UG-0018

S6801 USER'S GUIDE

Version 1.0

STATIC ANALYSIS OF PLANE FRAME AND TRUSS STRUCTURES

by

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PREFACE

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INTRODUCTION

S6801 is a plane frame and truss structural analysis program that is limited to static loads. It computes the displacements and the member end actions for each end of each member. The member end actions include the axial and shear forces, and the in-plane moment. The program is unique since the problem is posed with respect to the member. This means the user describes the problem member by member instead of building separate data tables and relating the tables to complete the problem description.

CAPABILITIES

S6801 is a static analysis program for plane frame and truss structures. It computes the member end actions and displacements for each member. The member end actions include the axial load, the shear load, and the bending moment quantities at each end of the member. The displacements include the horizontal and vertical displacement as well as the end rotation.

Member information is used by the user to pose the problem to the program. This means the section properties, displacement degrees of freedom, boundary conditions, joint coordinates, and load information are all associated with the member. This method of input is unique when compared to most frame analysis programs where most of this information is described in separate tables. The separate tables are then related using node numbers, member numbers, section property numbers, material type numbers, and member load case numbers.

This program allows loads to be applied to the joints and the members. The joint loads include horizontal and vertical forces, and the in-plane moment. The member loads include uniformly distributed horizontal and vertical loads, and horizontal and vertical concentrated loads applied at any location along the member length. This program calculates end actions of sloped members using actual (sloped) member lengths as compared to the use of projected member lengths.

The program only permits one modulus of elasticity, thus it cannot be used to analyze problems that contain more than one material.

Currently, the size of the problem is limited to the following: 200 members, 175 displacements, and nine load cases.

SOLUTION METHOD

The program employs the stiffness method of analysis. This method is fully described in most structural analysis textbooks, some of which are dedicated to the analysis of framed structures. It is assumed that the user is familiar with this method of analysis.

The solution process requires development of three matrices. The structure stiffness matrix is formed from the member section property

and material information. The applied loads are used to form the load matrix or vector. The unknown displacements are determined using Gaussian elimination. The displacement results are used to compute the internal forces and moments at each end of each member.

PROBLEM DATA PREPARATION

A sketch of the structure model is prepared. Each member is numbered, the order is not important but the sequence must be without gaps. The permissible displacements and rotations at each end of each member are numbered, again in a sequence without gaps. The following rules apply to the displacement and rotation scheme:

1. A member end release option may be employed. This means the "end 1" may be pinned (released) instead of fixed, while "end 2" always remains fixed. When the end release option is used, one must ensure the displacement numbering is consistent, which means there must not be a rotational displacement number assigned to the released end.

2. A displacement number is not assigned to a rotation that is associated with a pin.

3. Reactions are considered fixed, therefore a displacement number cannot be assigned.

4. Free ends (cantilever) are assigned a "pinned" condition and given x and y displacement numbers (see line type C), but no rotation numbers.

5. Enter a cross-sectional area for a member even though in some cases it is arbitrary and doesn't affect the solution.

6. Hinged ends of members are assigned a pinned condition and given a y displacement number and a z rotation number.

A second sketch is recommended for the loading conditions. In fact, each load case (multiple load conditions) might have a separate sketch. The following loading rules apply:

1. The forces are applied in the direction of the structure x and y axes, the moments are applied about the z axis (i.e., in the plane of the structure).

2. The forces and moments must be resolved into components that coincide with the direction of the structure axes.

3. The positive direction of the forces coincides with the positive direction of the x and y axis. The x forces are positive to the right, the y forces are positive up. The moments are positive with respect to the right-hand rule where the x axis is crossed into the y axis to determine the positive rotation of the moment.

4. The forces due to gravity are always in the negative y direction.

5. Joint loads may be entered with the load data for any member that frames into the joint; however, the load must only be entered once.

6. When locating member concentrated loads, use the direction measured from "end 1" to "end 2" as positive.

The data definition lines are required to describe the problems that will be analyzed. These lines can be prepared using a word processor, a screen editor, or a line editor. A right-hand tabulation feature is suggested to simplify insuring the data are entered in the proper field. The prepared data file must contain only alphanumeric characters, no special or nonprinting characters are permitted. Each of the lines are described below.

Line Type A:

A title consisting of up to 66 characters

Line Type B:

Variable	Column	Description
E	1 - 10	Modulus of elasticity (ksi) for all members
NM	11 - 15	Total number of members in the model
NU	16 - 20	Total number of displacements
NL	21 - 25	Total number of load cases

Line Type C:

Line Type C thru Line Type G are repeated as a group for each member, NM times.

