0254    0.0538   -0.0452   -0.0438   -0.0435    -0
.0435

   77    54   38.5940   12.9110  -10.4904    0.3601    0.0390   -0.0560    0.0477    0.0000    0.0000    0.0087     0
.0104
     0.8033    1.0005   -0.0382    0.0309   -0.3780    1.0022   -0.0382    0.0309   -0.0053   -0.0068   -0.0068    -0
.0068
     0.7680    0.9875    0.0178   -0.0159   -0.7382    0.9632    0.0178   -0.0167    0.0760    0.0732    0.0726     0
.0725
     0.0000    0.0000   -0.0276   -0.0276    1.0034    0.9635    0.0269    0.0591   -0.0813   -0.0800   -0.0794    -0
.0793

   78    55   37.4480   12.9106  -10.4883    0.2983    0.0783   -0.0700    0.0601    0.0000    0.0000    0.0087     0
.0104
     0.8227    1.0078   -0.0463    0.0364   -0.3905    1.0228   -0.0463    0.0369   -0.0470   -0.0491   -0.0493    -0
.0493
     0.7523    0.9809    0.0238   -0.0219   -0.6887    0.9445    0.0238   -0.0232    0.1138    0.1101    0.1089     0
.1087
     0.0000    0.0000   -0.0285   -0.0285    1.0245    0.9451    0.0437    0.0780   -0.1608   -0.1592   -0.1583    -0
.1580

   79    56   36.3021   12.9107  -10.4861    0.1687    0.2123   -0.1512    0.1306    0.0000    0.0000    0.0087     0
.0104
     0.8937    1.0315   -0.0871    0.0708   -0.4378    1.0907   -0.0871    0.0728   -0.1852   -0.1940   -0.1970    -0
.1961
     0.7016    0.9578    0.0641   -0.0550   -0.6066    0.8784    0.0641   -0.0578    0.2483    0.2364    0.2309     0
.2289
     0.0000    0.0000   -0.0282   -0.0282    1.0966    0.8826    0.1291    0.1625   -0.4335   -0.4304   -0.4279    -0
.4250

   82    57   44.3885   14.4174  -11.7593    0.2395   -0.0004   -0.1363    0.1141    0.0000    0.0000    0.0069     0
.0083
     0.7852    0.9910   -0.0761    0.0613   -0.5250    0.9777   -0.0761    0.0609    0.0415    0.0350    0.0349     0
.0348
     0.7847    0.9937    0.0602   -0.0526   -0.7644    0.9781    0.0602   -0.0532    0.0487    0.0375    0.0373     0
.0371
     0.0000    0.0000   -0.0285   -0.0285    0.9826    0.9814    0.0781    0.1049   -0.0072   -0.0025   -0.0024    -0
.0024

   83    58   43.4799   14.4169  -11.7570    0.2381    0.0018   -0.1356    0.1135    0.0000    0.0000    0.0069     0
.0083
     0.7872    0.9918   -0.0760    0.0618   -0.5067    0.9799   -0.0760    0.0614    0.0371    0.0306    0.0305     0
.0304
     0.7846    0.9936    0.0596   -0.0515   -0.7448    0.9780    0.0596   -0.0521    0.0487    0.0378    0.0375     0
```

```
.0374
   0.0000    0.0000   -0.0281   -0.0281    0.9848    0.9812    0.0778    0.1037   -0.0116   -0.0072   -0.0071    -0
.0070

  84    59   42.5713   14.4167  -11.7548    0.2366    0.0029   -0.1345    0.1125    0.0000    0.0000    0.0069     0
.0083
   0.7886    0.9923   -0.0766    0.0612   -0.4894    0.9815   -0.0766    0.0608    0.0340    0.0275    0.0274     0
.0273
   0.7849    0.9938    0.0580   -0.0512   -0.7260    0.9785    0.0580   -0.0517    0.0477    0.0370    0.0368     0
.0366
   0.0000    0.0000   -0.0289   -0.0289    0.9863    0.9816    0.0775    0.1021   -0.0137   -0.0095   -0.0094    -0
.0093

  85    60   41.6630   14.4162  -11.7521    0.2332    0.0049   -0.1330    0.1112    0.0000    0.0000    0.0069     0
.0083
   0.7903    0.9931   -0.0762    0.0612   -0.4741    0.9834   -0.0762    0.0609    0.0301    0.0235    0.0235     0
.0234
   0.7848    0.9938    0.0568   -0.0498   -0.7072    0.9786    0.0568   -0.0503    0.0476    0.0372    0.0370     0
.0369
   0.0000    0.0000   -0.0286   -0.0286    0.9883    0.9815    0.0768    0.1004   -0.0175   -0.0137   -0.0136    -0
.0135
1
   network id:          index:   1    source type =   0    doublet type = 12      number rows =    8    number columns =    8

  jc   ip        x         y         z        d0        dx        dy        dz        s0       anx       any         a
nz
  lmachu        wxu       wyu       wzu      pheu      vxu       vyu       vzu      cplinu    cpslnu    cp2ndu      cpi
snu
  lmachl        wxl       wyl       wzl      phel      vxl       vyl       vzl      cplinl    cpslnl    cp2ndl      cpi
snl
     wnu        wnl      pwnu      pwnl      vtu       vtl       pvtu      pvtl     cplind    cpslnd    cp2ndd      cpi
snd

