NATIONAL BUREAU OF STANDARDS REPORT

9998

CONCRETE BEAM AND COLUMN COMPUTER PROGRAMS

Modified for IBM 1130

For
The Construction Research Division
Post Office Department

NBS

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D. C. 20234.
[2] Located at Boulder, Colorado 80302.
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NATIONAL BUREAU OF STANDARDS REPORT

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CONCRETE BEAM AND COLUMN COMPUTER PROGRAMS

Modified for IBM 1130

by
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Structures Section
Building Research Division

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1. INTRODUCTION

1.1 General

This is the first of a series of reports designed to modify, consolidate and co-ordinate certain existing structural computer programs to make them compatible with current building codes and the IBM 1130/Fortran IV language. This report is intended as a reference manual for the structural engineering use of eight concrete beam and column computer programs.

The following programs are included:

(1) Reinforced concrete beam with a small axial load. (Selects reinforcing steel for given outside dimensions.

(2) Composite steel and concrete beam design.

(3) Analysis of reinforced concrete beam with tensile reinforcement only.

(4) Analysis of short, rectangular concrete columns subject to biaxial bending.

(5) Analysis of short, irregular concrete column subject to biaxial bending.

(6) Rectangular tied column subject to planar bending (Load-Moment envelope for short columns).

The original computer programs were written in various fortran forms including RCA 301/Fortran, IBM 1620/Fortran, IBM 7044/Fortran IV, and IBM 360/Fortran IV. These have all been modified to IBM 1130/Fortran operable with the following equipment:

(a) IBM 1130, Model 2C, 16K storage/Version II

(b) IBM 1132 Printer

(c) IBM Card Read-Punch

(d) IBM 2315 Disc Cartridge, removable/interchangeable.

1.2 Scope

Each program has been checked for Building Code references, and modified or changed where necessary to meet ACI 318-63 and AISC-63 specifications.

Programs have been debugged by performing an illustrative problem. No comprehensive full scale attempt has been made to check against manual solutions and establish analytical validity. The user must satisfy himself as to reliability by testing the program with problems of known solution. Good Engineering practice dictates that each program be used initially as a checking analysis until the User gains sufficient confidence and insight into the program's behavior. The theoretical basis and program abstracts described in Section 2 thru Section 7 are presented to provide the User a quick reference as to the general nature of the program. Several of these programs, notably 1.A.1, 1.B.1 and 1.B.2 have been previously documented in considerable detail. If further information is required, reference can be made to those documents.

A standard description sheet of each program is included in the summary to provide a consolidated definition of the program.

1.3 Program and Sample Problem Listing

Program listings include a sample problem output to illustrate the type of solution provided by the computer. These problems have been used for debugging purposes, but are not designed to test the reliability of the program.

The listings were taken directly from the source decks, and include all the normal job control cards for the IBM 1130 equipment.

2. PROGRAM 1.A.1 - CONCRETE BEAM, AXIALLY LOADED

2.1 Purpose

The purpose of Program 1.A.1 is to select reinforcing steel for an axially loaded concrete beam of given dimensions.

2.2 Theoretical Basis

Analytical calculations are based on conventional "straight line" theory for balanced design. Allowable material stresses are specified in accordance with ACI 318-6 recommendation for "working stress design" for beams. This dictates a loading situation free from instability considerations, i.e., a tension axial load or a small compressive axial load.

2.3 Method of Execution

Program input includes the allowable steel stress, cylinder strength of concrete, beam dimensions, and applied forces at the cross-section of interest.

The program computes an initial value of steel area assuming balanced design. This value is used to calculate the necessary depth of the concrete compression zone. An iterative process repeats the cycle until the computed depth and used depth of compression are approximately the same.

2.4 Input

Input parameters are read by the computer in the following sequence:

Card 1. JOB - Job Title

Card 2. FC - Cylinder strength of concrete, f'_c (lbs./sq. in)

FS - Allowable steel stress, fs (lbs./sq. in.)

WC - Density of concrete (lbs./cu. ft.)

Card 3. V - Total shear (kips)

M - Moment at the section (kip-ft.)

FN - Axial force, + for compression (kips)

DT - Overall depth of beam (ins.)

B - Width of Compressive area of beam (ins.)

D - Depth of tensile steel, d(ins.)

DP - Depth of compressive steel, d' (ins.).

Form S-1A1 illustrates sample input data. This input information is also included in the program output listing L-1A1.

2.5 Output

An illustration of sample output is included; with notes, after the program listing. Output information includes the following:

Job title

Input parameters

Depth of compression zone

Allowable shear and actual shear

Allowable concrete stress and actual stress

Tensile steel area and stress

Compressive steel area and stress.

3. PROGRAM 1.A.2 - COMPOSITE BEAM SECTION PROPERTIES

3.1 Purpose

The purpose of Program 1.A.2 is to compute the bottom flange area and the cross-sectional characteristics of a concrete slab and steel beam composite section.

3.2 Theoretical Basis

All calculations assume elastic materials with no tensile strain in the concrete slab. Composite section inertia computations are based on strain continuity between steel and concrete. Non-composite section calculations consider only the steel beam, and are to be used for construction loads.

3.3 Method of Execution

The program will consider only one beam at a time; however, the slab plus the web and lower flange of the steel beam can be varied in depth and width to optimize efficiency of material geometry.

Using the input geometry and modular ratio of materials, the computer generates the non-composite and composite section modulus by the conventional method of first locating the neutral axis and then calculating the moment of inertia.

3.4 Input

Input parameters are read by the computer in the following sequence:

Card 1.	A	- Job Title
Card 2.	XN	- Modular Ratio, n (ACI 318-63)
	NOFWZ	- Number of web sizes
	ID	- 0 or 1*
Card 3.	W3	- Width of top flange of steel (ins.)
	D3	- Depth of top flange of steel (ins.)
Card 4.	D4	- Initial depth of concrete (ins.)
	NID4	- Number of D4 being generated
	SID4	- Size of increment added to D4 (ins.)

	T4	- Width-depth ratio of concrete**
Card 5.	D1	- Initial depth of bottom flange (ins.)
	NID1	- Number of D1's being generated
	SID1	- Size of increment for D1 (ins.)
Card 6.	T1	- Initial width-depth ratio of bottom flange
(ID=0)	NIT1	- Number of T1's required
	SIT1	- Increment size for T1 (ins.)
Card 6.	W1	- Initial width of bottom flange (ins.)
(ID=1)	NIW1	- Number of W1's required
	SIW1	- Increment size for W1 (ins.)
Card 7,	W2	- Web thickness (ins)
etc.	D2	- Web depth (ins.)

*ID is a control number for bottom flange input where "0" decides that Width-depth ratio is to be varied, and "1" decides that the width will be varied, but not the thickness.

**The width of concrete is obtained by multiplying D4xT4. If T4 is left blank, the program supplys W4=16D4+W3 as required by AISC specifications.

4. PROGRAM 1.A.3 - CONCRETE BEAM REVIEW

4.1 Purpose

Program 1.A.3 will analyze a reinforced concrete beam with tension steel only. It is more efficient than manual analysis only if there is a number of known cross-sections to be considered.

4.2 Theoretical Basis

Computations are based on simple "working stress design" as described in the ACI Building Code.

4.3 Method of Execution

The computer first reads material characteristics. It next accepts any number of cross-section dimensions. The "WSD" equations are then solved for resisting moments of concrete and steel.

4.4 Input

Input parameters are read into the computer in the following sequence:

Card 1. FS - allowable steel stress (psi)

FC - allowable concrete stress (psi)

AN - modular ratio, n

Card 2. AS - area of tension steel (sq. in.)

etc. B - width of beam (ins.)

D - depth to steel (ins.)

4.5 Output

Output symbols are defined as follows:

P - ratio of steel to concrete (As/bd)

K - dimensionless depth of compressive Zone (k)

J - dimensionless internal moment arm (j)

MS - resisting moment of steel (kip-ft)

MC - resisting moment of concrete (kip-ft).

5. PROGRAM 1.B.1 - BIAXIAL BENDING OF RECTANGULAR COLUMNS

5.1 Purpose

Program 1.B.1 analyzes any short rectangular concrete column subjected to biaxial bending and determines the cross-sectional stress pattern.

5.2 Theoretical Basis

The method of solution is based on Paper No. 3239, Analytical Approach to Biaxial Eccentricity by E. Czerniak, ASCE Proceedings, Volume 88, No. ST4, August, 1962, Part I.

Theory is limited to the two basic assumptions: (A) plane sections remain plane; and (b) equilibrium conditions are satisfied.

Although the original reference reportedly is generalized for non-linear materials, the program considers the special case where elasticity prevails.

5.3 Method of Execution

Given the applied forces (relative to center lines) and the cross-section characteristics, the computer employs an iterative procedure to locate the neutral axis of the transformed section. Compressive reinforcement is transformed by the factor (2n-1) to allow for creep.

The program then computes the maximum concrete stress and the steel stress for each bar.

5.4 Input

Input parameters are arranged in the following sequence:

Card 1. Title, Users initials and date

Card 2.	T	- thickness of member along Y-axis (ins.)
	D	- depth of member along X-axis (ins.)
	*XMX	- moment about X-axis centerline (kip-ft)
	XMY	- moment about Y-axis centerline (kip-ft)
	THR	- compressive Load (kips)
	EN	- modular ratio of steel to concrete

*The X-Y co-ordinates are chosen so that the column edges with maximum compression lie on the axes.

Card 3. BARNO - identification number of re-bars.
Last number must be 100.

ACORX - the "X" distance to a re-bar. (ins)

ACORY - the "Y" distance to a re-bar. (ins)

AREA - area of the Re-bar (sq. ins)

Card 4. XLOAD - If "O" read card #1; if "1" read Card #5

Card 5. XMX (Card #5 is included if a second
XMY force system is to be applied to the
THR given cross-section.)

5.5 Output

Output of the input data is in the same sequence as read, and is identified by complete sentences. Output of calculated data is self-explanatory, and includes the following information:

(a) Equivalent eccentricities of axial load.

(b) Properties of Section and stresses for the given section.

(c) Properties of Section and Stresses for the given section, but neglecting compressive steel in neutral axis solution.

6. PROGRAM 1.B.2 - BIAXIAL BENDING OF NONPRISMATIC COLUMNS

6.1 Purpose

Program 1.B.2 will analyze any shape concrete section (including rectangular) subjected to an axial load and biaxial bending. It considers cross-sectional stress pattern, but not column stability.

8.2 Theoretical Basis

The following general flexure formula is used to solve for concrete stresses:

$$f = \frac{P}{A} + \left[\frac{Mx_o - My_o \dfrac{Ix_oy_o}{Iy_o}}{Ix_o - \dfrac{(Ix_oy_o)^2}{Iy_o}} \right] x_o + \left[\frac{My_o - Mx_o \dfrac{Ix_oy_o}{Ix_o}}{Iy_o - \dfrac{(Ix_oy_o)^2}{Ix_o}} \right] y_o$$

or:

$$f = a + bx + cy$$

The above equation defines the neutral axis location when

f=0. Theory is based on linear analysis and does not consider second order buckling. Thus the maximum length of column will be in accordance with code restrictions as set in ACI 318-63, Sections 915 and 916.

6.3 Method of Execution

The program determines the neutral axes location of the transformed section using an iterative procedure to solve the general flexure equation for the case when f=0. The computer then determines material stresses throughout the section. The geometry of the section is defined in cartesian co-ordinates.

6.4 Input

All input must be consistent in units. i.e., if the geometry is measured in inches, then the moments must be kip-ins. All output will be in the same system of units as input.

Card 1. Title

Card 2. NCON - The number of intersections (plus

one) of concrete boundry lines.

NSTL - Number of rows of steel

NLD - Number of sets of loads to be considered

ISWTI - A control option. Read "1" in if it is desirable to provide the computer with an estimate of the neutral axis location.

Card 3* XCON - X co-ordinates of concrete shape listed clockwise. (counter clockwise for the hole in a hollow shaft). The origin can be at any convenient location.

YCON - "Y" coordinates corresponding to "X" coordinates (not to exceed 100 points)

Card 4** AS - Area of one steel bar

XISTL - "X" coordinate of one bar or the first bar in a row.

YISTL - "Y" coordinate corresponding to the "X" coordinate

BARNO - Number of bars being described

X2STL - "X" Coordinate of last bar in the row

Y2STL - "Y" Coordinate of last bar in the row

*Card 3 represents a type for which there will normally be more than one, since only three points can be located by one cord.

**Card 4 represents a type for which there will be "NSTL" cards.

Card 5*	CODE	- Name of Load (i.e., L.L.+D.L.)
	P	- Axial Load acting at the origin (+=compression)
	XM	- Moment about the Y axis with P at the origin (+=clockwise)
	YM	- Moment about the Y axis with P at the origin (+=clockwise)
	RATIO	- Modular Ratio, n of steel to concrete.
	B	- Ratio of the effective modulus of the reinforcement in compression to that in tension (normally 2.0 for creep allowance. Note that B=0.0 stimulates holes in the compressive concrete.)
	ACCR	- Accuracy Desired. Maximum allowable Concrete Stress change between final iterations (e.g., .010 k.s.i.)

*Card 5 represents a type for which there will be "NLD" cards.

Card 6*	IDENT	- Any interger used to identify the "first guess card."
	S	- Estimate of the neutral axis x-coefficient
	T	- Estimate of the neutral axis y-coefficient
	U	- The constant term

*Card 6 is an optional card not normally used. It is only to be included if ISW1 has been read as "1".

This program has a "stacked job capability." After all load cases have been computed for the first cross-section, the computer returns and looks for a new job Title (Card 1). If the user prefers to retain the concrete shape and vary the steel arrangement, he can do so by placing a zero in column 10 of Card 2 of the second set of cards. This signals the computer to next read the steel Card 4 and use the concrete shape defined on the original Card 3.

68.5 Output

Output data is in the same units as the input and includes the following:

- P - Given axial load
- MX - Given moment about Y-axis (XM)
- MY - Given moment about X-axis (YM)
- N - Modular ratio given (RATIO)
- R - Ratio of effective compressive steel (B)

ITERATION COUNT - Number of trials to locate neutral axes.

GENERAL FORMULA - Gives numerical values of the flexure formula coefficients.

