

AD-A103 569 USER'S GUIDE: 2-D FRAME ANALYSIS LINK PROGRAM (LINK2D) 1/1
(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG MS INFORMATION TECHNOLOGY LAB C A MERRILL
UNCLASSIFIED JUN 87 WES/IR/ITL-87-4 F/G 12/5 NL

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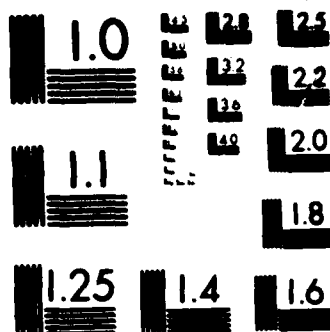
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This two-dimensional (2-D) frame analysis link program, LINK2D, provides the external link necessary for bridging the gap in data from rudimentary analysis design capabilities to data from more advanced structural analysis/design computer programs. The newly created data base could thereby be used throughout the building design process. Data generated in STRUCTURE, a module of the Computer-Aided Engineering and Architectural Design System (CAEADS), have been used to create input data for CFRAME and/or the 2-D capability of GTSTRUDL. CFRAME is a product of the Computer-Aided Structural Engineering (CASE) project and GTSTRUDL is a proprietary software program developed by and for the benefit of the Georgia Institute of Technology. (Continued)					
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19. ABSTRACT (Continued).

The meshing together of STRUCTURE, LINK2D, and CFRAME or GTSTRUDL into a building design process is discussed in the report as it outlines the steps for extracting data from STRUCTURE for use in LINK2D.



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PREFACE

This report documents and describes the use of a computer program called LINK2D. This program uses the two-dimensional (2-D) frame data extracted from the STRUCTURE module of the Computer-Aided Engineering and Architectural Design System (CAEADS), originally developed by the Construction Engineering Research Laboratory, Champaign, Ill. These data are converted into the proper format for 2-D frame analysis programs. Currently, the only 2-D frame program formats are for the Computer-Aided Structural Engineering (CASE) program CFRAME, implemented at the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., and the commercial program GTSTRU DL, developed by the Georgia Institute of Technology, Atlanta, Ga.

This user's guide and computer program were written by Mr. Chris A. Merrill, Professional Engineer, of the Engineering Applications Group, formerly Computer Aided Group, Scientific and Engineering Application Division (SEAD), Automation Technology Center (ATC), WES. The work was sponsored through funds provided to WES by the Military Programs Directorate of the Office, Chief of Engineers (OCE), US Army, under the CASE Project.

Specifications for the program were provided by the members of the CASE Task Group on Building Systems. The following were members of the task group (although all may not have served for the entire period) during program development:

- Mr. Dan Reynolds, Sacramento District (Chairman)
- Ms. Anjana Chudgar, Louisville District
- Mr. Joseph P. Hartman, Southwestern Division
- Mr. George Henson, Tulsa District
- Mr. David Illias, Portland District
- Mr. Sefton Lucas, Memphis District
- Mr. David Raisanen, North Pacific Division
- Mr. Peter Roszbach, Baltimore District
- Mr. Daniel Sommer, Omaha District
- Mr. Robert Tom, Pacific Ocean Division

Mr. Donald Dressler was the OCE point of contact. Overall guidance was provided at WES by Dr. N. Radhakrishnan, Acting Chief, Information Technology Laboratory (ITL), formerly Chief, ATC, and Mr. Paul K. Senter, Acting Chief, Information Research Division, ITL, formerly Chief, SEAD. Final editing for publication was done by Ms. Gilda Miller, Information Products Division, ITL, WES.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

CONTENTS

	<u>Page</u>
PREFACE.....	1
CONVERSION FACTORS, NON-SI TO SI (METRIC)	
UNITS OF MEASUREMENT.....	3
PART I: INTRODUCTION.....	4
Purpose.....	4
Application.....	4
PART II: DESIGN PROCESS.....	5
STRUCTURE Usage.....	6
LINK2D Usage.....	10
APPENDIX A: FRAME DATA EXTRACTED FROM STRUCTURE MODULE.....	A1
APPENDIX B: LINK2D-CFRAME USAGE AND FILES.....	B1
APPENDIX C: LINK2D-GTSTRU DL USAGE AND FILES.....	C1

CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
feet	0.3048	metres
foot-kips (force)	1355.818	newton-metres
inches	2.54	centimetres
inch-kips (force)	112.9848	newton-metres
kips (1,000 lb force)	4.448222	kilonewtons
kips (force) per foot	14.5939	kilonewtons per metre
kips (force) per inch	175.12685	kilonewtons per metre
kips (force) per square foot	47.88026	kilopascals
kips (force) per square inch	6.894757	megapascals
pounds (force)	4.448222	newtons
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre

PART I: INTRODUCTION

Purpose

1. The Computer-Aided Engineering and Architectural Design System (CAEADS) was developed by the Construction Engineering Research Laboratory, Champaign, Ill., to aid engineers in the preliminary design of buildings up to the 35 percent design level. STRUCTURE,* a module of CAEADS, allows the structural engineer to borrow the database created by the architectural module, to refine structural parameters and to layout a structural framing scheme. Sizes of structural members are determined assuming simple beam and column behavior. Thus, STRUCTURE incorporated only rudimentary analysis/design capabilities. Due to these limitations, the data created for this level of design could not easily be used during the final design phase of buildings.

Application

2. Externally linking these data to more advanced structural analysis/design computer programs would bridge this gap and allow the data base to be used throughout the building design process. LINK2D provides this external link by using data generated in STRUCTURE to create input data for CFRAME** and/or the two-dimensional (2-D) capability of GTSTRUDL.+

* Gene McDermott. 1984. "STRUCTURE User's Manual," Construction Engineering Research Laboratory, Champaign, Ill.

** Joseph P. Hartman, John J. Jobst. 1979. "User's Guide Computer Programs with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)," IR 0-79-2, superseded by IR K-83-1, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

+ Georgia Institute of Technology. 1984. "GTSTRUDL User's Manual," Atlanta, Ga.

PART II: DESIGN PROCESS

3. The meshing of STRUCTURE, LINK2D, and CFRAME or GTSTRU DL into the building design process is shown in Figure 1. The structural engineer uses STRUCTURE to determine the optimum building framing scheme. Data common to all analysis programs are extracted for individual 2-D frames selected by the engineer. These data are converted by LINK2D into the specific format required by CFRAME and/or GTSTRU DL. Data conversion in LINK2D may be interactively monitored or may be done automatically.