Variable	Column	Description
NC(1)	1 - 5	Horizontal displacement number at End 1 of the member
NC(2)	6 - 10	Vertical displacement number at End 1 of the member
NC(3)	11 - 15	Rotational displacement number at End 1 of the member
NC(4)	16 - 20	Horizontal displacement number at End 2 of the member
NC(5)	21 - 25	Vertical displacement number at End 2 of the member
NC(6)	26 - 30	Rotational displacement number at End 2 of the member
DX(J,1)	31 - 40	X coordinate (FT) of the member End 1
DY(J,1)	41 - 50	Y coordinate (FT) of the member End 1
DX(J,2)	51 - 60	X coordinate (FT) of the member End 2
DY(J21)	61 - 70	Y coordinate (FT) of the member End 2

Line Type D:

Variable	Column	Description
NM	1 - 5	Member number
AM	6 - 15	Member cross-section area ($in.^2$)
XI	16 - 25	Member moment of inertia about the Z axis ($in.^4$)
KL	26 - 30	Member End 1 fixity: 0 = pinned, 1 = fixed
KU	31 - 35	Member End 2 fixity: 0 = pinned, 1 = fixed

Line Type E:

Line Type E is repeated NL times

Variable	Column	Description
UV	1 - 10	Value of uniformly distributed vertical load (kips/ft)
UH	11 - 20	Value of uniformly distributed horizontal load (kips/ft)
NPV	21 - 25	Total number of vertical concentrated member loads
NPH	26 - 30	Total number of horizontal concentrated member loads
JL	31 - 35	Joint load location:

None	JL = 0
End 1	JL = 1
End 2	JL = 2

Line Type F:

Line Type F is required only for joint loads as indicated by the JL parameters in Line Type E.

Variable	Column	Description
ACT(1)	1 - 10	Value of horizontal joint force (kips)
ACT(2)	11 - 20	Value of vertical joint force (kips)
ACT(3)	21 - 30	Value of joint moment (kip ft)

Line Type G:

Line Type G is repeated NPV plus NPH times. NPV and NPH are parameters found on Line Type E. Vertical loads are grouped and ordered first.

Variable	Column	Description
A	1 - 10	Value of concentrated force (kips)
B	11 - 20	Location of the force measured from the member End 1 toward the member End 2 (ft)

EXECUTION INSTRUCTIONS

The program is designed to run on an IBM PC compatible personal computer having at least 512K memory and a math coprocessor. There are a number of ways to execute the program, each will be discussed.

Installation

The S6801 program is on a single diskette containing:

S6801.EXE	The executable program.
TRUSS.DAT	Truss sample problem.
FRAME.DAT	Frame sample problem.

```
BUILDING.DAT    A building frame sample problem.
RUNS6801.BAT    The batch execute file.
RMFORT.ERR      The execution error message file.
```

These files should be copied to the hard disk or to another floppy disk before the program is used. The standard DOS COPY Command can be used:

```
COPY A:*.* C:  For the hard disk
COPY A:*.* B:  For the floppy disk
```

The program is now ready to run using one of the methods described below.

Standard Execution

The standard way of executing the program involves preparing an input file and running the program with the print output going to a file. The program assumes the input data is contained in the file S6801.DAT. The data can be prepared using any line or screen editor program, such as the DOS EDLIN editor. The user should prepare this file using the S6801.DAT file name, or the input can be prepared using any file name, and then copying the prepared file to S6801.DAT by using the standard DOS COPY Command. The program will write the print output to S6801.OUT. The S6801.OUT file can be printed using the standard DOS PRINT Command. The program, S6801.EXE, is executed by typing S6801.

Output Redirection

The user can use the DOS SET Command to redirect the output. The default input, output, and plot file names can be changed by:

```
SET S6801.DAT= your input file name
SET S6801.OUT= your output file name
```

Then the program can be run by the S6801 command. CAUTION! The DOS redirection mechanism is active for the duration of the run of the program. The SET Command stays set until the connection is broken in the following manner, or through a system reboot:

```
SET S6801.DAT=
SET S6801.OUT=
```

Batch File Execution

The program can be run with a batch file. For example, the batch file might be called RUNS6801.BAT, and it would contain:

```
SET S6801.DAT=%1
SET S6801.OUT=LPT1
S6801
SET S6801.DAT=
SET S6801.OUT=
```

The program would then be executed by the command:

RUNS6801 <your data file name>

SAMPLE PROBLEMS

Three sample problems are provided to demonstrate the capabilities of the program. They will also help demonstrate how to prepare the data for the program. A typical truss problem is provided in Appendix A. Appendix B shows a typical frame program. A typical rigid frame two-story building is shown in Appendix C. Each appendix provides a sketch of the structural model and the loading conditions. The problem data file is presented along with the respective output information.

ACKNOWLEDGMENT

The General Electric Company gave the original version of S6801 to the Naval Facilities Engineering Command in 1968. Mr. Frank E. Eby enhanced the original version of the program and made it available to the Engineering Field Divisions through commercial time sharing computer service bureaus. Mr. Steve Davis of the Naval Civil Engineering Laboratory converted the program to operate on a microcomputer. He also reformatted the output to improve its readability. Mr. Troy E. Gillium validated the test problems.