The computer than lists material stresses and locations. Negative stresses indicate tensile zones.

7. PROGRAM 1.B.3 - TIED CONCRETE COLUMNS, PLANAR BENDING

7.1 Purpose

Program 1.B.3 analyzes a concrete column of known cross-section and develops the allowable load-moment envelope (interaction) curve for working stress design as defined by the ACI 318-63 building code.

7.2 Theoretical Basis

Computations are based on ACI equations for working stress design contained in Chapter 14 of ACI318-63. No provision is made for long slender columns as defined by Section 915 of the ACI code. Referring to ACI notation, the following equations are solved:

7.9 Input

Input parameters are read in the following sequence.

Card 1 FY - Yield stress of re-bar, fy (p.s.i.)

FCP - Concrete compression Strenght, fc' (p.s.i.)

C - Concrete working stress factor (0.45)

EN - Modular Ratio of Steel to Concrete, n

B - Breadth of Beam (ins.)

T - Total Depth of Beam (ins.)

D - Depth to Steel (ins.)

G - Ratio of distance between compression-tension rebar to total depth of beam.

Card 2* AS - Area of tensile re-bar (sq.in.)

ASP - Area of compressive re-bar (sq.in.)

Card 2 represents a type. There is no limit to the number of of steel area cards for any given column.

7.4 Output

Output includes values for Po/AgFc', Nb/Agfc', Mb/Agf'ct, Mo/Agf'ct, Po, Pa, Nb, Mb, and Mo. This data can be used to plot the type of load envelope shown on the output listing.

SUMMARY SHEET FOR PROGRAM NO. 1A1

PROGRAM NAME: Concrete Beam Axially Loaded

A. TYPE OF MATERIAL

x 1. Concrete
_ 2. Steel

B. TYPE OF STRUCTURE

x 1. Beams and Girders
_ 2. Columns
_ 3. Composite Beams
_ 4. Foundations
_ 5. Frames and Tunnels
_ 6. Prestress Construction
_ 7. Shells
_ 8. Slabs

C. REFERENCE CODES

x 1. A.C.I.
_ 2. A.I.S.C.
_ 3. A.A.S.H.O.

D. TYPE OF ANALYSIS

x 1. Elastic Analysis
_ 2. Plastic Analysis
_ 3. Working Strength Design
_ 4. Ultimate Strength Design

E. REMARKS

Chooses re-bar for axially-loaded concrete beam.

SUMMARY SHEET FOR PROGRAM NO. 1A2

PROGRAM NAME: Composite Beam Section Properties

A. TYPE OF MATERIAL

x 1. Concrete
x 2. Steel

B. TYPE OF STRUCTURE

___ 1. Beams and Girders
___ 2. Columns
x 3. Composite Beams
___ 4. Foundations
___ 5. Frames and Tunnels
___ 6. Prestress Construction
___ 7. Shells
___ 8. Slabs

C. REFERENCE CODES

x 1. A.C.I.
x 2. A.I.S.C.
___ 3. A.A.S.H.O.

D. TYPE OF ANALYSIS

x 1. Elastic Analysis
___ 2. Plastic Analysis
___ 3. Working Strength Design
___ 4. Ultimate Strength Design

E. REMARKS

Checks cross-sectional characteristics and optimizes selection of steel beam.

SUMMARY SHEET FOR PROGRAM NO. 1A3

PROGRAM NAME: Concrete Beam Review

A. TYPE OF MATERIAL

x 1. Concrete
__ 2. Steel

B. TYPE OF STRUCTURE

x 1. Beams and Girders
__ 2. Columns
__ 3. Composite Beams
__ 4. Foundations
__ 5. Frames and Tunnels
__ 6. Prestress Construction
__ 7. Shells
__ 8. Slabs

C. REFERENCE CODES

x 1. A.C.I.
__ 2. A.I.S.C.
__ 3. A.A.S.H.O.

D. TYPE OF ANALYSIS

__ 1. Elastic Analysis
__ 2. Plastic Analysis
x 3. Working Strength Design
__ 4. Ultimate Strength Design

E. REMARKS

Analyzes simple concrete beam - a trivial problem unless a large number of beams involved.

SUMMARY SHEET FOR PROGRAM NO. 1B1

PROGRAM NAME: Biaxial Bending of Rectangular Columns

A. TYPE OF MATERIAL

x 1. Concrete
_ 2. Steel

B. TYPE OF STRUCTURE

_ 1. Beams and Girders
x 2. Columns
_ 3. Composite Beams
_ 4. Foundations
_ 5. Frames and Tunnels
_ 6. Prestress Construction
_ 7. Shells
_ 8. Slabs

C. REFERENCE CODES

x 1. A.C.I.
_ 2. A.I.S.C.
_ 3. A.A.S.H.O.

D. TYPE OF ANALYSIS

x 1. Elastic Analysis
_ 2. Plastic Analysis
_ 3. Working Strength Design
_ 4. Ultimate Strength Design

E. REMARKS

Computes Cross-Sectional capacity, i.e., the "Biaxial Interaction Envelope" of a short column can be easily generated.

SUMMARY SHEET FOR PROGRAM NO. 1B2

PROGRAM NAME: Biaxial Bending of Irregular Columns

A. TYPE OF MATERIAL

x 1. Concrete
__ 2. Steel

B. TYPE OF STRUCTURE

__ 1. Beams and Girders
x 2. Columns
__ 3. Composite Beams
__ 4. Foundations
__ 5. Frames and Tunnels
__ 6. Prestress Construction
__ 7. Shells
__ 8. Slabs

C. REFERENCE CODES

x 1. A.C.I.
__ 2. A.I.S.C.
__ 3. A.A.S.H.O.

D. TYPE OF ANALYSIS

x 1. Elastic Analysis
__ 2. Plastic Analysis
__ 3. Working Strength Design
__ 4. Ultimate Strength Design

E. REMARKS

Similar to Program 1.B.1, but can also handle irregular shapes.

SUMMARY SHEET FOR PROGRAM NO. 1B3

PROGRAM NAME: Tied Concrete Columns, Planar Bending

A. TYPE OF MATERIAL

- x 1. Concrete
- ___ 2. Steel

B. TYPE OF STRUCTURE

- ___ 1. Beams and Girders
- x 2. Columns
- ___ 3. Composite Beams
- ___ 4. Foundations
- ___ 5. Frames and Tunnels
- ___ 6. Prestress Construction
- ___ 7. Shells
- ___ 8. Slabs

C. REFERENCE CODES

- x 1. A.C.I.
- ___ 2. A.I.S.C.
- ___ 3. A.A.S.H.O.

D. TYPE OF ANALYSIS

- ___ 1. Elastic Analysis
- ___ 2. Plastic Analysis
- x 3. Working Strength Design
- ___ 4. Ultimate Strength Design

E. REMARKS

Develops the allowable "Interaction Envelope".

SAMPLE INPUT FORMS

IBM FORTRAN Coding Form

PROGRAM 1A1 - Concrete Beam - Axial Load

PROGRAMMER Earle F. Carpenter DATE February 1, 1969

PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER*

Columns 1–10	Columns 11–20	Columns 21–30	Columns 31–40	Columns 41–50	Columns 51–60	Columns 61–72	Identification Sequence (73–80)
S A M P L E	P R Ø B L E M	F Ø R 1 A 1					CARD # 1
3000.	20000.	145.					CARD # 2
10.	100.	10.	24.	12.	22.	2.	CARD # 3

EXPLANATION

Columns 1–10	Columns 11–20	Columns 21–30	Columns 31–40	Columns 41–50	Columns 51–60	Columns 61–72	Identification Sequence (73–80)
Problem "TITLE" – Up to one card in length							CARD # 1
f'_c (psi)	fs (psi)	Wc (#/c.f.)					CARD # 2
SHEAR (kips)	MOMENT (k-ft)	AXIAL LOAD (kips)	t (inches)	b (inches)	d (inches)	d' (inches)	CARD # 3

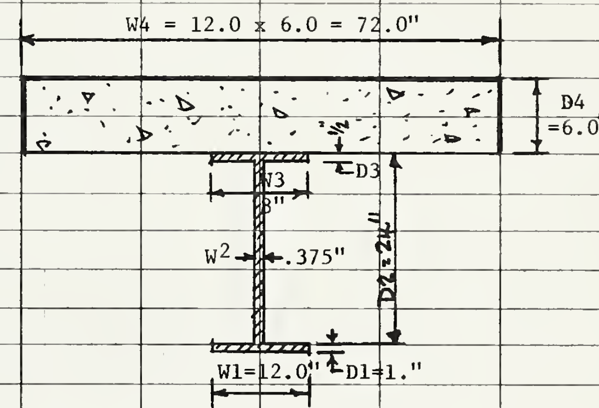
*A standard card form, IBM electro 888157, is available for punching statements from this form

Input Form No. 5.1

IBM FORTRAN Coding Form

PROGRAM	1A2 - Composite Beam Section Properties	PUNCHING INSTRUCTIONS	GRAPHIC / PUNCH
PROGRAMMER	Earle F. Carpenter	DATE February 3, 1969	PAGE 1 OF 1

Cols 1–5 (Statement Number)	6 (Cont.)	7–10	11–15	16–20	21–25	26–30	31–35	Identification Sequence
			SAMPLE	PRØBLEM		FØR	1A2	CARD # 1
10.		1	1					CARD # 2
8.			.5					CARD # 3
6.				1		0.	12.	CARD # 4
1.				1		0		CARD # 5
12.				1		0		CARD # 6
.375			24.					CARD # 7



EXPLANATION

Cols 1–5	6–10	11–20	21–30	31–40	Identification Sequence
PROBLEM TITLE (UP TO ONE FULL CARD)					CARD # 1
N(Es/Ec)	NOFWZ	ID (col. 15)			CARD # 2
W3 (inches)		D3 (inches)			CARD # 3
D4 (inches)		NID4	SID4 (inches)	T4	CARD # 4
D1 (inches)		NID1	SID1 (col. 30)		CARD # 5
W1 (inches)		NIW1	SIW1 (col. 30)		CARD # 6
W2 (inches)		D2 (inches)			CARD # 7

*A standard card form, IBM electro 888157, is available for punching statements from this form

Input Form No. 5.2

IBM FORTRAN Coding Form

PROGRAM: 1A3 - Concrete Beam Review
PROGRAMMER: Earle F. Carpenter
DATE: February 3, 1969
PUNCHING INSTRUCTIONS: GRAPHIC / PUNCH
PAGE 1 OF 1
CARD ELECTRO NUMBER*

Statement Number (cols 1–5)	Cont. (col 6)	FORTRAN Statement cols 11–15	cols 21–25	Identification Sequence (cols 73–80)
20000	.	1350.	10.	CARD # 1
6.93		17.0	31.0	CARD # 2

EXPLANATION

cols 1–10	cols 11–20	cols 21–30	Identification Sequence
← fs (psi) →	← fc (psi) →	← N = Es/Ec →	CARD # 1
As (sq. in.)	← b (ins.) →	← d (ins) →	CARD # 2

*A standard card form, IBM electro 888157, is available for punching statements from this form

Input Form No. 5.3

IBM

FORTRAN Coding Form

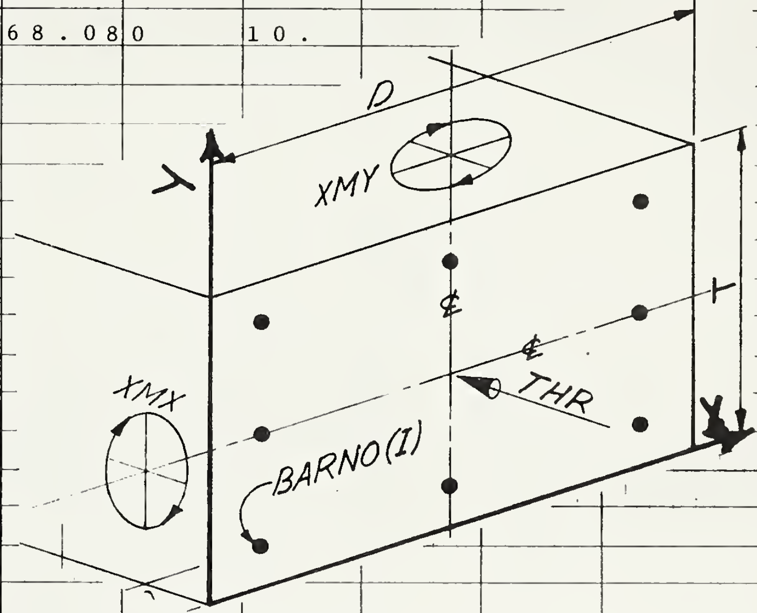
PROGRAM 1B1 - BIAXIAL BENDING OF RECTANGULAR COLUMN

PROGRAMMER Earle F. Carpenter DATE February 3, 1969

PUNCHING INSTRUCTIONS GRAPHIC / PUNCH

PAGE 1 OF 1 CARD ELECTRO NUMBER

STATEMENT NUMBER (1–5)	CONT. / 6–10	11–20	21–30	31–40	41–50	51–60	IDENTIFICATION SEQUENCE (73–80)
TEST	CASE	NØ 1 FØR S	P-17 FØR	1B1			CARD # 1
17.		25.	22.693	113.467	68.080	10.	CARD # 2
1.		2.5	2.5	.79			CARD # 3 A
2.		12.5	2.5	.79			B
3.		22.5	2.5	.79			C
4.		2.5	8.5	.79			D
5.		22.5	8.5	.79			E
6.		2.5	14.5	.79			F
7.		12.5	14.5	.79			G
100.		22.5	14.5	.79			H
0.							CARD # 4



EXPLANATION

1–10	11–20	21–30	31–40	41–50	51–60	IDENTIFICATION SEQUENCE
	PROBLEM TITLE	(UP TO	ONE FULL	CARD)		CARD # 1
← T (ins) →	D (ins) →	Mx (K-ins)	My (K-ins)	THR (Kip)	N = Es/Ec	CARD # 2
BAR NO.	X (ins)	Y (ins)	As (sq. in)			CARD # 3
XLOAD						CARD # 4

*A standard card form, IBM electro 888157, is available for punching statements from this form