  86    61   40.7547   14.4158  -11.7497    0.2278    0.0077   -0.1302    0.1088    0.0000    0.0000    0.0069     0
.0083
   0.7923    0.9939   -0.0752    0.0605   -0.4606    0.9858   -0.0752    0.0603    0.0254    0.0191    0.0190     0
.0190
   0.7841    0.9936    0.0550   -0.0480   -0.6884    0.9780    0.0550   -0.0486    0.0485    0.0386    0.0384     0
.0383
   0.0000    0.0000   -0.0285   -0.0285    0.9905    0.9808    0.0752    0.0980   -0.0231   -0.0195   -0.0194    -0
.0193

  87    62   39.8463   14.4154  -11.7475    0.2185    0.0140   -0.1254    0.1050    0.0000    0.0000    0.0069     0
.0083
   0.7955    0.9954   -0.0731    0.0591   -0.4498    0.9898   -0.0731    0.0589    0.0176    0.0116    0.0116     0
.0116
   0.7817    0.9927    0.0523   -0.0454   -0.6683    0.9758    0.0523   -0.0460    0.0529    0.0437    0.0435     0
.0433
   0.0000    0.0000   -0.0282   -0.0282    0.9942    0.9783    0.0722    0.0950   -0.0353   -0.0321   -0.0318    -0
.0317

  88    63   38.9378   14.4150  -11.7451    0.1989    0.0410   -0.1251    0.1052    0.0000    0.0000    0.0069     0
.0083
   0.8084    1.0005   -0.0738    0.0587   -0.4450    1.0040   -0.0738    0.0589   -0.0109   -0.0170   -0.0170    -0
.0169
   0.7706    0.9881    0.0513   -0.0454   -0.6439    0.9631    0.0513   -0.0463    0.0783    0.0693    0.0687     0
.0685
```

```
      0.0000      0.0000     -0.0289     -0.0289      1.0085      0.9655      0.0722      0.0983     -0.0892     -0.0862     -0.0857     -0
.0854

    89    64     38.0294     14.4148    -11.7426      0.1326      0.1914     -0.1885      0.1613      0.0000      0.0000      0.0069      0
.0083
      0.8864      1.0273     -0.1057      0.0857     -0.4642      1.0800     -0.1057      0.0876     -0.1647     -0.1784     -0.1808     -0
.1798
      0.7126      0.9618      0.0828     -0.0712     -0.5968      0.8886      0.0828     -0.0738      0.2290      0.2112      0.2065      0
.2044
      0.0000      0.0000     -0.0286     -0.0286      1.0887      0.8955      0.1404      0.1732     -0.3937     -0.3896     -0.3873     -0
.3842
1
0*b*for-mom-net#-   1
                                     force / moment data for network      1



 totals for column       1          area          fx            fy            fz            mx            my            mz

                                     40.29655      0.00000      -0.00355      -0.00424      -0.02639      -0.01477       0.0123
8
                                     40.29655      0.00000       0.00999       0.01196       0.07635       0.05750      -0.0480
5
                                     40.29655      0.00000       0.00644       0.00771       0.04996       0.04273      -0.0356
7

 totals for column       2          area          fx            fy            fz            mx            my            mz

                                     36.57013      0.00000      -0.00156      -0.00186      -0.01623      -0.00475       0.0039
9
                                     36.57013      0.00000       0.01074       0.01285       0.11449       0.05956      -0.0497
8
                                     36.57013      0.00000       0.00918       0.01099       0.09826       0.05481      -0.0457
9

 totals for column       3          area          fx            fy            fz            mx            my            mz

                                     32.84674      0.00000      -0.00043      -0.00051      -0.00566       0.00065      -0.0005
2
                                     32.84674      0.00000       0.01025       0.01227       0.14047       0.05580      -0.0466
3
                                     32.84674      0.00000       0.00982       0.01176       0.13480       0.05644      -0.0471
5

 totals for column       4          area          fx            fy            fz            mx            my            mz