Appendix A

TRUSS SAMPLE PROBLEM

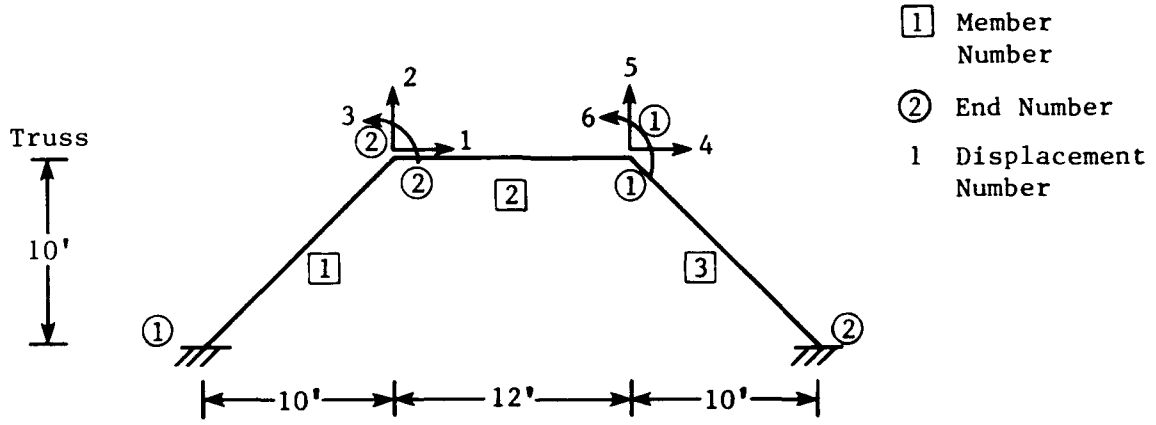


Figure A-1. Truss sample problem.

DATA INPUT FILE

LINE TYPE	COLUMN 1 2 3 4 5 6 7 8 12345678901234567890123456789012345678901234567890123456789012345678901234567890
A	FRAME SAMPLE PROBLEM ONE
B	1500.00 3 6 3
C-1	0 0 0 1 2 3 0.00 0.00 10.00 10.00
D-1	1 352.00 14197.00 1 1
E-1.1	0.00 0.00 0 0 0
E-1.2	0.02 0.02 0 0 0
E-1.3	0.02 0.02 0 0 0
C-2	4 5 6 1 2 3 22.00 10.00 10.00 10.00
D-2	2 352.00 14197.00 1 1
E-2.1	-1.02 0.00 0 0 0
E-2.2	0.00 0.00 0 0 0
E-2.3	-1.02 0.00 0 0 0
C-3	4 5 6 0 0 0 22.00 10.00 32.00 0.00
D-3	3 352.00 14197.00 1 1
E-3.1	0.00 0.00 0 0 0
E-3.2	0.00 0.00 0 0 0
E-3.3	0.00 0.00 0 0 0

++++ PLANE STRUCTURE ANALYSIS ++++

TRUSS SAMPLE PROBLEM

MODULUS OF ELASTICITY	1500.00	KSI
TOTAL NUMBER OF MEMBERS	3	
TOTAL NUMBER OF JOINT DISPLACEMENTS	6	
TOTAL NUMBER OF LOAD CASES	3	

MEMBER NUMBER 1

AREA	352.00	IN.**2
MOMENT OF INERTIA	14197.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	0	0	0	1	0.00	0.00
END 2	1	2	3	1	10.00	10.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.02	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.02	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 3

UNIFORM VERTICAL LOAD	0.02	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.02	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

MEMBER NUMBER 2

AREA	352.00	IN.**2
MOMENT OF INERTIA	14197.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	4	5	6	1	22.00	10.00
END 2	1	2	3	1	10.00	10.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	-1.02	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 3

UNIFORM VERTICAL LOAD	-1.02	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

MEMBER NUMBER 3

AREA	352.00	IN.**2
MOMENT OF INERTIA	14197.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	4	5	6	1	22.00	10.00
END 2	0	0	0	1	32.00	0.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER	2	
UNIFORM VERTICAL LOAD		0.00 KIPS/FT
UNIFORM HORIZONTAL LOAD		0.00 KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS		0
NUMBER OF CONCENTRATED HORIZONTAL LOADS		0
JOINT LOAD APPLIED TO MEMBER END		0

LOAD CASE NUMBER	3						
UNIFORM VERTICAL LOAD					0.00 KIPS/FT		
UNIFORM HORIZONTAL LOAD					0.00 KIPS/FT		
NUMBER OF CONCENTRATED VERTICAL LOADS					0		
NUMBER OF CONCENTRATED HORIZONTAL LOADS					0		
JOINT LOAD APPLIED TO MEMBER END					0		