Input Form No. 5.4

IBM FORTRAN Coding Form

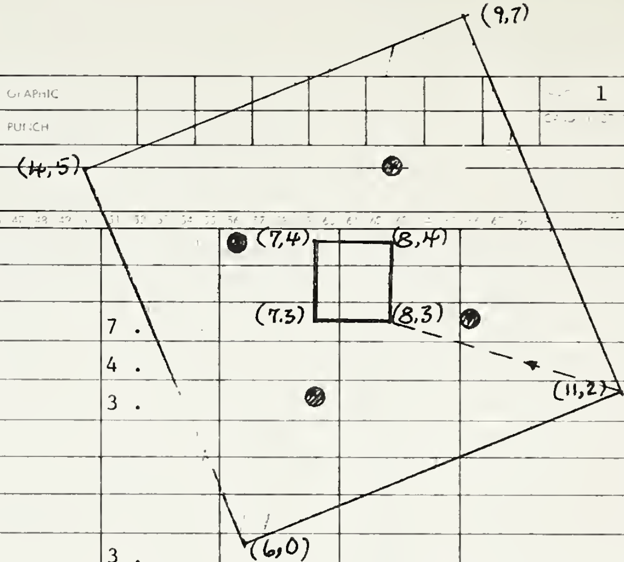
PROGRAM: 1B2 - Biaxial Bending of Irregular Columns

PROGRAMMER: Earle F. Carpenter

DATE: February 3, 1969

PUNCHING INSTRUCTIONS — GRAPHIC / PUNCH

PAGE 1 OF 1



Cols 1–10	11–20	21–30	31–40	41–50	51–60	61–72	Identification (73–80)
HØLLØW	REINFØRCE	D SHAFT FØ	R 1B2				CARD # 1
11	3	2					CARD # 2
6.	0.	4.	5.	9.	7.		CARD # 3 A
11.	2.	8.	3.	8.	4.		CARD # 3 B
7.	4.	7.	3.	8.	3.		CARD # 3 C
11.	2.	6.	0.				CARD # 3 D
1.	7.	2.	1.				CARD # 4 A
1.	6.	4.	1.				CARD # 4 B
1.	8.	5.	2.	9.	3.		CARD # 4 C
LL+DL		10.	80.	50.	10.	2. .0	1 CARD # 5 A
LL + DL +	WIND	10.	60.	10.	10.	2. .0	1 CARD # 5 B

EXPLANATION

Cols 1–10	11–20	21–30	31–40	41–50	51–60	61–72	Identification (73–80)
PROBLEM TITLE (UP TO ONE CARD IN LENGTH)							CARD # 1
NCON →	NSTL →	NLD →	ISWTI →	(optional)			# 2
XCON (ins)	YCON (ins)	XCON (ins)	YCON (in)	XCON (ins)	YCON (ins)		# 3
AS (sq. in)	XISTL (ins)	YISTL (ins)	BARNO	X2STL (ins)	Y2STL (ins)		# 4
← CODE →		P (kips)	Mx (K-in)	My (K-ins)	n = Es/Ec	← B → ACCR	# 5

*A standard card form, IBM electro 888157, is available for punching statements from this form

Input Form No. 5.5

IBM FORTRAN Coding Form

X28-7327-6 U/M 025 Printed in U.S.A.

PROGRAM: 1B3 - Tied Concrete Columns - Planar Bending

PROGRAMMER: Earle F. Carpenter | DATE: February 3, 1969

PUNCHING INSTRUCTIONS: GRAPHIC / PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

Statement No. (1–5)	Cont. (6)	7–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	Identification Sequence (73–80)
40000	.	3000	0 .. . 4	5	9 . 2	18 .	28 .	25 .	5 . 822	CARD # 1
3 . 16	2	. 40								CARD # 2 A
2 . 40	3	. 16								2 B
4 . 00	3	. 16								2 C
3 . 16	4	. 00								2 D
5 . 08	4	. 00								2 E
4 . 00	5	. 08								2 F
5 . 08	3	. 16								2 G
3 . 16	5	. 08								2 H

EXPLANATION

f_y (psi)	f'_c (psi)	C	n = Es/Ec	b (ins)	t (ins)	d (ins)	G	CARD # 1
As	A'_s							CARD # 2

Input Form No. 5.6

LISTING AND SAMPLE OUTPUT FOR 1.A.1

"Concrete Beam Axially Loaded"

```
// JOB 1
// FOR
*IOCS(CARD,1132PRINTER,DISK)
*LIST ALL
C       W.S.D. OF CONCRETE BEAM WITH AXIAL LOAD
C       FC= 28 DAY CONCRETE STRENGTH (PSI)
C       FS= ALLOWABLE STEEL STRESS (PSI)
C       V= SHEAR FORCE (KIPS)
C       FN= AXIAL FORCE(KIPS)
C       M= MOMENT(K-FT)
C       DT= BEAM DEPTH(IN)
C       B=  BEAM WIDTH(IN)
C       D= DEPTH TO STEEL (IN)
C       DP= DEPTH TO COMP. STEEL(IN)
        EXTERNAL ZZ,ZY
        REAL M
        DIMENSION JOB(16), Z(20)
        COMMON CFB,CFC,CFD,XL,XR,IER,CK,RFC,B,V,AMF
        DATA ES/29E6/
1       READ (2,41) JOB
        READ (2,42) FC,FS,WC
        READ (2,39) V,M,FN,DT,B,D,DP
        WRITE (3,47) JOB
        WRITE (3,48) FC,FS,V,FN,M,DT,B,D,DP
        AC=0.
        RFC=SQRT(FC)
        AVMAX=1.75*RFC
        EC=WC**1.5*33.*RFC
        DT=DT/12.
        B=B/12.
        D=D/12.
        DP=DP/12.
        AM=ABS(M)
        AMF=AM
        FSK=FS/1000.
        FCK=FC/1000.
        AFCA=.45*FC
        N=10.*ES/EC+.5
        AN=FLOAT(N)/10.
        AK=FLOAT(INT(1./(1.+FS/AN/AFCA)*1000.+.5))/1000.
        AJ=FLOAT(INT((1.-AK/3.)*1000.+.5))/1000.
        AJD=AJ*D
        Z(1)=AK*D
        UV=V/(B*D*.144)
        DO 32 J=1,19
        JP=J+1
        IF (FN) 10,2,10
2       CONTINUE
        AS=FLOAT(INT(AM/(FSK*AJD)*100.+.5))/100.
        CA=AN*AS/B/72.
        CB=(AN-1.)*AC/B/72.
        CFB=CA+CB
        CFC=-CA*D-CB*DP
        X=ROOT(CFB,CFC)
        Z(JP)=X
        AJD=D-X/3.
        AFC=1000.*AM/(72.*B*X*AJD+(AN-1.)/X*AC*(X-DP)*(D-DP))
        IF (AFC-AFCA) 4,4,3
3       AC=AC+FLOAT(INT(7200*(AFC-AFCA)*B*X/FS*X*AN/((AN-1.)*(X-DP))+.5))/
       1100.
4       CONTINUE
        IF (J-1) 6,5,6
```

```
5      IF (AC) 32,6,32
6      CONTINUE
       IF (ABS(X-Z(J))-.002*D) 7,7,32
7      CONTINUE
       AVBAS=AVB(AS)
       IF (AVBAS-AVMAX) 9,9,8
8      AVBAS=AVMAX
9      CONTINUE
       GO TO 34
10     PM=AM-FN*(4.*DT-D)/8.
       AMF=PM
       E=AM/FN+D-DT/2.
       DO 31 I=1,19
       IF (I-1) 11,11,22
11     CONTINUE
       IP=I+1
       IF (FN) 12,14,13
12     IF (E) 14,14,15
13     IF (E-AJD) 16,14,14
14     CONTINUE
       CK=125.*FN/FS*AN/B*E/D**2/3.
       XL=.1
       XR=15.
       CALL TPOLY (A,ZY,.005,20)
       IF (IER-1) 21,37,38
15     AFN=-FN
       AS2=E/(D-DF)*AFN/FSK
       AS1=AFN/FSK-AS2
       AVBAS=AVB(AS1)
       IF (AVBAS-AVMAX) 17,17,16
16     AVBAS=AVMAX
17     CONTINUE
       WRITE (3,44) AS1,AS2,AVBAS,UV
       GO TO 1
18     AG=B*DT
       AVC=AVMAX*SQRT(1.+FN/36./AG)
       FCA=(FN+6.*AM/DT)/(AG*.144)
       IF (FCA-AFCA) 20,20,19
19     WRITE (3,45)
20     WRITE (3,46) FCA,AVC,UV,AFCA
       GO TO 1
21     AFC=FS/AN/A                                                          1
22     IF (AFC-AFCA) 24,24,23                                               1
23     AC=AC+FLOAT(INT(7200*(AFC-AFCA)*B*Z(I)/FS*Z(I)*AN/((AN-1.)*(Z(I)-D   1
      1P))+.5))/100.                                                        1
24     CONTINUE                                                             1
       AS=(FN*(E-AJD)/FSK-AC*(AN-1.)/AN*(Z(I)-DP)*(Z(I)/3.-DP)/(D-Z(I)))/   1
      1AJD                                                                  1
       AS=FLOAT(INT(100.*AS+.5))/100.                                       1
       IF (AS-.01) 18,18,25                                                 1
25     CONTINUE                                                             1
       CFB=3.*(E-D)                                                         1
       CA=AN*AS*E/B/24.                                                     1
       CB=(AN-1.)*AC*(E-D+DP)/B/24.                                         1
       CFC=CA+CB                                                            1
       CFD=-CA*D-CB*DP                                                      1
       XL=.01*D                                                             1
       XR=.9*D                                                              1
       CALL TPOLY (X,ZZ,.005,20)                                            1
       Z(IP)=X                                                              1
       IF (IER-1) 26,37,38                                                  1
26     CD=72.*B*X                                                           1
```

```
      CE=(AN-1.)*(X-DP)/X                                                1
      CF=-AN*(D-X)/X                                                     1
      AFC=FM*1000./(CD+CE*AC+CF*AS)                                      1
      IF (I-19) 27,33,27                                                 1
27    CONTINUE                                                           1
      AJD=D-X/3.                                                         1
      IF (ABS(X-Z(I))-.002*D) 28,28,31                                   1
28    CONTINUE                                                           1
      AVBAS=AVB(AS)                                                      1
      IF (AVBAS-AVMAX) 30,30,29                                          1
29    AVBAS=AVMAX                                                        1
30    CONTINUE                                                           1
      GO TO 34                                                           1
31    CONTINUE                                                           1
32    CONTINUE                                                           1
33    WRITE (3,39) Z(20)                                                 1
34    FSC=(AN-1.)*AFC*(X-DP)/X                                           1
      IF (AC) 36,35,36                                                   1
35    FSC=0.                                                             1
36    CONTINUE                                                           1
      AFS=AN*AFC*(D-X)/X                                                 1
      X=12.*X                                                            1
      WRITE (3,49) X,AVBAS,UV,AFCA,AFC,AS,AFS,AC,FSC                     1
      GO TO 1                                                            1
37    WRITE (3,40)                                                       1
      GO TO 1                                                            1
38    WRITE (3,43)                                                       1
      GO TO 1                                                            1
C                                                                        1
C                                                                        1
39    FORMAT (8F10.0)                                                    1
40    FORMAT (31H0THERE IS NO ROOT IN THIS RANGE)                        1
41    FORMAT (16A5)                                                      1
42    FORMAT (8F10.0)                                                    1
43    FORMAT (41H0FUNCTION DOES NOT CONVERGE IN THIS RANGE)              1
44    FORMAT (60H0BEAM IS ENTIRELY IN TENSION.  THE REINFORCEMENT REQUIR 1
     1ED ISF7.2,4H ANDF7.2,35H SQUARE INCHES.  ALLOWABLE SHEAR ISF6.0,11 1
     2H LBS/SQ IN./20H THE SHEAR STRESS ISF6.0,11H LBS/SQ IN.)           1
45    FORMAT (74H0BEAM IS ENTIRELY IN COMPRESSION AND COMPRESSIVE REINFO 1
     1RCEMENT IS REQUIRED)                                               1
46    FORMAT (63H0BEAM IS ENTIRELY IN COMPRESSION AND THE MAXIMUM COMPRE 1
     1SSION ISF7.0,31H LBS/SQ IN.  ALLOWABLE SHEAR ISF6.0,11H LBS/SQ IN. 1
     2/20H THE SHEAR STRESS ISF6.0,48H LBS/SQ IN.  THE ALLOWABLE STRESS  1
     3IN CONCRETE ISF7.0,10H LBS/SQ IN)                                  1
47    FORMAT (1H110X,16A5)                                               1
48    FORMAT (53H0CONC STRNGTH  STEEL STRESS  TOTAL SHEAR  AXIAL FORCE5X 1
     147HMOMENT    TOTAL DEPTH  WIDTH      DEPTH      DEPTH/5X,4HF(C)10X,4H 1
     2F(S)11X,1HV12X1HN12X1HM11X1HD9X1HB9X1HD9X2HDP/12H  LBS/ SQ IN4X10H 1
     3LBS/ SQ IN7X4HKIPS9X4HKIPS8X6HKIP FT7X4HINCH7X2HIN8X2HIN8X2HIN/F10 1
     4.0,F14.0,F14.2,F13.2,F14.2,4F10.2)                                 1
49    FORMAT (22H0LENGTH IN COMPRESSIONF7.2,3H IN//19H ALLOWABLE SHEAR I 1
     1SF7.0,25H LBS/SQ IN  UNIT SHEAR ISF6.0,10H LBS/SQ IN//28H ALLOW ST 1
     2RESS IN CONCRETE ISF7.0,33H LBS/SQ IN  STRESS IN CONCRETE ISF7.0,1 1
     30H LBS/SQ IN//19H AREA TENSILE REINFF7.2,15H SQ IN   STRESSF8.0,10 1
     4H LBS/SQ IN//19H AREA COMPRSV REINFF7.2,15H SQ IN   STRESSF8.0,10H 1
     5 LBS/SQ IN)                                                        1
      END                                                                1
// DUP
*STORE      WS  UA  M1A1
// FOR
*LIST ALL
      SUBROUTINE TPOLY (X,ZZ,EPS,ITEND)
```

```
      COMMON CFB,CFC,CFD,XL,XR,IER,CK,RFC,B,V,AMF
      IER=0
      X=XL
      FL=ZZ(X)
      IF (FL) 1,23,1
1     X=XR
      FR=ZZ(X)
      IF (FR) 2,23,2
2     IF (FL*FR) 4,3,3
3     IER=1
      X=.5*(XL+X)
      RETURN
4     IT=ITEND+1
      DO 22 N=1,IT
      DO 12 K=1,ITEND
      X=.5*(XL+XR)
      F=ZZ(X)
      IF (F) 5,23,5
5     IF (F*FR) 6,7,7
6     DX=XL
      XL=XR
      XR=DX
      DX=FL
      FL=FR
      FR=DX
7     IF (ABS(F)-ABS(FR)) 8,9,9
8     IF (N-IT) 15,9,9
9     XR=X
      FR=F
      DX=ABS(XR-XL)
      ABSXR=ABS(XR)
      IF (ABSXR-1.) 11,11,10
10    DX=DX/ABSXR
11    IF (DX-EPS) 13,13,12
12    CONTINUE
      IER=2
13    X=XL
      IF (ABS(FL)-ABS(FR)) 23,23,14
14    X=XR
      RETURN
15    DFL=F-FL
      DFR=FR-F
      DX=(X-XL)*FL*(1.+F*(DFR-DFL)/(DFR*(FR-FL)))/DFL
      XM=X
      FM=F
      X=XL-DX
      DX=ABS(DX)
      ABSX=ABS(X)
      IF (ABSX-1.) 17,17,16
16    DX=DX/ABSX
17    IF (DX-EPS) 23,23,18
18    F=ZZ(X)
      IF (F) 19,23,19
19    IF (F*FL) 20,20,21
20    XR=X
      FR=F
      GO TO 22
21    XL=X
      FL=F
      XR=XM
      FR=FM
22    CONTINUE
```

```
23    RETURN
      END
// DUP
*STORE      WS  UA  TPOLY
// FOR
*LIST ALL
      FUNCTION ZZ (X)
      COMMON B,C,D,XL,XR,IER,CK,RFC,S,V,AMF
      ZZ=((X+B)*X+C)*X+D
      RETURN
      END
// DUP
*STORE      WS  UA  ZZ
// FOR
*LIST ALL
      FUNCTION ZY (X)
      COMMON CFB,CFC,CFD,XL,XR,IER,C,RFC,B,V,AMF
      ZY=((X+2.)*X+(1.-3./C))*X-2./C
      RETURN
      END
// DUP
*STORE      WS  UA  ZY
// FOR
*LIST ALL
      FUNCTION AVB (X)
      COMMON CFB,CFC,CFD,XL,XR,IER,CK,RFC,B,V,AMF
      AVB=RFC+13./1.44*X/B*V/AMF
      RETURN
      END
// DUP
*STORE      WS  UA  AVB
// FOR
      FUNCTION ROOT (B,C)
      ROOT=(SQRT(B**2-4.*C)-B)/2.
      RETURN
      END
// DUP
*STORE      WS  UA  ROOT
// XEQ M1A1
```

