DEPARTMENT OF THE NAVY
DAVID TAYLOR MODEL BASIN
Washington, D. C. 20007

DESCRIPTION AND USAGE OF GENERAL BENDING RESPONSE CODE 2 (GBRC2)

by

Francis M. Henderson

APPLIED MATHEMATICS LABORATORY
TECHNICAL NOTE

AUGUST 1966

AML-59-66

DESCRIPTION AND USAGE OF GENERAL BENDING RESPONSE CODE 2 (GBRC2)

by

Francis M. Henderson

APPLIED MATHEMATICS LABORATORY
TECHNICAL NOTE

AUGUST 1966

AML-59-66

TABLE OF CONTENTS

ABSTRACT

The method of extending the general bending response code (GBRC1) to handle ship vibration calculations involving coupled torsion-horizontal bending is described. Instructions for preparation of data for the extended code, designated GBRC2, are given and several sample problems demonstrate some of the code's facilities.

ADMINISTRATIVE INFORMATION

The work reported here was carried out under job order number 1-843-343-01, Subproject SR 003 03 01, Task 10919.

I. INTRODUCTION

The method of analysis described in Section II of reference 1 is applied to the set of partial differential equations for torsion-horizontal bending motion of a ship hull as represented by a moderately nonuniform slender beam. The resulting set of time-independent finite-difference equations is formulated in terms of matrices and is generalized for application to systems of beams connected by springs.

The set of difference equations is solved, subject to free-end conditions on each beam in the system, for deflection, moment, and angular twist at points along the divided beam (s). If the motion of the beam system is excited by a simple harmonic driving force, the solution of the difference equations represents an approximation to the steady-state response of the system for specific frequencies of the driving force. If the beam system is not driven by exciting forces, the difference equations are solved for the approximate natural frequencies and mode shapes of the system.

GBRC2 retains the following basic provisions of GBRC1: specification of various types of damping including Rayleigh (viscous) and hysteretic (structural) damping; automatic calculation of effective mass as a function of frequency; and frequency-proportional exciting forces and moments. The types of tabular output available with GBRC2 are the same as ~~those described~~ for GBRC1 in reference 1. A summary table gives the absolute values of deflection, moment, and twist at five (or fewer) selected beam sections, for all frequencies computed. A second edit gives for each frequency the real and imaginary components, and the absolute values of deflection, moment, and rotation at each beam section, and the phase angles of the associated vectors with respect to the

vector(s) of the exciting force(s). The twist is given in radians.

The graphic editing facilities of GBRC1 are extended in GBRC2 to allow the plotting of calculated results (deflection, moment, rotation) associated with particular components of the structural system such as the hull, propeller shaft, etc. on separate graph frames. The programming language for GBRC2 is a FORTRAN IV compatible version of FORTRAN II. The code is currently being run with the IBSYS Operating System on the IBM 7090 computer at the Applied Mathematics Laboratory.

GBRC1 and GBRC2 will ultimately be united under one program title, providing the user with the option of selecting either code by specifying an option as part of the data input.

II. ANALYSIS

The set of partial differential equations derived for a ship hull which is executing horizontal-torsion bending motion is (cf. reference 2, pp. 3-9 and 3-10):

$$(2.1)\quad \frac{\partial V(x,t)}{\partial x} = -\mu(x)\frac{\partial^2 y(x,t)}{\partial t^2} - c(x)\frac{\partial y(x,t)}{\partial t} + \mu(x)\bar{z}(x)\frac{\partial^2 \varphi(x,t)}{\partial t^2} + P(x,t)$$

$$(2.2)\quad \frac{\partial M(x,t)}{\partial x} = V(x,t) + I_{\mu z}(x)\frac{\partial^2 \gamma(x,t)}{\partial t^2} + Q(x,t)$$

$$(2.3)\quad \frac{\partial y(x,t)}{\partial x} = \gamma(x,t) - \frac{V(x,t)}{KAG(x)} - \frac{V(x,t)\left[\bar{\bar{z}}(x)\right]^2}{GJ_e(x)} - \frac{\bar{\bar{z}}(x)T(x,t)}{GJ_e(x)}$$

$$(2.4)\quad \frac{\partial \gamma(x,t)}{\partial x} = \frac{M(x,t)}{EI(x)}$$

$$(2.5)\quad \frac{\partial \varphi(x,t)}{\partial x} = -\frac{T(x,t)}{GJ_e(x)} - \frac{V(x,t)\,\bar{\bar{z}}(x)}{GJ_e(x)}$$

$$(2.6)\quad \frac{\partial T(x,t)}{\partial x} = \mu(x)\,\bar{z}(x)\frac{\partial^2 y(x,t)}{\partial t^2} - I_{\mu x}(x)\frac{\partial^2 \varphi(x,t)}{\partial t^2} + U(x,t)$$

with the following notation:

- x — distance in the longitudinal direction measured from the origin of coordinates
- t — time variable
- $\bar{z}$ — vertical distance from the x-axis to the center of mass (including allowance for added mass of water)
- $\bar{\bar{z}}$ — distance from the x-axis to the center of horizontal shear (assumed to be the centroid of the area of the cross section of the hull)
- GJ_e — effective torsional rigidity of a hull with respect to its longitudinal axis

φ rotation of the cross section of a beam or hull with respect to its longitudinal axis

T moment about the longitudinal axis of a hull due to all shearing stresses in the cross section

$I_{\mu x}$ mass moment of inertia per unit length with respect to the x-axis, including the allowance for the inertial effect of the water

U external forcing torque acting about the x-axis

c damping coefficient

P external forcing function, force in y-direction

Q external forcing moment acting about an axis parallel to z

The remaining parameters and variables are defined in reference 1, page 3.

Assuming that the forcing functions are simple harmonic functions of time,

$$P(x,t) = e^{i\omega t} P(x)$$

$$Q(x,t) = e^{i\omega t} Q(x)$$

$$U(x,t) = e^{i\omega t} U(x)$$

then

$$V(x,t) = e^{i\omega t} V(x)$$

$$y(x,t) = e^{i\omega t} y(x)$$

$$\varphi(x,t) = e^{i\omega t} \varphi(x)$$

$$M(x,t) = e^{i\omega t} M(x)$$

$$\gamma(x,t) = e^{i\omega t} \gamma(x)$$

$$T(x,t) = e^{i\omega t} T(x) \quad .$$

Substituting these into Equations (2.1) through (2.6), one obtains:

$$(2.7)\quad \frac{dV(x)}{dx} = \mu(x)\omega^2 y(x) - ic(x)\omega y(x) - \mu(x)\bar{z}(x)\omega^2\varphi(x) + P(x)$$

$$(2.8)\quad \frac{dM(x)}{dx} = V(x) - \omega^2 I_{\mu z}(x)\,\gamma(x) + Q(x)$$

$$(2.9)\quad \frac{dy(x)}{dx} = \gamma(x) - \frac{V(x)}{KAG(x)} - \frac{V(x)\left[\bar{\bar{z}}(x)\right]^2}{GJ_e(x)} - \frac{\bar{\bar{z}}(x)T(x)}{GJ_e(x)}$$

$$(2.10)\quad \frac{d\gamma(x)}{dx} = \frac{M(x)}{EI(x)}$$

$$(2.11)\quad \frac{d\varphi(x)}{dx} = -\frac{T(x)}{GJ_e(x)} - \frac{V(x)\bar{\bar{z}}(x)}{GJ_e(x)}$$

$$(2.12)\quad \frac{dT(x)}{dx} = -\mu(x)\bar{z}(x)\omega^2 y(x) + I_{\mu x}(x)\,\omega^2\varphi(x) + U(x) \quad .$$

Eliminating $T(x)$ from (2.9) and (2.11) gives,

$$\frac{1}{\bar{\bar{z}}(x)}\frac{dy(x)}{dx} - \frac{d\varphi(x)}{dx} = \frac{\gamma(x)}{\bar{\bar{z}}(x)} - \frac{V(x)}{\bar{\bar{z}}(x)KAG(x)} \quad .$$

This equation can be used with (2.8) to eliminate $V(x)$,

$$\frac{1}{\bar{\bar{z}}(x)}\left[\frac{dy(x)}{dx} + \left(\frac{1}{KAG(x)}\right)\frac{dM(x)}{dx}\right] - \frac{d\varphi(x)}{dx} = \frac{1}{\bar{\bar{z}}(x)}\left[1 - \frac{\omega^2 I_{\mu z}(x)}{KAG(x)}\right]\gamma(x) + \left(\frac{1}{\bar{\bar{z}}}\right)\frac{Q(x)}{KAG(x)} \quad .$$

Solving for $\gamma(x)$,

$$(2.13)\quad \gamma(x) = \left[\frac{dy(x)}{dx} + \left(\frac{1}{KAG(x)}\right)\frac{dM(x)}{dx} - \bar{\bar{z}}(x)\frac{d\varphi(x)}{dx} - \frac{Q(x)}{KAG(x)}\right]\left[1 - \frac{\omega^2 I_{\mu z}(x)}{KAG(x)}\right]^{-1} \quad .$$

Multiplying (2.11) by $-\bar{\bar{z}}(x)$ and adding it to (2.9) gives,

$$\frac{dy(x)}{dx} - \bar{\bar{z}}(x)\,\frac{d\varphi(x)}{dx} = \gamma(x) - \frac{V(x)}{KAG(x)} \quad .$$

Eliminating $\gamma(x)$ between this equation and (2.8),

$$\frac{dM(x)}{dx} + \omega^2 I_{\mu z}(x)\left[\frac{dy(x)}{dx} - \bar{\bar{z}}(x)\,\frac{d\varphi(x)}{dx}\right] = V(x) - \omega^2 I_{\mu z}(x)\frac{V(x)}{KAG(x)} + Q(x)$$

from which,

$$(2.14)\quad V(x) = \left[\frac{dM(x)}{dx} + \omega^2 I_{\mu z}(x)\left(\frac{dy(x)}{dx} - \bar{\bar{z}}(x)\,\frac{d\varphi(x)}{dx}\right) - Q(x)\right]\left[1 - \frac{\omega^2 I_{\mu z}(x)}{KAG(x)}\right]^{-1} .$$

Substituting (2.14) into (2.11) and solving for $T(x)$,

$$(2.15)\quad T(x) = -GJ_e(x)\,\frac{d\varphi(x)}{dx} - \bar{\bar{z}}(x)\left[\frac{dM(x)}{dx} + \omega^2 I_{\mu z}(x)\left(\frac{dy(x)}{dx} - \bar{\bar{z}}(x)\,\frac{d\varphi(x)}{dx}\right) - Q(x)\right]\left[1 - \frac{\omega^2 I_{\mu z}(x)}{KAG(x)}\right]^{-1} .$$

With the beam subdivided and numbered as shown on p. 5 in reference 14, Equation (2.7) is integrated from $x_{n-1/2}$ to $x_{n+1/2}$, for $n = 1, 2, 3, \ldots, N$, giving

$$V_{n+1/2} - V_{n-1/2} = \int_{n-1/2}^{n+1/2} \left(\mu(x)\omega^2 - ic(x)\omega\right) y(x)\,dx$$

$$- \int_{n-1/2}^{n+1/2} \left(\mu(x)\bar{\bar{z}}(x)\right) \varphi(x)\,dx + \int_{n-1/2}^{n+1/2} P(x)\,dx \quad .$$

This is approximated by

$$(2.16)\quad V_{n+1/2} - V_{n-1/2} = \left[(\mu\Delta x)_n \omega^2 - i\omega (c\Delta x)_n\right] y_n - \omega^2 (\mu\Delta x\bar{z})_n \varphi_n + (P\Delta x)_n ,$$

where

$$(\mu\Delta x)_n = \int_{x_{n-1/2}}^{x_{n+1/2}} \mu(x)dx$$

$$(c\Delta x)_n = \int_{x_{n-1/2}}^{x_{n+1/2}} c(x)dx$$

$$(\mu\Delta x\bar{z})_n = \int_{x_{n-1/2}}^{x_{n+1/2}} \mu(x)\bar{z}(x)dx$$

$$(P\Delta x)_n = \int_{x_{n-1/2}}^{x_{n+1/2}} P(x)dx \quad .$$

Using Equation(2.14), an approximation to $V_{n+1/2}$ for $n = 1, 2, \ldots, N-1$ is

$$(2.17)\quad V_{n+1/2} = \frac{1}{(\Delta x)_{n,n+1}} \left[M_{n+1} - M_n + \omega^2 \left(I_{\mu z}\right)_{n,n+1} (y_{n+1} - y_n) \right.$$

$$\left. - \omega^2 \left(I_{\mu z}\right)_{n,n+1} (\bar{z})_{n,n+1} (\varphi_{n+1} - \varphi_n) - Q_{n,n+1} \right] \left[1 - \omega^2 \left(\frac{I_{\mu z}}{KAG} \right)_{n,n+1} \right]^{-1},$$

where

$$Q_{n,n+1} = \int_{x_n}^{x_{n+1}} Q(x)dx$$

$$(I_{\mu z}\Delta x)_{n,n+1} = \int_{x_n}^{x_{n+1}} I_{\mu z}(x)dx$$

$$\left(\frac{\Delta x}{KAG}\right)_{n,n+1} = \int_{x_n}^{x_{n+1}} \frac{dx}{KAG(x)}$$

$$(\bar{\bar{z}})_{n,n+1} = \int_{x_n}^{x_{n+1}} \bar{\bar{z}}(x)dx \quad .$$

For the ends of the beam, the conditions

(2.18) $V_{1/2} = 0$, $V_{N+1/2} = 0$ are imposed.

Substituting Equation (2.17) and Equations (2.18) into Equation (2.16) gives for $n = 1, 2, \ldots, N$:

$$(2.19)\quad \alpha_{n,n+1}(M_{n+1}-M_n) + \beta_{n,n+1}(y_{n+1}-y_n) - \beta'_{n,n+1}(\varphi_{n+1}-\varphi_n) - \alpha_{n,n+1}Q_{n,n+1}$$

$$- \alpha_{n-1,n}(M_n-M_{n-1}) - \beta_{n-1,n}(y_n-y_{n-1}) + \beta'_{n-1,n}(\varphi_n-\varphi_{n-1})$$

$$+ \alpha_{n-1,n}Q_{n-1,n} = \delta_n y_n - F_n\varphi_n + P_n \quad ,$$

where

$$\alpha_{n,n+1} = \begin{cases} \left(\frac{1}{\Delta x}\right)_{n,n+1}\left[1 - \omega^2\left(\frac{I_{\mu z}}{KAG}\right)_{n,n+1}\right]^{-1} & \text{for } n=1,2,3,\ldots,N-1 \\ 0 \text{ otherwise} \end{cases}$$

$$\beta_{n,n+1} = \begin{cases} \omega^2(I_{\mu z})_{n,n+1}\ \alpha_{n,n+1} & \text{for } n=1,2,3,\ldots,N-1 \\ 0 \text{ otherwise} \end{cases}$$

$$\beta'_{n,n+1} = \begin{cases} (\bar{\bar{z}})_{n,n+1}\ \beta_{n,n+1} \\ 0 \quad \text{otherwise} \end{cases} \qquad \text{for } n=1,2,3,\ldots,N-1$$

$$\delta_n = \left[(\mu\Delta x)_n\,\omega^2 - i\omega(c\Delta x)_n\right] \qquad \text{for } n=1,2,3,\ldots,N$$

$$F_n = \omega^2(\mu\Delta x\bar{z})_n \qquad \text{for } n=1,2,3,\ldots,N\ .$$

Integrating (2.10) from $x_{n-1/2}$ to $x_{n+1/2}$ for $n=1,2,\ldots,N$ gives

$$\gamma_{n+1/2}-\gamma_{n-1/2} = \int_{x_{n-1/2}}^{x_{n+1/2}} \frac{M(x)}{EI(x)}\,dx\ ,$$

which is approximated by

$$(2.20)\quad \gamma_{n+1/2} - \gamma_{n-1/2} = \left(\frac{\Delta x}{EI}\right)_n M_n$$

where

$$\left(\frac{\Delta x}{EI}\right)_n = \int_{x_{n-1/2}}^{x_{n+1/2}} \frac{dx}{EI}\ .$$

From equation (2.13), $\gamma_{n+1/2}$ is approximated as follows:

$$(2.21)\quad \gamma_{n+1/2} = \frac{1}{(\Delta x)_{n,n+1}}\left[y_{n+1}-y_n+\left(\frac{1}{KAG}\right)_{n,n+1}(M_{n+1}-M_n)\right.$$
$$\left.-(\bar{\bar{z}})_{n,n+1}(\varphi_{n+1}-\varphi_n)-\left(\frac{1}{KAG}\right)_{n,n+1}Q_{n,n+1}\right]\left[1-\omega^2\left(\frac{I_{\mu z}}{KAG}\right)_{n,n+1}\right]^{-1}$$

for $n=1,2,\ldots,N-1$.

The end conditions $M_1 = M_n = 0$ determine $\gamma_{1/2}$ and $\gamma_{N+1/2}$ (see reference 1).

Substituting Equation(2.21) and these end conditions into Equation(2.20) gives for $n = 1, 2, \ldots, N-1$:

$$(2.22)\quad \alpha_{n,n+1}(y_{n+1}-y_n)+\epsilon_{n,n+1}(M_{n+1}-M_n)-\alpha'_{n,n+1}(\varphi_{n+1}-\varphi_n)$$

$$-\epsilon_{n,n+1}Q_{n,n+1}-\alpha_{n-1,n}(y_n-y_{n-1})-\epsilon_{n-1,n}(M_n-M_{n-1})$$

$$+\alpha'_{n-1,n}(\varphi_n-\varphi_{n-1})+\epsilon_{n-1,n}Q_{n-1,n}=\zeta_n M_n \quad ,$$

where

$$\epsilon_{n,n+1}=\begin{cases}\left(\frac{1}{KAG}\right)_{n,n+1}\alpha_{n,n+1} & \text{for } n=1,2,\ldots,N-1\\ 0 \text{ otherwise}\end{cases}$$

$$\alpha'_{n,n+1}=\begin{cases}(\bar{\bar{z}})_{n,n+1}\,\alpha_{n,n+1} & \text{for } n=1,2,\ldots,N-1\\ 0 \text{ otherwise}\end{cases}$$

$$\zeta_n=\left(\frac{\Delta x}{EI}\right)_n \qquad \text{for } n=2,3,\ldots,N-1 \ .$$

Integrating Equation(2.12) from $x_{n-1/2}$ to $x_{n+1/2}$ gives for $n = 1, 2, 3, \ldots N$,

$$T_{n+1/2}-T_{n-1/2}=-\int_{x_{n-1/2}}^{x_{n+1/2}}(\mu(x)\bar{z}(x)\omega^2)y(x)dx$$

$$+\int_{x_{n-1/2}}^{x_{n+1/2}}(I_{\mu x}(x)\omega^2)\varphi(x)dx+\int_{x_{n-1/2}}^{x_{n+1/2}}U(x)dx \quad ,$$

which is approximated by

$$(2.23)\quad T_{n+1/2} - T_{n-1/2} = -\omega^2(\mu \Delta x \bar{z})_n y_n + \omega^2 (I_{\mu x} \Delta x)_n \varphi_n + U_n \,,$$

where

$$(\mu \Delta x \bar{z})_n = \int_{x_{n-1/2}}^{x_{n+1/2}} \mu(x)\bar{z}(x)dx$$

$$(I_{\mu x} \Delta x)_n = \int_{x_{n-1/2}}^{x_{n+1/2}} I_{\mu x}(x)dx$$

$$U_n = \int_{x_{n-1/2}}^{x_{n+1/2}} U(x)dx \,.$$

From Equation (2.15), $T_{n+1/2}$ is approximated for $x = 1, 2, \ldots, N-1$, by

$$(2.24)\quad T_{n+1/2} = -\left(\frac{\Delta x}{GJ_e}\right)^{-1}_{n,n+1} (\varphi_{n+1} - \varphi_n) - (\bar{\bar{z}})_{n,n+1} \frac{1}{(\Delta x)_{n,n+1}} \Big[M_{n+1} - M_n$$

$$+ \omega^2 (I_{\mu z})_{n,n+1} (y_{n+1} - y_n) - \omega^2 (I_{\mu z})_{n,n+1} (\bar{\bar{z}})_{n,n+1} (\varphi_{n+1} - \varphi_n)$$

$$- Q_{n,n+1} \Big] \left[1 - \omega^2 \left(\frac{I_{\mu z}}{KAG} \right)_{n,n+1} \right]^{-1} \,,$$

where

$$\left(\frac{\Delta x}{GJ_e}\right)_{n,n+1} = \int_{x_n}^{x_{n+1}} \frac{dx}{GJ_e(x)} \,.$$

For the ends of the beam, the conditions

$$(2.25)\quad T_{1/2} = 0 \qquad \text{and} \qquad T_{n+1/2} = 0$$

are taken.

Substituting Equation (2.24) and (2.25) into Equation (2.23) gives, for $n = 1, 2, \ldots, N$:

$$(2.26)\quad -I_{n,n+1}(\varphi_{n+1}-\varphi_n) - \alpha'_{n,n+1}(M_{n+1}-M_n) - \beta'_{n,n+1}(y_{n+1}-y_n)$$

$$+ H_{n,n+1}(\varphi_{n+1}-\varphi_n) + \alpha'_{n,n+1}Q_{n,n+1} + I_{n-1,n}(\varphi_n - \varphi_{n-1})$$

$$+ \alpha'_{n-1,n}(M_n - M_{n-1}) + \beta'_{n-1,n}(y_n - y_{n-1}) - H_{n-1,n}(\varphi_n - \varphi_{n-1})$$

$$- \alpha'_{n-1,n}Q_{n-1,n} = -F_n y_n + K_n \varphi_n + U_n \quad ,$$

where

$$I_{n,n+1} = \left(\frac{\Delta x}{GJ_e}\right)^{-1}_{n,n+1}$$

$$H_{n,n+1} = (\bar{\bar{z}})_{n,n+1}\,\beta'_{n,n+1}$$

$$K_n = \omega^2(I_{\mu x}\,\Delta x)_n \quad .$$

Multiplying each of the equations (2.19), (2.22), and (2.26) by -1 and rearranging terms gives respectively,

$$(2.27)\quad -\beta_{n-1,n}\,y_{n-1} - \alpha_{n-1,n}M_{n-1} + \beta'_{n-1,n}\varphi_{n-1} + (\beta_{n-1,n}+\beta_{n,n+1}+\delta_n)y_n$$

$$+ (\alpha_{n-1,n}+\alpha_{n,n+1})M_n - (\beta'_{n-1,n} + \beta'_{n,n+1} + F_n)\varphi_n$$

$$- \beta_{n,n+1}y_{n+1} - \alpha_{n,n+1}M_{n+1} + \beta'_{n,n+1}\varphi_{n+1} = \alpha_{n-1,n}Q_{n-1,n}$$

$$- \alpha_{n,n+1}Q_{n,n+1} - P_n$$

$$(2.28)\quad -\alpha_{n-1,n}y_{n-1} - \epsilon_{n-1,n}M_{n-1} + \alpha'_{n-1,n}\varphi_{n-1} + (\alpha_{n-1,n} + \alpha_{n,n+1})y_n$$

$$+ (\epsilon_{n-1,n} + \epsilon_{n,n+1} + \zeta_n)M_n - (\alpha'_{n-1,n} + \alpha'_{n,n+1})\varphi_n$$

$$- \alpha_{n,n+1}y_{n+1} - \epsilon_{n,n+1}M_{n+1} + \alpha'_{n,n+1}\varphi_{n+1} = \epsilon_{n-1,n}Q_{n-1,n}$$

$$- \epsilon_{n,n+1}Q_{n,n+1}$$

$$(2.29)\quad \beta'_{n-1,n}y_{n-1} + \alpha'_{n-1,n}M_{n-1} + (I_{n-1,n} - H_{n-1,n})\varphi_{n-1} - (\beta'_{n,n+1} + \beta'_{n-1,n}$$

$$+ F_n)y_n - (\alpha'_{n-1,n} + \alpha'_{n,n+1})M_n + (H_{n-1,n} + H_{n,n+1} - I_{n-1,n} - I_{n,n+1}$$

$$+ K_n)\varphi_n + \beta'_{n,n+1}y_{n+1} + \alpha'_{n,n+1}M_{n+1} + (I_{n,n+1} - H_{n,n+1})\varphi_{n+1} =$$

$$- \alpha'_{n-1,n}Q_{n-1,n} + \alpha'_{n,n+1}Q_{n,n+1} - U_n \quad .$$

For n=1 and n=N, these equations will incorporate the previously indicated end conditions.