++++ PLANE STRUCTURE ANALYSIS ++++

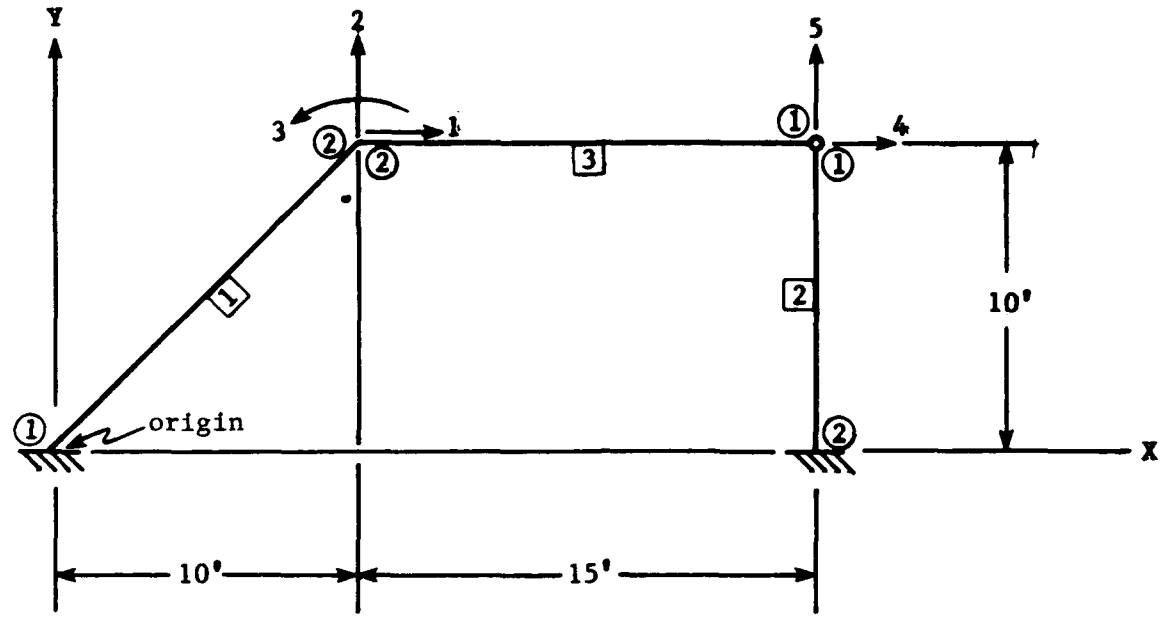
		END 1			END 2		
LOAD CASE	MEMBER NUMBER	AXIAL FORCE (KIPS)	SHEAR (KIPS)	MOMENT (KIP-FT)	AXIAL FORCE (KIPS)	SHEAR (KIPS)	MOMENT (KIP-FT)
1	1	9.35	-0.70	-2.74	-9.35	0.70	-7.10
2	1	-0.40	0.00	-0.01	0.00	0.00	-0.01
3	1	8.95	-0.70	-2.75	-9.35	0.70	-7.11
1	2	7.10	-6.12	-7.10	-7.10	-6.12	7.10
2	2	0.00	0.00	0.00	0.00	0.00	0.01
3	2	7.11	-6.12	-7.11	-7.11	-6.12	7.11
1	3	9.35	0.70	7.10	-9.35	-0.70	2.74
2	3	0.00	0.00	0.00	0.00	0.00	0.01
3	3	9.35	0.70	7.11	-9.35	-0.70	2.75

JOINT DISPLACEMENTS

		END 1			END 2		
LOAD CASE	MEMBER NUMBER	HORIZONTAL FEET	VERTICAL FEET	ROTATION RADIANS	HORIZONTAL FEET	VERTICAL FEET	ROTATION RADIANS
1	1	0.00000	0.00000	0.00000	0.00008	-0.00043	-0.00021
2	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	1	0.00000	0.00000	0.00000	0.00008	-0.00043	-0.00021
1	2	-0.00008	-0.00043	0.00021	0.00008	-0.00043	-0.00021
2	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	2	-0.00008	-0.00043	0.00021	0.00008	-0.00043	-0.00021
1	3	-0.00008	-0.00043	0.00021	0.00000	0.00000	0.00000
2	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	3	-0.00008	-0.00043	0.00021	0.00000	0.00000	0.00000

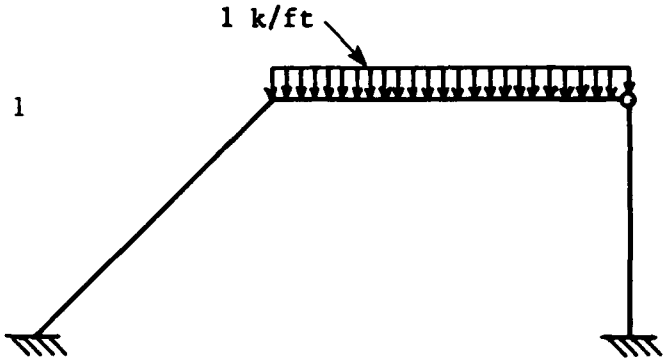
Appendix B

FRAME SAMPLE PROBLEM



LEGEND: [1] - Member No.
(1) - End No.
1 - Displacement No.

Load Case 1



Load Case 2

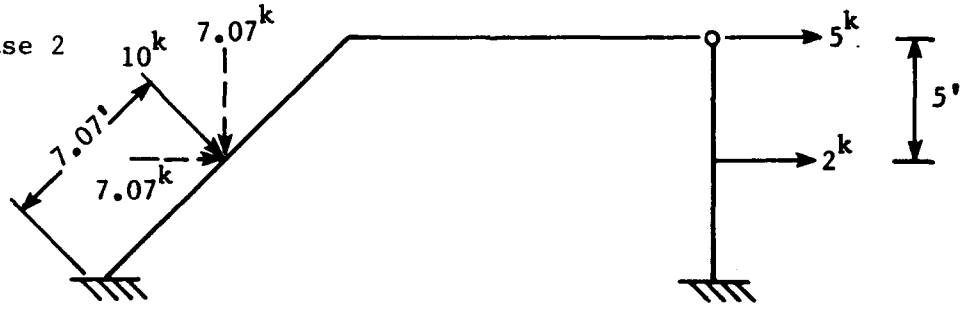


Figure B-1. Frame sample problem.