SAMPLE PROBLEM FOR 1A1

CONC STRNGTH	STEEL STRESS	TOTAL SHEAR	AXIAL FORCE	MOMENT	TOTAL DEPTH	WIDTH	DEPTH	DEPTH
F(C)	F(S)	V	N	M	D	B	D	DP
LBS/ SQ IN	LBS/ SQ IN	KIPS	KIPS	KIP FT	INCH	IN	IN	IN
3000.	20000.	10.00	10.00	100.00	24.00	12.00	22.00	2.00

LENGTH IN COMPRESSION 8.41 IN

ALLOWABLE SHEAR IS 58. LBS/SQ IN UNIT SHEAR IS 38. LBS/SQ IN

ALLOW STRESS IN CONCRETE IS 1350. LBS/SQ IN STRESS IN CONCRETE IS 1343. LBS/SQ IN

AREA TENSILE REINF 2.89 SQ IN STRESS 19971. LBS/SQ IN

AREA COMPRSV REINF .00 SQ IN STRESS 0. LBS/SQ IN

LISTING AND SAMPLE OUTPUT FOR 1.A.2

"Composite Beam Section Properties"

```
// JOB 1
// FOR
*IOCS(CARD,1132PRINTER,DISK)
C       PROGRAM FOR FINDING SECTION PROPERTIES OF COMPOSITE SECTIONS          1A2
C       MEANING OF OUTPUT TERMS                                               1A2
C                                                                             1A2
C       N-MODULAR RATIO                                                       1A2
C       W/F - WEIGHT OF STEEL PER FOOT OF BEAM                                1A2
C       I - MOMENT OF INERTIA                                                 1A2
C       STF - SECTION MODULUS TO TOP FLANGE                                   1A2
C       SBF - SECTION MODULUS TO BOTTOM FLANGE                                1A2
C       SC - SECTION MODULUS TO TOP OF CONCRETE                               1A2
C       M - MOMENT OF TRANSFORMED CONCRETE SECTION ABOUT NEUTRAL AXIS         1A2
C                                                                             1A2
C                                                                             1A2
C       A1 - AREA OF BOTTOM FLANGE                                            1A2
C       A2 - AREA OF WEB                                                      1A2
C       A3 - AREA OF TOP FLANGE                                               1A2
C       A4 - AREA OF TRANSFORMED CONCRETE SLAB                                1A2
C       A1YS - AY OF BOTTOM FLANGE FOR NON COMPOSITE SECTION                  1A2
C       A2YS - AY OF WEB FOR NON COMPOSITE SECTION                            1A2
C       A3YS - AY OF TOP FLANGE FOR NON COMPOSITE SECTION                     1A2
C       A4YT  - AY OF CONCRETE SLAB FOR COMPOSITE SECTION                     1A2
C       ASYT - AY OF STEEL FOR COMPOSITE SECTION                              1A2
C       ATS - AREA OF STEEL                                                   1A2
C       AYTSC - AY OF COMPOSITE SECTION                                       1A2
C       D1 - DEPTH OF BOTTOM FLANGE                                           1A2
C       D2 - DEPTH OF WEB                                                     1A2
C       D3 - DEPTH OF TOP FLANGE                                              1A2
C       D4 - DEPTH OF SLAB                                                    1A2
C       DI1  - NAME OF ARRAY FOR GENERATING D1                                1A2
C       DI4  - NAME OF ARRAY FOR GENERATING D4                                1A2
C       DI2 - NAME OF ARRAY FOR READING D2                                    1A2
C       ID - IF 0 USE T1 ROUTINE IF 1 USE W1 ROUTINE                          1A2
C       L - COUNTER FOR PRINTING OF TITLE                                     1A2
C       NID1 - NUMBER OF DEPTHS OF BOTTOM FLANGE BEING READ                   1A2
C       NID4 - NUMBER OF DEPTHS OF SLAB BEING READ                            1A2
C       NIT1 - NUMBER OF T1 BEING READ                                        1A2
C       NIW1 - NUMBER OF WIDTHS OF BOTTOM FLANGE BEING READ                   1A2
C       NIWT - DUMMY VARIBLE FOR SETTING UP DO LOOP                           1A2
C       NOFW2 - NUMBER OF DEPTHS AND WIDTHS OF WEB BEING READ                 1A2
C       SBF - SECTION MODULUS TO BOTTOM FLANGE                                1A2
C       SC - SECTION MODULUS TO CONCRETE                                      1A2
C       STF - SECTION MODULUS TO TOP FLANGE                                   1A2
C       SID1 - SIZE OF INCREMENTS OF DEPTH OF BOTTOM FLANGE                   1A2
C       SID4 - SIZE OF INCREMENTS OF DEPTH OF SLAB                            1A2
C       SIT1 - SIZE OF INCREMENTS OF T1                                       1A2
C       SIW1 - SIZE OF INCREMENTS OF WIDTH OF BOTTOM FLANGE                   1A2
C       T1 - NUMBER DEPTH OF BOTTOM FLANGE IS MULTIPLIED BY TO GET WIDTH      1A2
C       T4 - NUMBER DEPTH OF CONCRETE IS MULTIPLIED BY TO GET WIDTH W4        1A2
C       TI1  - NAME OF ARRAY FOR GENERATING T1                                1A2
C       W - WEIGHT PER FOOT OF STEEL                                          1A2
C       W1 - WIDTH OF BOTTOM FLANGE                                           1A2
C       W2 - WIDTH OF WEB                                                     1A2
C       W3 - WIDTH OF TOP FLANGE                                              1A2
C       W4 - WIDTH OF SLAB                                                    1A2
C       WI1 - NAME OF ARRAY FOR GENERATING W1                                 1A2
C       WI2 - NAME OF ARRAY FOR READING W2                                    1A2
C       XI - I OF STEEL SECTION                                               1A2
C       XIC - I OF CONCRETE FOR COMPOSITE SECTION                             1A2
C       XIBF - I OF BOTTOM FLANGE FOR NON COMPOSITE SECTION                   1A2
C       XITF - I OF TOP FLANGE FOR NON COMPOSITE SECTION                      1A2
```

```
C       XIS - I OF STEEL FOR COMPOSITE SECTION                                1A2
C       XIT - I OF COMPOSITE SECTION                                          1A2
C       XIW  - I OF WEB FOR NON COMPOSITE SECTION                             1A2
C       XM - MOMENT OF TRANSFORMED CONCRETE SECTION ABOUT NEUTRAL AXIS        1A2
C       XN - MODULAR RATIO                                                    1A2
C       YS - DISTANCE TO NEUTRAL AXIS FROM TOP FLANGE FOR NON COMPOSITE SE1A2
C       YST - DISTANCE TO NEUTRAL AXIS FROM CONCRETE FOR COMPOSITE SECTION1A2
        DIMENSION DI2(300), WI2(300), DI4(300), DI1(300), TI1(300), A(8)  1A2
        DIMENSION WI1(300)                                                    1A2
        COMMON W4,W2,XN,W3,D3,D4,D2,A,L                                       1A2
1       READ (2,21) A                                                         1A2
        READ (2,22) XN,NOFW2,ID                                               1A2
        READ (2,23) W3,D3                                                     1A2
        READ (2,24) D4,NID4,SID4,T4                                           1A2
        READ (2,24) D1,NID1,SID1                                              1A2
        IF (ID) 20,2,4                                                        1A2
2       READ (2,24) T1,NIT1,SIT1                                              1A2
        TI1(1)=T1                                                             1A2
        DO 3 J=1,NIT1                                                         1A2
3       TI1(J+1)=TI1(J)+SIT1                                                  1A2
        GO TO 6                                                               1A2
4       READ (2,24) W1,NIW1,SIW1                                              1A2
        WI1(1)=W1                                                             1A2
        DO 5 I=1,NIW1                                                         1A2
5       WI1(I+1)=WI1(I)+SIW1                                                  1A2
6       READ (2,25) (WI2(N),DI2(N),N=1,NOFW2)                                 1A2
        L=0                                                                   1A2
        DI4(1)=D4                                                             1A2
        DO 7 M=1,NID4                                                         1A2
7       DI4(M+1)=DI4(M)+SID4                                                  1A2
        DI1(1)=D1                                                             1A2
        DO 8 K=1,NID1                                                         1A2
8       DI1(K+1)=DI1(K)+SID1                                                  1A2
        A3=W3*D3                                                              1A2
        A3YS=A3*(D3/2.)                                                       1A2
        DO 19 M=1,NID4                                                        1A2
        D4=DI4(M)                                                             1A2
C       IF T4 = 0, PROGRAM SUPPLIES T4 = 16*D4+W3 PER AISC SPECS              1A2
C       IF T4 = XX, PROGRAM USES XX TO FIND W4 (W4 = T4*D4)                   1A2
        IF (T4) 9,9,10                                                        1A2
9       W4=D4*16.+W3                                                          1A2
        GO TO 11                                                              1A2
10      W4=D4*T4                                                              1A2
11      CONTINUE                                                              1A2
        A4=W4*D4/XN                                                           1A2
        A4YT=A4*(D4/2.)                                                       1A2
        DO 19 N=1,NOFW2                                                       1A2
        D2=DI2(N)                                                             1A2
        W2=WI2(N)                                                             1A2
        A2=D2*W2                                                              1A2
        A2YS=A2*(D3+(D2/2.))                                                  1A2
        CALL TITLE                                                            1A2
        DO 19 K=1,NID1                                                        1A2
        D1=DI1(K)                                                             1A2
        IF (ID) 20,12,13                                                      1A2
12      NIWT=NIT1                                                             1A2
        GO TO 14                                                              1A2
13      NIWT=NIW1                                                             1A2
14      DO 19 JTW=1,NIWT                                                      1A2
        IF (ID) 19,15,16                                                      1A2
15      T1=TI1(JTW)                                                           1A2
        W1=D1*T1                                                              1A2
```

```
      GO TO 17                                                          1A2
16    W1=W11(JTW)                                                       1A2
17    A1=D1*W1                                                          1A2
      A1YS=A1*(D3+D2+D1/2.)                                             1A2
      A1YST=A1YS+A2YS+A3YS                                              1A2
      ATS=A1+A2+A3                                                      1A2
      YS=A1YST/ATS                                                      1A2
      XITF=A3*((D3*D3)/12.+(YS-D3/2.)*(YS-D3/2.))                       1A2
      XIW=A2*((D2*D2)/12.+(YS-D3-D2/2.)*(YS-D3-D2/2.))                  1A2
      XIBF=A1*((D1*D1)/12.+(D2+D3+D1/2.-YS)*(D2+D3+D1/2.-YS))           1A2
      XI=XITF+XIW+XIBF                                                  1A2
      STF=XI/YS                                                         1A2
      SBF=XI/(D3+D2+D1-YS)                                              1A2
      W=ATS*490./144.                                                   1A2
      WRITE (3,26) D1,W1,A1,W,XI,STF,SBF                                1A2
      ASYT=ATS*(YS+D4)                                                  1A2
      AYTSC=A4YT+ASYT                                                   1A2
      YST=AYTSC/(ATS+A4)                                                1A2
      XIC=A4*(D4*D4/12.+(YST-D4/2.)*(YST-D4/2.))                        1A2
      XIS=XI+ATS*(YS+D4-YST)*(YS+D4-YST)                                1A2
      XIT=XIC+XIS                                                       1A2
      STF=XIT/(YST-D4)                                                  1A2
      SBF=XIT/(D4+D3+D2+D1-YST)                                         1A2
      SC=XIT/YST                                                        1A2
      XM=A4*(YST-D4/2.)                                                 1A2
      WRITE (3,27) XIT,STF,SBF,SC,XM                                    1A2
      L=L+1                                                             1A2
      IF (L-46) 19,18,18                                                1A2
18    CALL TITLE                                                        1A2
19    CONTINUE                                                          1A2
20    CONTINUE                                                          1A2
      GO TO 1                                                           1A2
C                                                                       1A2
21    FORMAT (8A10)                                                     1A2
22    FORMAT (F5.2,2I5)                                                 1A2
23    FORMAT (2F10.3)                                                   1A2
24    FORMAT (F10.3,I10,2F10.3)                                         1A2
25    FORMAT (2F10.3)                                                   1A2
26    FORMAT (1H ,F8.3,1H(,F9.3,1H(,F9.2,1H(,F9.2,1H(,F10.1,1H(F9.1,1H(F1A2
     19.1,1H()                                                          1A2
27    FORMAT (1H+,70X,F10.1,1H(,F9.1,1H(,F9.1,1H(,F9.1,1H(,F9.2)        1A2
      END                                                               1A2
// DUP
*STORE      WS  UA  M1A2
// FOR
      SUBROUTINE TITLE
      DIMENSION A(8)
      COMMON W4,W2,XN,W3,D3,D4,D2,A,L
      WRITE (3,1)
      WRITE (3,13) A
      WRITE (3,2)
      WRITE (3,3)
      WRITE (3,4) W4,W2
      WRITE (3,5)
      WRITE (3,6) XN,W3,D3
      WRITE (3,7) D4,D2
      WRITE (3,5)
      WRITE (3,3)
      WRITE (3,12)
      WRITE (3,8)
      WRITE (3,9)
      WRITE (3,8)
```

```
      WRITE (3,12)
      WRITE (3,10)
      WRITE (3,10)
      WRITE (3,11)
      WRITE (3,10)
      WRITE (3,12)
      WRITE (3,10)
      L=0
      RETURN
C
1     FORMAT (1H1)
2     FORMAT (121H .............................................................
     1..................................................................
     2.)
3     FORMAT (16X,1H(,34X,1H(,34X,1H()
4     FORMAT (1H ,15X,1H(,15X,8HWIDTH = ,F8.3,3X,1H(,14X,8HWIDTH = F8.3)
5     FORMAT (1H+,85X,1H()
6     FORMAT (5X,4HN = ,F6.2,3X,12H(   CONCRETE,23X,8H(    WEB,27X,13H(
     1 TOP FLANGE,2X,F8.3,2H X,F8.3)
7     FORMAT (1H ,15X,1H(,15X,8HDEPTH = ,F8.3,5X,1H(,14X,8HDEPTH = ,F8.3
     1)
8     FORMAT (29X,1H(,40X,1H()
9     FORMAT (8X,14HBOTTOM  FLANGE,7X,1H(,8X,23HNON  COMPOSITE  SECTION,
     19X,1H(,16X,18HCOMPOSITE  SECTION)
10    FORMAT (9X,1H(,9X,1H(,9X,1H(,9X,1H(,10X,1H(,9X,1H(,9X,1H(,10X,1H(,
     19X,1H(,9X,1H(,9X,1H()
11    FORMAT (1H+,1X,5HDEPTH,5X,5HWIDTH,5X,4HAREA,6X,4HW/FT,8X,1HI,9X,3H
     1STF,7X,3HSBF,8X,1HI,9X,3HSTF,7X3HSBF,7X2HSC,9X,1HM)
12    FORMAT (121H+.............................................................
     1..................................................................
     2.)
13    FORMAT (1X,8A10)
      END
// DUP
*STORE      WS  UA  TITLE
// XEQ M1A2
```