In matrix notation these equations can be written

$$A\vec{z} = \vec{P}$$

for $n = 1, 2, \ldots, N$. A, $\vec{z}$, and $\vec{P}$ are defined by Equation (2.21) and (2.22) on pp. 8-9 of reference 1. For GBRC2, $\vec{z}_n$ and $\vec{P}_n$ as defined by Equation (2.23) in reference 1, now become

$$(2.30)\qquad \vec{z}_n = \begin{vmatrix} y_n \\ M_n \\ \varphi_n \end{vmatrix}, \qquad \vec{P}_n = \begin{vmatrix} \tilde{P}_n \\ \tilde{P}'_n \\ \tilde{P}''_n \end{vmatrix},$$

where

$$\tilde{P}_n = \alpha_{n-1,n}Q_{n-1,n} - \alpha_{n,n+1}Q_{n,n+1} - P_n,$$

$$\tilde{P}'_n = \epsilon_{n-1,n} Q_{n-1,n} - \epsilon_{n,n+1} Q_{n,n+1} \text{ , and}$$

$$\tilde{P}''_n = -\alpha'_{n-1,n} Q_{n-1,n} + \alpha'_{n,n+1} Q_{n,n+1} - U_n \text{ .}$$

The submatrices of A which are defined on pg. 9 of reference 1 become, for $n = 2, 3, \ldots, N-1$,

$$A_{n,n} = \begin{vmatrix} (\beta_{n-1,n}+\beta_{n,n+1}+\delta_n) & (\alpha_{n-1,n}+\alpha_{n,n+1}) & -(\beta'_{n-1,n}+\beta'_{n,n+1}+F_n) \\ (\alpha_{n-1,n}+\alpha_{n,n+1}) & (\epsilon_{n-1,n}+\epsilon_{n,n+1}+\zeta_n) & -(\alpha'_{n-1,n}+\alpha'_{n,n+1}) \\ -(\beta'_{n-1,n}+\beta'_{n,n+1}+F_n) & -(\alpha'_{n-1,n}+\alpha'_{n,n+1}) & (H_{n-1,n}+H_{n,n+1}-I_{n-1,n} \\ & & -I_{n,n+1}+K_n) \end{vmatrix} ,$$

$$A_{n,n+1} = \begin{vmatrix} -\beta_{n,n+1} & -\alpha_{n,n+1} & \beta'_{n,n+1} \\ -\alpha_{n,n+1} & -\epsilon_{n,n+1} & \alpha'_{n,n+1} \\ \beta'_{n,n+1} & \alpha'_{n,n+1} & (I_{n,n+1}-H_{n,n+1}) \end{vmatrix} ,$$

$$A_{n,n-1} = \begin{vmatrix} -\beta_{n-1,n} & -\alpha_{n-1,n} & \beta'_{n-1,n} \\ -\alpha_{n-1,n} & -\epsilon_{n-1,n} & \alpha'_{n-1,n} \\ \beta'_{n-1,n} & \alpha'_{n-1,n} & (I_{n-1,n}-H_{n-1,n}) \end{vmatrix} = A_{n-1,n} ,$$

and for $n = 1$, $n = N$,

$$A_{1,1} = \begin{vmatrix} (\beta_{1,2} + \delta_1) & \alpha_{1,2} & -(\beta'_{1,2} + F_1) \\ \alpha_{1,2} & (\epsilon_{1,2} + \zeta_1) & -\alpha'_{1,2} \\ -(\beta'_{1,2} + F_1) & -\alpha'_{1,2} & (H_{1,2} - I_{1,2} + K_1) \end{vmatrix} ,$$

$$A_{N,N} = \begin{vmatrix} (\beta_{N-1,N} + \delta_N) & \alpha_{N-1,N} & -(\beta'_{N-1,N} + F_N) \\ \alpha_{N-1,N} & (\epsilon_{N-1,N} + \zeta_N) & -\alpha'_{N-1,N} \\ -(\beta'_{N-1,N} + F_N) & -\alpha'_{N-1,N} & (H_{N-1,N} - I_{N-1,N} + K_N) \end{vmatrix} .$$

ζ_1 and ζ_N incorporate the end conditions, respectively, for moments at the ends of the beam.

The generalized form of the GBRC2 A-matrix which is derived for application to systems of beams with elastic connections is analogous to the GBRC1 generalized A-matrix described on pp. 10-11 of reference 1. The various forms of the 3x3 submatrices of the generalized GBRC2 A-matrix are as follows:
for a rigid connection between sections n and m,

$$A_{n,m} = \begin{vmatrix} -\beta_{n,m} & -\alpha_{n,m} & \beta'_{n,m} \\ -\alpha_{n,m} & -\epsilon_{n,m} & \alpha'_{n,m} \\ \beta'_{n,m} & \alpha'_{n,m} & (I_{n,m} - H_{n,m}) \end{vmatrix} ,$$

for a linear spring-like connection between sections n and m,

$$A_{n,m} = \begin{vmatrix} +k_{n,m}+i\omega c_{n,m} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

where $k_{n,m}$ and $c_{n,m}$ are respectively the spring constant and damping coefficient for the connection.

The general form for diagonal submatrices is

$$A_{n,n} = - \sum_{\substack{m=1 \\ \neq n}}^{N} A_{n,m} + D_n \quad ,$$

where

$$D_n = \begin{vmatrix} \delta_n & 0 & -F_n \\ 0 & \zeta_n & 0 \\ -F_n & 0 & K_n \end{vmatrix} .$$

III. INPUT PREPARATION

This section is given as a supplement to Section IV (Input Preparation) of reference 1. Therefore, only those parameters and options required for torsion-bending problems which are not already described in Section IV of reference 1. will be discussed. It should be noted that GBRC2 data preparation is within the data specifications for GBRC1 except for the following:

a) Number of beam sections

At present the GBRC2 divided beam system can have only 53 sections. This number is completely adequate for the problems which have been run thus far, since these have included at most 20 beam sections. A later version of the code will handle an 80-section beam system, as does GBRC1.

b) System Numbering

In designating the system to which each beam section belongs, i.e., whether to the hull, shaft, etc., any integer between 1 and 80, inclusive, may be used if plotting of results is not required. If plotting is required, only integers 1-5, inclusive, may be used for designating systems. (See Section IV of this report.)

The additonal options available with GBRC2 are specified on the Option Control Card which is described on p. 16 of reference 1. These options are:

Columns	Contents	Description
13 to 16	0001	Op 2: Selects A-matrix and P-vector setup for torsion-bending problems.

Columns	Contents	Description
21 to 24		Op 4: Selector for plotting.
	0001	Used if plots of the edited tables for each frequency are required.
	0002	Used if a plot of the summary edit is required.
	0003	Used if both types of plots described above are required.
29 to 32		Op 6: ≠0 Plot displacements and/or moments and/or twist versus sections for each frequency.
	0004	Plot twist only.
	0005	Plot displacement, moment and twist.
33-36		Op 7: ≠0 Plot displacement and/or moment and/or twist versus frequency for selected sections.
	0004 0005	Same designation as above.

Additional Parameters for Torsion-Bending

a) The integral over a section of $\mu \bar{z}$. GBRC2 notation is $(MZB\Delta X)_n$.

b) The integral over a section of the mass polar moment of inertia with respect to the x-axis. GBRC2 notation is $(IMX\Delta X)_n$.

c) The average value of the distance of the shear center from the x-axis taken from the midpoint of each section to the midpoint of the next. GBRC2 notation is $(ZBB)_{n, n+1}$.

d) The integral from the mid-point of each section to the midpoint of the next section of the reciprocal of the torsional rigidity. GBRC2 notation is $\left(\frac{\Delta X}{GJ_e}\right)_{n, n+1}$.

e) The integral over a section of the externally acting torque. GBRC2 notation is U_n.

Card Format for Additional Torsion-Bending Parameters

The parameters just described are placed on continuation cards which are placed behind the appropriate cards identified as type "41", "42", "43", "51", "52", or "53" (see reference 1, pp. 19-21). No card-type identification number precedes the data on the continuation cards. At present, the GBRC2 code will expect a continuation card behind each "41", "42", "43", "51", "52", and "53" that is used, even if the continuation card has no data.

The card formats are:

A. Continuation "41" card (Real Parts of Scaling Factors for Section Parameters)

Card Columns	Contents
1-16	blank
17-24	scaling for $(\mu \bar{z} \Delta x)_n$
25-32	scaling for $(I_{\mu x} \Delta x)_n$
33-40	scaling for $(\tilde{\bar{z}})_{n, n+1}$
41-48	scaling for $\left(\frac{\Delta x}{GJ_e}\right)_{n, n+1}$
49-56	scaling for U_n

B. Continuation "42" card (Imaginary Parts of Scaling Factors for Section Parameters)

Format same as that for A.

C. Continuation "43" card (Section Parameter Cards)

Card Columns	Contents
1-16	blank
17-24	$(\mu \bar{z} \Delta x)_n$
25-32	$(I_{\mu x} \Delta x)_n$
33-40	$(\bar{\bar{z}})_{n, n+1}$
41-48	$\left(\frac{\Delta x}{GJ_e}\right)_{n, n+1}$
49-56	U_n

D. Continuation "51" card (Real Parts of Scaling Factors for Parameters in Special Connections)

Card Columns	Contents
1-16	blank
17-24	scaling for $(\bar{\bar{z}})_{n, m}$
25-32	scaling for $\left(\frac{\Delta x}{GJ_e}\right)_{n, m}$

E. Continuation "52" card (Imaginary Parts of Scaling Factors for Parameters in Special Connections)

Format same as for D.

F. Continuation "53" card (Special Connection Parameter Cards)

Card Columns	Contents
1-16	blank
17-24	$(\bar{\bar{z}})_{n, m}$
25-32	$\left(\frac{\Delta x}{GJ_e}\right)_{n, m}$

Formats for preparing remaining data such as $\left(\frac{\Delta x}{EI}\right)$, $\left(\frac{\Delta x}{KAG}\right)$, $(I_{\mu z}\Delta x)$, (Δx), etc. are described in Section IV of reference 1.

Note 1. When specifying the option and data required for automatic calculation of the effective mass as a function of frequency it should be kept in mind that the parameter $\bar{z}$ (distance from x-axis to center of mass of a section) as used in this program takes into account the effect of added mass.

Note 2. In listing the numbers of each type of data card used on the Data Control Card as described in reference 1, Section IV, page 16, only the number of each type of data card which actually has an identification number (columns 3 and 4) should be given. In other words, disregard the continuation cards.

IV. MULTI-COMPONENT PLOTTING

To obtain multi-component plots one must specify an option 6 as described on page 18 and assign the same system number to all sections of the beam system which are to appear on the same graph frame. A maximum of five systems can be handled at present by the code. This means that each section of the beam system must have assigned to it a system number, which is an integer 1 through 5. The code will then generate the type of graph or graphs designated by the sub-option under option 6 for each system and for all frequencies computed. If the same system number is given to all sections of the beam system, then the multi-component feature is nullified and the graphs obtained under option 6 will be exactly the type produced by GBRC1 (see reference 1, page 63-64).

It should be noted that GBRC2 will not generate graphs for any system comprising 2 or fewer sections.

An example of the multi-component facility of GBRC2 is given in Sample Problem 4, Section VI. The multi-component facility does not apply to the option 7 summary graphs, because for this option one selects particular sections for plotting, regardless of the system to which they belong.

It should be especially noted that the system numbers (see Sample Data Input Forms - Section V, Figures 4 and 5) assigned to special connections do not affect plotting. These integers may always be in the range 1-80.

V. SAMPLE INPUT FORMS

The data forms for GBRC1 (see Section V of reference 1) have been revised to include the additional parameters required for torsion-bending problems. The revised forms are presented here in Figures 2-6. The data form in Figure 1 is the same as the one used with GBRC1, and has been included only to give completeness to the set of forms for GBRC2. The revised forms are completely consistent with those for GBRC1, and in fact may be used to submit data for either GBRC1 or GBRC2.

TITLE _____ PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL [ ] _____ SHEET _____ OF _____

RUN TITLE CARD

C00000(62HΔΔ

DATA CONTROL CARD

NO TYPE NO TYPE etc.

0090

CASE TITLE CARD

001000(62HΔΔ

OPTION CONTROL CARD

OP1 OP2 OP3 OP4 OP5 OP6 OP7 OP8 OP9 OP10

00200000

EDIT CONTROL CARD

00210000

GENERAL DATA CARD

No. Sections ω_1(CPS) ω_2(CPS) $\Delta\omega$ (CPS)

0030

SYSTEMS DATA CARDS

	SYSTEMS	RADIUS	INITIAL J	
0031				
0031				

Figure 1 - Data Input Card (1)

TITLE _____ PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL ☐☐☐ _____ SHEET _____ OF _____

SECTION DATA CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

IMAGINARY PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

Figure 2 - Data Input Card (2)

TITLE ________ PROGRAMMER ________ DATE ________

PROBLEM NO. ________ PHASE ________ LABEL ☐☐☐☐ ________ SHEET ____ OF ____

SECTION PARAMETER VALUES - UNSCALED

	5	9	13	17	25	33	41	49	57	65–73
0043	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
← BLANK →				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
0043	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
← BLANK →				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
0043	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
← BLANK →				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
0043	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
← BLANK →				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
0043	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
← BLANK →				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		

Figure 3 - Data Input Card (3)

TITLE _____ PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL [ ] _____ SHEET _____

SPECIAL CONNECTION CARDS

5	9	13	17	25	33	41	49	57	65	73

REAL PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{xz}\Delta X)_{n,m}$	$Q_{n,m}$
0051				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{xz}\Delta X)_{n,m}$	$Q_{n,m}$
0051				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{xz}\Delta X)_{n,m}$	$Q_{n,m}$
0051				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										

IMAGINARY PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{xz}\Delta X)_{n,m}$	$Q_{n,m}$
0052				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{xz}\Delta X)_{n,m}$	$Q_{n,m}$
0052				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										

Figure 4 - Data Input Card (4)

TITLE ________ PROGRAMMER ________ DATE ________

PROBLEM NO. ________ PHASE ______ LABEL ☐☐☐☐ ______ SHEET ____ OF ____

SPECIAL CONNECTIONS PARAMETER VALUES

	5	9	13	17	25	33	41	49	57	65
0053	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\,\Delta X)_{n,m}$	$Q_{n,m}$
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
0053	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\,\Delta X)_{n,m}$	$Q_{n,m}$
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
0053	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\,\Delta X)_{n,m}$	$Q_{n,m}$
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
0053	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\,\Delta X)_{n,m}$	$Q_{n,m}$
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
0053	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\,\Delta X)_{n,m}$	$Q_{n,m}$
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
0053	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\,\Delta X)_{n,m}$	$Q_{n,m}$
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										

Figure 5 - Data Input Card (5)

TITLE _____ PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL [ ] _____ SHEET _____ OF _____

CHARACTRON PLOTTING CHARACTERS

3 4	7	13	19	25	31	37	43
00 60 00	BLANK						

NATURAL FREQUENCY SELECTION CARD

3 4	9	11
00 70	0000	

START NEW DATA SET CARD

3 4
00 98

END OF DATA CARD

3 4
00 99

Figure 6 - Data Input Card (6)

VI. SAMPLE PROBLEMS

Four sample problems illustrate the types of vibration calculations to which GBRC2 can be applied. The first three problems are based upon the simple beam structure shown in Figure 7. In these problems, the use of the code for calculating the steady-state damped response and/or undamped natural frequencies of the sample structure and plotting of results is demonstrated. The fourth sample problem shows how multi-component plotting is obtained for a coupled beam structure.

These problems were run on the IBM 7090 computer with IBSYS Monitor at the Applied Mathematics Laboratory. Automatic plotting was done by a Stromberg-Carlson 4020 Microfilm Recorder. The average computer time, including plotting, was 2 minutes for each sample problem.

SAMPLE PROBLEM 1: DAMPED HORIZONTAL TORSION-BENDING RESPONSE OF A BEAM WITH SPRUNG MASS

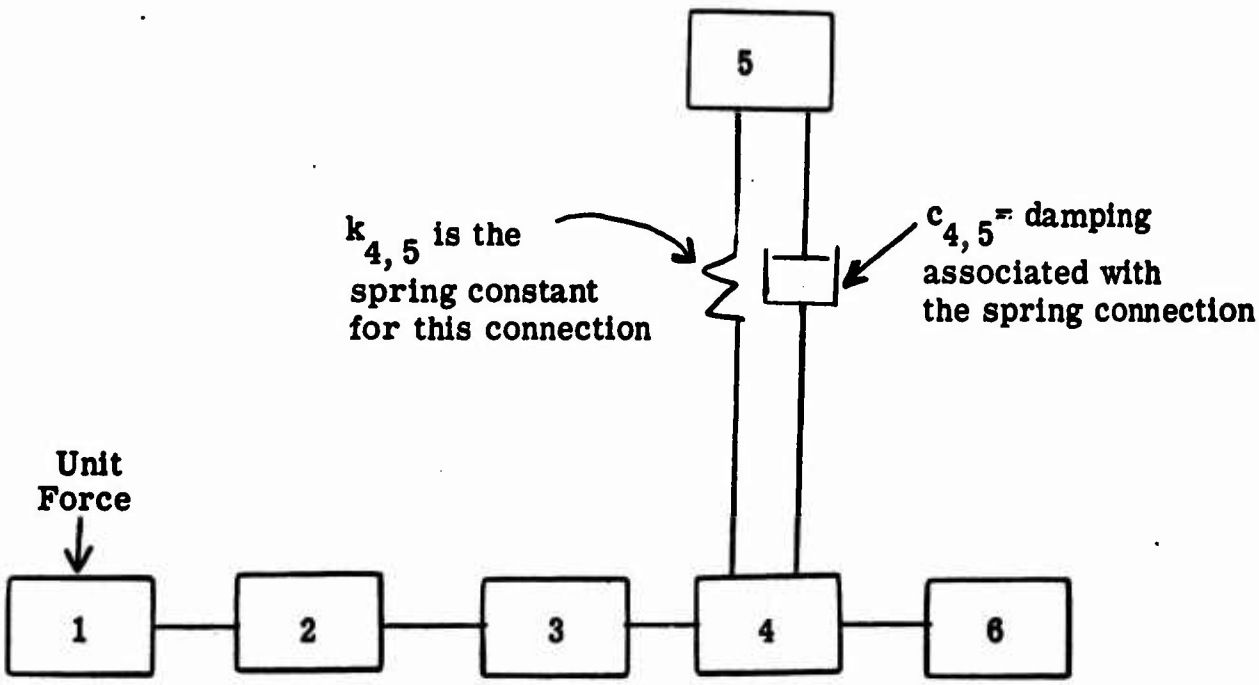


Figure 7

TITLE SAMPLE PROBLEM 1 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 1 OF 2

RUN TITLE CARD (space)

C00000(62 HΔΔ SAMPLE PROBLEM 1

DATA CONTROL CARD

NO TYPE NO TYPE etc.

0090	01	10	01	20	01	30	01	41	01	42	06	43	01	51	02	53	01	21																						
5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71									

CASE TITLE CARD (space)

001000(62 HΔΔ DAMPED RESPONSE TO UNIT FORCE

OPTION CONTROL CARD

	OP1	OP2	OP3	OP4	OP5	OP6	OP7	OP8	OP9	OP10
00200000		0001								
	9	13	17	21	25	29	33	37	41	45

EDIT CONTROL CARD

00210000	0001	0003	0006			
	3	13	17	21	25	29

GENERAL DATA CARD

	No. Systems	ω_1 (CPS)	ω_2 (CPS)	$\Delta\omega$ (CPS)
C030	0006	1.0	25.0	1.0
	5	9	17	25

SYSTEMS DATA CARDS

	SYSTEMS	RADIUS	INITIAL J
0031			
0031			

SAMPLE PROBLEM 1

DATE

PHASE ____ LABEL [ ][ ][ ] SHEET 2 OF 9

SECTION DATA CARDS

5 9 13 17 25 33 41 49 57 65 73

FIRST PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000	0001	1.0		ΔΔ1.0 E-8	1.0	ΔΔ1.0 E-5		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK →				1.0	ΔΔ1.0 E2	1.0	ΔΔ1.0 E-8			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
	0000									
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK										

IMAGINARY PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000	0001	-.03 ← Rayleigh Damping		Constant				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

TITLE SAMPLE PROBLEM 1 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 2 OF 7

SECTION PARAMETER VALUES - UNSCALED

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0001	0001	0001	2.35		12.89	15.0	2.13		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				173.0	101.04	8.93	0.497			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0002		0001	4.89		2.01	14.0	0.54		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				109.0	101.43	8.7	0.375			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0003		0001	6.04		1.02	14.0	0.33		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				116.8	125.8	8.48	0.274			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0004		0001	11.3		0.57				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				165.0	159.12					
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0005		0001	0.26		0.90				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

TITLE **SAMPLE PROBLEM 1** PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 4 OF 7

SECTION PARAMETER VALUES - UNSCALED

1	5	9	13	17	25	33	41	49	57	65
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0006	0002	0001	6.74		0.39				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				79.2	327.9					
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
OC43										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

TITLE **SAMPLE PROBLEM 1** PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 5 OF 7

SPECIAL CORRECTION CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051			0001	ΔΔ1.0E5	1.0		1.0	ΔΔ1.0E-5		
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK				1.0	ΔΔ1.0E-8					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

IMAGINARY PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0052										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0052										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

SAMPLE PROBLEM 1

TITLE SAMPLE PROBLEM 1 — PROGRAMMER ____ DATE ____

PROBLEM NO. ____ PHASE ____ LABEL ____ SHEET 6 OF 7

SPECIAL CONNECTIONS — PARAMETER VALUES

	5	9	13	17	25	33	41	49	57	65
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{uz}\Delta X)_{n,m}$	$Q_{n,m}$
0053	0004	0005	0001	0.319	0.2					
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{uz}\Delta X)_{n,m}$	$Q_{n,m}$
0053	0004	0006	0001				15.0	0.25		
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →				8.6	0.57					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{uz}\Delta X)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{uz}\Delta X)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{uz}\Delta X)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta X)_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{uz}\Delta X)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{Z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										

TITLE SAMPLE PROBLEM 1 PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL [ ] SHEET 1 OF 2

CHARACTRON PLOTTING CHARACTERS

3 4	7	13	19	25	31	37	43
00 60 00	BLANK						

NATURAL FREQUENCY SELECTION CARD

3 4	9	11
00 70	0000	

START NEW DATA SET CARD

3 4
00 98

END OF DATA CARD

3 4
00 99

38

GBRC2 SEPT 20, 1964
SAMPLE PROBLEM 1

DATA CONTROL CARD

NO	TYPE
1	10
1	20
1	30
1	41
1	42
6	43
1	51
2	53
1	21

CASE TITLE-DAMPED RESPONSE TO UNIT FORCE

OPTION DATA
20 -0 1 -0 -0 -0 -0 -0 -0 -0 -0

GENERAL DATA - NUMBER OF SECTIONS 6
FREQUENCY RANGE FROM 1.000 CPS TO 25.000 CPS
FREQUENCY INTERVAL 1.000 CPS

REAL PARTS OF SCALING FACTORS

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	INZ*DX(N,N+1)	P(N)
1	1.0000E 00	-0.	1.0000E-08	1.0000E 00	1.0000E-05	-0.	1.0000E 00

MZB*DX(N)	INX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0000E 00	1.0000E 02	1.0000E 00	1.0000E-08	-0.

IMAGINARY PARTS OF SCALING FACTORS

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	INZ*DX(N,N+1)	P(N)
1	-3.0000E-02	-0.	-0.	-0.	-0.	-0.	-0.

MZB*DX(N)	INX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
-0.	-0.	-0.	-0.	-0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	INZ*DX(N,N+1)	P(N)
1 1 1	2.3500E 00	-0.	1.2890E 01	1.5000E 01	2.1300E 00	-0.	1.0000E 00

MZB*DX(N)	INX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.7300E 02	1.0104E 02	8.9300E 00	4.9700E-01	-0.

	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	INZ*DX(N,N+1)	P(N)
2 -0 1	4.8900E 00	-0.	2.0100E 00	1.4000E 01	5.4000E-01	-0.	-0.

MZB*DX(N)	INX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0900E 02	1.0143E 02	8.7000E 00	3.7500E-01	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
3	-0	1	6.0400E 00	-0.	1.0200E 00	1.4000E 01	3.3000E-01	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.1680E 02	1.2580E 02	8.4800E 00	2.7400E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
4	-0	1	1.1300E 01	-0.	5.7000E-01	-0.	-0.	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.6500E 02	1.5912E 02	-0.	-0.	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
5	-0	1	2.6000E-01	-0.	9.0000E-01	-0.	-0.	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			-0.	-0.	-0.	-0.	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
6	2	1	6.7400E 00	-0.	3.9000E-01	-0.	-0.	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			7.9200E 01	3.2790E 02	-0.	-0.	-0.		