DATA INPUT FILE

LINE TYPE	COLUMN 1 2 3 4 5 6 7 8 12345678901234567890123456789012345678901234567890123456789012345678901234567890
A	FRAME SAMPLE PROBLEM TWO
B	30000.00 3 5 2
C-1	0 0 0 1 2 3 0.00 0.00 10.00 10.00
D-1	1 10.00 100.00 1 1
E-1.1	0.00 0.00 0 0 0
E-1.2	0.00 0.00 1 1 0
G-1.2V	-7.07 7.07
G-1.2H	7.07 7.07
C-2	4 5 0 0 0 0 25.00 10.00 25.00 0.00
D-2	2 10.00 100.00 0 1
E-2.1	0.00 0.00 0 0 0
E-2.2	0.00 0.00 0 1 1
F-2.2	5.00 0.00 0.00
G-2.2H	2.00 5.00
C-3	4 5 0 1 2 3 25.00 10.00 10.00 10.00
D-3	3 10.00 100.00 0 1
E-3.1	-1.00 0.00 0 0 0
E-3.2	0.00 0.00 0 0 0

++++ PLANE STRUCTURE ANALYSIS ++++

FRAME SAMPLE PROBLEM

MODULUS OF ELASTICITY	30000.00	KSI
TOTAL NUMBER OF MEMBERS	3	
TOTAL NUMBER OF JOINT DISPLACEMENTS	5	
TOTAL NUMBER OF LOAD CASES	2	

MEMBER NUMBER 1

AREA	10.00	IN.**2
MOMENT OF INERTIA	100.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	0	0	0	1	0.00	0.00
END 2	1	2	3	1	10.00	10.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	1	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	1	
JOINT LOAD APPLIED TO MEMBER END	0	

CONCENTRATED MEMBER LOAD (KIPS)	DISTANCE FROM END 1 (FEET)
VERTICAL	
-7.07	7.07
HORIZONTAL	
7.07	7.07

MEMBER NUMBER 2

AREA	10.00	IN.**2
MOMENT OF INERTIA	100.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	4	5	0	0	25.00	10.00
END 2	0	0	0	1	25.00	0.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	1	
JOINT LOAD APPLIED TO MEMBER END	1	

HORIZONTAL JOINT LOAD	5.00	KIPS
VERTICAL JOINT LOAD	0.00	KIPS
ROTATIONAL JOINT LOAD	0.00	KIPS

CONCENTRATED MEMBER LOAD (KIPS)	DISTANCE FROM END 1 (FEET)
HORIZONTAL	
2.00	5.00

MEMBER NUMBER 3

AREA	10.00	IN.**2
MOMENT OF INERTIA	100.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	4	5	0	0	25.00	10.00
END 2	1	2	3	1	10.00	10.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	-1.00 KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00 KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0
JOINT LOAD APPLIED TO MEMBER END	0

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00 KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00 KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0
JOINT LOAD APPLIED TO MEMBER END	0

++++ PLANE STRUCTURE ANALYSIS ++++

		END 1			END 2		
LOAD CASE	MEMBER NUMBER	AXIAL FORCE (KIPS)	SHEAR (KIPS)	MOMENT (KIP-FT)	AXIAL FORCE (KIPS)	SHEAR (KIPS)	MOMENT (KIP-FT)
1	1	7.03	2.63	27.18	-7.03	-2.63	10.04
2	1	-2.61	10.68	59.94	2.61	-0.68	20.43
1	2	8.17	3.11	0.00	-8.17	-3.11	31.10
2	2	1.36	2.67	0.00	-1.36	-4.67	36.70
1	3	3.11	-8.17	0.00	-3.11	-6.83	-10.04
2	3	-2.33	-1.36	0.00	2.33	1.36	-20.43

JOINT DISPLACEMENTS

		END 1			END 2		
LOAD CASE	MEMBER NUMBER	HORIZONTAL FEET	VERTICAL FEET	ROTATION RADIANS	HORIZONTAL FEET	VERTICAL FEET	ROTATION RADIANS
1	1	0.00000	0.00000	0.00000	0.04991	-0.05038	-0.00582
2	1	0.00000	0.00000	0.00000	0.05260	-0.05243	-0.00141
1	2	0.04975	-0.00027	0.00000	0.00000	0.00000	0.00000
2	2	0.05272	-0.00005	0.00000	0.00000	0.00000	0.00000
1	3	0.04975	-0.00027	0.00000	0.04991	-0.05038	-0.00582
2	3	0.05272	-0.00005	0.00000	0.05260	-0.05243	-0.00141