SAM PROBLM OR 1A2

N = 10.00	CONCRETE	WIDTH = 72.000 DEPTH = 6.000	WEB	WIDTH = .375 DEPTH = 24.000	TOP FLANGE 8.000 X .500

BOTTOM FLANGE			NON COMPOSITE SECTION				COMPOSITE SECTION				
DEPTH	WIDTH	AREA	W/FT	I	STF	SBF	I	STF	SBF	SC	M
1.000	12.000	12.00	85.07	2503.3	151.2	279.1	8676.2	2084.2	406.6	853.7	309.43

LISTING AND SAMPLE OUTPUT FOR 1.A.3

"Concrete Beam Review"

```
// JOB T
// FOR
*IOCS(CARD,1132PRINTER,DISK)
C      REVIEW OF SIMPLE CONCRETE BEAM
       READ (2,2) FS,FC,AN
       READ (2,2) AS,B,D
       P=AS/(B*D)
       AK=(((2.0*P*AN)+((P*AN)**2.0))**0.5)-(P*AN)
       AJ=1.0-(AK/3.0)
       AMS=(AS*FS*AJ*D)/12000.0
       AMC=(FC*0.5*AK*AJ*B*(D**2.0))/12000.0
       WRITE (3,3)
       WRITE (3,4)
       WRITE (3,1) FS,FC,AN,AS,B,D
       WRITE (3,5)
       WRITE (3,1) P,AK,AJ,AMS,AMC
       WRITE (3,3)
       WRITE (3,3)
       WRITE (3,6)
C
1      FORMAT (1X,6F12.4)
2      FORMAT (3F10.0)
3      FORMAT (1X,1H )
4      FORMAT (7X,2HFS,10X,2HFC,11X,1HN,10X,2HAS,11X,1HB,11X,1HD)
5      FORMAT (8X,1HP,11X,1HK,11X,1HJ,10X,2HMS,10X,2HMC)
6      FORMAT (1H1)
       END
// DUP
*STORE      WS  UA  MIAS
// XEQ MIAS
// JOB
```