                                     29.12062      0.00000       0.00028       0.00034       0.00478       0.00379      -0.0031
```

5								
		29.12062	0.00001	0.00945	0.01131	0.15828	0.05062	-0.0422
8								
		29.12062	0.00001	0.00972	0.01165	0.16305	0.05440	-0.0454
2								
totals for column	5	area	fx	fy	fz	mx	my	mz
		25.40189	0.00000	0.00073	0.00088	0.01453	0.00560	-0.0046
5								
		25.40189	0.00001	0.00845	0.01012	0.16733	0.04459	-0.0372
3								
		25.40189	0.00001	0.00917	0.01100	0.18186	0.05018	-0.0418
8								
totals for column	6	area	fx	fy	fz	mx	my	mz
		21.67510	0.00000	0.00094	0.00114	0.02161	0.00619	-0.0051
4								
		21.67510	0.00001	0.00726	0.00870	0.16598	0.03775	-0.0315
2								
		21.67510	0.00001	0.00820	0.00984	0.18759	0.04394	-0.0366
6								
totals for column	7	area	fx	fy	fz	mx	my	mz
		17.95490	0.00000	0.00085	0.00103	0.02206	0.00525	-0.0043
6								
		17.95490	0.00001	0.00580	0.00695	0.14997	0.02966	-0.0247
6								
		17.95490	0.00001	0.00665	0.00797	0.17204	0.03491	-0.0291
2								
totals for column	8	area	fx	fy	fz	mx	my	mz
		14.22880	0.00000	0.00037	0.00045	0.01058	0.00233	-0.0019
4								
		14.22880	0.00001	0.00352	0.00422	0.10168	0.01772	-0.0147
9								
		14.22880	0.00001	0.00389	0.00467	0.11226	0.02005	-0.0167
3								
totals for network		area	fx	fy	fz	mx	my	mz
		218.09473	0.00000	-0.00237	-0.00279	0.02527	0.00427	-0.0033
9								
		218.09473	0.00005	0.06546	0.07837	1.07455	0.35320	-0.2950

```
3
                                218.09473     0.00006     0.06308     0.07559     1.09982     0.35747     -0.2984
2


 totals for all networks so far  area          fx          fy          fz          mx          my          mz


                                218.09473     0.00000    -0.00237    -0.00279     0.02527     0.00427     -0.0033
9
                                218.09473     0.00005     0.06546     0.07837     1.07455     0.35320     -0.2950
3
                                218.09473     0.00006     0.06308     0.07559     1.09982     0.35747     -0.2984
2
0•e•for-mom
1
   network id:          index:   2   source type =  0   doublet type = 12    number rows =   8   number columns =   8

  jc   ip        x         y         z         d0        dx        dy        dz        s0        anx       any       a
nz
  lmachu        wxu       wyu       wzu       pheu      vxu       vyu       vzu       cplinu    cpslnu    cp2ndu    cpi
snu
  lmachl        wxl       wyl       wzl       phel      vxl       vyl       vzl       cplinl    cpslnl    cp2ndl    cpi
snl
     wnu        wnl       pwnu      pwnl      vtu       vtl       pvtu      pvtl      cplind    cpslnd    cp2ndd    cpi
snd

  112     65   43.9301   -2.9497   -3.8857   -0.3830    0.0239    0.1109    0.1332    0.0000    0.0000    0.0234    -0
.0196
     0.7810    0.9895    0.0571    0.0684   -1.0960    0.9741    0.0571    0.0679    0.0483    0.0439    0.0437     0
.0436
     0.7609    0.9839   -0.0538   -0.0641   -0.7130    0.9501   -0.0538   -0.0653    0.1054    0.0928    0.0918     0
.0914
     0.0000    0.0000    0.0222    0.0222    0.9781    0.9539    0.0669    0.1218   -0.0571   -0.0489   -0.0481    -0
.0477

  113     66   41.3597   -2.9495   -3.8858   -0.4581    0.0263    0.0643    0.0775    0.0000    0.0000    0.0234    -0
.0196
     0.7883    0.9942    0.0345    0.0412   -1.0532    0.9853    0.0345    0.0409    0.0278    0.0266    0.0265     0
.0265
     0.7655    0.9864   -0.0298   -0.0356   -0.5950    0.9590   -0.0298   -0.0366    0.0857    0.0800    0.0793     0
.0791
     0.0000    0.0000    0.0224    0.0224    0.9867    0.9601    0.0302    0.0842   -0.0579   -0.0534   -0.0528    -0
.0526

  114     67   38.7894   -2.9495   -3.8858   -0.5064    0.0122    0.0308    0.0371    0.0000    0.0000    0.0234    -0
.0196
     0.7849    0.9936    0.0181    0.0216   -1.0143    0.9826    0.0181    0.0212    0.0345    0.0340    0.0339     0
.0339
     0.7743    0.9901   -0.0127   -0.0152   -0.5079    0.9705   -0.0127   -0.0159    0.0614    0.0587    0.0584     0
.0583
     0.0000    0.0000    0.0224    0.0224    0.9830    0.9707    0.0168    0.0553   -0.0269   -0.0248   -0.0245    -0
.0245

  115     68   36.2197   -2.9493   -3.8859   -0.5195   -0.0020    0.0076    0.0091    0.0000    0.0000    0.0234    -0
.0196
     0.7800    0.9921    0.0066    0.0081   -0.9653    0.9774    0.0066    0.0076    0.0459    0.0451    0.0449     0
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