Appendix C

BUILDING SAMPLE PROBLEM

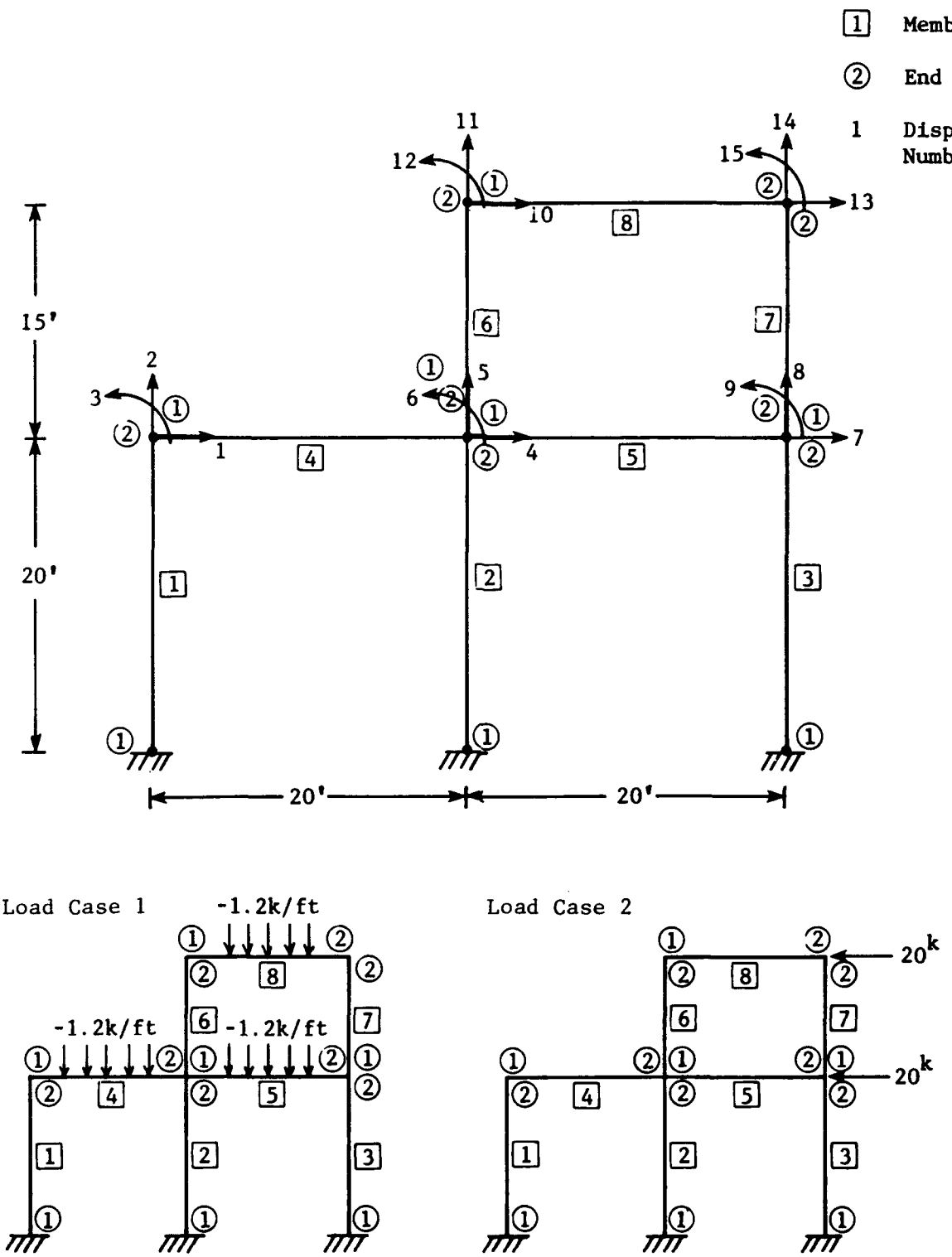


Figure C-1. Building sample problem.

DATA INPUT FILE

LINE TYPE	COLUMN 1 2 3 4 5 6 7 8 12345678901234567890123456789012345678901234567890123456789012345678901234567890
A	FRAME SAMPLE PROBLEM THREE
B	30000.00 8 15 2
C-1	0 0 0 1 2 3 0.00 0.00 0.00 20.00
D-1	1 20.00 200.00 1 1
E-1.1	0.00 0.00 0 0 0
E-1.2	0.00 0.00 0 0 0
C-2	0 0 0 4 5 6 20.00 0.00 20.00 20.00
D-2	2 20.00 200.00 1 1
E-2.1	0.00 0.00 0 0 0
E-2.2	0.00 0.00 0 0 0
C-3	0 0 0 7 8 9 40.00 0.00 40.00 20.00
D-3	3 20.00 200.00 1 1
E-3.1	0.00 0.00 0 0 0
E-3.2	0.00 0.00 0 0 2
F-3.2	-20.00 0.00 0.00
C-4	1 2 3 4 5 6 0.00 20.00 20.00 20.00
D-4	4 10.00 300.00 1 1
E-4.1	-1.20 0.00 0 0 0
E-4.2	0.00 0.00 0 0 0
C-5	4 5 6 7 8 9 20.00 20.00 40.00 20.00
D-5	5 10.00 300.00 1 1
E-5.1	-1.20 0.00 0 0 0
E-5.2	0.00 0.00 0 0 0
C-6	4 5 6 10 11 12 20.00 20.00 20.00 35.00
D-6	6 20.00 180.00 1 1
E-6.1	0.00 0.00 0 0 0
E-6.2	0.00 0.00 0 0 0
C-7	7 8 9 13 14 15 40.00 20.00 40.00 35.00
D-7	7 20.00 180.00 1 1
E-7.1	0.00 0.00 0 0 0
E-7.2	0.00 0.00 0 0 2
F-7.2	-20.00 0.00 0.00
C-8	10 11 12 13 14 15 20.00 35.00 40.00 35.00
D-8	8 10.00 300.00 1 1
E-8	-1.20 0.00 0 0 0
E-8	0.00 0.00 0 0 0