FS	FC	N	AS	B	D
20000.0000	1350.0000	10.0000	6.9300	17.0000	31.0000
P	K	J	MS	MC	
.0131	.3979	.8674	310.5576	317.1720	

LISTING AND SAMPLE OUTPUT FOR 1.B.1

"Biaxial Bending of Rectangular Columns"

```
// JOB T
// FOR
*IOCS(CARD,1132PRINTER,DISK)
C     RECT. CONCRETE COLUMN WITH BIAXIAL BENDING                         1B1
      REAL MALLA,MALLB
      DIMENSION ACORX(100), ACORY(100), AREA(100), TAREA(100), BARNO(1001B1
     1)                                                                  1B1
1     READ (2,41) ENGR,DATE                                              1B1
      READ (2,40) T,D,XMX,XMY,THR,EN                                     1B1
      DO 2 I=1,100                                                       1B1
      ACORX(I)=0.0                                                       1B1
      ACORY(I)=0.0                                                       1B1
      AREA(I)=0.0                                                        1B1
2     TAREA(I)=0.0                                                       1B1
      I=1                                                                1B1
3     READ (2,40) BARNO(I),ACORX(I),ACORY(I),AREA(I)                     1B1
      I=I+1                                                              1B1
      IF (BARNO(I-1)-100.) 3,4,4                                         1B1
4     NOBAR=I-1                                                          1B1
      N=1                                                                1B1
      JJ=1                                                               1B1
      NCOMP=1                                                            1B1
5     WRITE (3,43)                                                       1B1
      WRITE (3,75)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,72) ENGR,DATE                                             1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,41)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,48)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,52)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,49)                                                       1B1
      WRITE (3,50)                                                       1B1
      WRITE (3,51)                                                       1B1
      WRITE (3,53) T,D,XMX,XMY,THR,EN                                    1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,54)                                                       1B1
      WRITE (3,55)                                                       1B1
      WRITE (3,57)                                                       1B1
      DO 6 I=1,NOBAR                                                     1B1
6     WRITE (3,56) BARNO(I),ACORX(I),ACORY(I),AREA(I)                    1B1
7     A=T*D                                                              1B1
      WRITE (3,43)                                                       1B1
      WRITE (3,73)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,72) ENGR,DATE                                             1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,41)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,48)                                                       1B1
      WRITE (3,42)                                                       1B1
      WRITE (3,58)                                                       1B1
      WRITE (3,42)                                                       1B1
      QOX=.5*T**2*D                                                      1B1
      QOY=.5*T*D**2                                                      1B1
      ERTOX=(T**3/3.)*D                                                  1B1
      ERTOY=(T/3.)*D**3                                                  1B1
      ERTXY=(T**2/4.)*D**2                                               1B1
      ESUBX=XMY*12./THR                                                  1B1
      ESUBY=XMX*12./THR                                                  1B1
```

```
      XSUBP=D/2.-ESUBX                                                  1B1
      YSUBP=T/2.-ESUBY                                                  1B1
      RATIO=ESUBX/D+ESUBY/T                                             1B1
8     SMAL1=(ERTXY-YSUBP*QOY)*(ERTXY-XSUBP*QOX)-(ERTOX-YSUBP*QOX)*(ERTOY1B1
     1-XSUBP*QOY)                                                       1B1
      MALLA=SMAL1/((QOX-YSUBP*A)*(ERTXY-XSUBP*QOX)-(QOY-XSUBP*A)*(ERTOX-1B1
     1YSUBP*QOX))                                                       1B1
      MALLB=SMAL1/((QOY-XSUBP*A)*(ERTXY-YSUBP*QOY)-(QOX-YSUBP*A)*(ERTOY-1B1
     1XSUBP*QOY))                                                       1B1
      SLOPE=MALLA/MALLB                                                 1B1
      AREAT=0.0                                                         1B1
      AREAC=0.0                                                         1B1
      DO 13 I=1,NOBAR                                                   1B1
      TAREA(I)=0.0                                                      1B1
      STOR1=MALLA-ACORY(I)*SLOPE                                        1B1
      GO TO (10,9), NCOMP                                               1B1
9     IF (STOR1-ACORX(I)) 12,12,13                                      1B1
10    IF (STOR1-ACORX(I)) 12,12,11                                      1B1
11    TAREA(I)=(2.*EN-1.)*AREA(I)                                       1B1
      AREAC=AREAC+TAREA(I)                                              1B1
      GO TO 13                                                          1B1
12    TAREA(I)=EN*AREA(I)                                               1B1
      AREAT=AREAT+TAREA(I)                                              1B1
13    CONTINUE                                                          1B1
      QOX=0.0                                                           1B1
      QOY=0.0                                                           1B1
      ERTOX=0.0                                                         1B1
      ERTOY=0.0                                                         1B1
      ERTXY=0.0                                                         1B1
      DO 14 I=1,NOBAR                                                   1B1
      QOX=QOX+TAREA(I)*ACORY(I)                                         1B1
      QOY=QOY+TAREA(I)*ACORX(I)                                         1B1
      ERTOX=ERTOX+TAREA(I)*ACORY(I)**2                                  1B1
      ERTOY=ERTOY+TAREA(I)*ACORX(I)**2                                  1B1
      ERTXY=ERTXY+TAREA(I)*ACORY(I)*ACORX(I)                            1B1
14    CONTINUE                                                          1B1
      T1=MALLA*MALLB                                                    1B1
      T2=(MALLB-T)/MALLB                                                1B1
      T3=(MALLA-D)/MALLA                                                1B1
      IF (MALLA-D) 15,15,16                                             1B1
15    IF (MALLB-T) 19,19,20                                             1B1
16    IF (MALLB-T) 21,21,17                                             1B1
17    IF (MALLA*((MALLB-T)/MALLB)-D) 22,18,18                           1B1
18    IF (MALLB*((MALLA-D)/MALLA)-T) 22,23,23                           1B1
C     CASE I FOLLOWS                                                    1B1
19    A=.5*T1+AREAC+AREAT                                               1B1
      QOX=QOX+(T1*MALLB)/6.                                             1B1
      QOY=QOY+(T1*MALLA)/6.                                             1B1
      ERTOX=ERTOX+(T1*MALLB**2)/12.                                     1B1
      ERTOY=ERTOY+(T1*MALLA**2)/12.                                     1B1
      ERTXY=ERTXY+(T1*T1)/24.                                           1B1
      GO TO 24                                                          1B1
C     CASE II FOLLOWS                                                   1B1
20    A=.5*T1*(1.-(T2)**2)+AREAC+AREAT                                  1B1
      QOX=QOX+MALLA*T**2*(3.-2.*T/MALLB)/6.                             1B1
      QOY=QOY+MALLA**2*MALLB*(1.-T2**3)/6.                              1B1
      ERTOX=ERTOX+MALLA*T**3*(4.-3.*T/MALLB)/12.                        1B1
      ERTOY=ERTOY+MALLA**3*MALLB*(1.-T2**4)/12.                         1B1
      ERTXY=ERTXY+T1**2*(1.-T2**4-4.*T2**3*T/MALLB)/24.                 1B1
      GO TO 24                                                          1B1
C     CASE III FOLLOWS                                                  1B1
21    A=.5*T1*(1.-T3**2)+AREAC+AREAT                                    1B1
```

```
      QOX=QOX+T1*MALLB*(1.-T3**3)/6.                                    1B1
      QOY=QOY+MALLB*D**2*(3.-2.*D/MALLA)/6.                             1B1
      ERTOX=ERTOX+T1*MALLB**2*(1.-T3**4)/12.                            1B1
      ERTOY=ERTOY+MALLB*D**3*(4.-3.*D/MALLA)/12.                        1B1
      ERTXY=ERTXY+T1**2*(1.-T3**4-4.*T3**3*D/MALLA)/24.                 1B1
      GO TO 24                                                          1B1
C     CASE IV FOLLOWS                                                   1B1
22    A=.5*T1*(1.-T3**2-T2**2)+AREAC+AREAT                              1B1
      QOX=QOX+T1*MALLB*(1.-T3**3-T2**3-3.*T2**2*T/MALLB)/6.             1B1
      QOY=QOY+T1*MALLA*(1.-T3**3-T2**3-3.*T3**2*D/MALLA)/6.             1B1
      ERTOX=ERTOX+T1*MALLB**2*(1.-T3**4-T2**4-2.*T2**2*(T/MALLB)*((2.*MA1B1
     1LLB+T)/MALLB))/12.                                                1B1
      ERTOY=ERTOY+T1*MALLA**2*(1.-T3**4-T2**4-2.*T3**2*(D/MALLA)*((2.*MA1B1
     1LLA+D)/MALLA))/12.                                                1B1
      ERTXY=ERTXY+T1**2*(1.-T3**4-T2**4-4.*T3**3*(D/MALLA)-4.*T2**3*(T/M1B1
     1ALLB))/24.                                                        1B1
      GO TO 24                                                          1B1
C     CASE V FOLLOWS                                                    1B1
23    A=D*T+AREAC+AREAT                                                 1B1
      QOX=QOX+.5*D*T**2                                                 1B1
      QOY=QOY+.5*D**2*T                                                 1B1
      ERTOX=ERTOX+D*T**3/3.                                             1B1
      ERTOY=ERTOY+D**3*T/3.                                             1B1
      ERTXY=ERTXY+D**2*T**2/4.                                          1B1
24    GO TO (25,26), N                                                  1B1
25    SMALA=MALLA                                                       1B1
      SMALB=MALLB                                                       1B1
      N=2                                                               1B1
      GO TO 8                                                           1B1
26    JJ=JJ+1                                                           1B1
      IF (JJ-50) 27,27,29                                               1B1
27    TSMLA=ABS(MALLA-SMALA)                                            1B1
      TSMLB=ABS(MALLB-SMALB)                                            1B1
      IF (TSMLA-.005) 28,25,25                                          1B1
28    IF (TSMLB-.005) 29,25,25                                          1B1
29    CSTR=THR*1000./(A-(QOY/MALLA)-(QOX/MALLB))                        1B1
      WRITE (3,59) RATIO                                                1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,62) ESUBX                                                1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,63) ESUBY                                                1B1
      WRITE (3,42)                                                      1B1
      GO TO (131,132),NCOMP
  131 WRITE (3,64)                                                      1B1
      WRITE (3,42)                                                      1B1
      GO TO 133
  132 WRITE (3,65)                                                      1B1
      WRITE (3,42)                                                      1B1
  133 WRITE (3,45) JJ                                                   1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,60) MALLA                                                1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,61) MALLB                                                1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,69)                                                      1B1
      WRITE (3,70)                                                      1B1
      WRITE (3,71) A,ERTOX,ERTOY                                        1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,44) CSTR                                                 1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,66)                                                      1B1
```

```
      WRITE (3,67)                                                      1B1
      WRITE (3,68)                                                      1B1
      LINE=1                                                            1B1
      DO 36 I=1,NOBAR                                                   1B1
      GO TO (31,30), NCOMP                                              1B1
30    IF (TAREA(I)) 36,36,31                                            1B1
31    IF (AREA(I)*EN-TAREA(I)) 33,32,32                                 1B1
32    FS=EN*CSTR*(1.-(ACORX(I)/MALLA)-(ACORY(I)/MALLB))                 1B1
      WRITE (3,46) I,FS                                                 1B1
      GO TO 34                                                          1B1
33    FPS=2.*EN*CSTR*(1.-ACORX(I)/MALLA-(ACORY(I)/MALLB))               1B1
      WRITE (3,47) I,FPS                                                1B1
34    LINE=LINE+1                                                       1B1
      IF (LINE-25) 36,36,35                                             1B1
35    LINE=1                                                            1B1
      WRITE (3,43)                                                      1B1
      WRITE (3,73)                                                      1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,72) ENGR,DATE                                            1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,41)                                                      1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,48)                                                      1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,58)                                                      1B1
      WRITE (3,42)                                                      1B1
      WRITE (3,66)                                                      1B1
      WRITE (3,67)                                                      1B1
      WRITE (3,68)                                                      1B1
36    CONTINUE                                                          1B1
      WRITE (3,42)                                                      1B1
      GO TO (37,38), NCOMP                                              1B1
37    NCOMP=2                                                           1B1
      N=1
      JJ=1                                                              1B1
      GO TO 7                                                           1B1
38    READ (2,40) XLOAD                                                 1B1
      IF (XLOAD) 39,1,39                                                1B1
39    READ (2,41) ENGR,DATE                                             1B1
      READ (2,41) ENGR,DATE                                             1B1
      NCOMP=1                                                           1B1
      N=1                                                               1B1
      JJ=1                                                              1B1
      GO TO 5                                                           1B1
C                                                                       1B1
40    FORMAT (8F10.3)                                                   1B1
41    FORMAT (66H                                                       1B1
     1                       ,A3,A6)                                    1B1
42    FORMAT (1X)                                                       1B1
43    FORMAT (1H1)                                                      1B1
44    FORMAT (2X,25HMAXIMUM CONCRETE STRESS =,F8.1,5H(PSI))             1B1
45    FORMAT (2X,53HNUMBER OF PASSES REQUIRED FOR NEUTRAL AXIS SOLUTION 1B1
     1=,I4)                                                             1B1
46    FORMAT (18X,I4,F14.1,2X,7HTENSILE)                                1B1
47    FORMAT (18X,I4,F14.1,2X,11HCOMPRESSIVE)                           1B1
48    FORMAT (11X,54HBIAXIAL BENDING - WORKING STRESS - PROGRAM(13=R3=C11B1
     118))                                                              1B1
49    FORMAT (2X,73HMEMBER HEIGHT  MEMBER WIDTH  MOMENT ABT.  MOMENT ABT1B1
     1.  THRUST AT  MODULAR)                                            1B1
50    FORMAT (2X,72HALONG Y-AXIS   ALONG X-AXIS  X=AXIS C.L.  Y-AXIS C.L1B1
     1.   C.L.     RATIO)                                               1B1
51    FORMAT (3X,61H(INCHES)       (INCHES)      (KIP-FT)     (KIP=FT)  1B1
```

```
     1   (KIPS))                                                           1B1
52    FORMAT (1X,75H*********************************  INPUT DATA  ******1B1
     1**********************)                                              1B1
53    FORMAT (1X,F11.3,F15.3,F13.3,F13.3,F12.3,F10.2)                      1B1
54    FORMAT (17X,46HDESIGNATED  BAR    X-AXIS  BAR     Y-AXIS   BAR)      1B1
55    FORMAT (17X,42HBAR NUMBER   COORDINATE  COORDINATE   AREA)           1B1
56    FORMAT (19X,F5.0,F16.3,F13.3,F11.2)                                  1B1
57    FORMAT (33X,30H(INCHES)    (INCHES)    (SQ,IN.))                     1B1
58    FORMAT (1X,72H******************************  OUTPUT  ***********1B1
     1*******************)                                                 1B1
59    FORMAT (2X,53HSUM OF ECCENTRICITY TO THICKNESS IN BOTH DIRECTIONS 1B1
     1=,F5.3)                                                              1B1
60    FORMAT (2X,38HTHE NEUTRAL AXIS INTERSECTS THE X-AXIS,F8.2,24H(INCH1B1
     1 S) FROM THE ORIGIN)                                                 1B1
61    FORMAT (2X,38HTHE NEUTRAL AXIS INTERSECTS THE Y-AXIS,F8.2,24H(INCH1B1
     1 S) FROM THE ORIGIN)                                                 1B1
62    FORMAT (2X,48HTHE ECC. FROM C.L. OF MEMBER ALONG THE X-AXIS = ,F7.1B1
     12,8H(INCHES))                                                        1B1
63    FORMAT (2X,48HTHE ECC. FROM C.L. OF MEMBER ALONG THE Y-AXIS = ,F7.1B1
     12,8H(INCHES))                                                        1B1
64    FORMAT (2X,70HALL COMPRESSIVE REINFORCEMENT IS TRANSFORMED FOR NEU1B1
     1TRAL AXIS SOLUTION)                                                  1B1
65    FORMAT (2X,66HALL COMPRESSIVE REINFORCEMENT IS IGNORED FOR NEUTRAL1B1
     1 AXIS SOLUTION)                                                      1B1
66    FORMAT (17X,8HCOMPUTER,15X,4HTYPE)                                   1B1
67    FORMAT (16X,29HDESIGNATED    STRESS   STRESS)                        1B1
68    FORMAT (16X,19HBAR NUMBER     (PSI))                                 1B1
69    FORMAT (2X,57HPROPERTIES OF SECTION (EFF. CONCRETE + TRANSFORMED S1B1
     1TEEL))                                                               1B1
70    FORMAT (7X,4HAREA,8X,4HI(X),9X,4HI(Y))                               1B1
71    FORMAT (1X,F10.2,F12.1,F13.1)                                        1B1
72    FORMAT (50X,6HENGR, ,A3,6H DATE ,A8)                                 1B1
73    FORMAT (50X,5HSHEET,5X,2HOF)                                         1B1
      END                                                                  1B1
// DUP
*STORE      WS  UA  M1B1
// XQT M1B1
// JOB
```

SHEET OF

ENGR. EFC DATE /12/68

TEST CASE NO 1 FOR SP-17 FOR 1B1

BIAXIAL BENDING - WORKING STRESS - PROGRAM(13=R3=C118)

****************************** INPUT DATA ******************************

MEMBER HEIGHT ALONG Y-AXIS (INCHES)	MEMBER WIDTH ALONG X-AXIS (INCHES)	MOMENT ABT. X=AXIS C.L. (KIP-FT)	MOMENT ABT. Y-AXIS C.L. (KIP=FT)	THRUST AT C.L. (KIPS)	MODULAR RATIO
17.000	25.000	22.693	113.467	68.080	10.00

DESIGNATED BAR NUMBER	BAR X-AXIS COORDINATE (INCHES)	BAR Y-AXIS COORDINATE (INCHES)	BAR AREA (SQ.IN.)
1.	2.500	2.500	.79
2.	12.500	2.500	.79
3.	22.500	2.500	.79
4.	2.500	8.500	.79
5.	22.500	8.500	.79
6.	2.500	14.500	.79
7.	12.500	14.500	.79
100.	22.500	14.500	.79

EST CASE NO. 1 FOR 181

BIAXIAL BENDING - WORKING STRESS - PROGRAM(13=R3=C118)

******************************** OUTPUT ********************************

SUM OF ECCENTRICITY TO THICKNESS IN BOTH DIRECTIONS =1.035

THE ECC. FROM C.L. OF MEMBER ALONG THE X-AXIS = 20.00(INCHES)

THE ECC. FROM C.L. OF MEMBER ALONG THE Y-AXIS = 4.00(INCHES)

ALL COMPRESSIVE REINFORCEMENT IS TRANSFORMED FOR NEUTRAL AXIS SOLUTION

NUMBER OF PASSES REQUIRED FOR NEUTRAL AXIS SOLUTION = 5

THE NEUTRAL AXIS INTERSECTS THE X-AXIS 12.66(INCH S) FROM THE ORIGIN

THE NEUTRAL AXIS INTERSECTS THE Y-AXIS 29.21(INCH S) FROM THE ORIGIN

PROPERTIES OF SECTION (EFF. CONCRETE + TRANSFORMED STEEL)

AREA	I(X)	I(Y)
237.09	20007.0	19533.9

MAXIMUM CONCRETE STRESS = 1350.0(PSI)

COMPUTER DESIGNATED BAR NUMBER	STRESS (PSI)	TYPE STRESS
1	19356.7	COMPRESSIVE
2	-987.6	TENSILE
3	-11653.6	TENSILE
4	13811.1	COMPRESSIVE
5	-14426.4	TENSILE
6	8265.5	COMPRESSIVE
7	-6533.2	TENSILE
8	-17199.2	TENSILE

EST CASE NO. 1 FOR 181

BIAXIAL BENDING - WORKING STRESS - PROGRAM(13=R3=C118)

******************************** OUTPUT ********************************

SUM OF ECCENTRICITY TO THICKNESS IN BOTH DIRECTIONS =1.035

THE ECC. FROM C.L. OF MEMBER ALONG THE X-AXIS = 20.00(INCHES)

THE ECC. FROM C.L. OF MEMBER ALONG THE Y-AXIS = 4.00(INCHES)

ALL COMPRESSIVE REINFORCEMENT IS IGNORED FOR NEUTRAL AXIS SOLUTION

NUMBER OF PASSES REQUIRED FOR NEUTRAL AXIS SOLUTION = 5

THE NEUTRAL AXIS INTERSECTS THE X-AXIS 13.47(INCH S) FROM THE ORIGIN

THE NEUTRAL AXIS INTERSECTS THE Y-AXIS 32.53(INCH S) FROM THE ORIGIN

PROPERTIES OF SECTION (EFF. CONCRETE + TRANSFORMED STEEL)

AREA	I(X)	I(Y)
208.72	17410.5	20755.3

MAXIMUM CONCRETE STRESS = 1699.4(PSI)

COMPUTER DESIGNATED BAR NUMBER	STRESS (PSI)	TYPE STRESS
2	-76.4	TENSILE
3	-12688.4	TENSILE
5	-15822.6	TENSILE
7	-6344.9	TENSILE
8	-18956.9	TENSILE