REAL PARTS OF SCALING FACTORS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
		1	1.0000E 05	1.0000E 00	-0.	1.0000E 00	1.0000E-05	-0.	-0.
			ZBB(N,M)	DX/GJE(N,M)					
			1.0000E 00	1.0000E-08					

PARAMETER VALUES FOR SPECIAL CONNECTIONS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
4	5	1	5.1900E-01	2.0000E-01	-0.	-0.	-0.	-0.	-0.
			ZBB(N,M)	DX/GJE(N,M)					
			-0.	-0.					
			K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
4	6	1	-0.	-0.	-0.	1.5000E 01	2.5000E-01	-0.	-0.
			ZBB(N,M)	DX/GJE(N,M)					
			8.6000E 00	5.9000E-01					

OPTION DATA

21 1 3 6 -0 -0 -0 -0 -0 -0 -0

GHRC

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY		SECTION 1	SECTION 3	SECTION 6	SECTION
1.00	DEFLECTION	3.094E-03	1.931E-03	1.255E-03	
	MOMENT	1.095E-06	1.043E 01	1.099E-06	
	TWIST	1.743E-05	1.773E-05	1.796E-05	
2.00	DEFLECTION	1.251E-03	4.809E-04	3.126E-04	
	MOMENT	2.704E-07	1.042E 01	2.738E-07	
	TWIST	4.029E-06	4.332E-06	4.566E-06	
3.00	DEFLECTION	5.395E-04	2.123E-04	1.381E-04	
	MOMENT	1.176E-07	1.041E 01	1.210E-07	
	TWIST	1.545E-06	1.848E-05	2.087E-06	
4.00	DEFLECTION	2.902E-04	1.182E-04	7.692E-05	
	MOMENT	6.413E-08	1.039E 01	6.745E-08	
	TWIST	6.719E-07	9.752E-07	1.223E-06	
5.00	DEFLECTION	1.746E-04	7.449E-05	4.855E-05	
	MOMENT	3.933E-08	1.036E 01	4.264E-08	
	TWIST	2.634E-07	5.674E-07	8.258E-07	
6.00	DEFLECTION	1.117E-04	5.063E-05	3.303E-05	
	MOMENT	2.582E-08	1.031E 01	2.911E-08	
	TWIST	3.588E-08	3.411E-07	6.146E-07	
7.00	DEFLECTION	7.339E-05	3.606E-05	2.355E-05	
	MOMENT	1.762E-08	1.023E 01	2.089E-08	
	TWIST	1.088E-07	1.987E-07	4.927E-07	
8.00	DEFLECTION	4.817E-05	2.636E-05	1.722E-05	
	MOMENT	1.223E-08	1.010E 01	1.545E-08	
	TWIST	2.129E-07	9.857E-08	4.207E-07	
9.00	DEFLECTION	3.035E-05	1.936E-05	1.263E-05	
	MOMENT	8.430E-09	9.882E 00	1.158E-08	
	TWIST	2.993E-07	1.916E-08	3.813E-07	
10.00	DEFLECTION	1.679E-05	1.380E-05	8.920E-06	
	MOMENT	5.561E-09	9.481E 00	8.581E-09	
	TWIST	3.852E-07	5.383E-08	3.686E-07	
11.00	DEFLECTION	5.339E-06	8.660E-06	5.407E-06	
	MOMENT	3.167E-09	8.678E 00	5.932E-09	
	TWIST	4.927E-07	1.357E-07	3.862E-07	
12.00	DEFLECTION	6.427E-06	2.445E-06	9.602E-07	
	MOMENT	7.519E-10	6.781E 00	2.926E-09	
	TWIST	6.743E-07	2.579E-07	4.587E-07	
13.00	DEFLECTION	2.600E-05	1.064E-05	8.917E-06	
	MOMENT	3.184E-09	8.024E-01	3.016E-09	
	TWIST	1.172E-06	5.572E-07	7.196E-07	

14.00	DEFLECTION	2.443E-04	1.958E-04	1.535E-04
	MOMENT	4.814E-08	1.238E 02	8.576E-08
	TWIST	8.619E-06	4.790E-06	4.880E-06
15.00	DEFLECTION	2.258E-05	3.384E-05	2.667E-05
	MOMENT	6.464E-09	3.249E 01	1.640E-08
	TWIST	8.581E-07	5.172E-07	4.406E-07
16.00	DEFLECTION	4.212E-06	2.158E-05	1.755E-05
	MOMENT	2.802E-09	2.734E 01	1.112E-08
	TWIST	3.547E-07	1.920E-07	1.452E-07
17.00	DEFLECTION	7.461E-06	1.791E-05	1.541E-05
	MOMENT	1.070E-09	2.911E 01	9.817E-09
	TWIST	2.172E-07	4.598E-08	3.706E-08
18.00	DEFLECTION	1.871E-05	1.780E-05	1.687E-05
	MOMENT	7.853E-10	3.777E 01	1.065E-08
	TWIST	2.196E-07	1.421F-07	6.594E-08
19.00	DEFLECTION	5.591E-05	2.611E-05	3.190E-05
	MOMENT	4.975E-09	8.398E 01	1.970E-08
	TWIST	6.040E-07	7.376E-07	3.419E-07
20.00	DEFLECTION	5.360E-05	1.282E-05	2.252E-05
	MOMENT	6.441E-09	7.002E 01	1.339E-08
	TWIST	8.623E-07	1.075E-06	4.764E-07
21.00	DEFLECTION	1.174E-05	4.366E-07	4.085E-06
	MOMENT	1.807E-09	1.544E 01	2.255E-09
	TWIST	3.788E-07	4.028F-07	1.713E-07
22.00	DEFLECTION	2.451E-06	2.377E-06	9.829E-07
	MOMENT	6.559E-10	5.139E 00	4.285E-10
	TWIST	3.004E-07	2.628F-07	1.085E-07
23.00	DEFLECTION	2.214E-06	2.875E-06	8.547E-08
	MOMENT	2.156E-11	8.931F-01	1.737E-10
	TWIST	2.749E-07	1.983E-07	8.059E-08
24.00	DEFLECTION	5.300E-06	2.951E-06	5.176E-07
	MOMENT	4.409E-10	1.378E 00	3.878E-10
	TWIST	2.655E-07	1.596E-07	6.498E-08
25.00	DEFLECTION	7.686E-06	2.865E-06	6.747E-07
	MOMENT	8.161E-10	2.752E 00	4.390E-10
	TWIST	2.633E-07	1.329E-07	5.537E-08

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 1.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-5.0908E-03	-1.8317E-04	5.0941E-03	-1.7794E 02
	MOMENT	1.0948E-06	3.7446E-08	1.0954E-06	1.9590E 00
	TWIST	-1.7416E-05	-6.6550E-07	1.7428E-05	-1.7781E 02
2	DEFLECTION	-3.4639E-03	-1.2709E-04	3.4662E-03	-1.7790E 02
	MOMENT	9.6921E 00	2.5802E-02	9.6921E 00	1.5253E-01
	TWIST	-1.7583E-05	-6.7047E-07	1.7595E-05	-1.7782E 02
3	DEFLECTION	-1.9299E-03	-7.4696E-05	1.9313E-03	-1.7778E 02
	MOMENT	1.0425E 01	2.7654E-02	1.0425E 01	1.5198E-01
	TWIST	-1.7718E-05	-6.7522E-07	1.7731E-05	-1.7782E 02
4	DEFLECTION	-3.9265E-04	-2.2287E-05	3.9329E-04	-1.7575E 02
	MOMENT	5.8522E 00	1.7014E-02	5.8522E 00	1.6657E-01
	TWIST	-1.7809E-05	-6.7869E-07	1.7822E-05	-1.7782E 02
5	DEFLECTION	-3.9278E-04	-2.2290E-05	3.9341E-04	-1.7575E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.2543E-03	3.3849E-05	1.2548E-03	1.5458E 00
	MOMENT	-1.0981E-06	-3.7455E-08	1.0988E-06	-1.7805E 02
	TWIST	-1.7949E-05	-6.8448E-07	1.7962E-05	-1.7782E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 2.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-1.2504E-03	-4.4857E-05	1.2512E-03	-1.7795E 02
	MOMENT	2.7027E-07	9.1843E-09	2.7043E-07	1.9462E 00
	TWIST	-4.0260E-06	-1.5390E-07	4.0289E-06	-1.7781E 02
2	DEFLECTION	-8.6023E-04	-3.1156E-05	8.6080E-04	-1.7793E 02
	MOMENT	9.6819E 00	2.2182E-02	9.6820E 00	1.3127E-01
	TWIST	-4.1925E-06	-1.5884E-07	4.1955E-06	-1.7783E 02
3	DEFLECTION	-4.8059E-04	-1.8334E-05	4.8094E-04	-1.7782E 02
	MOMENT	1.0419E 01	2.3331E-02	1.0419E 01	1.2830E-01
	TWIST	-4.3285E-06	-1.6357E-07	4.3316E-06	-1.7784E 02
4	DEFLECTION	-9.7690E-05	-5.4935E-06	9.7844E-05	-1.7578E 02
	MOMENT	5.8487E 00	1.4427E-02	5.8487E 00	1.4133E-01
	TWIST	-4.4198E-06	-1.6705E-07	4.4230E-06	-1.7784E 02
5	DEFLECTION	-9.7816E-05	-5.4968E-06	9.7971E-05	-1.7678E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	3.1248E-04	8.2465E-06	3.1259E-04	1.5117E 00
	MOMENT	-2.7362E-07	-9.1919E-09	2.7377E-07	-1.7808E 02
	TWIST	-4.5625E-06	-1.7289E-07	4.5658E-06	-1.7783E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 3.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-5.3911E-04	-1.9245E-05	5.3946E-04	-1.7796E 02
	MOMENT	1.1757E-07	3.9505E-09	1.1763E-07	1.9245E 00
	TWIST	-1.5437E-06	-5.9176E-08	1.5448E-06	-1.7780E 02
2	DEFLECTION	-3.7797E-04	-1.3386E-05	3.7820E-04	-1.7797E 02
	MOMENT	9.6639E 00	1.6091E-02	9.6640E 00	9.5399E-02
	TWIST	-1.7094E-06	-6.4047E-08	1.7106E-06	-1.7785E 02
3	DEFLECTION	-2.1213E-04	-7.8915E-06	2.1228E-04	-1.7787E 02
	MOMENT	1.0407E 01	1.6052E-02	1.0407E 01	8.8374E-02
	TWIST	-1.8465E-06	-6.8763E-08	1.8477E-06	-1.7787E 02
4	DEFLECTION	-4.3046E-05	-2.3822E-06	4.3111E-05	-1.7683E 02
	MOMENT	5.8422E 00	1.0072E-02	5.8422E 00	9.8778E-02
	TWIST	-1.9392E-06	-7.2257E-08	1.9406E-06	-1.7787E 02
5	DEFLECTION	-4.3171E-05	-2.3854E-06	4.3237E-05	-1.7684E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.3802E-04	3.5024E-06	1.3807E-04	1.4536E 00
	MOMENT	-1.2090E-07	-3.9559E-09	1.2097E-07	-1.7813E 02
	TWIST	-2.0857E-06	-7.8178E-08	2.0872E-06	-1.7785E 02

GBRC 2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 4.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-2.9002E-04	-1.0283E-05	2.9020E-04	-1.7797E 02
	MOMENT	6.4092E-08	2.1185E-09	6.4127E-08	1.8931E 00
	TWIST	-6.7138E-07	-2.6037E-08	6.7189E-07	-1.7778E 02
2	DEFLECTION	-2.0903E-04	-7.1585E-06	2.0915E-04	-1.7804E 02
	MOMENT	9.6362E 00	7.4411E-03	9.6362E 00	4.4244E-02
	TWIST	-8.3611E-07	-3.0818E-08	8.3667E-07	-1.7789E 02
3	DEFLECTION	-1.1809E-04	-4.2309E-06	1.1816E-04	-1.7795E 02
	MOMENT	1.0387E 01	5.7059E-03	1.0387E 01	3.1473E-02
	TWIST	-9.7451E-07	-3.5513E-08	9.7516E-07	-1.7791E 02
4	DEFLECTION	-2.3893E-05	-1.2915E-06	2.3928E-05	-1.7691E 02
	MOMENT	5.8312E 00	3.8859E-03	5.8312E 00	3.8182E-02
	TWIST	-1.0695E-06	-3.9023E-08	1.0702E-06	-1.7791E 02
5	DEFLECTION	-2.4016E-05	-1.2944E-06	2.4051E-05	-1.7591E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	7.6901E-05	1.8384E-06	7.6923E-05	1.3694E 00
	MOMENT	-6.7421E-08	-2.1205E-09	6.7454E-08	-1.7820E 02
	TWIST	-1.2217E-06	-4.5061E-08	1.2226E-06	-1.7789E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 5.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-1.7454E-04	-6.1366E-06	1.7465E-04	-1.7799E 02
	MOMENT	3.9308E-08	1.2701E-09	3.9329E-08	1.8506E 00
	TWIST	-2.6319E-07	-1.0710E-08	2.6341E-07	-1.7767E 02
2	DEFLECTION	-1.3066E-04	-4.2676E-06	1.3073E-04	-1.7813E 02
	MOMENT	9.5954E 00	-3.8943E-03	9.5954E 00	-2.3255E-02
	TWIST	-4.2665E-07	-1.5375E-08	4.2693E-07	-1.7794E 02
3	DEFLECTION	-7.4445E-05	-2.5296E-06	7.4486E-05	-1.7805E 02
	MOMENT	1.0357E 01	-7.8661E-03	1.0357E 01	-4.3520E-02
	TWIST	-5.6703E-07	-2.0039E-08	5.6738E-07	-1.7798E 02
4	DEFLECTION	-1.4994E-05	-7.8453E-07	1.5014E-05	-1.7700E 02
	MOMENT	5.8136E 00	-4.2205E-03	5.8136E 00	-4.1595E-02
	TWIST	-6.6499E-07	-2.3577E-08	6.6541E-07	-1.7797E 02
5	DEFLECTION	-1.5116E-05	-7.8719E-07	1.5136E-05	-1.7702E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	4.8534E-05	1.0639E-06	4.8545E-05	1.2558E 00
	MOMENT	-4.2625E-08	-1.2683E-09	4.2644E-08	-1.7830E 02
	TWIST	-8.2529E-07	-2.9765E-08	8.2582E-07	-1.7793E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 6.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-1.1159E-04	-3.8846E-06	1.1165E-04	-1.7801E 02
	MOMENT	2.5805E-08	8.0854E-10	2.5817E-08	1.7947E 00
	TWIST	-3.5797E-08	-2.3922E-09	3.5877E-08	-1.7518E 02
2	DEFLECTION	-8.7868E-05	-2.6866E-06	8.7909E-05	-1.7825E 02
	MOMENT	9.5359E 00	-1.8079E-02	9.5359E 00	-1.0863E-01
	TWIST	-1.9781E-07	-6.9149E-09	1.9794E-07	-1.7800E 02
3	DEFLECTION	-5.0601E-05	-1.5972E-06	5.0626E-05	-1.7819E 02
	MOMENT	1.0308E 01	-2.4065E-02	1.0308E 01	-1.3821E-01
	TWIST	-3.4092E-07	-1.1539E-08	3.4112E-07	-1.7806E 02
4	DEFLECTION	-1.0118E-05	-5.0666E-07	1.0131E-05	-1.7713E 02
	MOMENT	5.7853E 00	-1.4359E-02	5.7854E 00	-1.4216E-01
	TWIST	-4.4298E-07	-1.5108E-08	4.4324E-07	-1.7805E 02
5	DEFLECTION	-1.0237E-05	-5.0897E-07	1.0250E-05	-1.7715E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	3.3027E-05	6.3841E-07	3.3033E-05	1.1074E 00
	MOMENT	-2.9103E-06	-8.0158E-10	2.9114E-08	-1.7842E 02
	TWIST	-6.1423E-07	-2.1482E-08	6.1460E-07	-1.7800E 02

84

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 7.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-7.3344E-05	-2.5253E-06	7.3388E-05	-1.7803E 02
	MOMENT	1.7610E-08	5.2909E-10	1.7618E-08	1.7209E 00
	TWIST	1.0875E-07	2.6141E-09	1.0878E-07	1.3770E 00
2	DEFLECTION	-6.1778E-05	-1.7204E-06	6.1802E-05	-1.7840E 02
	MOMENT	9.4476E 00	-3.5284E-02	9.4477E 00	-2.1398E-01
	TWIST	-5.1756E-08	-1.7357E-09	5.1785E-08	-1.7808E 02
3	DEFLECTION	-3.6045E-05	-1.0258E-06	3.6060E-05	-1.7837E 02
	MOMENT	1.0230E 01	-4.5493E-02	1.0230E 01	-2.5479E-01
	TWIST	-1.9864E-07	-6.3054E-09	1.9874E-07	-1.7818E 02
4	DEFLECTION	-7.1255E-06	-3.3617E-07	7.1335E-06	-1.7730E 02
	MOMENT	5.7394E 00	-2.6615E-02	5.7395E 00	-2.6569E-01
	TWIST	-3.0624E-07	-9.9074E-09	3.0640E-07	-1.7815E 02
5	DEFLECTION	-7.2399E-06	-3.3804E-07	7.2477E-06	-1.7733E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	2.3550E-05	3.7628E-07	2.3553E-05	9.1541E-01
	MOMENT	-2.0880E-08	-5.1584E-10	2.0886E-08	-1.7858E 02
	TWIST	-4.9238E-07	-1.6520E-08	4.9266E-07	-1.7908E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 0.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-4.8144E-05	-1.6391E-06	4.8172E-05	-1.7805E 02
	MOMENT	1.2221E-08	3.4592E-10	1.2226E-08	1.6213E 00
	TWIST	2.1282E-07	5.8333E-09	2.1290E-07	1.5701E 00
2	DEFLECTION	-4.4457E-05	-1.0788E-06	4.4470E-05	-1.7861E 02
	MOMENT	9.3124E 00	-5.5591E-02	9.3126E 00	-3.4203E-01
	TWIST	5.3671E-08	1.6969E-09	5.3698E-08	1.8109E 00
3	DEFLECTION	-2.6355E-05	-6.4311E-07	2.6363E-05	-1.7860E 02
	MOMENT	1.0102E 01	-6.9821E-02	1.0102E 01	-3.9601E-01
	TWIST	-9.8529E-08	-2.7917E-09	9.8568E-08	-1.7838E 02
4	DEFLECTION	-5.1129E-06	-2.2199E-07	5.1177E-06	-1.7751E 02
	MOMENT	5.5630E 00	-4.0994E-02	5.5631E 00	-4.1476E-01
	TWIST	-2.1375E-07	-6.4203E-09	2.1385E-07	-1.7828E 02
5	DEFLECTION	-5.2206E-06	-2.2334E-07	5.2253E-06	-1.7755E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.7223E-05	2.0001E-07	1.7224E-05	6.6534E-01
	MOMENT	-1.5446E-08	-3.2529E-10	1.5450E-08	-1.7879E 02
	TWIST	-4.2045E-07	-1.3292E-08	4.2066E-07	-1.7819E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 9.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-3.0334E-05	-1.0239E-06	3.0351E-05	-1.7807E 02
	MOMENT	8.4274E-09	2.1770E-10	8.4302E-09	1.4797E 00
	TWIST	2.9919E-07	7.9286E-09	2.9930E-07	1.5179E 00
2	DEFLECTION	-3.2021E-05	-6.201 E-07	3.2027E-05	-1.7889E 02
	MOMENT	9.0945E 00	-7.8621E-02	9.0949E 00	-4.9530E-01
	TWIST	1.4083E-07	4.0724E-09	1.4089E-07	1.6563E 00
3	DEFLECTION	-1.9359E-05	-3.6807E-07	1.9363E-05	-1.7891E 02
	MOMENT	9.8814E 00	-9.7326E-02	9.8819E 00	-5.6431E-01
	TWIST	-1.9163E-08	-3.7450E-10	1.9165E-08	-1.7918E 02
4	DEFLECTION	-3.6340E-06	-1.3951E-07	3.6367E-06	-1.7780E 02
	MOMENT	5.5308E 00	-5.7078E-02	5.5310E 00	-5.9128E-01
	TWIST	-1.4521E-07	-3.8957E-09	1.4526E-07	-1.7846E 02
5	DEFLECTION	-3.7313E-06	-1.4021E-07	3.7340E-06	-1.7785E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.2626E-05	7.2692E-08	1.2626E-05	3.3077E-01
	MOMENT	-1.1579E-08	-1.8871E-10	1.1580E-08	-1.7907E 02
	TWIST	-3.8118E-07	-1.1007E-08	3.8133E-07	-1.7835E 02

GBRCE

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 10.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-1.6779E-05	-5.7269E-07	1.6789E-05	-1.7805E 02
	MOMENT	5.5595E-09	1.2837E-10	5.5609E-09	1.2509E 00
	TWIST	3.8506E-07	9.0310E-09	3.8517E-07	1.3435E 00
2	DEFLECTION	-2.2240E-05	-2.7469E-07	2.2241E-05	-1.7929E 02
	MOMENT	8.7178E 00	-1.0218E-01	8.7184E 00	-6.7142E-01
	TWIST	2.2597E-07	5.5990E-09	2.2604E-07	1.4193E 00
3	DEFLECTION	-1.3795E-05	-1.5847E-07	1.3796E-05	-1.7934E 02
	MOMENT	9.4801E 00	-1.2517E-01	9.4809E 00	-7.5645E-01
	TWIST	5.3805E-08	1.5510E-09	5.3827E-08	1.6512E 00
4	DEFLECTION	-2.4234E-06	-7.5721E-08	2.4245E-06	-1.7821E 02
	MOMENT	5.2883E 00	-7.2937E-02	5.2888E 00	-7.9013E-01
	TWIST	-8.8490E-08	-1.9439E-09	8.8511E-08	-1.7874E 02
5	DEFLECTION	-2.5040E-06	-7.5708E-08	2.5052E-06	-1.7827E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	8.9203E-06	-2.2056E-08	8.9203E-06	-1.4163E-01
	MOMENT	-8.5802E-09	-8.4911E-11	8.5806E-09	-1.7943E 02
	TWIST	-3.6850E-07	-9.1009E-09	3.6861E-07	-1.7859E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 11.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-5.3339E-06	-2.3117E-07	5.3389E-06	-1.7752E 02
	MOMENT	3.1664E-09	4.8434E-11	3.1668E-09	8.7633E-01
	TWIST	4.9261E-07	8.3985E-09	4.9268E-07	9.7675E-01
2	DEFLECTION	-1.3398E-05	-1.7077E-08	1.3398E-05	-1.7993E 02
	MOMENT	7.9943E 00	-1.1609E-01	7.9952E 00	-8.3197E-01
	TWIST	3.2888E-07	5.7779E-09	3.2893E-07	1.0065E 00
3	DEFLECTION	-8.6596E-06	-8.2840E-10	8.6596E-06	-1.7999E 02
	MOMENT	8.6766E 00	-1.4070E-01	8.6777E 00	-9.2901E-01
	TWIST	1.3568E-07	2.5156E-09	1.3571E-07	1.0622E 00
4	DEFLECTION	-1.2589E-06	-2.4946E-08	1.2591E-06	-1.7886E 02
	MOMENT	4.8010E 00	-8.0349E-02	4.8017E 00	-9.5880E-01
	TWIST	-3.3465E-08	-4.2562E-10	3.3468E-08	-1.7927E 02
5	DEFLECTION	-1.3099E-06	-2.4342E-08	1.3101E-06	-1.7894E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	5.4062E-06	-8.3389E-08	5.4068E-06	-8.8370E-01
	MOMENT	-5.9320E-09	-6.1692E-12	5.9320E-09	-1.7994E 02
	TWIST	-3.8614E-07	-6.7401E-09	3.8620E-07	-1.7900E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 12.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	6.4274E-06	-3.1649E-08	6.4275E-06	-2.8213E-01
	MOMENT	7.5191E-10	1.0941E-12	7.5191E-10	8.3374E-02
	TWIST	6.7431E-07	1.3806E-09	6.7432E-07	1.1730E-01
2	DEFLECTION	-3.0538E-06	5.9612E-08	3.0543E-06	1.7888E 02
	MOMENT	6.3401E 00	-6.5349E-02	6.3405E 00	-5.9053E-01
	TWIST	4.9447E-07	1.0251E-09	4.9447E-07	1.1878E-01
3	DEFLECTION	-2.4450E-06	4.2907E-08	2.4454E-06	1.7899E 02
	MOMENT	6.7802E 00	-7.6378E-02	6.7806E 00	-6.4541E-01
	TWIST	2.5789E-07	5.5356E-10	2.5789E-07	1.2299E-01
4	DEFLECTION	2.1653E-07	1.8849E-09	2.1654E-07	4.9875E-01
	MOMENT	3.6482E 00	-3.6664E-02	3.6484E 00	-5.7585E-01
	TWIST	3.5986E-08	9.3933E-11	3.5986E-08	1.4956E-01
5	DEFLECTION	2.2705E-07	1.6403E-09	2.2706E-07	4.1390E-01
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	9.5910E-07	-4.5808E-08	9.6019E-07	-2.7344E 00
	MOMENT	-2.9258E-09	2.1922E-11	2.9259E-09	1.7957E 02
	TWIST	-4.5869E-07	-9.1761E-10	4.5869E-07	-1.7989E 02

GBRC?