++++ PLANE STRUCTURE ANALYSIS ++++

BUILDING SAMPLE PROBLEM

MODULUS OF ELASTICITY	30000.00
KSI TOTAL NUMBER OF MEMBERS	8
TOTAL NUMBER OF JOINT DISPLACEMENTS	15
TOTAL NUMBER OF LOAD CASES	2

MEMBER NUMBER 1

AREA	20.00	IN.**2
MOMENT OF INERTIA	200.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	0	0	0	1	0.00	0.00
END 2	1	2	3	1	0.00	20.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

MEMBER NUMBER 2

AREA	20.00	IN.**2
MOMENT OF INERTIA	200.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	0	0	0	1	20.00	0.00
END 2	4	5	6	1	20.00	20.00

```
 LOAD CASE NUMBER          1
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          0


 LOAD CASE NUMBER          2
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          0


MEMBER NUMBER          3
  AREA                              20.00  IN.**2
  MOMENT OF INERTIA                200.00  IN.**4

        DISPLACEMENT IDENTIFICATION     END       COORDINATES  (FEET)
      HORIZONTAL VERTICAL ROTATIONAL    FIXITY         X           Y
END 1         0        0         0       1         40.00         0.00
END 2         7        8         9       1         40.00        20.00


 LOAD CASE NUMBER          1
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          0


 LOAD CASE NUMBER          2
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          2
   HORIZONTAL JOINT LOAD                                -20.00 KIPS
   VERTICAL JOINT LOAD                                    0.00 KIPS
   ROTATIONAL JOINT LOAD                                  0.00 KIPS
```

MEMBER NUMBER 4

AREA	10.00	IN.**2
MOMENT OF INERTIA	300.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	1	2	3	1	0.00	20.00
END 2	4	5	6	1	20.00	20.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	-1.20	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

MEMBER NUMBER 5

AREA	10.00	IN.**2
MOMENT OF INERTIA	300.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	4	5	6	1	20.00	20.00
END 2	7	8	9	1	40.00	20.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	-1.20	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

```
MEMBER NUMBER          6
  AREA                              20.00  IN.**2
  MOMENT OF INERTIA                180.00  IN.**4

        DISPLACEMENT IDENTIFICATION     END       COORDINATES  (FEET)
      HORIZONTAL VERTICAL ROTATIONAL    FIXITY        X           Y
END 1        4         5        6       1          20.00        20.00
END 2       10        11       12       1          20.00        35.00


 LOAD CASE NUMBER          1
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          0


 LOAD CASE NUMBER          2
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          0



MEMBER NUMBER          7
  AREA                              20.00  IN.**2
  MOMENT OF INERTIA                180.00  IN.**4

        DISPLACEMENT IDENTIFICATION     END       COORDINATES  (FEET)
      HORIZONTAL VERTICAL ROTATIONAL    FIXITY        X           Y
END 1        7         8        9       1          40.00        20.00
END 2       13        14       15       1          40.00        35.00


 LOAD CASE NUMBER          1
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          0


 LOAD CASE NUMBER          2
   UNIFORM VERTICAL LOAD                                  0.00 KIPS/FT
   UNIFORM HORIZONTAL LOAD                                0.00 KIPS/FT
   NUMBER OF CONCENTRATED VERTICAL LOADS                     0
   NUMBER OF CONCENTRATED HORIZONTAL LOADS                   0
   JOINT LOAD APPLIED TO MEMBER END                          2
```

HORIZONTAL JOINT LOAD	-20.00	KIPS
VERTICAL JOINT LOAD	0.00	KIPS
ROTATIONAL JOINT LOAD	0.00	KIPS

MEMBER NUMBER 8

AREA	10.00	IN.**2
MOMENT OF INERTIA	300.00	IN.**4

	DISPLACEMENT IDENTIFICATION			END	COORDINATES (FEET)	
	HORIZONTAL	VERTICAL	ROTATIONAL	FIXITY	X	Y
END 1	10	11	12	1	20.00	35.00
END 2	13	14	15	1	40.00	35.00

LOAD CASE NUMBER 1

UNIFORM VERTICAL LOAD	-1.20	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

LOAD CASE NUMBER 2

UNIFORM VERTICAL LOAD	0.00	KIPS/FT
UNIFORM HORIZONTAL LOAD	0.00	KIPS/FT
NUMBER OF CONCENTRATED VERTICAL LOADS	0	
NUMBER OF CONCENTRATED HORIZONTAL LOADS	0	
JOINT LOAD APPLIED TO MEMBER END	0	