LISTING AND SAMPLE OUTPUT FOR 1.B.2

"Biaxial Bending of Irregular Columns"

```
// JOB T
// FOR
*IOCS(CARD,1132PRINTER,DISK)
C      WSD OF CONCRETE COLUMNS WITH BIAXIAL END MOMENTS (LOADS AND X-SEC1B2
C       CONSTANT WITH RESPECT TO LENGTH)                                 1B2
      DIMENSION XCON(100), YCON(100), AS(100), X1STL(100), Y1STL(100), B1B2
     1ARN(100), X2STL(100), Y2STL(100), FZ(100), TITLE(20), CODE(5)     1B2
      ICON1=1                                                          1B2
      ICON2=2                                                          1B2
      ICON3=3                                                          1B2
      ICON4=4                                                          1B2
      NCON1=1                                                          1B2
      NSTL1=1                                                          1B2
1     READ (2,103) TITLE                                               1B2
      READ (2,97) NCON,NSTL,NLD,ISWT1,ISWT2,ICLMT                      1B2
      IF (ICLMT) 3,2,3                                                 1B2
2     ICLMT=16                                                         1B2
3     IF (NCON) 10,10,4                                                1B2
4     I=NCON1                                                          1B2
5     XCON(I)=0.                                                       1B2
      YCON(I)=0.                                                       1B2
      I=I-1                                                            1B2
      IF (NCON-I) 5,6,6                                                1B2
6     DO 7 I=1,NCON,3                                                  1B2
      J=I+1                                                            1B2
      K=I+2                                                            1B2
7     READ (2,98) XCON(I),YCON(I),XCON(J),YCON(J),XCON(K),YCON(K)      1B2
      IF (XCON(1)-XCON(NCON)) 8,9,8                                    1B2
8     WRITE (3,113) TITLE                                              1B2
      WRITE (3,115)                                                    1B2
      GO TO 96                                                         1B2
9     IF (YCON(1)-YCON(NCON)) 8,10,8                                   1B2
10    IF (NSTL) 15,15,11                                               1B2
11    I=NSTL1                                                          1B2
12    AS(I)=0.                                                         1B2
      X1STL(I)=0.                                                      1B2
      Y1STL(I)=0.                                                      1B2
      BARN(I)=0.                                                       1B2
      X2STL(I)=0.                                                      1B2
      Y2STL(I)=0.                                                      1B2
      I=I-1                                                            1B2
      IF (NSTL-I) 12,13,13                                             1B2
13    DO 14 J=1,NSTL                                                   1B2
14    READ (2,98) AS(J),X1STL(J),Y1STL(J),BARN(J),X2STL(J),Y2STL(J)    1B2
15    READ (2,101) CODE,P,XM,YM,RATIO,B,ACCR                           1B2
      ITCNT=0                                                          1B2
      KSWC=1                                                           1B2
      KSWD=1                                                           1B2
      KSWE=1                                                           1B2
      KSWH=1                                                           1B2
      KSW6=1                                                           1B2
      ONEN=B*RATIO-1.                                                  1B2
      PRMN=ONEN                                                        1B2
      IF (ISWT1) 16,17,16                                              1B2
16    READ (2,116) IDENT,S,T,U                                         1B2
      WRITE (3,117) IDENT                                              1B2
      WRITE (3,109) S,T,U                                              1B2
      GO TO 78                                                         1B2
17    KSWFZ=1                                                          1B2
      KSWG=1                                                           1B2
      ITCNT=ITCNT+1                                                    1B2
      IF (ITCNT-ICLMT) 19,19,18                                        1B2
```

```
18      WRITE (3,114)                                                      1B2
        WRITE (3,104)                                                      1B2
        WRITE (3,105)                                                      1B2
        WRITE (3,106) CODE                                                 1B2
        WRITE (3,107)                                                      1B2
        WRITE (3,108) P,XM,YM,RATIO,B,ACCR                                 1B2
        WRITE (3,104)                                                      1B2
        GO TO 93                                                           1B2
19      A=0.                                                               1B2
        ABARX=0.                                                           1B2
        ABARY=0.                                                           1B2
        XIN=0.                                                             1B2
        YIN=0.                                                             1B2
        XYIN=0.                                                            1B2
        I=1                                                                1B2
        XI=XCON(I)                                                         1B2
        YI=YCON(I)                                                         1B2
        GO TO (20,25), KSWC                                                1B2
20      DO 24 I=2,NCON                                                     1B2
        XI=XCON(I)                                                         1B2
        XIM1=XCON(I-1)                                                     1B2
        YI=YCON(I)                                                         1B2
        YIM1=YCON(I-1)                                                     1B2
        GO TO (21,25), KSWC                                                1B2
21      DELX=XI-XIM1                                                       1B2
        V1=YI+YIM1                                                         1B2
        V2=XI+XIM1                                                         1B2
        V3=XI*YI                                                           1B2
        V4=XIM1*YIM1                                                       1B2
        V5=V1*V1                                                           1B2
        A=A+(DELX/2)*V1                                                    1B2
        ABARX=ABARX+(DELX/6.)*(V1*V2+V3+V4)                                1B2
        ABARY=ABARY+(DELX/6.)*(V5-YI*YIM1)                                 1B2
        XIN=XIN+(DELX/12.)*(V2*V2*V1+2.*(V3*XI+V4*XIM1))                   1B2
        YIN=YIN+(DELX/12.)*(V5*V1-2.*YI*YIM1*V1)                           1B2
        XYIN=XYIN+(DELX/24.)*(XI*(V5+2.*YI*YI)+XIM1*(V5+2.*YIM1*YIM1))     1B2
        IF (ISWT2) 22,23,22                                                1B2
22      WRITE (3,99) ITCNT,ICON1                                           1B2
        WRITE (3,100) A,ABARX,ABARY,XIN,YIN,XYIN                           1B2
        WRITE (3,100) XI,YI,XIM1,YIM1                                      1B2
23      GO TO (24,49,49,48), KSWH                                          1B2
24      CONTINUE                                                           1B2
        GO TO 52                                                           1B2
25      FI=U+S*XI+T*YI                                                     1B2
        GO TO (26,32,30), KSW3                                             1B2
26      DEL=FI-FZ(I)                                                       1B2
27      DELL=DEL                                                           1B2
        IF (DEL) 28,29,29                                                  1B2
28      DELL=-DELL                                                         1B2
29      IF (DELL-ACCR) 32,32,31                                            1B2
30      DEL=FI                                                             1B2
        GO TO 27                                                           1B2
31      KSWD=1                                                             1B2
        KSW3=2                                                             1B2
32      FZ(I)=FI                                                           1B2
        IF (FI) 33,35,35                                                   1B2
33      GO TO (34,24,39), KSWFZ                                            1B2
34      KSWFZ=2                                                            1B2
        GO TO 20                                                           1B2
35      GO TO (36,37,21), KSWFZ                                            1B2
36      KSWFZ=3                                                            1B2
        GO TO 20                                                           1B2
```

```
                                                     1B2
37    KSWFZ=3                                        1B2
      KSW4=2                                         1B2
38    DELX=XI-XIM1                                   1B2
      DELY=YI-YIM1                                   1B2
      FIOD=FI/(FI-FZ(I-1))                           1B2
      XINT=XI-DELX*FIOD                              1B2
      YINT=YI-DELY*FIOD                              1B2
      GO TO (40,46), KSW4                            1B2
39    KSWFZ=2                                        1B2
      KSW4=1                                         1B2
      GO TO 38                                       1B2
40    GO TO (41,45), KSWG                            1B2
41    KSWG=2                                         1B2
      XINTL=XINT                                     1B2
      YINTL=YINT                                     1B2
      GO TO (96,42,44), KSWFZ                        1B2
42    KSWH=3                                         1B2
43    XI=XINT                                        1B2
      YI=YINT                                        1B2
      GO TO 21                                       1B2
44    XIM1=XINT                                      1B2
      YIM1=YINT                                      1B2
      GO TO 21                                       1B2
45    KSWG=1                                         1B2
      KSWH=4                                         1B2
      GO TO 43                                       1B2
46    GO TO (41,47), KSWG                            1B2
47    KSWG=1                                         1B2
      KSWH=2                                         1B2
      XIM1=XINTL                                     1B2
      YIM1=YINTL                                     1B2
      GO TO 43                                       1B2
48    KSWH=3                                         1B2
      XI=XINTL                                       1B2
      YI=YINTL                                       1B2
      GO TO 44                                       1B2
49    XI=XCON(I)                                     1B2
      YI=YCON(I)                                     1B2
      GO TO (96,50,51,96), KSWH                      1B2
50    KSWH=1                                         1B2
      GO TO 44                                       1B2
51    KSWH=1                                         1B2
      GO TO 24                                       1B2
52    GO TO (53,61), KSWD                            1B2
53    IF (NSTL) 96,75,54                             1B2
54    DO 61 J=1,NSTL                                 1B2
      ASJ=AS(J)                                      1B2
      X1=X1STL(J)                                    1B2
      Y1=Y1STL(J)                                    1B2
      BARNO=BARN(J)                                  1B2
      X2=X2STL(J)                                    1B2
      Y2=Y2STL(J)                                    1B2
      KSW8=1                                         1B2
      GO TO (55,66), KSWC                            1B2
55    AFN=PRMN*ASJ*BARNO                             1B2
      IF (BARNO-1.0) 96,56,57                        1B2
56    FRAC=0.                                        1B2
      X2=X1                                          1B2
      Y2=Y1                                          1B2
      GO TO 58                                       1B2
57    FRAC=(2.0*BARNO-1.0)/(6.0*(BARNO-1.0))         1B2
58    A=A+AFN
```

```
      ABARX=ABARX+(AEN*(X1+X2)/2.0)                                     1B2
      XIN=XIN+AEN*(X1*X2+FRAC*(X2-X1)**2)                               1B2
      YIN=YIN+AEN*(Y1*Y2+FRAC*(Y2-Y1)**2)                               1B2
      ABARY=ABARY+AEN*(Y1+Y2)/2.0                                       1B2
      XYIN=XYIN+AEN*(((X1*Y2+X2*Y1)/2.0)+FRAC*(X2-X1)*(Y2-Y1))          1B2
      IF (ISWT2) 59,60,59                                               1B2
59    WRITE (3,99) ITCNT,ICON2                                          1B2
      WRITE (3,100) A,ABARX,ABARY,XIN,YIN,XYIN                          1B2
      WRITE (3,100) X1,Y1,X2,Y2                                         1B2
60    GO TO (61,62), KSW8                                               1B2
61    CONTINUE                                                          1B2
      GO TO 75                                                          1B2
62    BARNO=PRN                                                         1B2
      F1=FI                                                             1B2
      X1=X2+DX                                                          1B2
      Y1=Y2+DY                                                          1B2
      X2=X2STL(J)                                                       1B2
      Y2=Y2STL(J)                                                       1B2
      KSW8=1                                                            1B2
63    IF (F1) 64,64,65                                                  1B2
64    PRMN=RATIO                                                        1B2
      GO TO 55                                                          1B2
65    PRMN=ONEN                                                         1B2
      GO TO 55                                                          1B2
66    F1=U+S*X1+T*Y1                                                    1B2
      IF (BARNO-1.0) 96,63,67                                           1B2
67    F2=U+S*X2+T*Y2                                                    1B2
      IF (F1) 69,68,68                                                  1B2
68    IF (F2) 70,65,65                                                  1B2
69    IF (F2) 64,70,70                                                  1B2
70    DX=(X2-X1)/(BARNO-1.0)                                            1B2
      DY=(Y2-Y1)/(BARNO-1.0)                                            1B2
      COUNT=0.0                                                         1B2
      GO TO 72                                                          1B2
71    X1=X1+DX                                                          1B2
      Y1=Y1+DY                                                          1B2
72    FI=U+S*X1+T*Y1                                                    1B2
      IF (F1*FI) 74,74,73                                               1B2
73    COUNT=COUNT+1.0                                                   1B2
      IF (COUNT-BARNO) 71,63,96                                         1B2
74    PRN=BARNO-COUNT                                                   1B2
      BARNO=COUNT                                                       1B2
      X2=X1-DX                                                          1B2
      Y2=Y1-DY                                                          1B2
      X1=X1STL(J)                                                       1B2
      Y1=Y1STL(J)                                                       1B2
      KSW8=2                                                            1B2
      GO TO 63                                                          1B2
75    BARX=ABARX/A                                                      1B2
      BARY=ABARY/A                                                      1B2
      XOI=XIN-ABARX*BARX                                                1B2
      YOI=YIN-ABARY*BARY                                                1B2
      XYOI=XYIN-ABARX*BARY                                              1B2
      XOM=XM-P*BARX                                                     1B2
      YOM=YM-P*BARY                                                     1B2
      CN=XOM-YOM*XYOI/YOI                                               1B2
      CD=XOI-XYOI*XYOI/YOI                                              1B2
      DN=YOM-XOM*XYOI/XOI                                               1B2
      DD=YOI-XYOI*XYOI/XOI                                              1B2
      S=CN/CD                                                           1B2
      T=DN/DD                                                           1B2
      U=(P-S*ABARX-T*ABARY)/A                                           1B2
```

```
      IF (ISWT2) 76,77,76                                                1B2
76    WRITE (3,99) ITCNT,ICON3                                           1B2
      WRITE (3,100) XO1,YO1,XYO1,XOM,YOM                                 1B2
      WRITE (3,100) CN,CD,ON,DO                                          1B2
      WRITE (3,100) S,T,U                                                1B2
77    GO TO (78,80), KSWE                                                1B2
78    KSWC=2                                                             1B2
      KSWE=2                                                             1B2
      KSW3=3                                                             1B2
79    KSWD=2                                                             1B2
      GO TO 17                                                           1B2
80    KSW3=1                                                             1B2
      GO TO 79                                                           1B2
81    WRITE (3,113) TITLE                                                1B2
      WRITE (3,106) CODE                                                 1B2
      WRITE (3,107)                                                      1B2
      WRITE (3,108) P,XM,YM,RATIO,B,ACCR                                 1B2
      WRITE (3,99) ITCNT                                                 1B2
      WRITE (3,109) S,T,U                                                1B2
      WRITE (3,110)                                                      1B2
      DO 82 I=1,NCON,1                                                   1B2
82    WRITE (3,111) F2(I),XCON(I),YCON(I)                                1B2
      IF (NSTL) 96,93,83                                                 1B2
83    WRITE (3,102)                                                      1B2
      DO 92 J=1,NSTL                                                     1B2
      F1=U+S*X1STL(J)+T*Y1STL(J)                                         1B2
      IF (F1) 84,86,85                                                   1B2
84    F1=F1*RATIO                                                        1B2
      GO TO 86                                                           1B2
85    F1=F1*RATIO*B                                                      1B2
86    IF (BARN(J)-1.0) 96,91,87                                          1B2
87    F2=U+S*X2STL(J)+T*Y2STL(J)                                         1B2
      IF (F2) 88,90,89                                                   1B2
88    F2=F2*RATIO                                                        1B2
      GO TO 90                                                           1B2
89    F2=F2*RATIO*B                                                      1B2
90    GO TO 92                                                           1B2
91    F2=0.0                                                             1B2
      X2STL(J)=0.0                                                       1B2
      Y2STL(J)=0.0                                                       1B2
92    WRITE (3,112) X1STL(J),Y1STL(J),F1,X2STL(J),Y2STL(J),F2,AS(J)      1B2
93    IF (NLD-KLD) 94,94,95                                              1B2
94    KLD=1                                                              1B2
      NCON1=NCON                                                         1B2
      NSTL1=NSTL                                                         1B2
      GO TO 1                                                            1B2
95    KLD=KLD+1                                                          1B2
      GO TO 15                                                           1B2
96    CALL EXIT                                                          1B2
C                                                                        1B2
97    FORMAT (6I10)                                                      1B2
98    FORMAT (6F10.3)                                                    1B2
99    FORMAT ('0',T25,'ITERATIONCOUNT=',I3,I5)                           1B2
100   FORMAT (T25,6F10.2)                                                1B2
101   FORMAT (5A4,6F10.0)                                                1B2
102   FORMAT ('0',T25,'STEELSTRESSES'/T31,'X1',T41,'Y1',T49,'STRESS',T61 1B2
     1,'X2',T71,'Y2',T79,'STRESS',T89,'BARAREA')                         1B2
103   FORMAT (20A4)                                                      1B2
104   FORMAT ('0/////////////////////////////////////////////////////////1B2
     1////////////////////////////////////////////////////////////////////1B2
     2//////////')                                                       1B2
105   FORMAT ('0',T25,'EXCESSIVEITERATIONS-CHECKDATA/CONSULTPROGRAMWRITE1B2
```

```
      1-UP')                                                                1B2
106    FORMAT (T25,'LOADINGIDENTIFICATION=',5A4,T1'0')                      1B2
107    FORMAT ('0',T25,'AXIALLOAD',T43,'MX',T53,'MY',T62,'N',T73,'R',T84,   1B2
      1'ACCURACY')                                                          1B2
108    FORMAT (T25,F10.2,T37,F10.1,T47,F10.1,T57,F10.3,T67,F10.3,T77,F10.   1B2
      13)                                                                   1B2
109    FORMAT (T25,'GENERALFLEXUREFORMULA---STRESS=',F10.5,'X+',F10.5,'Y+   1B2
      1',F10.5,T1'0')                                                       1B2
110    FORMAT ('0',T25,'CONCRETESTRESSATCOORDINATES'/T48,'X',T58,'Y')       1B2
111    FORMAT (T27,F10.3,T42,F10.3,T52,F10.3)                               1B2
112    FORMAT (T25,/F10.3)                                                  1B2
113    FORMAT (1H1,T25,20A4)                                                1B2
114    FORMAT ('1')                                                         1B2
115    FORMAT ('0',T25,'CONCRETECOORDINATESDONOTCLOSE-JOBTERMINATED')       1B2
116    FORMAT (I10,3F10.3)                                                  1B2
117    FORMAT (T45,'FIRSTGUESSNO.',I10,T1,'0')                              1B2
       END                                                                  1B2
// DUP
*STORE      WS  UA   M1B2
// XEQ M1B2
```