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 13.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	2.5985E-05	-9.0199E-07	2.6001E-05	-1.9880E 00
	MOMENT	-3.1801E-09	1.6042E-10	3.1842E-09	1.7711E 02
	TWIST	1.1703E-06	-5.7276E-08	1.1717E-06	-2.8019E 00
2	DEFLECTION	1.7825E-05	-1.3985E-06	1.7880E-05	-4.4861E 00
	MOMENT	8.4325E-01	5.9617E-01	1.0327E 00	3.5260E 01
	TWIST	9.2476E-07	-4.5024E-08	9.2586E-07	-2.7874E 00
3	DEFLECTION	1.0601E-05	-9.0145E-07	1.0640E-05	-4.8602E 00
	MOMENT	3.3761E-01	7.2797E-01	8.0244E-01	6.5119E 01
	TWIST	5.5650E-07	-2.7144E-08	5.5717E-07	-2.7925E 00
4	DEFLECTION	3.4050E-06	-1.9089E-07	3.4104E-06	-3.2087E 00
	MOMENT	-2.7361E-01	4.6790E-01	5.4202E-01	1.2032E 02
	TWIST	1.8224E-07	-9.1065E-09	1.8246E-07	-2.8507E 00
5	DEFLECTION	3.6005E-06	-2.0819E-07	3.6065E-06	-3.3093E 00
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	-8.8772E-06	8.3688E-07	8.9166E-06	1.7461E 02
	MOMENT	2.9918E-09	-3.8117E-10	3.0160E-09	-7.2606E 00
	TWIST	-7.1880E-07	3.4852E-08	7.1965E-07	1.7722E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 14.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	6.5331E-05	-2.3541E-04	2.4430E-04	-7.4489E 01
	MOMENT	-1.1166E-08	4.6832E-08	4.8145E-08	1.0341E 02
	TWIST	1.9780E-06	-8.3894E-06	8.6195E-06	-7.6733E 01
2	DEFLECTION	5.8364E-05	-3.0005E-04	3.0567E-04	-7.8992E 01
	MOMENT	-8.8247E 00	1.0371E 02	1.0409E 02	9.4863E 01
	TWIST	1.6702E-06	-7.0026E-06	7.1990E-06	-7.6585E 01
3	DEFLECTION	3.6120E-05	-1.9247E-04	1.9583E-04	-7.9371E 01
	MOMENT	-1.0634E 01	1.2333E 02	1.2378E 02	9.4928E 01
	TWIST	1.1155E-06	-4.6584E-06	4.7901E-06	-7.6534E 01
4	DEFLECTION	1.0276E-05	-4.6793E-05	4.7908E-05	-7.7615E 01
	MOMENT	-6.7010E 00	7.5239E 01	7.5537E 01	9.5089E 01
	TWIST	4.9247E-07	-2.0665E-06	2.1244E-06	-7.6596E 01
5	DEFLECTION	1.0865E-05	-4.9965E-05	5.1133E-05	-7.7732E 01
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	-2.6472E-05	1.5115E-04	1.5345E-04	9.9934E 01
	MOMENT	1.4406E-08	-8.4546E-08	8.5765E-08	-8.0330E 01
	TWIST	-1.1380E-06	4.7459E-06	4.8804E-06	1.0348E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 15.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-2.1489E-05	-6.9386E-06	2.2582E-05	-1.6211E 02
	MOMENT	6.3139E-09	1.3843E-09	6.4638E-09	1.2366E 01
	TWIST	-8.4081E-07	-1.7155E-07	8.5813E-07	-1.6847E 02
2	DEFLECTION	-5.0038E-05	-7.5211E-06	5.0600E-05	-1.7145E 02
	MOMENT	2.7587E 01	1.9835E 00	2.7659E 01	4.1125E 00
	TWIST	-7.1151E-07	-1.5389E-07	7.2796E-07	-1.6780E 02
3	DEFLECTION	-3.3500E-05	-4.7679E-06	3.3837E-05	-1.7190E 02
	MOMENT	3.2414E 01	2.2601E 00	3.2493E 01	3.9884E 00
	TWIST	-5.0489E-07	-1.1210E-07	5.1718E-07	-1.6748E 02
4	DEFLECTION	-7.1406E-06	-1.2797E-06	7.2544E-06	-1.6984E 02
	MOMENT	1.9305E 01	1.3384E 00	1.9352E 01	3.9657E 00
	TWIST	-2.6459E-07	-5.8790E-08	2.7104E-07	-1.6747E 02
5	DEFLECTION	-7.7012E-06	-1.3513E-06	7.8205E-06	-1.6998E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	2.6450E-05	3.4023E-06	2.6668E-05	7.3297E 00
	MOMENT	-1.6266E-08	-2.0898E-09	1.6399E-08	-1.7268E 02
	TWIST	4.3020E-07	9.5184E-08	4.4060E-07	1.2476E 01

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 16.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-2.9765E-06	-2.9800E-06	4.2119E-06	-1.3497E 02
	MOMENT	2.7427E-09	5.7417E-10	2.8022E-09	1.1824E 01
	TWIST	-3.5075E-07	-5.2693E-08	3.5469E-07	-1.7146E 02
2	DEFLECTION	-3.0926E-05	-2.6209E-06	3.1037E-05	-1.7516E 02
	MOMENT	2.3107E 01	3.5214E-01	2.3109E 01	8.7310E-01
	TWIST	-2.6697E-07	-5.2887E-08	2.7216E-07	-1.6879E 02
3	DEFLECTION	-2.1522E-05	-1.6184E-06	2.1583E-05	-1.7570E 02
	MOMENT	2.7339E 01	3.2530E-01	2.7341E 01	6.8172E-01
	TWIST	-1.8716E-07	-4.2680E-08	1.9197E-07	-1.6715E 02
4	DEFLECTION	-3.9827E-06	-4.8627E-07	4.0122E-06	-1.7304E 02
	MOMENT	1.6230E 01	1.7249E-01	1.6231E 01	6.0892E-01
	TWIST	-1.0761E-07	-2.5380E-08	1.1057E-07	-1.6673E 02
5	DEFLECTION	-4.3416E-06	-5.1798E-07	4.3724E-06	-1.7320E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.7519E-05	1.0611E-06	1.7551E-05	3.4660E 00
	MOMENT	-1.1101E-08	-6.8797E-10	1.1122E-08	-1.7645E 02
	TWIST	1.4180E-07	3.1205E-08	1.4519E-07	1.2411E 01

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 17.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	7.0943E-06	-2.3086E-06	7.4605E-06	-1.8027E 01
	MOMENT	9.8734E-10	4.1284E-10	1.0702E-09	2.2592E 01
	TWIST	-2.1567E-07	-2.5844E-08	2.1721E-07	-1.7317E 02
2	DEFLECTION	-2.4718E-05	-1.3995E-06	2.4758E-05	-1.7676E 02
	MOMENT	2.4211E 01	-2.4899E-01	2.4212E 01	-5.8923E-01
	TWIST	-9.4144E-08	-3.2949E-08	9.9743E-08	-1.6071E 02
3	DEFLECTION	-1.7890E-05	-8.0533E-07	1.7909E-05	-1.7742E 02
	MOMENT	2.9106E 01	-4.2159E-01	2.9109E 01	-8.2983E-01
	TWIST	-3.4231E-08	-3.0692E-08	4.5975E-08	-1.3812E 02
4	DEFLECTION	-2.6021E-06	-3.0389E-07	2.6198E-06	-1.7334E 02
	MOMENT	1.7357E 01	-2.8073E-01	1.7360E 01	-9.2659E-01
	TWIST	-1.4481E-08	-2.0440E-08	2.5050E-08	-1.2532E 02
5	DEFLECTION	-2.8699E-06	-3.2601E-07	2.8883E-06	-1.7352E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.5403E-05	4.5028E-07	1.5410E-05	1.6745E 00
	MOMENT	-9.8119E-09	-3.0379E-10	9.8166E-09	-1.7823E 02
	TWIST	3.1382E-08	1.9706E-08	3.7056E-08	3.2127E 01

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 18.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.8492E-05	-2.8437E-06	1.8709E-05	-8.7423E 00
	MOMENT	-6.4620E-10	4.4614E-10	7.8525E-10	1.4538E 02
	TWIST	-2.1935E-07	-1.0272E-08	2.1959E-07	-1.7732E 02
2	DEFLECTION	-2.3635E-05	-6.7163E-07	2.3644E-05	-1.7837E 02
	MOMENT	3.0580E 01	-1.1913E 00	3.0603E 01	-2.2310E 00
	TWIST	3.4435E-08	-3.1423E-08	4.6617E-08	-4.2382E 01
3	DEFLECTION	-1.7800E-05	-2.5270E-07	1.7802E-05	-1.7919E 02
	MOMENT	3.7736E 01	-1.6572E 00	3.7772E 01	-2.5145E 00
	TWIST	1.3720E-07	-3.7180E-08	1.4215E-07	-1.5163E 01
4	DEFLECTION	-1.3611E-06	-2.6604E-07	1.3869E-06	-1.6894E 02
	MOMENT	2.2761E 01	-1.0410E 00	2.2784E 01	-2.6188E 00
	TWIST	1.1596E-07	-2.7844E-08	1.1926E-07	-1.3502E 01
5	DEFLECTION	-1.5206E-06	-2.9158E-07	1.5483E-06	-1.6914E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.6868E-05	-5.1501E-08	1.6868E-05	-1.7493E-01
	MOMENT	-1.0647E-08	2.1594E-11	1.0647E-08	1.7988E 02
	TWIST	-6.2484E-08	2.1062E-08	6.5938E-08	1.6137E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 19.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	5.4843E-05	-1.0844E-05	5.5905E-05	-1.1185E 01
	MOMENT	-4.7838E-09	1.3668E-09	4.9752E-09	1.6405E 02
	TWIST	-6.0004E-07	6.8785E-08	6.0397E-07	1.7346E 02
2	DEFLECTION	-3.5906E-05	2.3348E-06	3.5982E-05	1.7528E 02
	MOMENT	6.4580E 01	-8.8182E 00	6.5179E 01	-7.7755E 00
	TWIST	3.1035E-07	-8.7232E-08	3.2238E-07	-1.5699E 01
3	DEFLECTION	-2.8019E-05	2.3208E-06	2.8115E-05	1.7526E 02
	MOMENT	8.3141E 01	-1.1822E 01	8.3977E 01	-8.0931E 00
	TWIST	7.2079E-07	-1.5675E-07	7.3764E-07	-1.2269E 01
4	DEFLECTION	2.0268E-06	-7.8048E-07	2.1719E-06	-2.1060E 01
	MOMENT	5.1222E 01	-7.3640E 00	5.1749E 01	-8.1811E 00
	TWIST	6.2338E-07	-1.3247E-07	6.3730E-07	-1.1997E 01
5	DEFLECTION	2.2896E-06	-8.9226E-07	2.4573E-06	-2.1291E 01
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	3.1733E-05	-3.2512E-06	3.1899E-05	-5.8498E 00
	MOMENT	-1.9597E-08	2.0313E-09	1.9702E-08	1.7408E 02
	TWIST	-3.3311E-07	7.7244E-08	3.4195E-07	1.6694E 02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 20.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-5.3238E-05	-6.2179E-06	5.3600E-05	-1.7334E 02
	MOMENT	6.4186E-09	5.3661E-10	6.4410E-09	4.7789E 00
	TWIST	8.5428E-07	1.1726E-07	8.6229E-07	7.8160E 00
2	DEFLECTION	1.5839E-05	3.6736E-06	1.6259E-05	1.3058E 01
	MOMENT	-4.9746E 01	-7.3774E 00	5.0290E 01	-1.7156E 02
	TWIST	-3.9882E-07	-3.8321E-08	4.0066E-07	-1.7451E 02
3	DEFLECTION	1.2556E-05	2.6078E-06	1.2824E-05	1.1732E 01
	MOMENT	-6.9323E 01	-9.8819E 00	7.0024E 01	-1.7189E 02
	TWIST	-1.0680E-06	-1.1963E-07	1.0746E-06	-1.7361E 02
4	DEFLECTION	-7.5295E-06	-8.9441E-07	7.5824E-06	-1.7323E 02
	MOMENT	-4.4453E 01	-6.3185E 00	4.4899E 01	-1.7191E 02
	TWIST	-9.8674E-07	-1.1091E-07	9.9295E-07	-1.7359E 02
5	DEFLECTION	-8.6462E-06	-9.8720E-07	8.7023E-06	-1.7349E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	-2.2155E-05	-4.0362E-06	2.2520E-05	-1.6968E 02
	MOMENT	1.3185E-08	2.3144E-09	1.3387E-08	9.9557E 00
	TWIST	4.7378E-07	4.9878E-08	4.7640E-07	6.0098E 00

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 21.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-1.1740E-05	-3.1862E-07	1.1745E-05	-1.7845E 02
	MOMENT	1.8070E-09	1.6576E-11	1.8071E-09	5.2558E-01
	TWIST	3.7873E-07	7.1732E-09	3.7880E-07	1.0850E 00
2	DEFLECTION	-7.3026E-08	4.6587E-08	8.6621E-08	1.4746E 02
	MOMENT	-9.3216E 00	-3.0347E-01	9.3265E 00	-1.7814E 02
	TWIST	-1.0055E-07	-2.9698E-09	1.0059E-07	-1.7831E 02
3	DEFLECTION	-4.3648E-07	-8.7297E-09	4.3657E-07	-1.7885E 02
	MOMENT	-1.5436E 01	-4.4966E-01	1.5442E 01	-1.7833E 02
	TWIST	-4.0267E-07	-8.6616E-09	4.0277E-07	-1.7877E 02
4	DEFLECTION	-3.8414E-06	-1.5552E-07	3.8445E-06	-1.7768E 02
	MOMENT	-1.0729E 01	-3.4285E-01	1.0735E 01	-1.7817E 02
	TWIST	-4.0243E-07	-8.0973E-09	4.0252E-07	-1.7885E 02
5	DEFLECTION	-4.4774E-06	-1.5842E-07	4.4802E-06	-1.7797E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	-4.0748E-06	-2.8250E-07	4.0846E-06	-1.7603E 02
	MOMENT	2.2527E-09	1.0983E-10	2.2554E-09	2.7912E 00
	TWIST	1.7126E-07	2.9385E-09	1.7129E-07	9.8298E-01

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 22.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-2.4489E-06	-1.0514E-07	2.4512E-06	-1.7754E 02
	MOMENT	6.5584E-10	8.7959E-12	6.5590E-10	7.6838E-01
	TWIST	3.0043E-07	-1.3859E-09	3.0043E-07	-2.6431E-01
2	DEFLECTION	-2.1595E-06	-1.6404E-07	2.1657E-06	-1.7566E 02
	MOMENT	-1.5481E 00	4.7388E-02	1.5488E 00	1.7825E 02
	TWIST	-2.3492E-08	-1.9236E-09	2.3570E-08	-1.7532E 02
3	DEFLECTION	-2.3736E-06	-1.2800E-07	2.3770E-06	-1.7691E 02
	MOMENT	-5.1393E 00	1.7875E-02	5.1393E 00	1.7980E 02
	TWIST	-2.6278E-07	-2.0378E-09	2.6279E-07	-1.7956E 02
4	DEFLECTION	-3.0092E-06	-8.1798E-08	3.0103E-06	-1.7844E 02
	MOMENT	-4.3613E 00	-3.9723E-02	4.3615E 00	-1.7948E 02
	TWIST	-2.8647E-07	-1.5165E-09	2.8647E-07	-1.7970E 02
5	DEFLECTION	-3.5647E-06	-7.6590E-08	3.5655E-06	-1.7877E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	-9.8191E-07	-4.4560E-08	9.8292E-07	-1.7740E 02
	MOMENT	4.2812E-10	-1.7880E-11	4.2849E-10	-2.3915E 00
	TWIST	1.0845E-07	4.6468E-10	1.0845E-07	2.4549E-01

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 23.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	2.2114E-06	-1.0728E-07	2.2140E-06	-2.7772E 00
	MOMENT	1.7148E-11	1.3074E-11	2.1564E-11	3.7324E 01
	TWIST	2.7486E-07	-3.8300E-09	2.7489E-07	-7.9833E-01
2	DEFLECTION	-2.4844E-06	-1.8435E-07	2.4912E-06	-1.7576E 02
	MOMENT	1.7298E 00	7.9752E-02	1.7316E 00	2.6397E 00
	TWIST	2.1197E-08	-1.9756E-09	2.1288E-08	-5.3248E 00
3	DEFLECTION	-2.8721E-06	-1.2196E-07	2.8747E-06	-1.7757E 02
	MOMENT	-8.9109E-01	6.0133E-02	8.9312E-01	1.7614E 02
	TWIST	-1.9828E-07	-3.5702E-10	1.9828E-07	-1.7990E 02
4	DEFLECTION	-2.6068E-06	-4.9966E-08	2.6073E-06	-1.7890E 02
	MOMENT	-1.8194E 00	-1.0507E-02	1.8194E 00	-1.7967E 02
	TWIST	-2.3802E-07	3.5136E-10	2.3802E-07	1.7992E 02
5	DEFLECTION	-3.1418E-06	-4.0297E-08	3.1420E-06	-1.7927E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	8.5391E-08	-3.7777E-09	8.5475E-08	-2.5331E 00
	MOMENT	-1.7024E-10	-3.4639E-11	1.7373E-10	-1.6850E 02
	TWIST	8.0589E-08	-1.1600E-10	8.0589E-08	-8.2474E-02

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 24.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	5.2975E-06	-1.4471E-07	5.2995E-06	-1.5647E 00
	MOMENT	-4.4048E-10	1.8489E-11	4.4087E-10	1.7760E 02
	TWIST	2.6550E-07	-5.0844E-09	2.6555E-07	-1.0971E 00
2	DEFLECTION	-2.3179E-06	-1.7232E-07	2.3243E-06	-1.7575E 02
	MOMENT	3.5759E 00	5.6643E-02	3.5764E 00	9.0750E-01
	TWIST	5.5318E-08	-2.2753E-09	5.5365E-08	-2.3553E 00
3	DEFLECTION	-2.9497E-06	-9.6325E-08	2.9513E-06	-1.7813E 02
	MOMENT	1.3774E 00	2.8457E-02	1.3777E 00	1.1835E 00
	TWIST	-1.5955E-07	4.0266E-10	1.5955E-07	1.7986E 02
4	DEFLECTION	-2.3627E-06	-2.8328E-08	2.3628E-06	-1.7931E 02
	MOMENT	-5.6565E-01	-2.9765E-02	5.6643E-01	-1.7699E 02
	TWIST	-2.1348E-07	1.3914E-09	2.1348E-07	1.7963E 02
5	DEFLECTION	-2.9003E-06	-1.4359E-08	2.9003E-06	-1.7972E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	5.1761E-07	-1.9520E-09	5.1762E-07	-2.1507E-01
	MOMENT	-3.8653E-10	-3.1081E-11	3.8778E-10	-1.7540E 02
	TWIST	6.4983E-08	-3.8581E-10	6.4984E-08	-3.4017E-01

GBRC2

SAMPLE PROBLEM 1

DAMPED RESPONSE TO UNIT FORCE

FREQUENCY 25.00 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	7.6836E-06	-1.9795E-07	7.6861E-06	-1.4757E 00
	MOMENT	-8.1574E-10	2.5051E-11	8.1612E-10	1.7824E 02
	TWIST	2.6318E-07	-6.0866E-09	2.6325E-07	-1.3249E 00
2	DEFLECTION	-1.9776E-06	-1.6521E-07	1.9837E-06	-1.7551E 02
	MOMENT	4.8265E 00	1.7070E-02	4.8266E 00	2.0263E-01
	TWIST	8.5812E-08	-2.7949E-09	8.5857E-08	-1.8655E 00
3	DEFLECTION	-2.8639E-06	-6.7634E-08	2.8647E-06	-1.7865E 02
	MOMENT	2.7518E 00	-2.3731E-02	2.7519E 00	-4.9410E-01
	TWIST	-1.3289E-07	8.7959E-10	1.3289E-07	1.7962E 02
4	DEFLECTION	-2.2006E-06	-1.0315E-08	2.2006E-06	-1.7973E 02
	MOMENT	5.9136E-02	-6.1879E-02	8.5589E-02	-4.6297E 01
	TWIST	-2.0134E-07	2.2761E-09	2.0135E-07	1.7935E 02
5	DEFLECTION	-2.7544E-06	3.5725E-09	2.7545E-06	1.7982E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	6.7464E-07	-1.1411E-08	6.7473E-07	-9.6898E-01
	MOMENT	-4.3845E-10	-2.2534E-11	4.3903E-10	-1.7706E 02
	TWIST	5.5366E-08	-5.8259E-10	5.5369E-08	-6.0287E-01

GBRC2 SEPT 20, 1964
SAMPLE PROBLEM 1

DATA CONTROL CARD

NO TYPE

END GERC2 RUN

SAMPLE PROBLEM 2: UNDAMPED NATURAL FREQUENCIES AND MODE SHAPES OF HORIZONTAL TORSION-BENDING FOR A BEAM WITH SPRUNG MASS

The structure shown in Figure 7 is again used for this problem. The SAMPLE PROBLEM 1 data is revised by removing all damping from the structural system and also removing the forces which were acting upon it. To accomplish this, the value of P(N) becomes zero on the first "43" card, the Rayleigh damping constant, -0.03 is removed from the "42" card, and the damping associated with the spring connection, $c'(4,5) = 0.2$ is removed from the first "53" card.

The "70" card which now must be included indicates the number of natural frequencies to be calculated. The "30" card indicates that the frequencies are to be in the range ω_1(cps) to ω_2(cps) and that the frequences are expected to be separated from one another by at least $\Delta\omega$(cps). The values ω_1, ω_2 and $\Delta\omega$ may be arbitrarily selected according to varying requirements among problems.

Calculated results are normalized with respect to the deflection of the first section which is assigned the unit value.

TITLE SAMPLE PROBLEM 2 PROGRAMMER ______ DATE ______

PROBLEM NO. ______ PHASE ______ LABEL ______ SHEET 1 OF 2

RUN TITLE CARD

C00000(62HΔΔ SAMPLE PROBLEM 2

DATA CONTROL CARD

	NO	TYPE	NO	TYPE	etc.															
0090	01	10	01	20	01	30	01	41	01	42	06	43	01	51	02	53	01	21	01	70
	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43

CASE TITLE CARD

001000(62HΔΔ SELECT FIRST TWO NAT. FREQ. FOR STRUCTURE OF SAMPLE PROB. 1

OPTION CONTROL CARD

	OP1	OP2	OP3	OP4	OP5	OP6	OP7	OP8	OP9	OP10
00200000		0001								0001
	9	13	17	21	25	29	33	37	41	45

EDIT CONTROL CARD

00210000	0001	0003	0006		
	9	13	17	21	25

GENERAL DATA CARD

	NO. SYSTEMS	ω_1 (CPS)	ω_2 (CPS)	$\Delta\omega$ (CPS)
0030	0006	1.0	30.0	1.0
	5	9	17	25

SYSTEMS DATA CARDS

	SYSTEMS	RADIUS	INITIAL J
0031			
0031			

TITLE SAMPLE PROBLEM 2 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 2 OF 7

SECTION DATA CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000	0001	1.0		ΔΔ1.0 E-8	1.0	ΔΔ1.0 E-5		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK				1.0	ΔΔΔ1.0 E2	1.0	ΔΔ1.0 E-8			

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK										

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK										

IMAGINARY PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000	0001	0.0						
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK										

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK										

SAMPLE PROBLEM 2

PROGRAMMER _____ DATE _____

JOB _____ LEVEL [ ][ ][ ] SHEET 2 OF 2

5	9	13	17	25	33	41	49	57	65	73
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/GJ)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
CO43	0001	0001	0001	2.35		12.89	15.0	2.13		0.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
	BLANK			173.0	101.04	8.93	0.497			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
CO43	0002		0001	4.89		2.01	14.0	0.54		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
	BLANK			109.0	101.43	8.7	0.375			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
CO43	0003		0001	6.04		1.02	14.0	0.33		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
	BLANK			116.8	125.8	8.48	0.274			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
CO43	0004		0001	11.3		0.57				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
	BLANK			165.0	159.12					
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
CO43	0005		0001	0.26		0.9				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
	BLANK									

TITLE **SAMPLE PROBLEM 2** PROGRAMMER ____ DATE ____

PROBLEM NO. ____ PHASE ____ LABEL ____ SHEET 4 OF 7

SECTION PARAMETER VALUES - UNSCALED

1	5	9	13	17	25	33	41	49	57	65–73
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0006	0002	0001	6.74		0.39				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
←BLANK→				79.2	327.9					
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
←BLANK→										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
←BLANK→										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
←BLANK→										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
←BLANK→										

TITLE SAMPLE PROBLEM 2 PROGRAMMER C DATE

PROBLEM NO. PHASE LABEL SHEET 5 OF 7

SPECIAL CONNECTION CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051			0001	ΔΔΔ1.0 E5	1.0		1.0	ΔΔ 1.0 E-5		
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK				1.0	ΔΔ1.0 E-8					

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

IMAGINARY PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0052										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0052										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

TITLE SAMPLE PROBLEM 2 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 6 OF 7

SPECIAL CONNECTIONS PARAMETER VALUES

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053	0004	0005	0001	0.319	0.0					
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053	0004	0006	0001				15.0	0.25		
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK				8.6	0.59					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053									c	
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$		c			
BLANK										

TITLE SAMPLE PROBLEM 2 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 2 OF 2

CHARACTRON PLOTTING CHARACTERS

1	3 4	7	13	19	25	31	37	43
00	60	00	BLANK					

NATURAL FREQUENCY SELECTION CARD

	1	3 4	9	11
✓	00	70	0000	02

START NEW DATA SET CARD

	1	3 4
TT	00	98

END OF DATA CARD

	1	3 4
✓	00	99

GBRC2 SEPT 20. 1964
SAMPLE PROBLEM 2

DATA CONTROL CARD

NO	TYPE
1	10
1	20
1	30
1	41
1	42
6	43
1	51
2	53
1	21
1	70

CASE TITLE-SELECT FIRST TWO NAT FREQ.FOR STRUCTURE OF SAMPLE PROB. 1

OPTION DATA
20 -0 1 -0 -0 -0 -0 -0 -0 -0 1

GENERAL DATA - NUMBER OF SECTIONS 6
FREQUENCY RANGE FROM 1.000 CPS TO 30.000 CPS
FREQUENCY INTERVAL 1.000 CPS

REAL PARTS OF SCALING FACTORS

SECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1		1.0000E 00	-0.	1.0000E-08	1.0000E 00	1.0000E-05	-0.	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0000E 00	1.0000E 02	1.0000E 00	1.0000E-08	-0.