++++ PLANE STRUCTURE ANALYSIS ++++

		END 1			END 2		
LOAD CASE	MEMBER NUMBER	AXIAL FORCE (KIPS)	SHEAR (KIPS)	MOMENT (KIP-FT)	AXIAL FORCE (KIPS)	SHEAR (KIPS)	MOMENT (KIP-FT)
1	1	10.54	-1.23	-7.72	-10.54	1.23	-16.87
2	1	11.20	-13.33	-148.02	-11.20	13.33	-118.66
1	2	38.98	0.48	3.67	-38.98	-0.48	5.96
2	2	10.38	-14.73	-157.52	-10.38	14.73	-137.11
1	3	22.47	0.75	5.47	-22.47	-0.75	9.48
2	3	-21.57	-11.93	-139.10	21.57	11.93	-99.58
1	4	1.23	10.54	16.87	-1.23	13.46	-45.97
2	4	13.33	11.20	118.66	-13.33	-11.20	105.24
1	5	-1.85	13.37	52.37	1.85	10.63	-25.05
2	5	16.47	13.38	119.51	-16.47	-13.38	148.18

++++ PLANE STRUCTURE ANALYSIS ++++
(Continued)

LOAD CASE	MEMBER NUMBER	END 1 AXIAL FORCE (KIPS)	END 1 SHEAR (KIPS)	END 1 MOMENT (KIP-FT)	END 2 AXIAL FORCE (KIPS)	END 2 SHEAR (KIPS)	END 2 MOMENT (KIP-FT)
1	6	12.16	-2.59	-12.35	-12.16	2.59	-26.56
2	6	8.19	-11.60	-87.64	-8.19	11.60	-86.35
1	7	11.84	2.59	15.56	-11.84	-2.59	23.35
2	7	-8.19	-8.40	-48.60	8.19	8.40	-77.41
1	8	2.59	12.16	26.56	-2.59	11.84	-23.35
2	8	11.60	8.19	86.35	-11.60	-8.19	77.41

JOINT DISPLACEMENTS

LOAD CASE	MEMBER NUMBER	END 1 HORIZONTAL FEET	END 1 VERTICAL FEET	END 1 ROTATION RADIANS	END 2 HORIZONTAL FEET	END 2 VERTICAL FEET	END 2 ROTATION RADIANS
1	1	0.00000	0.00000	0.00000	0.00229	-0.00035	-0.00220
2	1	0.00000	0.00000	0.00000	-0.28381	-0.00037	0.00705
1	2	0.00000	0.00000	0.00000	0.00221	-0.00130	0.00055
2	2	0.00000	0.00000	0.00000	-0.28470	-0.00035	0.00490
1	3	0.00000	0.00000	0.00000	0.00234	-0.00075	0.00096
2	3	0.00000	0.00000	0.00000	-0.28579	0.00072	0.00949
1	4	0.00229	-0.00035	-0.00220	0.00221	-0.00130	0.00055
2	4	-0.28381	-0.00037	0.00705	-0.28470	-0.00035	0.00490
1	5	0.00221	-0.00130	0.00055	0.00234	-0.00075	0.00096
2	5	-0.28470	-0.00035	0.00490	-0.28579	0.00072	0.00949
1	6	0.00221	-0.00130	0.00055	-0.00416	-0.00160	-0.00229
2	6	-0.28470	-0.00035	0.00490	-0.44710	-0.00055	0.00516
1	7	0.00234	-0.00075	0.00096	-0.00433	-0.00105	0.00252
2	7	-0.28579	0.00072	0.00949	-0.44787	0.00092	0.00372
1	8	-0.00416	-0.00160	-0.00229	-0.00433	-0.00105	0.00252
2	8	-0.44710	-0.00055	0.00516	-0.44787	0.00092	0.00372

S6801 - VERSION 1.0

FEEDBACK REPORT

The Naval Civil Engineering Laboratory (NCEL) is fully dedicated to supporting GEMS users. A primary requirement for this task is to establish a priority listing of user requirements. It would be of great value to the development of new software if you, the user, would complete the feedback questions below. Since each individual user may have specific requirements, please reproduce this page as many times as necessary.

Please circle the number that best applies in Questions 1 through 4; complete the other questions, fold at the tic marks, and mail to NCEL with the franked label on the reverse side, or to the address at the bottom of the page.

1. Was the software beneficial (productive)?

No benefit 0 1 2 3 4 5 6 7 8 9 10 Very beneficial

2. Was it easy to use (user friendly)?

Difficult 0 1 2 3 4 5 6 7 8 9 10 Very easy

3. Does this software make decisions more reliable?

No 0 1 2 3 4 5 6 7 8 9 10 Yes

4. Does it better document the design?

No 0 1 2 3 4 5 6 7 8 9 10 Yes

5. Did it save time?

Yes ___ No ___ Estimated percent saved?

6. What would make future software more user friendly?

7. What further support would you like to have on the GEMS system?

8. What other comments or remarks would you like to add?

Activity _____
Telephone _____

Mailing address is: NAVFAC GEMS Support Group
Naval Civil Engineering Laboratory
Code L54
Port Hueneme CA 93043-5003

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