HOLLOW REINFORCED CONCRETE SHAFT FOR 1B2
LOADINGIDENTIFICATION= LL + DL + WIND

AXIALLOAD	MX	MY	N	R	ACCURACY
10.00	60.0	10.0	10.000	2.000	.010

ITERATIONCOUNT= 5
GENERALFLEXUREFORMULA---STRESS= -.13771X+ -.23104Y+ 1.84827

CONCRETESTRESSATCOORDINATES

	X	Y
1.022	6.000	.000
.142	4.000	5.000
-1.006	9.000	7.000
-.129	11.000	2.000
.053	8.000	3.000
-.178	8.000	4.000
-.040	7.000	4.000
.191	7.000	3.000
.053	8.000	3.000
-.129	11.000	2.000
1.022	6.000	.000

STEELSTRESSES

X1	Y1	STRESS	X2	Y2	STRESS	BARAREA
7.000	2.000	8.444	.000	.000	.000	1.000
6.000	4.000	1.957	.000	.000	.000	1.000
8.000	5.000	-4.086	9.000	3.000	-.842	1.000

HOLLOW REINFORCED CONCRETE SHAFT FOR 1B2
LOADINGIDENTIFICATION= LL + DL

AXIALLOAD	MX	MY	N	R	ACCURACY
10.00	80.0	50.0	10.000	2.000	.010

ITERATIONCOUNT= 4
GENERALFLEXUREFORMULA---STRESS= .04016X+ .11907Y+ -.64652

CONCRETESTRESSATCOORDINATES

	X	Y
-.406	6.000	.000
.109	4.000	5.000
.548	9.000	7.000
.033	11.000	2.000
.032	8.000	3.000
.151	8.000	4.000
.111	7.000	4.000
-.008	7.000	3.000
.032	8.000	3.000
.033	11.000	2.000
-.406	6.000	.000

STEELSTRESSES

X1	Y1	STRESS	X2	Y2	STRESS	BARAREA
7.000	2.000	-1.273	.000	.000	.000	1.000
6.000	4.000	1.415	.000	.000	.000	1.000
8.000	5.000	5.402	9.000	3.000	1.443	1.000

LISTING AND SAMPLE OUTPUT FOR 1.B.3

"Tied Concrete Columns, Planar Bending"

```
// JOB T
// FOR
*IOCS(CARD,1132PRINTER,DISK)
C       UNSYMMETRICAL TIED COLUMN ANALYSIS                                  1B3
        READ (2,2) FY,FCP,C,EN,B,T,D,G                                      1B3
1       READ (2,3) AS,ASP                                                   1B3
        WRITE (3,4)                                                         1B3
        WRITE (3,5)                                                         1B3
        WRITE (3,6)                                                         1B3
        WRITE (3,7) FY,FCP,C,EN,B,T,D,G,AS,ASP                              1B3
        R=AS/ASP                                                            1B3
        PG=(AS+ASP)/(B*T)                                                   1B3
        DDT=D/T                                                             1B3
        EM=FY/(.85*FCP)                                                     1B3
        AG=B*T                                                              1B3
        AGFCP=(AG*FCP)/1000.                                                1B3
        AFT=(AGFCP*T)/12.                                                   1B3
        WRITE (3,8)                                                         1B3
        WRITE (3,9) PG,R,DDT                                                1B3
        ALPHA=((((PG*EM)*G)*(1./(1.+R)))+(.1*(DDT**2)))/(((PG*EM)*((1.-R)/1B3
       1(1.+R)))+(0.6*(DDT)))                                               1B3
        BETA=(.5+((((2.*EN)-1.)/(1.+R))*PG)*(((R+1.)*DDT)-G))/(1.+(((2.*EN1B3
       1)-1.)*PG))                                                          1B3
        PHI=(.0833+((((2.*EN)-1.)/(1.+R))*PG)*((R*((DDT-.5)**2))+(((.5-DD1B3
       1T)+G)**2))))-((1.+(((2.*EN)-1.)*PG))*((BETA-.5)**2))                1B3
        GAMM =     (((2.*PG)/(1.+R))*((R*EN*DDT)+(((2.*EN)-1.)*(DDT-G)))+((1B3
       1(PG/(1.+R))*(((2.*EN)-1.)+(R*EN)))**2))
        GAM =SQRT(GAMM)
        GAMMA=GAM      -((PG/(1.+R))*(((2.*EN)-1.)+R*EN))                   1B3
        UPS=(((GAMMA**2)/6.)+((((2.*EN)-1.)/(1.+R))*(PG/GAMMA)*((GAMMA-DDT1B3
       1)+G)*(DDT-G)))/((GAMMA/2.)+((((2.*EN)-1.)/(1.+R))*(PG/GAMMA)*((GAM1B3
       2MA-DDT)+G)))                                                        1B3
        PODAF=.34*(1.+(PG*EM))                                              1B3
        PO=PODAF*AGFCP                                                      1B3
        PABAF=.2125+((.209*PG)*EM)                                          1B3
        PA=PABAF*AGFCP                                                      1B3
        XNBAF=((PODAF*PHI)*C)/((PHI*C)+((PODAF*ALPHA)*BETA))                1B3
        XNB=XNBAF*AGFCP                                                     1B3
        XMBAF=ALPHA*XNBAF                                                   1B3
        XMB=XMBAF*AFT                                                       1B3
        XMOAF=(((.34*PG)*EM)*(R/(1.+R)))*(DDT-UPS)                          1B3
        XMO=XMOAF*AFT                                                       1B3
        WRITE (3,10)                                                        1B3
        WRITE (3,11) PODAF,PABAF,XNBAF,XMBAF,XMOAF                          1B3
        WRITE (3,5)                                                         1B3
        WRITE(3,13)
        WRITE (3,12) PO,PA,XNB,XMB,XMO                                      1B3
        GO TO 1                                                             1B3
C                                                                           1B3
2       FORMAT (2F6.0,F5.3,4F5.2,F5.3)                                      1B3
3       FORMAT (2F5.0)                                                      1B3
4       FORMAT ('1',T41,'1963ACIUNSYMMETRICALTIEDCOLUMNANALYSIS(WSD)')      1B3
5       FORMAT ('0')                                                        1B3
6       FORMAT ('0',T30,'FY',T39,'FC''',T47,'C',T53,'N',T61,'B',T69,'T',T71B3
       17,'D',T84,'G',T92,'AS',T100,'AS''')                                 1B3
7       FORMAT (T25,F9.0,F8.0,F7.3,F7.2,3F8.2,F7.3,2F8.2)                   1B3
8       FORMAT ('0',T58,'PG        R        D/T')                           1B3
9       FORMAT (T52,F9.4,F9.3,F8.4)                                         1B3
10      FORMAT ('0',T35,'PO/AGFC''',T45,'PA/AGFC''',T60,'NB/AGFC''',T75,'M1B3
       1B/AGFC''T',T85,'MO/AGFC''T')                                        1B3
11      FORMAT (T34,F7.4,2(6X,F7.4),2(7X,F7.4))                             1B3
12      FORMAT(' ',T32,F9.0,2(4X,F9.0),5X,F10.1,4X,F10.1)                   1B3
```

```
  13 FORMAT(T37,'PO',T50,'PA',T65,'NB',T79,'MB',T93,'MO')
     END
// DUP
*STORE       WS  UA  MIB3
// XEQ MIB3
```

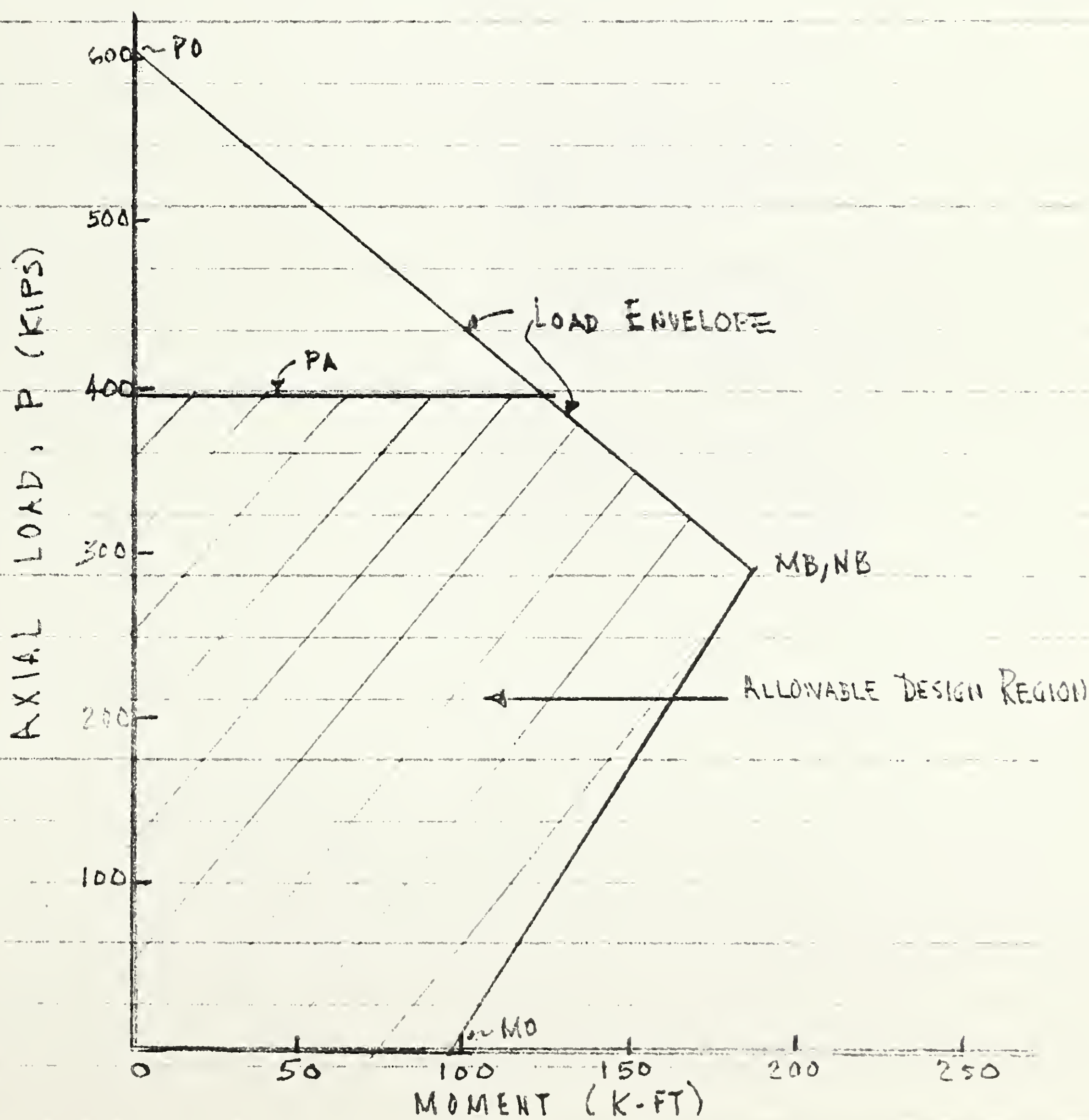
1963ACIUNSYMMETRICALTIEDCOLUMNANALYSIS(WSD)

FY	FC'	C	N	B	T	D	G	AS	AS'
40000.	3000.	.450	9.20	18.00	28.00	25.50	.822	3.16	2.40

PG	R	D/T
.0110	1.317	.9107

PO/AGFC'	PA/AGFC'	NB/AGFC'	MB/AGFC'T	MO/AGFC'T
.3988	.2625	.1920	.0530	.0277

PO	PA	NB	MB	MO
603.	397.	290.	187.0	97.9



ACKNOWLEDGEMENT

Program No.	Originator
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1.A.2	E. C. Demsky U. S. Army Engineer District St. Louis, Mo.
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