IMAGINARY PARTS OF SCALING FACTORS

SECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1		0.	-0.	-0.	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
-0.	-0.	-0.	-0.	-0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

SECTION-END	CONDN-SYSTEM		MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1	1	1	2.3500E 00	-0.	1.2800E 01	1.5000E 01	2.1300E 00	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.7300E 02	1.0104E 02	8.9300E 00	4.9700E-01	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
2	-0	1	4.8900E 00	-0.	2.0100E 00	1.4000E 01	5.4000E-01	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0900E 02	1.0143E 02	8.7000E 00	3.7300E-01	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
3	-0	1	6.0400E 00	-0.	1.0200E 00	1.4000E 01	3.3000E-01	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.1680F 02	1.25?0E 02	8.4800E 00	2.7400E-01	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
4	-0	1	1.1300E 01	-0.	5.7000E-01	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.6500E 02	1.5912E 02	-0.	-0.	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
5	-0	1	2.6000E-01	-0.	9.0000E-01	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
-0.	-0.	-0.	-0.	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
6	2	1	6.7400E 00	-0.	3.9000E-01	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
7.9200E 01	3.2790E 02	-0.	-0.	-0.

77

REAL PARTS OF SCALING FACTORS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
		1	1.0000F 05	1.0040E 00	-0.	1.0000E 00	1.0000E-05	-0.	-0.

ZBB(N,M)	DX/GJE(N,M)
1.0000E 00	1.0000E-08

PARAMETER VALUES FOR SPECIAL CONNECTIONS

N	K	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
4	5	1	3.1900E-01	0.	-0.	-0.	-0.	-0.	-0.

ZBB(N,M)	DX/GJE(N,M)
-0.	-0.

			K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
4	6	1	-0.	-0.	-0.	1.5000E 01	2.5000E-01	-0.	-0.

ZBB(N,M)	DX/GJE(N,M)
8.6000E 00	5.9000E-01

OPTION DATA

21 1 3 6 -0 -0 -0 -0 -0 -0 -0

NFREQ= 2

GBRC2

SAMPLE PROBLEM 2

SELECT FIRST TWO NAT FREQ.FOR STRUCTURE OF SAMPLE PROB. 1

FREQUENCY		SECTION 1	SECTION 3	SECTION 6	SECTION
14.02	DEFLECTION	1.000E 00	8.157E-01	6.386E-01	
	MOMENT	1.992E-04	5.206E 05	3.584E-04	
	TWIST	3.530E-02	1.967E-02	1.994E-02	
19.53	DEFLECTION	1.000E 00	3.564E-01	4.801E-01	
	MOMENT	1.058E-04	1.377E 06	2.915E-04	
	TWIST	1.285E-02	1.642E-02	7.431E-03	

GBRC2

SAMPLE PROBLEM 2

SELECT FIRST TWO NAT FREQ.FOR STRUCTURE OF SAMPLE PROB. 1

FREQUENCY 14.02 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-1.9918E-04	0.	1.9918E-04	0.
	TWIST	3.5298E-02	-0.	3.5298E-02	-0.
2	DEFLECTION	1.2715E 00	0.	1.2715E 00	0.
	MOMENT	-4.3802E 05	-0.	4.3802E 05	0.
	TWIST	2.9507E-02	-0.	2.9507E-02	-0.
3	DEFLECTION	8.1566E-01	0.	8.1566E-01	0.
	MOMENT	-5.2057E 05	-0.	5.2057E 05	0.
	TWIST	1.9673E-02	0.	1.9673E-02	0.
4	DEFLECTION	1.9886E-01	0.	1.9886E-01	0.
	MOMENT	-3.1734E 05	-0.	3.1734E 05	0.
	TWIST	8.7707E-03	0.	8.7707E-03	0.
5	DEFLECTION	2.1229E-01	0.	2.1229E-01	0.
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	-6.3857E-01	0.	6.3857E-01	0.
	MOMENT	3.5841E-04	0.	3.5841E-04	0.
	TWIST	-1.9941E-02	0.	1.9941E-02	0.

GBRC

SAMPLE PROBLEM 7

SELECT FIRST TWO NAT FREQ.FOR STRUCTURE OF SAMPLE PROB. 1

FREQUENCY 19.03 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-1.0579E-04	0.	1.0579E-04	0.
	TWIST	-1.2852E-02	-0.	1.2852E-02	0.
2	DEFLECTION	-4.5003E-01	0.	4.5003E-01	0.
	MOMENT	1.0327E 06	-0.	1.0327E 06	-0.
	TWIST	6.7582E-03	-0.	6.7582E-03	0.
3	DEFLECTION	-3.5644E-01	0.	3.5644E-01	0.
	MOMENT	1.3774E 06	0.	1.3774E 06	0.
	TWIST	1.6416E-02	-0.	1.6416E-02	-0.
4	DEFLECTION	8.8985E-02	0.	8.8985E-02	0.
	MOMENT	8.6391E 05	0.	8.6391E 05	0.
	TWIST	1.4673E-02	-0.	1.4673E-02	-0.
5	DEFLECTION	1.0143E-01	0.	1.0143E-01	0.
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	4.8014E-01	0.	4.8014E-01	0.
	MOMENT	-2.9151E-04	0.	2.9151E-04	0.
	TWIST	-7.4310E-03	0.	7.4310E-03	0.

GBRC2 SEPT 20, 1964
SAMPLE PROBLEM 2

DATA CONTROL CARD

NO TYPE

END GBRC2 RUN

SAMPLE PROBLEM 3: PLOT THE DEFLECTIONS CALCULATED IN SAMPLE PROBLEM 1

The data for SAMPLE PROBLEM 1 is revised to include Option 4 = 0001 and Option 6 = 0001 on the "20" card and to include the "60" card which specifies the plotting characters which the program will use to label the individual curves plotted. It should be observed that the scaling printed at the bottom of the graph is in exponential form, 10.E-3, which corresponds to 10^{-3}.

TITLE **SAMPLE PROBLEM 3**

PROBLEM NO. ______ PROGRAMMER ______ DATE ______

PHASE ______ LABEL ______ SHEET 1 OF 2

RUN TITLE CARD

C00000(62HΔΔ SAMPLE PROBLEM 3

DATA CONTROL CARD

NO TYPE NO TYPE etc.

0090	01	10	01	20	01	30	01	41	01	42	06	43	01	51	02	53	01	21	01	60
	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43

CASE TITLE CARD

001000(62HΔΔ GRAPH SAMPLE PROB. 1 RESULTS WITH OPT. 6 = 1

OPTION CONTROL CARD

	OP1	OP2	OP3	OP4	OP5	OP6	OP7	OP8	OP9	OP10
00200000		0001		0001		0001				
	9	13	17	21	25	29	33	37	41	45

EDIT CONTROL CARD

00210000	0001	0003	0006		
	9	13	17	21	25

GENERAL DATA CARD

	NO. SYSTEMS	ω_1(CPS)	ω_2(CPS)	$\Delta\omega$ (CPS)
0030	0006	1.0	1.0	1.0
	5	9	17	25

SYSTEMS DATA CARDS

	SYSTEMS	RADIUS	INITIAL J
0031			
0031			

TITLE SAMPLE PROBLEM 3 PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL [ ] SHEET 2 OF 7

SECTION DATA CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000	0001	1.0		Δ Δ 1.0 E-8	1.0	Δ Δ 1.0 E-5		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				1.0	Δ Δ Δ 1.0 E2	1.0	Δ Δ 1.0 E-8			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0041	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

IMAGINARY PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000	0001	0.03						
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

TITLE SAMPLE PROBLEM 3 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 3 OF 7

SECTION PARAMETER VALUES - UNSCALED

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0001	0001	0001	2.35		12.89	15.0	2.13		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				173.0	101.64	8.93	0.497			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0002		0001	4.89		2.01	14.0	0.54		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				109.0	101.43	8.7	0.375			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0003		0001	6.04		1.02	14.0	0.33		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				116.8	125.8	8.48	0.274			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0004		0001	11.3		0.57				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				165.0	159.12					
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0043	0005		0001	0.26		0.9				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

TITLE **SAMPLE PROBLEM 3** PROGRAMMER ______ DATE ______

PROBLEM NO. ______ PHASE ______ LABEL ☐☐☐☐ ______ SHEET 4 OF 7

SECTION PARAMETER VALUES - UNSCALED

1	5	9	13	17	25	33	41	49	57	65	73
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n	
0043	0006	0002	0001	6.74		0.39					
				$(\mu \bar{z} \Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n			
← BLANK →				79.2	327.9						
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n	
0043											
				$(\mu \bar{z} \Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n			
← BLANK →											
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n	
0043											
				$(\mu \bar{z} \Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n			
← BLANK →											
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n	
0043											
				$(\mu \bar{z} \Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n			
← BLANK →											
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n	
0043											
				$(\mu \bar{z} \Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n			
← BLANK →											

TITLE SAMPLE PROBLEM 3 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 5 OF 7

SPECIAL CONNECTION CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051			0001	ΔΔ1.0E5	1.0		1.0	ΔΔ1.0E-5		
				$(\equiv Z)_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK				1.0	ΔΔ1.0 E-8					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051										
				$(\equiv Z)_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0051										
				$(\equiv Z)_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

IMAGINARY PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0052										
				$(\equiv Z)_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta x_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{\mu z}\Delta x)_{n,m}$	$Q_{n,m}$
0052										
				$(\equiv Z)_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

TITLE SAMPLE PROBLEM 3 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 6 OF 7

SPECIAL CONNECTIONS PARAMETER VALUES

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053	0004	0005	0001	0.319	0.2					
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053	0004	0006	0001				15.0	0.25		
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK				8.6	0.59					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0055										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0055										
				$(\bar{z})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
BLANK										

TITLE SAMPLE PROBLEM 3 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 7 OF 7

CHARACTRON PLOTTING CHARACTERS

3 4	7	13	19	25	31	37	43
00 60	00	BLANK	ΔΔΔΔΔ+	ΔΔΔΔΔ)	ΔΔΔΔΔX	ΔΔΔΔΔ−	ΔΔΔΔΔ•

NATURAL FREQUENCY SELECTION CARD

3 4	9	11
00 70	0000	

START NEW DATA SET CARD

3 4
00 98

END OF DATA CARD

3 4
00 99

28

GBRC2 SEPT 20. 1964
SAMPLE PROBLEM 3

DATA CONTROL CARD

NO	TYPE
1	10
1	20
1	30
1	41
1	42
6	43
1	51
2	53
1	21
1	60

CASE TITLE-GRAPH SAMPLE PROB. 1 RESULTS WITH OPT. 6=1

OPTION DATA
20 -0 1 -0 1 -0 1 -0 -0 -0 -0

GENERAL DATA - NUMBER OF SECTIONS 6
FREQUENCY RANGE FROM 1.000 CPS TO 1.000 CPS
FREQUENCY INTERVAL 1.000 CPS

REAL PARTS OF SCALING FACTORS

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1	1.0000E 00	-0.	1.0000E-08	1.0000E 00	1.0000E-05	-0.	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0000E 00	1.0000E 02	1.0000E 00	1.0000E-08	-0.

IMAGINARY PARTS OF SCALING FACTORS

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1	-3.0000E-02	-0.	-0.	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
-0.	-0.	-0.	-0.	-0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1 1 1	2.3500E 00	-0.	1.2890E 01	1.5000E 01	2.1300E 00	-0.	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.7300E 02	1.0104E 02	8.9300E 00	4.9700E-01	-0.

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
2 -0 1	4.8900E 00	-0.	2.0100E 00	1.4000E 01	5.4000E-01	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0900E 02	1.0143E 02	8.7000E 00	3.7500E-01	-0.

			MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
3	-0	1	6.0400E 00	-0.	1.0200E 00	1.4000E 01	3.3000E-01	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.1680E 02	1.2580E 02	8.4800E 00	2.7400E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
4	-0	1	1.1300E 01	-0.	5.7000E-01	-0.	-0.	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.6500E 02	1.5912E 02	-0.	-0.	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
5	-0	1	2.6000E-01	-0.	9.0000E-01	-0.	-0.	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			-0.	-0.	-0.	-0.	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
6	2	1	6.7400E 00	-0.	3.9000E-01	-0.	-0.	-0.	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			7.9200E 01	3.2790E 02	-0.	-0.	-0.		

#6

REAL PARTS OF SCALING FACTORS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
		1	1.0000E 05	1.0000E 00	-0.	1.0000E 00	1.0000E-05	-0.	-0.
			ZBB(N,M)	DX/GJE(N,M)					
			1.0000E 00	1.0000E-08					

PARAMETER VALUES FOR SPECIAL CONNECTIONS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
4	5	1	3.1900E-01	2.0000E-01	-0.	-0.	-0.	-0.	-0.
			ZBB(N,M)	DX/GJE(N,M)					
			-0.	-0.					
			K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
4	6	1	-0.	-0.	-0.	1.5000E 01	2.5000E-01	-0.	-0.
			ZBB(N,M)	DX/GJE(N,M)					
			8.6000E 00	5.9000E-01					

OPTION DATA

21 1 3 6 -0 -0 -0 -0 -0 -0 -0

CHARACTRON PLOTTING CHARACTERS

CHAR(1)=

CHAR(2)= +

CHAR(3)= o
CHAR(4)= x
CHAR(5)= -
CHAR(6)= .

GBRC2

SAMPLE PROBLEM 3

GRAPH SAMPLE PROB. 1 RESULTS WITH OPT. 6=1

FREQUENCY		SECTION 1	SECTION 3	SECTION 6	SECTION
1.00	DEFLECTION	5.094E-03	1.931E-03	1.255E-03	
	MOMENT	1.095E-06	1.043E 01	1.099E-06	
	TWIST	1.743E-05	1.773E-05	1.796E-05	

GBRC2

SAMPLE PROBLEM 3

GRAPH SAMPLE PROB. 1 RESULTS WITH OPT. 6=1

FREQUENCY 1.00 CPS

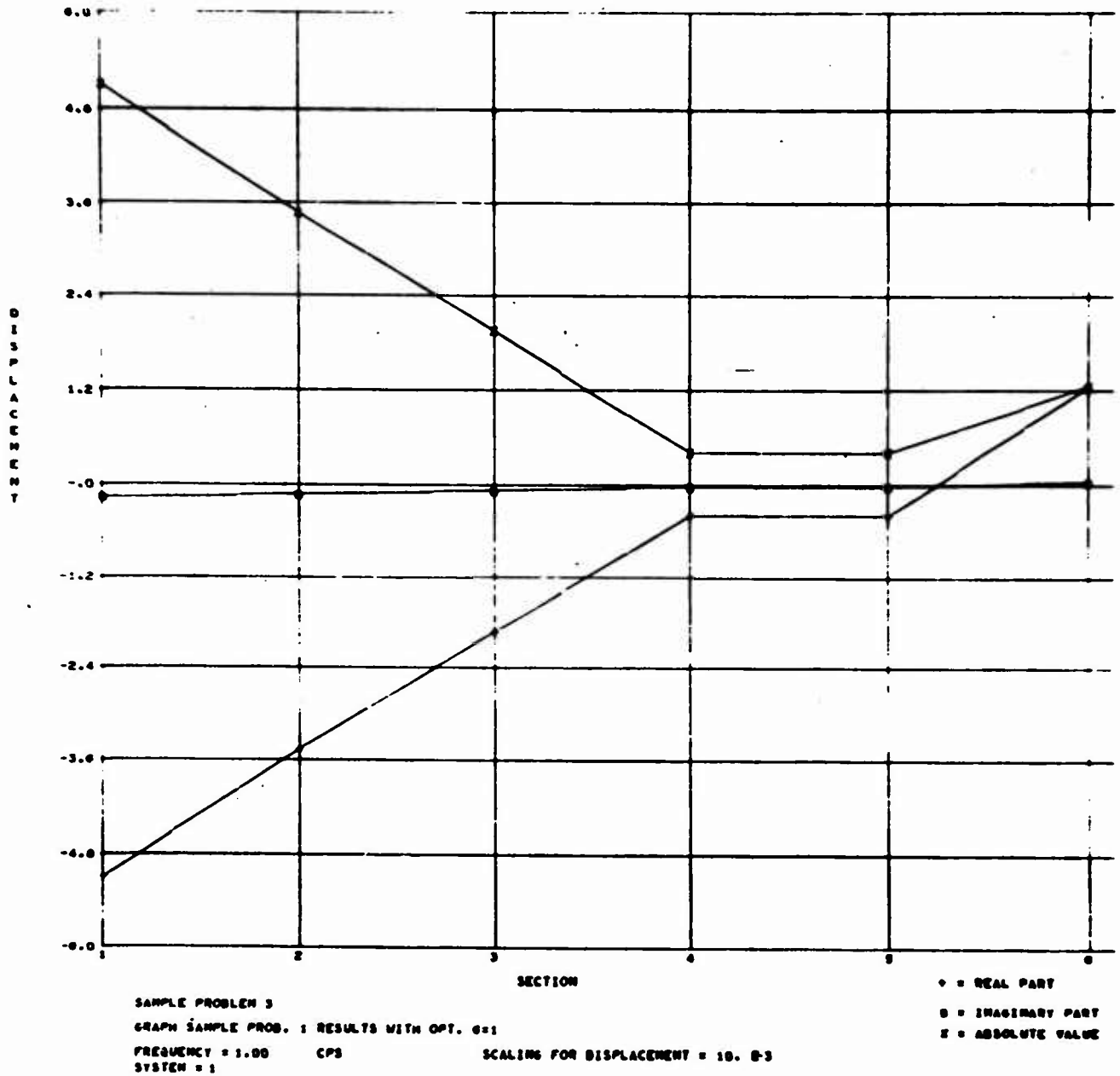
SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-5.0908E-03	-1.8317E-04	5.0941E-03	-1.7794E 02
	MOMENT	1.0948E-06	3.7446E-08	1.0954E-06	1.9590E 00
	TWIST	-1.7416E-05	-6.6550E-07	1.7428E-05	-1.7781E 02
2	DEFLECTION	-3.4639E-03	-1.2709E-04	3.4662E-03	-1.7790E 02
	MOMENT	9.6921E 00	2.5802E-02	9.6921E 00	1.5253E-01
	TWIST	-1.7583E-05	-6.7047E-07	1.7595E-05	-1.7782E 02
3	DEFLECTION	-1.9299E-03	-7.4696E-05	1.9313E-03	-1.7778E 02
	MOMENT	1.0425E 01	2.7654E-02	1.0425E 01	1.5198E-01
	TWIST	-1.7718E-05	-6.7522E-07	1.7731E-05	-1.7782E 02
4	DEFLECTION	-3.9265E-04	-2.2287E-05	3.9329E-04	-1.7675E 02
	MOMENT	5.8522E 00	1.7014E-02	5.8522E 00	1.6657E-01
	TWIST	-1.7809E-05	-6.7869E-07	1.7822E-05	-1.7782E 02
5	DEFLECTION	-3.9278E-04	-2.2290E-05	3.9341E-04	-1.7675E 02
	MOMENT	0.	0.	0.	0.
	TWIST	0.	0.	0.	0.
6	DEFLECTION	1.2543E-03	3.3849E-05	1.2548E-03	1.5458E 00
	MOMENT	-1.0981E-06	-3.7455E-08	1.0988E-06	-1.7805E 02
	TWIST	-1.7949E-05	-6.8448E-07	1.7962E-05	-1.7782E 02

GBRC2 SEPT 20, 1964
SAMPLE PROBLEM 3

DATA CONTROL CARD

NO TYPE

END GBRC2 RUN


6.0
4.8
3.6
2.4
1.2
-.0
-1.2
-2.4
-3.6
-4.8
-6.0
DISPLACEMENT
1
2
3
4
5
6
SECTION
+ = REAL PART
B = IMAGINARY PART
X = ABSOLUTE VALUE
SAMPLE PROBLEM 3
GRAPH SAMPLE PROB. 1 RESULTS WITH OPT. G=1
FREQUENCY = 1.00 CPS
SYSTEM = 1
SCALING FOR DISPLACEMENT = 10. E-3

SAMPLE PROBLEM 4: MULTI-COMPONENT PLOTTING

In this problem, multi-component plots are obtained for specific components of a structure which is represented by two beams coupled together. One component consists of the beam sections numbered 1 through 5, respectively. The second component consists of the beam sections 6 through 9, respectively. To obtain separate plots of these components, one assigns the same system integer (1, for example) to sections 1 through 5; and assigns another integer (2, for example) to sections 6 through 9. In addition, for this problem Option 4 is specified as 0001 and the sub-option under Option 6 is taken to be 0001 for plotting of deflections.

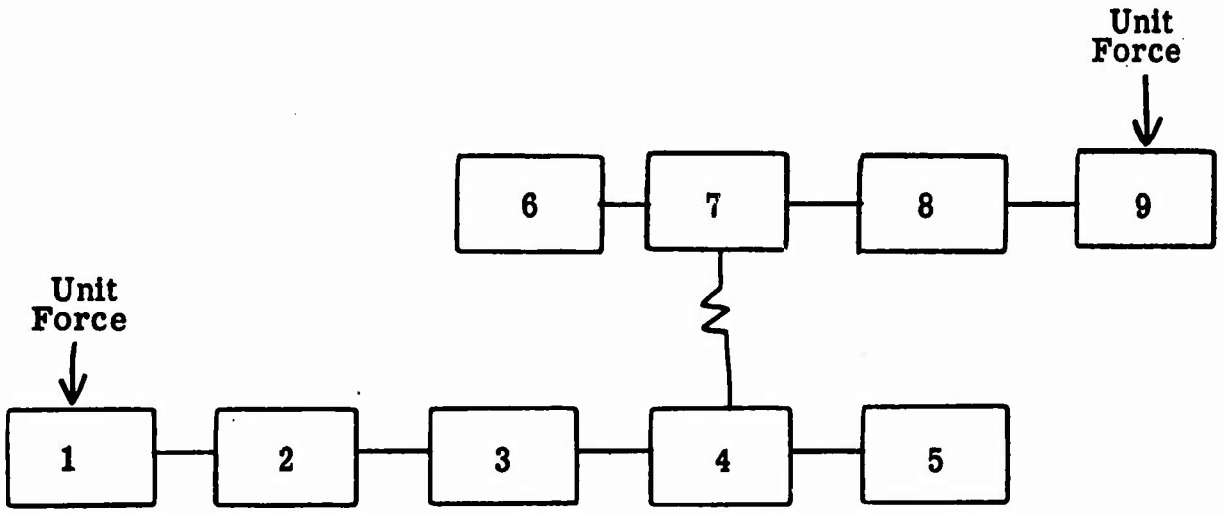


Figure 8

TITLE SAMPLE PROBLEM 4 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 1 OF 2

RUN TITLE CARD

C00000(62HAA SAMPLE PROBLEM 4

DATA CONTROL CARD

NO TYPE NO TYPE etc.

0090|01|10|01|20|01|30|02|41|09|43|01|51|01|53|01|60

CASE TITLE CARD

001000(62HAA MULTI-COMPONENT PLOTTING

OPTION CONTROL CARD

	OP1	OP2	OP3	OP4	OP5	OP6	OP7	OP8	OP9	OP10
00200000		0001		0001		0001				

EDIT CONTROL CARD

00210000

GENERAL DATA CARD

	NO. SECTIONS	ω_1 (CPS)	ω_2 (CPS)	$\Delta\omega$ (CPS)
C030	0009	1.0	1.0	1.0

SYSTEMS DATA CARDS

	SYSTEMS	RADIUS	INITIAL J
0031			
0031			

SAMPLE PROBLEM 4

PROGRAMMER _____ DATE _____

PHASE _____ LABEL [ ][ ][ ] SHEET 2 OF 7

SECTION DATA CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0001	0000	0000	0001	1.0		ΔΔ 1.0 E-8	1.0	ΔΔ 1.0 E-5		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
BLANK →				1.0	ΔΔΔ 1.0 E2	1.0	ΔΔ 1.0 E-8			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0001	0000	0000	0002	1.0		ΔΔ 1.0 E-8	1.0	ΔΔ 1.0 E-5		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				1.0	ΔΔΔ 1.0 E2	1.0	ΔΔ 1.0 E-8			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0001	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

IMAGINARY PART OF SCALING FACTORS

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0002	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{\mu z}\Delta x)_{n,n+1}$	P_n
0042	0000	0000								
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

102

TITLE SAMPLE PROBLEM 4 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 3 OF 2

SECTION PARAMETER VALUES - UNSCALED

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{xz}\Delta x)_{n,n+1}$	P_n
0043	0001	0001	0001	2.35		12.89	15.0	2.13		1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				173.0	101.04	8.93	0.497			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{xz}\Delta x)_{n,n+1}$	P_n
0043	0002		0001	4.89		2.01	14.0	0.54		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				109.0	101.43	8.7	0.375			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{xz}\Delta x)_{n,n+1}$	P_n
0043	0003		0001	6.04		1.02	14.0	0.33		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				116.8	125.8	8.48	0.274			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{xz}\Delta x)_{n,n+1}$	P_n
0043	0004		0001	11.3		0.57	15.0	0.25		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				165.0	159.12	7.90	0.45			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{xz}\Delta x)_{n,n+1}$	P_n
0043	0005	0002	0001	6.74		0.39				
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{z})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				79.2	327.9					

TITLE SAMPLE PROBLEM 4 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 4 OF 7

SECTION PARAMETER VALUES - UNSCALED

	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{uz}\Delta x)_{n,n+1}$	P_n
0043	0006	0001	0002	0.1		0.47	15.0	0.65		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				94.7	100.0	7.5	0.35			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{uz}\Delta x)_{n,n+1}$	P_n
0043	0007		0002	0.5		1.0	15.0	0.94		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				86.9	92.4	6.9	0.72			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{uz}\Delta x)_{n,n+1}$	P_n
0043	0008		0002	0.9		1.5	15.0	0.51		
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				84.3	97.0	7.0	0.90			
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{uz}\Delta x)_{n,n+1}$	P_n
0043	0009	0002	0002	0.4		0.8				1.0
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →				75.0	84.0					
	SECTION NO.	END CONDN.	SYSTEM	MASS	WATER INERTIA	$(\Delta x/EI)_n$	$(\Delta x)_{n,n+1}$	$(\Delta x/KAG)_{n,n+1}$	$(I_{uz}\Delta x)_{n,n+1}$	P_n
0043										
				$(\mu\bar{z}\Delta x)_n$	$(I_{\mu x}\Delta x)_n$	$(\bar{\bar{z}})_{n,n+1}$	$(\Delta x/GJ_e)_{n,n+1}$	U_n		
← BLANK →										

TITLE SAMPLE PROBLEM 4 PROGRAMMER _____ DATE _____

PROBLEM NO. _____ PHASE _____ LABEL [ ] _____ SHEET 5 OF 7

SPECIAL CONNECTION CARDS

5 9 13 17 25 33 41 49 57 65 73

REAL PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\Delta X)_{n,m}$	$Q_{n,m}$
0051			0003	ΔΔΔ1.0 E5						
				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\Delta X)_{n,m}$	$Q_{n,m}$
0051										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\Delta X)_{n,m}$	$Q_{n,m}$
0051										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										

IMAGINARY PART OF SCALING FACTORS

	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\Delta X)_{n,m}$	$Q_{n,m}$
0052										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$\Delta X_{n,m}$	$(\Delta X/KAG)_{n,m}$	$(I_{\mu z}\Delta X)_{n,m}$	$Q_{n,m}$
0052										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta X/GJ_e)_{n,m}$					
← BLANK →										

TITLE **SAMPLE PROBLEM 4** PROGRAMMER ______ DATE ______

PROBLEM NO. ______ PHASE ______ LABEL ☐☐☐☐ ______ SHEET 6 OF 7

SPECIAL CONNECTIONS PARAMETER VALUES

	5	9	13	17	25	33	41	49	57	65
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053	0004	0007	0003	0.319						
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	-BLANK-									
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	-BLANK-									
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	-BLANK-									
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	-BLANK-									
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	n	m	SYSTEM	$K_{n,m}$	$C_{n,m}$	$C_{n,m}/\omega$	$(\Delta x)_{n,m}$	$(\Delta x/KAG)_{n,m}$	$(I_{uz}\Delta x)_{n,m}$	$Q_{n,m}$
0053										
				$(\bar{\bar{z}})_{n,m}$	$(\Delta x/GJ_e)_{n,m}$					
	-BLANK-									

TITLE SAMPLE PROBLEM 4 PROGRAMMER DATE

PROBLEM NO. PHASE LABEL SHEET 7 OF 7

CHARACTRON PLOTTING CHARACTERS

3 4	7	13	19	25	31	37	43
00 60 00	BLANK	ΔΔΔΔΔ+	ΔΔΔΔΔ0	ΔΔΔΔΔX	ΔΔΔΔΔ−	ΔΔΔΔΔ•	

NATURAL FREQUENCY SELECTION CARD

3 4	9	11
00 70 0000		

START NEW DATA SET CARD

3 4
00 98

END OF DATA CARD

3 4
00 99

GBRC2 SEPT 20, 1964
SAMPLE PROBLEM 4

DATA CONTROL CARD

NO	TYPE
1	10
1	20
1	30
2	41
9	43
1	51
1	53
1	60

CASE TITLE-MULTI-COMPONENT PLOTTING

OPTION DATA
20 -0 1 -0 1 -0 1 -0 -0 -0 -0

GENERAL DATA - NUMBER OF SECTIONS 9
FREQUENCY RANGE FROM 1.000 CPS TO 1.000 CPS
FREQUENCY INTERVAL 1.000 CPS

801

REAL PARTS OF SCALING FACTORS

SECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
	1	1.0000E 00	-0.	1.0000E-08	1.0000E 00	1.0000E-05	-0.	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0000E 00	1.0000E 02	1.0000E 00	1.0000E-08	-0.

	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
2	1.0000E 00	-0.	1.0000E-08	1.0000E 00	1.0000E-05	-0.	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0000E 00	1.0000E 02	1.0000E 00	1.0000E-08	-0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

SECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1 1	1	2.3500E 00	-0.	1.2890E 01	1.5000E 01	2.1300E 00	-0.	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.7300E 02	1.0104E 02	8.9300E 00	4.9700E-01	-0.

	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
2 -0	1	4.8900E 00	-0.	2.0100E 00	1.4000E 01	5.4000E-01	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0900E 02	1.0143E 02	8.7000E 00	3.7500E-01	-0.

	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
3 -0	1	6.0400E 00	-0.	1.0200E 00	1.4000E 01	3.3000E-01	-0.	-0.

				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				1.1680E 02	1.2580E 02	8.4800E 00	2.7400E-01	-0.		
				MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
4	-0	1		1.1300E 01	-0.	5.7000E-01	1.5000E 01	2.5000E-01	-0.	-0.
				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				1.6500E 02	1.5912E 02	7.9000E 00	4.5000E-01	-0.		
				MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
5	2	1		6.7400E 00	-0.	3.9000E-01	-0.	-0.	-0.	-0.
				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				7.9200E 01	3.2790E 02	-0.	-0.	-0.		
				MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
6	1	2		1.0000E-01	-0.	4.7000E-01	1.5000E 01	6.5000E-01	-0.	-0.
				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				9.4700E 01	1.0000E 02	7.5000E 00	3.5000E-01	-0.		
				MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
7	-0	2		5.0000E-01	-0.	1.0000E 00	1.5000E 01	9.4000E-01	-0.	-0.
				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				8.6900E 01	9.2400E 01	6.9000E 00	7.2000E-01	-0.		
				MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
8	-0	2		9.0000E-01	-0.	1.5000E 00	1.5000E 01	5.1000E-01	-0.	-0.
				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				8.4300E 01	9.7000E 01	7.0000E 00	9.0000E-01	-0.		
				MASS	WATER INERTIA	DX/FI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
9	2	2		4.0000E-01	-0.	8.0000E-01	-0.	-0.	-0.	1.0000E 00
				MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
				7.5000E 01	9.4000E 01	-0.	-0.	-0.		

REAL PARTS OF SCALING FACTORS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)
		3	1.0000E 05	-0.	-0.	-0.	-0.	-0.	-0.

ZBB(N,M)	DX/GJE(N,M)
-0.	-0.

PARAMETER VALUES FOR SPECIAL CONNECTIONS

N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG(N,M)	IMZ*DX(N,M)	Q(N,M)

4	7	3	3.1900E-01	-0.	-0.	-0.	-0.	-0.	-0.

ZBB(N,M) DX/GJE(N,M)
-0. -0.

CHARACTRON PLOTTING CHARACTERS

CHAR(1)=
CHAR(2)= +
CHAR(3)= 0
CHAR(4)= X
CHAR(5)= -
CHAR(6)= .

GBRC2

SAMPLE PROBLEM 4

MULTI-COMPONENT PLOTTING

FREQUENCY 1.00 CPS

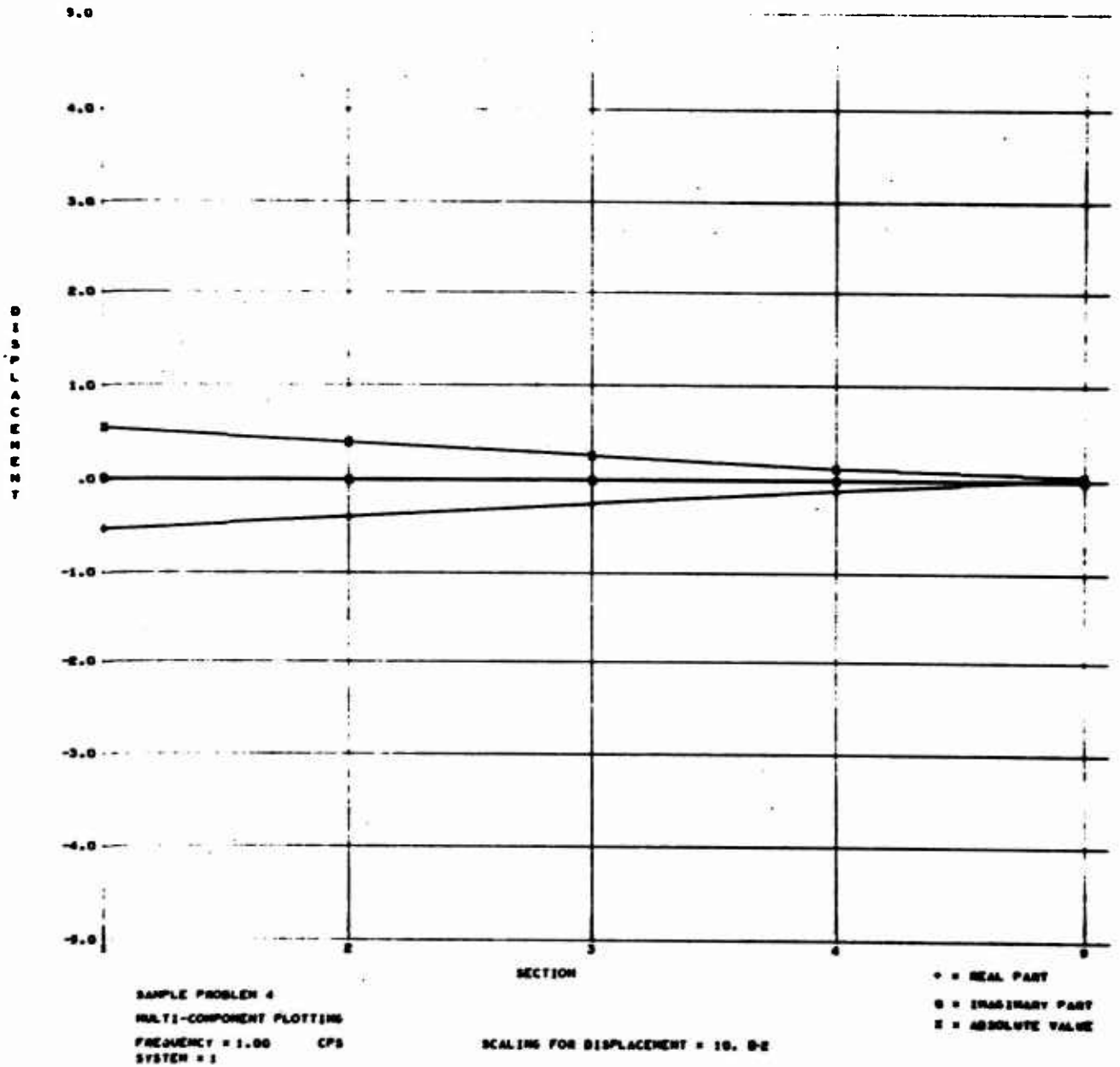
SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	-5.3971E-03	0.	5.3971E-03	0.
	MOMENT	9.8376E-07	0.	9.8376E-07	0.
	TWIST	-2.2110E-05	0.	2.2110E-05	0.
2	DEFLECTION	-3.9368E-03	0.	3.9368E-03	0.
	MOMENT	9.7544E 00	0.	9.7544E 00	0.
	TWIST	-2.2278E-05	0.	2.2278E-05	0.
3	DEFLECTION	-2.5579E-03	0.	2.5579E-03	0.
	MOMENT	9.5607E 00	0.	9.5607E 00	0.
	TWIST	-2.2413E-05	0.	2.2413E-05	0.
4	DEFLECTION	-1.1755E-03	0.	1.1755E-03	0.
	MOMENT	2.2750E 00	0.	2.2750E 00	0.
	TWIST	-2.2501E-05	0.	2.2501E-05	0.
5	DEFLECTION	3.0405E-04	0.	3.0405E-04	0.
	MOMENT	-9.8682E-07	0.	9.8682E-07	0.
	TWIST	-2.2632E-05	0.	2.2632E-05	0.
6	DEFLECTION	2.2875E-02	0.	2.2875E-02	0.
	MOMENT	-1.6018E-05	0.	1.6018E-05	0.
	TWIST	-1.0139E-04	0.	1.0139E-04	0.
7	DEFLECTION	-1.1521E-03	0.	1.1521E-03	0.
	MOMENT	7.0403E 00	0.	7.0403E 00	0.
	TWIST	-1.0096E-04	0.	1.0096E-04	0.
8	DEFLECTION	-2.5171E-02	0.	2.5171E-02	0.
	MOMENT	7.7362E 00	0.	7.7362E 00	0.
	TWIST	-9.9822E-05	0.	9.9822E-05	0.
9	DEFLECTION	-4.9186E-02	0.	4.9186E-02	0.
	MOMENT	1.6016E-05	0.	1.6016E-05	0.
	TWIST	-9.8774E-05	0.	9.8774E-05	0.

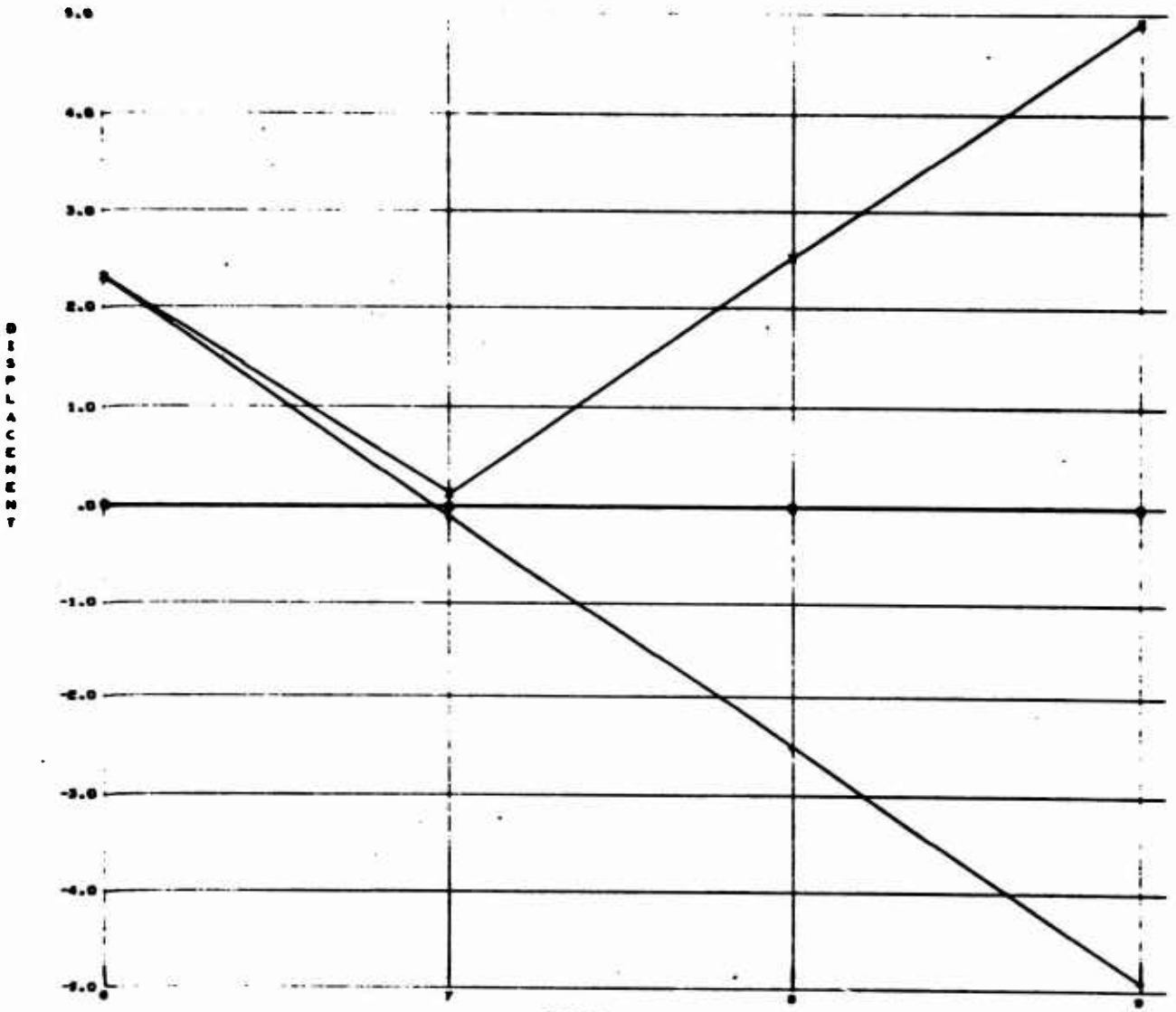
GBRC2 SEPT 20, 1964
SAMPLE PROBLEM 4

DATA CONTROL CARD

NO TYPE

END GBRC2 RUN


5.0
4.0
3.0
2.0
1.0
.0
-1.0
-2.0
-3.0
-4.0
-5.0
DISPLACEMENT
2
3
4
5
SECTION
+ = REAL PART
0 = IMAGINARY PART
X = ABSOLUTE VALUE
SAMPLE PROBLEM 4
MULTI-COMPONENT PLOTTING
FREQUENCY = 1.00 CPS
SYSTEM = 1
SCALING FOR DISPLACEMENT = 10. 0-2


DISPLACEMENT
5.0
4.0
3.0
2.0
1.0
.0
-1.0
-2.0
-3.0
-4.0
-5.0
7
8
9
SECTION
+ = REAL PART
0 = IMAGINARY PART
X = ABSOLUTE VALUE
SAMPLE PROBLEM 4
MULTI-COMPONENT PLOTTING
FREQUENCY = 1.00 CPS
SYSTEM = 2
SCALING FOR DISPLACEMENT = 10. 0-2

VII. COMPARISON OF RESULTS

GBRC2 was run using data from the U.S.S. SACRAMENTO in order to compare its calculations of the first ten natural frequencies and mode shapes of coupled torsion-bending with similar calculations from two other computer codes. One of these codes is designated AML code 173. B; the other is MacNeal-Schwendler Corporation's digital computer program, SADSAM III.

The comparison of results for frequencies calculated is given in Table 1.

GBRC2 SEPT 20. 1964
TORSION HORIZ. BENDING. USS SACRAMENTO

DATA CONTROL CARD

NO	TYPE
1	10
1	20
1	30
1	41
1	42
20	43
1	70

CASE TITLE-COMPARE GBRC2 RESULTS WITH MCN.-SCHW. RESULTS

OPTION DATA
20 -0 1 -0 -0 -0 -0 -0 -0 -0 1

GENERAL DATA - NUMBER OF SECTIONS 20
FREQUENCY RANGE FROM 1.000 CPS TO 15.000 CPS
FREQUENCY INTERVAL 1.000 CPS

REAL PARTS OF SCALING FACTORS

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1	1.0000E 00	-0.	1.0000E-08	1.0000E 00	1.0000E-06	1.0000E 02	1.0000E 00

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.0000E 00	1.0000E 02	1.0000E 00	1.0000E-08	-0.

IMAGINARY PARTS OF SCALING FACTORS

SECTION-END CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1	-0.	-0.	-0.	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
-0.	-0.	-0.	-0.	-0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

SECTION-END CONDN-SYSTEM			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
1	1	1	3.9370E 01	-0.	2.3940E-01	3.8500E 01	5.2000E-03	2.9842E 02	-0.

MZB*DX(N)	IMX*DX(N)	ZHB(N,N+1)	DX/GJE(N,N+1)	U(N)
1.9048E 02	4.3800E 01	-4.8300E 00	4.8870E-01	-0.

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
2	-0	1	6.6330E 01	-0.	1.4540E-01	3.8500E 01	4.7800E-03	5.3186E 02	-0.

MZB*DX(N)	IMX*DX(N)	ZHB(N,N+1)	DX/GJE(N,N+1)	U(N)
7.6589E 02	2.2410E 02	-3.8500E 00	3.2310E-01	-0.

MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)

3	-0	1	6.2240E 01	-0.	1.0440E-01	3.8500E 01	4.0700E-03	7.0168E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.2231E 03	4.3056E 02	-1.6000E 00	2.2710E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
4	-0	1	1.0783E 02	-0.	7.3800E-02	3.8500E 01	2.9900E-03	7.1121E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			2.2097E 03	9.1124E 02	1.3300E 00	1.6100E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
5	-0	1	1.0236E 02	-0.	5.3200E-02	3.8500E 01	2.4800E-03	8.4032E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			2.0783E 03	9.0455E 02	4.7800E 00	1.2060E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
6	-0	1	1.0187E 02	-0.	4.3300E-02	3.8500E 01	2.4300E-03	1.4190E 03	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			2.2383E 03	1.1138E 03	5.9300E 00	9.6000E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
7	-0	1	1.3804E 02	-0.	3.8000E-02	3.8500E 01	2.3400E-03	1.4127E 03	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			3.6053E 03	1.8539E 03	6.2600E 00	7.8000E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
8	-0	1	1.7317E 02	-0.	3.5600E-02	3.8500E 01	1.9100E-03	1.3274E 03	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			5.2208E 03	2.4579E 03	6.6000E 00	6.9300E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
9	-0	1	1.4306E 02	-0.	3.5300E-02	3.8500E 01	1.2600E-03	1.5795E 03	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			3.8244E 03	1.7691E 03	6.8300E 00	6.5200E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
10	-0	1	1.7164E 02	-0.	3.5100E-02	3.8500E 01	1.2200E-03	1.6033E 03	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			4.8020E 03	2.0936E 03	6.6500E 00	6.6500E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
11	-0	1	1.7575E 02	-0.	3.5100E-02	3.8500E 01	1.2600E-03	1.4743E 03	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		

			4.9200E 04	2.1402E 03	6.0700E 00	6.8500E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
12	-0	1	1.7782E 02	-0.	3.6400E-02	3.8500E 01	1.5100E-03	8.9145E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			4.9548E 03	2.1197E 04	5.7200E 00	7.5400E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
13	-0	1	1.5172E 02	-0.	3.9600E-02	3.8500E 01	1.9000E-03	5.4091E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			4.0478E 03	1.7839E 03	5.0000E 00	8.9500E-02	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
14	-0	1	8.9370E 01	-0.	4.7200E-02	3.8500E 01	2.5600E-03	5.2501E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.7235E 03	7.8992E 02	4.6900E 00	1.2590E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
15	-0	1	8.8710E 01	-0.	6.6200E-02	3.8500E 01	3.4700E-03	5.2592E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.7121E 03	7.8033E 02	4.0000E 00	1.8900E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
16	-0	1	1.0528E 02	-0.	1.0440E-01	3.8500E 01	4.9500E-03	3.7929E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			2.2992E 03	1.0019E 03	1.3200E 00	2.5770E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
17	-0	1	1.2267E 02	-0.	2.0570E-01	3.8500E 01	8.2100E-03	1.7085E 02	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			2.7052E 03	9.9538E 02	2.6000E-01	3.5940E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
18	-0	1	9.4640E 01	-0.	4.1040E-01	3.8500E 01	1.4960E-02	6.4810E 01	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.7561E 03	5.6435E 02	-4.6000E-01	6.3680E-01	-0.		
			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
19	-0	1	7.1350E 01	-0.	5.2230E-01	3.8500E 01	2.3940E-02	6.6000E 00	-0.
			MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)		
			1.0684E 03	3.0620E 02	-8.0000E-01	1.4036E 00	-0.		

			MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX(N,N+1)	P(N)
20	2	1	3.7120E 01	-0.	7.0070E-01	-0.	-0.	-0.	-0.

MZB*DX(N)	IMX*DX(N)	ZBB(N,N+1)	DX/GJE(N,N+1)	U(N)
3.6843E 02	8.5100E 01	-0.	-0.	-0.

NFREQ=10

GBRC2

TORSION HORIZ. BENDING. USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHW. RESULTS

FREQUENCY 1.20 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-6.4118E-05	0.	6.4118E-05	0.
	TWIST	-6.2832E-03	-0.	6.2832E-03	0.
2	DEFLECTION	7.5258E-01	0.	7.5258E-01	0.
	MOMENT	9.9240E 04	-0.	9.9240E 04	-0.
	TWIST	-6.1686E-03	-0.	6.1686E-03	0.
3	DEFLECTION	5.1034E-01	0.	5.1034E-01	0.
	MOMENT	3.2579E 05	-0.	3.2579E 05	-0.
	TWIST	-5.9306E-03	-0.	5.9306E-03	0.
4	DEFLECTION	2.8168E-01	0.	2.8168E-01	0.
	MOMENT	6.6444E 05	-0.	6.6444E 05	-0.
	TWIST	-5.6674E-03	-0.	5.6674E-03	0.
5	DEFLECTION	7.2652E-02	0.	7.2652E-02	0.
	MOMENT	1.0950E 06	-0.	1.0950E 06	-0.
	TWIST	-5.4208E-03	-0.	5.4208E-03	0.
6	DEFLECTION	-1.1342E-01	0.	1.1342E-01	0.
	MOMENT	1.5677E 06	-0.	1.5677E 06	-0.
	TWIST	-5.2425E-03	-0.	5.2425E-03	0.
7	DEFLECTION	-2.7334E-01	0.	2.7334E-01	0.
	MOMENT	2.0512E 06	-0.	2.0512E 06	-0.
	TWIST	-5.0955E-03	-0.	5.0955E-03	0.
8	DEFLECTION	-4.0337E-01	0.	4.0337E-01	0.
	MOMENT	2.4860E 06	-0.	2.4860E 06	-0.
	TWIST	-4.9755E-03	-0.	4.9755E-03	0.
9	DEFLECTION	-4.9953E-01	0.	4.9953E-01	0.
	MOMENT	2.8168E 06	-0.	2.8168E 06	-0.
	TWIST	-4.8948E-03	-0.	4.8948E-03	0.
10	DEFLECTION	-5.5760E-01	0.	5.5760E-01	0.
	MOMENT	3.0272E 06	-0.	3.0272E 06	-0.
	TWIST	-4.8445E-03	-0.	4.8445E-03	0.
11	DEFLECTION	-5.7505E-01	0.	5.7505E-01	0.
	MOMENT	3.0700E 06	-0.	3.0700E 06	-0.
	TWIST	-4.8380E-03	-0.	4.8380E-03	0.
12	DEFLECTION	-5.5132E-01	0.	5.5132E-01	0.
	MOMENT	2.9349E 06	0.	2.9349E 06	0.
	TWIST	-4.8825E-03	-0.	4.8825E-03	0.
13	DEFLECTION	-4.8679E-01	-0.	4.8679E-01	0.
	MOMENT	2.6353E 06	0.	2.6353E 06	0.
	TWIST	-4.9882E-03	-0.	4.9882E-03	0.

14	DEFLECTION	-3.8232E-01	-0.	3.8232E-01	0.
	MOMENT	2.2187E 06	0.	2.2187E 06	0.
	TWIST	-5.1582E-03	-0.	5.1582E-03	0.
15	DEFLECTION	-2.3786E-01	0.	2.3786E-01	0.
	MOMENT	1.7442E 06	-0.	1.7442E 06	-0.
	TWIST	-5.4108E-03	-0.	5.4108E-03	0.
16	DEFLECTION	-4.9293E-02	0.	4.9293E-02	0.
	MOMENT	1.2403E 06	-0.	1.2403E 06	-0.
	TWIST	-5.7991E-03	-0.	5.7991E-03	0.
17	DEFLECTION	1.8996E-01	0.	1.8996E-01	0.
	MOMENT	7.5550E 05	-0.	7.5550E 05	-0.
	TWIST	-6.3496E-03	-0.	6.3496E-03	0.
18	DEFLECTION	4.8965E-01	0.	4.8965E-01	0.
	MOMENT	3.6492E 05	-0.	3.6492E 05	-0.
	TWIST	-6.9327E-03	-0.	6.9327E-03	0.
19	DEFLECTION	8.4745E-01	0.	8.4745E-01	0.
	MOMENT	1.0616E 05	-0.	1.0616E 05	-0.
	TWIST	-7.5500E-03	0.	7.5500E-03	0.
20	DEFLECTION	1.2266E 00	0.	1.2266E 00	0.
	MOMENT	-9.8380E-05	0.	9.8380E-05	0.
	TWIST	-7.9946E-03	-0.	7.9946E-03	0.

RC2

TORSION HORIZ. BENDING, USS SACRAMENTO

COMPARE GRRC2 RESULTS WITH MCN.-SCHW. RESULTS

FREQUENCY 2.51 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-9.3911E-05	0.	9.3911E-05	0.
	TWIST	-9.8421E-04	-0.	9.8421E-04	0.
2	DEFLECTION	6.3613E-01	0.	6.3613E-01	0.
	MOMENT	4.4695E 05	-0.	4.4695E 05	-0.
	TWIST	-5.1604E-04	-0.	5.1604E-04	0.
3	DEFLECTION	2.9637E-01	0.	2.9637E-01	0.
	MOMENT	1.3479E 06	-0.	1.3479E 06	-0.
	TWIST	2.9587E-04	-0.	2.9587E-04	-0.
4	DEFLECTION	1.2809E-02	0.	1.2809E-02	0.
	MOMENT	2.4913E 06	-0.	2.4913E 06	-0.
	TWIST	9.8171E-04	-0.	9.8171E-04	-0.
5	DEFLECTION	-1.9839E-01	0.	1.9839E-01	0.
	MOMENT	3.5964E 06	-0.	3.5964E 06	-0.
	TWIST	1.3194E-03	-0.	1.3194E-03	-0.
6	DEFLECTION	-3.3627E-01	0.	3.3627E-01	0.
	MOMENT	4.4582E 06	-0.	4.4582E 06	-0.
	TWIST	1.3370E-03	-0.	1.3370E-03	-0.
7	DEFLECTION	-4.0090E-01	0.	4.0090E-01	0.
	MOMENT	4.9466E 06	-0.	4.9466E 06	-0.
	TWIST	1.1658E-03	-0.	1.1658E-03	-0.
8	DEFLECTION	-3.9457E-01	0.	3.9457E-01	0.
	MOMENT	4.7981E 06	0.	4.7981E 06	0.
	TWIST	7.7364E-04	-0.	7.7364E-04	-0.
9	DEFLECTION	-3.2430E-01	-0.	3.2430E-01	0.
	MOMENT	3.9003E 06	0.	3.9003E 06	0.
	TWIST	1.2039E-04	-0.	1.2039E-04	-0.
10	DEFLECTION	-2.0201E-01	0.	2.0201E-01	0.
	MOMENT	2.4873E 06	-0.	2.4873E 06	-0.
	TWIST	-6.5545E-04	-0.	6.5545E-04	0.
11	DEFLECTION	-4.6694E-02	0.	4.6694E-02	0.
	MOMENT	7.3549E 05	-0.	7.3549E 05	-0.
	TWIST	-1.5419E-03	-0.	1.5419E-03	0.
12	DEFLECTION	1.1892E-01	0.	1.1892E-01	0.
	MOMENT	-1.0183E 06	-0.	1.0183E 06	0.
	TWIST	-2.4540E-03	-0.	2.4540E-03	0.
13	DEFLECTION	2.7092E-01	0.	2.7092E-01	0.
	MOMENT	-2.3803E 06	-0.	2.3803E 06	0.
	TWIST	-3.7075E-03	-0.	3.7075E-03	0.

14	DEFLECTION	3.8797E-01	0.	3.8797E-01	0.
	MOMENT	-3.1720E 06	-0.	3.1720E 06	0.
	TWIST	-4.0137E-03	-0.	4.0137E-03	0.
15	DEFLECTION	4.4735E-01	0.	4.4735E-01	0.
	MOMENT	-3.5444E 06	0.	3.5444E 06	0.
	TWIST	-4.7670E-03	-0.	4.7670E-03	0.
16	DEFLECTION	4.1711E-01	0.	4.1711E-01	0.
	MOMENT	-3.4277E 06	-0.	3.4277E 06	0.
	TWIST	-5.4645E-03	0.	5.4645E-03	0.
17	DEFLECTION	2.5180E-01	-0.	2.5180E-01	-0.
	MOMENT	-2.7387E 06	0.	2.7387E 06	0.
	TWIST	-5.4779E-03	-0.	5.4779E-03	0.
18	DEFLECTION	-1.3024E-01	0.	1.3024E-01	0.
	MOMENT	-1.6101E 06	-0.	1.6101E 06	0.
	TWIST	-4.3461E-03	-0.	4.3461E-03	0.
19	DEFLECTION	-7.6814E-01	0.	7.6814E-01	0.
	MOMENT	-5.4193E 05	-0.	5.4193E 05	0.
	TWIST	-2.1886E-03	-0.	2.1886E-03	0.
20	DEFLECTION	-1.5156E 00	0.	1.5156E 00	0.
	MOMENT	1.9363E-04	0.	1.9363E-04	0.
	TWIST	-8.3410E-05	-0.	8.3410E-05	0.

GBRC2

TORSION HORIZ. BENDING. USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHW. RESULTS

FREQUENCY 3.97 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-1.3006E-04	0.	1.3006E-04	0.
	TWIST	-4.9945E-04	-0.	4.9945E-04	0.
2	DEFLECTION	4.9348E-01	0.	4.9348E-01	0.
	MOMENT	1.1934E 06	-0.	1.1934E 06	-0.
	TWIST	6.7081E-04	-0.	6.7081E-04	-0.
3	DEFLECTION	5.2876E-02	0.	5.2876E-02	0.
	MOMENT	3.2917E 06	-0.	3.2917E 06	-0.
	TWIST	2.3480E-03	-0.	2.3480E-03	-0.
4	DEFLECTION	-2.5038E-01	0.	2.5038E-01	0.
	MOMENT	5.3945E 06	-0.	5.3945E 06	-0.
	TWIST	3.2497E-03	-0.	3.2497E-03	-0.
5	DEFLECTION	-3.9931E-01	0.	3.9931E-01	0.
	MOMENT	6.5052E 06	-0.	6.5052E 06	-0.
	TWIST	2.8664E-03	-0.	2.8664E-03	-0.
6	DEFLECTION	-4.1938E-01	0.	4.1938E-01	0.
	MOMENT	6.3417E 06	0.	6.3417E 06	0.
	TWIST	1.8273E-03	-0.	1.8273E-03	-0.
7	DEFLECTION	-3.3663E-01	0.	3.3663E-01	0.
	MOMENT	4.8260E 06	-0.	4.8260E 06	-0.
	TWIST	4.8796E-04	-0.	4.8796E-04	-0.
8	DEFLECTION	-1.8508E-01	0.	1.8508E-01	0.
	MOMENT	1.9923E 06	-0.	1.9923E 06	-0.
	TWIST	-1.0788E-03	-0.	1.0788E-03	0.
9	DEFLECTION	-6.9919E-03	0.	6.9919E-03	0.
	MOMENT	-1.5118E 06	-0.	1.5118E 06	0.
	TWIST	-2.6833E-03	-0.	2.6833E-03	0.
10	DEFLECTION	1.5177E-01	0.	1.5177E-01	0.
	MOMENT	-4.8180E 06	-0.	4.8180E 06	0.
	TWIST	-4.0450E-03	-0.	4.0450E-03	0.
11	DEFLECTION	2.4905E-01	0.	2.4905E-01	0.
	MOMENT	-6.8703E 06	-0.	6.8703E 06	0.
	TWIST	-4.8941E-03	0.	4.8941E-03	0.
12	DEFLECTION	2.5847E-01	-0.	2.5847E-01	-0.
	MOMENT	-7.0512E 06	0.	7.0512E 06	0.
	TWIST	-4.9947E-03	0.	4.9947E-03	0.
13	DEFLECTION	1.7424E-01	-0.	1.7424E-01	-0.
	MOMENT	-5.3830E 06	0.	5.3830E 06	0.
	TWIST	-4.1864E-03	-0.	4.1864E-03	0.

14	DEFLECTION	1.1559E-02	0.	1.1559E-02	0.
	MOMENT	-2.6523E 06	-0.	2.6523E 06	0.
	TWIST	-2.5246E-03	-0.	2.5246E-03	0.
15	DEFLECTION	-1.9588E-01	0.	1.9588E-01	0.
	MOMENT	2.4423E 05	-0.	2.4423E 05	-0.
	TWIST	-8.4783E-06	-0.	8.4783E-06	0.
16	DEFLECTION	-3.9470E-01	0.	3.9470E-01	0.
	MOMENT	2.7191E 06	-0.	2.7191E 06	-0.
	TWIST	3.5480E-03	-0.	3.5480E-03	-0.
17	DEFLECTION	-4.9397E-01	0.	4.9397E-01	0.
	MOMENT	3.8833E 06	-0.	3.8833E 06	-0.
	TWIST	6.8853E-03	-0.	6.8853E-03	-0.
18	DEFLECTION	-2.8974E-01	0.	2.8974E-01	0.
	MOMENT	3.0263E 06	0.	3.0263E 06	0.
	TWIST	7.1655E-03	-0.	7.1655E-03	-0.
19	DEFLECTION	3.9463E-01	0.	3.9463E-01	0.
	MOMENT	1.1940E 06	-0.	1.1940E 06	-0.
	TWIST	3.8688E-03	-0.	3.8688E-03	-0.
20	DEFLECTION	1.3214E 00	0.	1.3214E 00	0.
	MOMENT	-2.3955E-04	0.	2.3955E-04	0.
	TWIST	-7.9523E-04	-0.	7.9523E-04	0.

GBRC2

TORSION HORIZ. BENDING, USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCH#. RESULTS

FREQUENCY 4.56 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-8.2553E-06	0.	8.2553E-06	0.
	TWIST	8.6484E-02	-0.	8.6484E-02	-0.
2	DEFLECTION	9.6975E-01	0.	9.6975E-01	0.
	MOMENT	7.0527E 05	-0.	7.0527E 05	-0.
	TWIST	8.6148E-02	-0.	8.6148E-02	-0.
3	DEFLECTION	9.9065E-01	0.	9.9065E-01	0.
	MOMENT	1.3264E 06	-0.	1.3264E 06	-0.
	TWIST	8.2698E-02	-0.	8.2698E-02	-0.
4	DEFLECTION	1.0628E 00	0.	1.0628E 00	0.
	MOMENT	1.2420E 06	-0.	1.2420E 06	-0.
	TWIST	7.5741E-02	-0.	7.5741E-02	-0.
5	DEFLECTION	1.1448E 00	0.	1.1448E 00	0.
	MOMENT	-5.6732E 05	-0.	5.6732E 05	0.
	TWIST	6.4873E-02	0.	6.4873E-02	0.
6	DEFLECTION	1.1754E 00	-0.	1.1754E 00	-0.
	MOMENT	-2.9408E 06	0.	2.9408E 06	0.
	TWIST	5.3537E-02	-0.	5.3537E-02	-0.
7	DEFLECTION	1.1425E 00	0.	1.1425E 00	0.
	MOMENT	-5.2734E 06	-0.	5.2734E 06	0.
	TWIST	4.1947E-02	-0.	4.1947E-02	-0.
8	DEFLECTION	1.0274E 00	0.	1.0274E 00	0.
	MOMENT	-7.1680E 06	-0.	7.1680E 06	0.
	TWIST	3.0174E-02	-0.	3.0174E-02	-0.
9	DEFLECTION	8.1054E-01	0.	8.1054E-01	0.
	MOMENT	-8.1463E 06	-0.	8.1463E 06	0.
	TWIST	1.8480E-02	-0.	1.8480E-02	-0.
10	DEFLECTION	4.8205E-01	0.	4.8205E-01	0.
	MOMENT	-7.2428E 06	-0.	7.2428E 06	0.
	TWIST	7.0547E-03	0.	7.0547E-03	0.
11	DEFLECTION	5.9215E-02	0.	5.9215E-02	0.
	MOMENT	-4.4448E 06	-0.	4.4448E 06	0.
	TWIST	-4.1414E-03	0.	4.1414E-03	0.
12	DEFLECTION	-4.1579E-01	-0.	4.1579E-01	0.
	MOMENT	-5.7927E 05	0.	5.7927E 05	0.
	TWIST	-1.5102E-02	-0.	1.5102E-02	0.
13	DEFLECTION	-8.9815E-01	0.	8.9815E-01	0.
	MOMENT	2.8216E 06	-0.	2.8216E 06	-0.
	TWIST	-2.6595E-02	-0.	2.6595E-02	0.

14	DEFLECTION	-1.3342E 00	0.	1.3342E 00	0.
	MOMENT	4.9553E 06	-0.	4.9553E 06	-0.
	TWIST	-3.9094E-02	-0.	3.9094E-02	0.
15	DEFLECTION	-1.6950E 00	0.	1.6950E 00	0.
	MOMENT	5.3338E 06	-0.	5.3338E 06	-0.
	TWIST	-5.5592E-02	-0.	5.5592E-02	0.
16	DEFLECTION	-1.9312E 00	0.	1.9312E 00	0.
	MOMENT	3.8134E 06	-0.	3.8134E 06	-0.
	TWIST	-7.7781E-02	-0.	7.7781E-02	0.
17	DEFLECTION	-1.9559E 00	0.	1.9559E 00	0.
	MOMENT	1.3478E 06	0.	1.3478E 06	0.
	TWIST	-1.0117E-01	-0.	1.0117E-01	0.
18	DEFLECTION	-1.8480E 00	0.	1.8480E 00	0.
	MOMENT	-8.6066E 04	-0.	8.6066E 04	0.
	TWIST	-1.1993E-01	-0.	1.1993E-01	0.
19	DEFLECTION	-1.7421E 00	0.	1.7421E 00	0.
	MOMENT	-3.6211E 05	-0.	3.6211E 05	0.
	TWIST	-1.3481E-01	-0.	1.3481E-01	0.
20	DEFLECTION	-1.7111E 00	0.	1.7111E 00	0.
	MOMENT	-6.7794E-06	0.	6.7794E-06	0.
	TWIST	-1.4131E-01	0.	1.4131E-01	0.

GBRC2

TORSION HORIZ. BENDING, USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHN. RESULTS

FREQUENCY 5.98 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-1.8264E-04	0.	1.8264E-04	0.
	TWIST	-3.5112E-03	-0.	3.5112E-03	0.
2	DEFLECTION	2.8323E-01	0.	2.8323E-01	0.
	MOMENT	2.9454E 06	-0.	2.9454E 06	-0.
	TWIST	-7.5821E-04	-0.	7.5821E-04	0.
3	DEFLECTION	-2.6720E-01	0.	2.6720E-01	0.
	MOMENT	7.2220E 06	-0.	7.2220E 06	-0.
	TWIST	2.2892E-03	-0.	2.2892E-03	-0.
4	DEFLECTION	-5.1577E-01	0.	5.1577E-01	0.
	MOMENT	9.7429E 06	-0.	9.7429E 06	-0.
	TWIST	2.5137E-03	-0.	2.5137E-03	-0.
5	DEFLECTION	-4.9083E-01	0.	4.9083E-01	0.
	MOMENT	8.2317E 06	0.	8.2317E 06	0.
	TWIST	-4.7971E-04	-0.	4.7971E-04	0.
6	DEFLECTION	-3.0915E-01	0.	3.0915E-01	0.
	MOMENT	3.5155E 06	-0.	3.5155E 06	-0.
	TWIST	-3.8271E-03	-0.	3.8271E-03	0.
7	DEFLECTION	-6.8942E-02	0.	6.8942E-02	0.
	MOMENT	-3.1678E 06	-0.	3.1678E 06	0.
	TWIST	-6.5494E-03	-0.	6.5494E-03	0.
8	DEFLECTION	1.3343E-01	0.	1.3343E-01	0.
	MOMENT	-8.8404E 06	0.	8.8404E 06	0.
	TWIST	-7.7608E-03	-0.	7.7608E-03	0.
9	DEFLECTION	2.2915E-01	0.	2.2915E-01	0.
	MOMENT	-1.0406E 07	-0.	1.0406E 07	0.
	TWIST	-6.6752E-03	-0.	6.6752E-03	0.
10	DEFLECTION	1.9386E-01	0.	1.9386E-01	0.
	MOMENT	-8.0701E 06	0.	8.0701E 06	0.
	TWIST	-4.0860E-03	-0.	4.0860E-03	0.
11	DEFLECTION	5.8016E-02	0.	5.8016E-02	0.
	MOMENT	-2.2189E 06	-0.	2.2189E 06	0.
	TWIST	-1.3404E-04	-0.	1.3404E-04	0.
12	DEFLECTION	-1.0764E-01	0.	1.0764E-01	0.
	MOMENT	4.3068E 06	-0.	4.3068E 06	-0.
	TWIST	4.2270E-03	-0.	4.2270E-03	-0.
13	DEFLECTION	-2.1872E-01	0.	2.1872E-01	0.
	MOMENT	8.0504E 06	-0.	8.0504E 06	-0.
	TWIST	7.8366E-03	-0.	7.8366E-03	-0.

14	DEFLECTION	-2.1851E-01	0.	2.1851E-01	0.
	MOMENT	7.8593E 06	0.	7.8593E 06	0.
	TWIST	9.6492E-03	-0.	9.6492E-03	-0.
15	DEFLECTION	-8.0525E-02	-0.	8.0525E-02	0.
	MOMENT	5.4307E 06	0.	5.4307E 06	0.
	TWIST	1.0477E-02	-0.	1.0477E-02	-0.
16	DEFLECTION	1.8773E-01	0.	1.8773E-01	0.
	MOMENT	1.3740E 06	-0.	1.3740E 06	-0.
	TWIST	9.3674E-03	-0.	9.3674E-03	-0.
17	DEFLECTION	5.1054E-01	0.	5.1054E-01	0.
	MOMENT	-2.7095E 06	-0.	2.7095E 06	0.
	TWIST	5.3883E-03	0.	5.3883E-03	0.
18	DEFLECTION	6.2334E-01	-0.	6.2334E-01	-0.
	MOMENT	-3.8009E 06	0.	3.8009E 06	0.
	TWIST	3.6964E-03	0.	3.6964E-03	0.
19	DEFLECTION	1.3277E-01	-0.	1.3277E-01	-0.
	MOMENT	-1.8564E 06	0.	1.8564E 06	0.
	TWIST	8.7476E-03	-0.	8.7476E-03	-0.
20	DEFLECTION	-7.3630E-01	0.	7.3630E-01	0.
	MOMENT	2.2359E-04	0.	2.2359E-04	0.
	TWIST	1.7617E-02	-0.	1.7617E-02	-0.

GBRC2

TORSION HORIZ. BENDING, USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHW. RESULTS

FREQUENCY 7.20 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-5.6076E-05	0.	5.6076E-05	0.
	TWIST	8.8777E-02	-0.	8.8777E-02	-0.
2	DEFLECTION	7.8820E-01	0.	7.8820E-01	0.
	MOMENT	2.1165E 06	-0.	2.1165E 06	-0.
	TWIST	8.7880E-02	-0.	8.7880E-02	-0.
3	DEFLECTION	7.2981E-01	0.	7.2981E-01	0.
	MOMENT	2.9745E 06	-0.	2.9745E 06	-0.
	TWIST	7.7725E-02	-0.	7.7725E-02	-0.
4	DEFLECTION	7.8243E-01	0.	7.8243E-01	0.
	MOMENT	7.1119E 05	0.	7.1119E 05	0.
	TWIST	5.8826E-02	-0.	5.8826E-02	-0.
5	DEFLECTION	7.9211E-01	0.	7.9211E-01	0.
	MOMENT	-5.2261E 06	-0.	5.2261E 06	0.
	TWIST	3.3922E-02	-0.	3.3922E-02	-0.
6	DEFLECTION	6.2417E-01	0.	6.2417E-01	0.
	MOMENT	-9.8799E 06	-0.	9.8799E 06	0.
	TWIST	1.2255E-02	-0.	1.2255E-02	-0.
7	DEFLECTION	2.9134E-01	0.	2.9134E-01	0.
	MOMENT	-1.0241E 07	0.	1.0241E 07	0.
	TWIST	-5.2094E-03	-0.	5.2094E-03	0.
8	DEFLECTION	-1.6030E-01	0.	1.6030E-01	0.
	MOMENT	-4.8329E 06	-0.	4.8329E 06	0.
	TWIST	-1.6755E-02	-0.	1.6755E-02	0.
9	DEFLECTION	-6.4688E-01	0.	6.4688E-01	0.
	MOMENT	5.5788E 06	0.	5.5788E 06	0.
	TWIST	-2.2931E-02	-0.	2.2931E-02	0.
10	DEFLECTION	-1.0423E 00	0.	1.0423E 00	0.
	MOMENT	1.5569E 07	-0.	1.5569E 07	-0.
	TWIST	-2.6672E-02	-0.	2.6672E-02	0.
11	DEFLECTION	-1.2182E 00	0.	1.2182E 00	0.
	MOMENT	1.9804E 07	-0.	1.9804E 07	-0.
	TWIST	-2.9160E-02	-0.	2.9160E-02	0.
12	DEFLECTION	-1.1196E 00	0.	1.1196E 00	0.
	MOMENT	1.6264E 07	0.	1.6264E 07	0.
	TWIST	-3.0786E-02	-0.	3.0786E-02	0.
13	DEFLECTION	-7.8240E-01	-0.	7.8240E-01	0.
	MOMENT	8.3090E 06	0.	8.3090E 06	0.
	TWIST	-3.0671E-02	-0.	3.0671E-02	0.

14	DEFLECTION	-2.9812E-01	0.	2.9812E-01	0.
	MOMENT	1.0460E 06	-0.	1.0460E 06	-0.
	TWIST	-2.6469E-02	-0.	2.6469E-02	0.
15	DEFLECTION	2.2959E-01	0.	2.2959E-01	0.
	MOMENT	-4.7348E 06	-0.	4.7348E 06	0.
	TWIST	-1.6782E-02	0.	1.6782E-02	0.
16	DEFLECTION	6.7184E-01	0.	6.7184E-01	0.
	MOMENT	-6.3091E 06	-0.	6.3091E 06	0.
	TWIST	3.4391E-03	-0.	3.4391E-03	-0.
17	DEFLECTION	8.2303E-01	0.	8.2303E-01	0.
	MOMENT	-2.1372E 06	0.	2.1372E 06	0.
	TWIST	3.6805E-02	-0.	3.6805E-02	-0.
18	DEFLECTION	7.7000E-01	0.	7.7000E-01	0.
	MOMENT	2.4181E 06	-0.	2.4181E 06	-0.
	TWIST	7.3195E-02	-0.	7.3195E-02	-0.
19	DEFLECTION	1.0774E 00	0.	1.0774E 00	0.
	MOMENT	2.4185E 06	-0.	2.4185E 06	-0.
	TWIST	1.0164E-01	0.	1.0164E-01	0.
20	DEFLECTION	1.8813E 00	-0.	1.8813E 00	-0.
	MOMENT	-2.0958E-04	0.	2.0958E-04	0.
	TWIST	1.0726E-01	0.	1.0726E-01	0.

GBRC2

TORSION HORIZ. BENDING. USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHN. RESULTS

FREQUENCY 8.15 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-2.7696E-04	0.	2.7696E-04	0.
	TWIST	-2.8286E-02	-0.	2.8286E-02	0.
2	DEFLECTION	-9.9745E-02	0.	9.9745E-02	0.
	MOMENT	6.6854E 06	-0.	6.6854E 06	-0.
	TWIST	-2.1490E-02	-0.	2.1490E-02	0.
3	DEFLECTION	-8.2280E-01	0.	8.2280E-01	0.
	MOMENT	1.4705E 07	-0.	1.4705E 07	-0.
	TWIST	-1.3619E-02	-0.	1.3619E-02	0.
4	DEFLECTION	-9.2678E-01	0.	9.2678E-01	0.
	MOMENT	1.5558E 07	0.	1.5558E 07	0.
	TWIST	-1.1800E-02	-0.	1.1800E-02	0.
5	DEFLECTION	-5.8844E-01	0.	5.8844E-01	0.
	MOMENT	6.8308E 06	-0.	6.8308E 06	-0.
	TWIST	-1.4244E-02	-0.	1.4244E-02	0.
6	DEFLECTION	-1.0874E-01	0.	1.0874E-01	0.
	MOMENT	-6.0851E 06	0.	6.0851E 06	0.
	TWIST	-1.4640E-02	-0.	1.4640E-02	0.
7	DEFLECTION	2.8989E-01	0.	2.8989E-01	0.
	MOMENT	-1.7728E 07	-0.	1.7728E 07	0.
	TWIST	-1.1499E-02	-0.	1.1499E-02	0.
8	DEFLECTION	4.6044E-01	0.	4.6044E-01	0.
	MOMENT	-1.8645E 07	-0.	1.8645E 07	0.
	TWIST	-3.4445E-03	0.	3.4445E-03	0.
9	DEFLECTION	4.0296E-01	0.	4.0296E-01	0.
	MOMENT	-7.3308E 06	-0.	7.3306E 06	0.
	TWIST	8.4394E-03	-0.	8.4394E-03	-0.
10	DEFLECTION	2.4330E-01	0.	2.4330E-01	0.
	MOMENT	7.8451E 06	-0.	7.8451E 06	-0.
	TWIST	1.9536E-02	-0.	1.9536E-02	-0.
11	DEFLECTION	1.5860E-01	0.	1.5860E-01	0.
	MOMENT	1.6653E 07	-0.	1.6653E 07	-0.
	TWIST	2.6236E-02	-0.	2.6236E-02	-0.
12	DEFLECTION	2.5139E-01	0.	2.5139E-01	0.
	MOMENT	1.2885E 07	0.	1.2885E 07	0.
	TWIST	2.5689E-02	-0.	2.5689E-02	-0.
13	DEFLECTION	4.8214E-01	0.	4.8214E-01	0.
	MOMENT	7.3555E 04	-0.	7.3555E 04	-0.
	TWIST	1.7599E-02	-0.	1.7599E-02	-0.

14	DEFLECTION	6.9804E-01	0.	6.9804E-01	0.
	MOMENT	-1.1889E 07	-0.	1.1889E 07	0.
	TWIST	5.1294E-03	0.	5.1294E-03	0.
15	DEFLECTION	6.8573E-01	0.	6.8573E-01	0.
	MOMENT	-1.7651E 07	-0.	1.7651E 07	0.
	TWIST	-1.0720E-02	-0.	1.0720E-02	0.
16	DEFLECTION	2.3493E-01	0.	2.3493E-01	0.
	MOMENT	-1.3817E 07	0.	1.3817E 07	0.
	TWIST	-2.6315E-02	-0.	2.6315E-02	0.
17	DEFLECTION	-7.1027E-01	0.	7.1027E-01	0.
	MOMENT	-3.4263E 05	-0.	3.4263E 05	0.
	TWIST	-2.6457E-02	-0.	2.6457E-02	0.
18	DEFLECTION	-1.6810E 00	0.	1.6810E 00	0.
	MOMENT	1.0257E 07	0.	1.0257E 07	0.
	TWIST	-1.8822E-02	-0.	1.8822E-02	0.
19	DEFLECTION	-1.0217E 00	0.	1.0217E 00	0.
	MOMENT	6.7310E 06	-0.	6.7310E 06	-0.
	TWIST	-3.6654E-02	-0.	3.6654E-02	0.
20	DEFLECTION	1.0175E 00	0.	1.0175E 00	0.
	MOMENT	-5.2036E-04	0.	5.2036E-04	0.
	TWIST	-7.6222E-02	0.	7.6222E-02	0.

GBRC2

TORSION HORIZ. BENDING, USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHR. RESULTS

FREQUENCY 9.50 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-1.7723E-04	0.	1.7723E-04	0.
	TWIST	4.8839E-02	-0.	4.8839E-02	-0.
2	DEFLECTION	3.0677E-01	0.	3.0677E-01	0.
	MOMENT	6.0423E 06	-0.	6.0423E 06	-0.
	TWIST	5.0979E-02	-0.	5.0979E-02	-0.
3	DEFLECTION	1.7826E-03	0.	1.7826E-03	0.
	MOMENT	9.3205E 06	-0.	9.3205E 06	-0.
	TWIST	4.0771E-02	0.	4.0771E-02	0.
4	DEFLECTION	6.8450E-02	-0.	6.8450E-02	-0.
	MOMENT	3.8810E 06	0.	3.8810E 06	0.
	TWIST	1.8537E-02	-0.	1.8537E-02	-0.
5	DEFLECTION	1.7852E-01	0.	1.7852E-01	0.
	MOMENT	-6.8964E 06	-0.	6.8964E 06	0.
	TWIST	-5.1547E-03	0.	5.1547E-03	0.
6	DEFLECTION	1.1307E-01	0.	1.1307E-01	0.
	MOMENT	-1.2764E 07	-0.	1.2764E 07	0.
	TWIST	-1.8833E-02	-0.	1.8833E-02	0.
7	DEFLECTION	-1.2257E-01	0.	1.2257E-01	0.
	MOMENT	-8.4672E 06	-0.	8.4672E 06	0.
	TWIST	-2.2596E-02	0.	2.2596E-02	0.
8	DEFLECTION	-4.2131E-01	0.	4.2131E-01	0.
	MOMENT	6.2977E 06	-0.	6.2977E 06	-0.
	TWIST	-1.6367E-02	-0.	1.6367E-02	0.
9	DEFLECTION	-6.0820E-01	0.	6.0820E-01	0.
	MOMENT	2.1450E 07	-0.	2.1450E 07	-0.
	TWIST	-6.5955E-03	-0.	6.5955E-03	0.
10	DEFLECTION	-5.1605E-01	0.	5.1605E-01	0.
	MOMENT	2.4444E 07	0.	2.4444E 07	0.
	TWIST	9.5013E-04	-0.	9.5013E-04	-0.
11	DEFLECTION	-1.2668E-01	-0.	1.2668E-01	0.
	MOMENT	9.7400E 06	0.	9.7400E 06	0.
	TWIST	3.6628E-03	-0.	3.6628E-03	-0.
12	DEFLECTION	3.7568E-01	0.	3.7568E-01	0.
	MOMENT	-1.1846E 07	-0.	1.1846E 07	0.
	TWIST	3.5319E-03	0.	3.5319E-03	0.
13	DEFLECTION	7.2417E-01	0.	7.2417E-01	0.
	MOMENT	-2.2582E 07	-0.	2.2582E 07	0.
	TWIST	5.5463E-03	-0.	5.5463E-03	-0.

14	DEFLECTION	7.5147E-01	0.	7.5147E-01	0.
	MOMENT	-1.8502E 07	0.	1.8502E 07	0.
	TWIST	1.2574E-02	-0.	1.2574E-02	-0.
15	DEFLECTION	4.5537E-01	-0.	4.5537E-01	-0.
	MOMENT	-6.5443E 06	0.	6.5443E 06	0.
	TWIST	2.2900E-02	-0.	2.2900E-02	-0.
16	DEFLECTION	-2.0100E-02	0.	2.0100E-02	0.
	MOMENT	6.3913E 06	-0.	6.3913E 06	-0.
	TWIST	3.1929E-02	-0.	3.1929E-02	-0.
17	DEFLECTION	-2.9328E-01	0.	2.9328E-01	0.
	MOMENT	7.3649E 06	0.	7.3649E 06	0.
	TWIST	1.7217E-02	-0.	1.7217E-02	-0.
18	DEFLECTION	2.5023E-02	0.	2.5023E-02	0.
	MOMENT	-4.4048E 06	0.	4.4048E 06	0.
	TWIST	-3.5141E-02	-0.	3.5141E-02	0.
19	DEFLECTION	-3.1867E-01	0.	3.1867E-01	0.
	MOMENT	-6.6379E 06	-0.	6.6379E 06	0.
	TWIST	-8.2561E-02	0.	8.2561E-02	0.
20	DEFLECTION	-2.0298E 00	0.	2.0298E 00	0.
	MOMENT	4.4188E-04	0.	4.4188E-04	0.
	TWIST	-7.5299E-02	-0.	7.5299E-02	0.

GBRC2

TO SION HORIZ. BENDING, USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCHW. RESULTS

FREQUENCY 10.90 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-6.3058E-04	0.	6.3058E-04	0.
	TWIST	-1.9012E-01	-0.	1.9012E-01	0.
2	DEFLECTION	-1.5837E 00	0.	1.5837E 00	0.
	MOMENT	2.2642E 07	-0.	2.2642E 07	-0.
	TWIST	-1.5822E-01	-0.	1.5822E-01	0.
3	DEFLECTION	-2.9625E 00	0.	2.9625E 00	0.
	MOMENT	4.6914E 07	0.	4.6914E 07	0.
	TWIST	-1.0201E-01	-0.	1.0201E-01	0.
4	DEFLECTION	-2.3062E 00	0.	2.3062E 00	0.
	MOMENT	3.6032E 07	-0.	3.6032E 07	-0.
	TWIST	-5.8538E-02	-0.	5.8538E-02	0.
5	DEFLECTION	-5.0923E-01	0.	5.0923E-01	0.
	MOMENT	-5.3287E 06	0.	5.3287E 06	0.
	TWIST	-2.4150E-02	-0.	2.4150E-02	0.
6	DEFLECTION	1.2998E 00	0.	1.2998E 00	0.
	MOMENT	-4.8671E 07	-0.	4.8671E 07	0.
	TWIST	1.0860E-02	0.	1.0860E-02	0.
7	DEFLECTION	2.3270E 00	-0.	2.3270E 00	-0.
	MOMENT	-7.0045E 07	0.	7.0045E 07	0.
	TWIST	4.4254E-02	-0.	4.4254E-02	-0.
8	DEFLECTION	2.2807E 00	0.	2.2807E 00	0.
	MOMENT	-4.4563E 07	-0.	4.4563E 07	0.
	TWIST	6.8411E-02	-0.	6.8411E-02	-0.
9	DEFLECTION	1.5027E 00	0.	1.5027E 00	0.
	MOMENT	-2.5955E 06	0.	2.5955E 06	0.
	TWIST	7.2990E-02	-0.	7.2990E-02	-0.
10	DEFLECTION	5.4662E-01	0.	5.4662E-01	0.
	MOMENT	3.0947E 07	-0.	3.0947E 07	-0.
	TWIST	5.6399E-02	-0.	5.6399E-02	-0.
11	DEFLECTION	-1.5325E-01	0.	1.5325E-01	0.
	MOMENT	2.4634E 07	-0.	2.4634E 07	-0.
	TWIST	1.4837E-02	0.	1.4837E-02	0.
12	DEFLECTION	-5.6848E-01	0.	5.6848E-01	0.
	MOMENT	-6.3505E 06	-0.	6.3505E 06	0.
	TWIST	-3.8745E-02	-0.	3.8745E-02	0.
13	DEFLECTION	-9.9115E-01	0.	9.9115E-01	0.
	MOMENT	-2.0617E 07	0.	2.0617E 07	0.
	TWIST	-8.1273E-02	-0.	8.1273E-02	0.

14	DEFLECTION	-1.5356E 00	0.	1.5356E 00	0.
	MOMENT	-1.3559E 06	-0.	1.3559E 06	0.
	TWIST	-9.1126E-02	-0.	9.1126E-02	0.
15	DEFLECTION	-1.9968E 00	0.	1.9968E 00	0.
	MOMENT	2.1543E 07	-0.	2.1543E 07	-0.
	TWIST	-7.8517E-02	-0.	7.8517E-02	0.
16	DEFLECTION	-1.7874E 00	0.	1.7874E 00	0.
	MOMENT	3.3229E 07	0.	3.3229E 07	0.
	TWIST	-3.3424E-02	-0.	3.3424E-02	0.
17	DEFLECTION	-3.4647E-01	0.	3.4647E-01	0.
	MOMENT	1.8714E 07	0.	1.8714E 07	0.
	TWIST	2.2777E-02	-0.	2.2777E-02	-0.
18	DEFLECTION	2.5133E 00	0.	2.5133E 00	0.
	MOMENT	-1.4203E 07	0.	1.4203E 07	0.
	TWIST	4.6827E-02	-0.	4.6827E-02	-0.
19	DEFLECTION	3.0731E 00	0.	3.0731E 00	0.
	MOMENT	-1.3595E 07	-0.	1.3595E 07	0.
	TWIST	1.4121E-01	-0.	1.4121E-01	-0.
20	DEFLECTION	8.1996E-01	0.	8.1996E-01	0.
	MOMENT	5.5327E-04	0.	5.5327E-04	0.
	TWIST	2.8454E-01	0.	2.8454E-01	0.

GBRC2

TORSION HORIZ. BENDING, USS SACRAMENTO

COMPARE GBRC2 RESULTS WITH MCN.-SCH. RESULTS

FREQUENCY 11.68 CPS

SECTION		REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	DEFLECTION	1.0000E 00	0.	1.0000E 00	0.
	MOMENT	-2.5565E-04	0.	2.5565E-04	0.
	TWIST	3.4803E-02	-0.	3.4803E-02	-0.
2	DEFLECTION	-1.0124E-02	0.	1.0124E-02	0.
	MOMENT	1.0900E 07	-0.	1.0900E 07	-0.
	TWIST	3.9969E-02	-0.	3.9969E-02	-0.
3	DEFLECTION	-3.2665E-01	0.	3.2665E-01	0.
	MOMENT	1.3984E 07	0.	1.3984E 07	0.
	TWIST	2.5016E-02	-0.	2.5016E-02	-0.
4	DEFLECTION	-8.9831E-02	0.	8.9831E-02	0.
	MOMENT	5.3417E 05	-0.	5.3417E 05	-0.
	TWIST	-4.7185E-03	0.	4.7185E-03	0.
5	DEFLECTION	9.0769E-02	0.	9.0769E-02	0.
	MOMENT	-1.2939E 07	-0.	1.2939E 07	0.
	TWIST	-2.2379E-02	-0.	2.2379E-02	0.
6	DEFLECTION	3.2025E-02	0.	3.2025E-02	0.
	MOMENT	-1.2101E 07	-0.	1.2101E 07	0.
	TWIST	-2.1736E-02	0.	2.1736E-02	0.
7	DEFLECTION	-1.6223E-01	0.	1.6223E-01	0.
	MOMENT	3.9976E 06	-0.	3.9976E 06	-0.
	TWIST	-9.9377E-03	-0.	9.9377E-03	0.
8	DEFLECTION	-2.7773E-01	0.	2.7773E-01	0.
	MOMENT	2.1702E 07	-0.	2.1702E 07	-0.
	TWIST	4.5020E-03	-0.	4.5020E-03	-0.
9	DEFLECTION	-1.5246E-01	0.	1.5246E-01	0.
	MOMENT	1.8803E 07	0.	1.8803E 07	0.
	TWIST	9.4740E-03	-0.	9.4740E-03	-0.
10	DEFLECTION	1.8307E-01	0.	1.8307E-01	0.
	MOMENT	-2.0924E 06	-0.	2.0924E 06	0.
	TWIST	7.5941E-03	0.	7.5941E-03	0.
11	DEFLECTION	4.7423E-01	0.	4.7423E-01	0.
	MOMENT	-2.3516E 07	-0.	2.3516E 07	0.
	TWIST	3.2404E-03	-0.	3.2404E-03	-0.
12	DEFLECTION	4.7562E-01	0.	4.7562E-01	0.
	MOMENT	-2.3844E 07	0.	2.3844E 07	0.
	TWIST	3.1580E-03	-0.	3.1580E-03	-0.
13	DEFLECTION	1.7267E-01	0.	1.7267E-01	0.
	MOMENT	-5.7083E 06	-0.	5.7083E 06	0.
	TWIST	8.3811E-03	-0.	8.3811E-03	-0.

14	DEFLECTION	-2.3372E-01	0.	2.3372E-01	0.
	MOMENT	9.8558E 06	-0.	9.8558E 06	-0.
	TWIST	1.1085E-02	-0.	1.1085E-02	-0.
15	DEFLECTION	-4.9045E-01	0.	4.9045E-01	0.
	MOMENT	1.5724E 07	0.	1.5724E 07	0.
	TWIST	7.6207E-03	-0.	7.6207E-03	-0.
16	DEFLECTION	-3.9861E-01	0.	3.9861E-01	0.
	MOMENT	6.9285E 06	0.	6.9285E 06	0.
	TWIST	-9.7314E-03	-0.	9.7314E-03	0.
17	DEFLECTION	1.0442E-02	0.	1.0442E-02	0.
	MOMENT	-7.0751E 06	-0.	7.0751E 06	0.
	TWIST	-3.3587E-02	0.	3.3587E-02	0.
18	DEFLECTION	-1.0452E-01	0.	1.0452E-01	0.
	MOMENT	6.3388E 05	-0.	6.3388E 05	-0.
	TWIST	-3.2534E-03	-0.	3.2534E-03	0.
19	DEFLECTION	-1.5327E-01	0.	1.5327E-01	0.
	MOMENT	7.2064E 06	0.	7.2064E 06	0.
	TWIST	5.1312E-02	0.	5.1312E-02	0.
20	DEFLECTION	1.2903E 00	0.	1.2903E 00	0.
	MOMENT	-3.7091E-04	0.	3.7091E-04	0.
	TWIST	3.7341E-02	-0.	3.7341E-02	-0.

GBRC2 SEPT 20, 1964
TORSION HORIZ. BENDING, USS SACRAMENTO

DATA CONTROL CARD

NO TYPE

END GBRC2 RUN

Table 1 - Comparison of Calculated Frequencies

Mode Number	Code 173. B	*GBRC2	MacN. -SCHW. SADSAM III
1	1.20	1.20	1.195
2	2.51	2.51	2.481
3	3.97	3.97	3.902
4	4.56	4.56	4.541
5	5.97	5.98	5.904
6	7.20	7.20	7.140
7	8.14	8.15	7.977
8	9.50	9.50	9.240
9	10.89	10.90	10.90
10	11.67	11.68	11.39

* GBRC2 uses a total of 6.1 minutes of 7090 computer time to calculate the ten frequencies.

REFERENCES

1. Cuthill, E. H. and Henderson, F. M., "Description and Usage of General Bending Response Code 1 (GBRC1)", David Taylor Model Basin Report 1925 (July 1965).

2. McGoldrick, R. T., "Ship Vibration", David Taylor Model Basin Report 1451 (December 1960).

3. Reed, F. E. and Cuthill, E., "Ship Hull Vibrations - 5: Analysis of Hull Structure as Applied to SSB(N)598 GEORGE WASHINGTON," CONESCO Report Number F-111-2 (March 1963), CONESCO, Inc., 205 Sixth Street, Cambridge 42, Massachusetts.

4. Peterson, L. and Winemiller, A. F. of the MacNeal-Schwendler Corporation, "A Study of the Dynamic Behavior of the Rudder-Rudderstock-Ram System of the USS SACRAMENTO (AOE-1)," AVL-119-962 (May 1966).

DISTRIBUTION LIST

Code 012.1	1	Dr. Frederick H. Todd
Code 810-800	1	
Code 820	1	Dr. Cuthill
Code 840	1	Dr. Wrench
Code 843	1	Mrs. J. Schot
Code 850	1	Mr. Liang
Code 745	1	Mr. Goben
Code 962	1	Mr. Kilcullen
Code 964	1	Mr. Zaloumis

External Distribution

1 General Dynamics, Electric Boat Division, Naval Architecture Department, Groten, Connecticut
ATTN: Mr. Bruce Maddock

1 CONESCO, Inc., 205 Sixth Street, Cambridge 42, Massacushètts
ATTN: Mr. Ronald T. Bradshaw