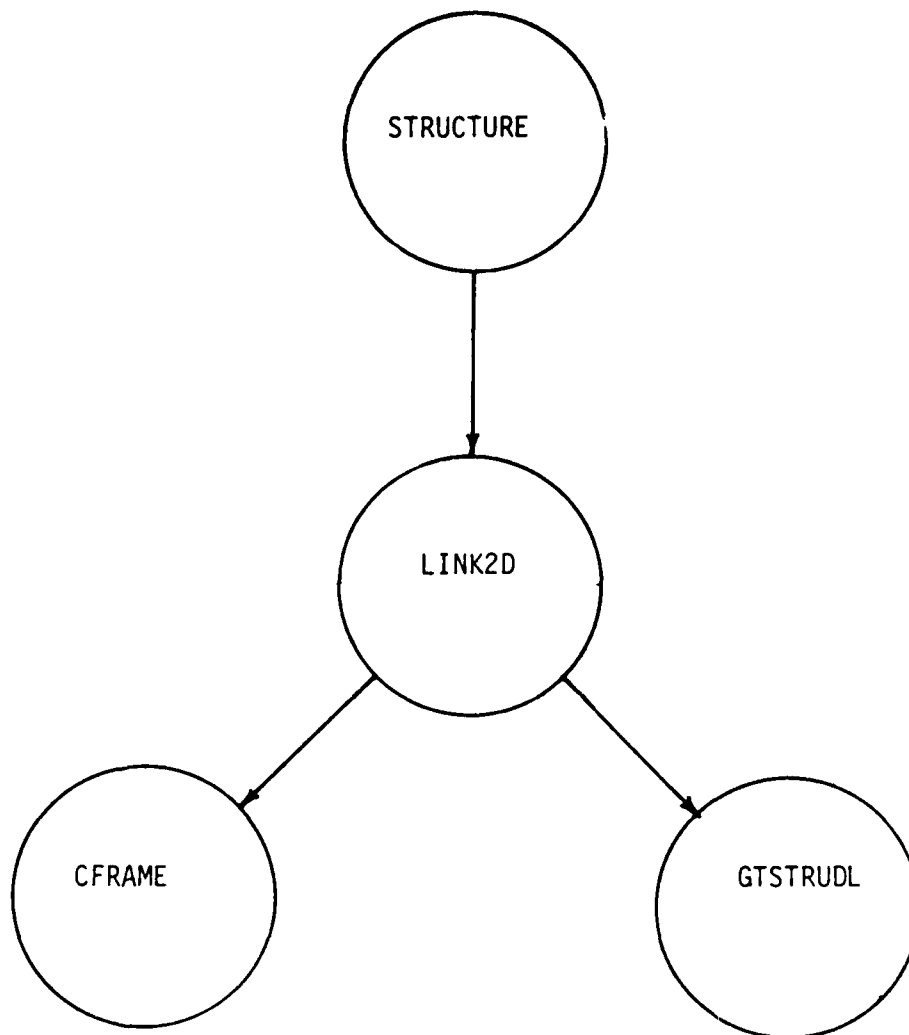


Figure 1. Meshing of programs into building design process

STRUCTURE Usage

4. Refer to the "STRUCTURE User's Manual" for detailed information on program usage. Steps outlined in this part pertain only to extracting data from STRUCTURE for use in LINK2D. Note that all loads and member sizes must be initially determined in STRUCTURE before individual frame data can be extracted. Since STRUCTURE utilizes color graphics, it functions best on a Tektronix 4100 series color terminal; however a Tektronix 4014 terminal is adequate.

5. The following list describes the proper procedure for obtaining STRUCTURE data to be used in LINK2D:

- a. Move the cross hairs to the menu area box labeled ANALYSIS (Figure 2) and press any key. The program will respond with "*ANALYSIS MODE".

SCREEN COMMAND MODE

					PROJECT: GEN LEVEL: 1 5.00 ELEVATION: 48.00 F TO C: 10.00 IS NGRT: 1.00																																																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>BRC WALL</td> <td>COLUMN</td> <td>BEAM</td> <td>LOAD</td> <td>GRID</td> <td>PARAMETER</td> <td></td> <td></td> <td></td> <td>LEVEL</td> </tr> <tr> <td>EDIT</td> <td>EDIT</td> <td>EDIT</td> <td>EDIT</td> <td>EDIT</td> <td>EDIT</td> <td></td> <td></td> <td></td> <td>EDIT</td> </tr> <tr> <td>MEMBER</td> <td>FLA-ROOF</td> <td></td> <td></td> <td>DRAW</td> <td>DRAW</td> <td>DRAW</td> <td>OVERLAY</td> <td>UPDAT</td> <td></td> </tr> <tr> <td>SIZE</td> <td>EDI*</td> <td></td> <td></td> <td>ROOMS</td> <td>NETWORK</td> <td>STRUCTUR</td> <td>PLANS</td> <td>EDIT</td> <td></td> </tr> <tr> <td>DISPLAY</td> <td></td> <td>PLQT</td> <td>ANALYSIS</td> <td>SYSTEM</td> <td></td> <td>SAVE</td> <td>NEXT</td> <td>RTS</td> <td>STOP</td> </tr> <tr> <td>VALUES</td> <td></td> <td></td> <td></td> <td>SUMMARY</td> <td></td> <td>PROJECT</td> <td>PROJECT</td> <td></td> <td></td> </tr> </table>										BRC WALL	COLUMN	BEAM	LOAD	GRID	PARAMETER				LEVEL	EDIT	EDIT	EDIT	EDIT	EDIT	EDIT				EDIT	MEMBER	FLA-ROOF			DRAW	DRAW	DRAW	OVERLAY	UPDAT		SIZE	EDI*			ROOMS	NETWORK	STRUCTUR	PLANS	EDIT		DISPLAY		PLQT	ANALYSIS	SYSTEM		SAVE	NEXT	RTS	STOP	VALUES				SUMMARY		PROJECT	PROJECT		
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Figure 2. ANALYSIS MODE selection

- b. Move the cross hairs into the graphics display area and press the F key. All options can be displayed by pressing L but only the F option is available (Figure 3). The program will respond with "LOCATE REFERENCE LINE".

MENU COMMAND MODE
 ANALYSIS MODE
 L - LIST COMMANDS
 F - 2-D FRAME ANALYSIS
 B - 3-D FRAME ANALYSIS
 R - REDRAW
 T - STOP
 C - BACK UP
 ANALYSIS MODE

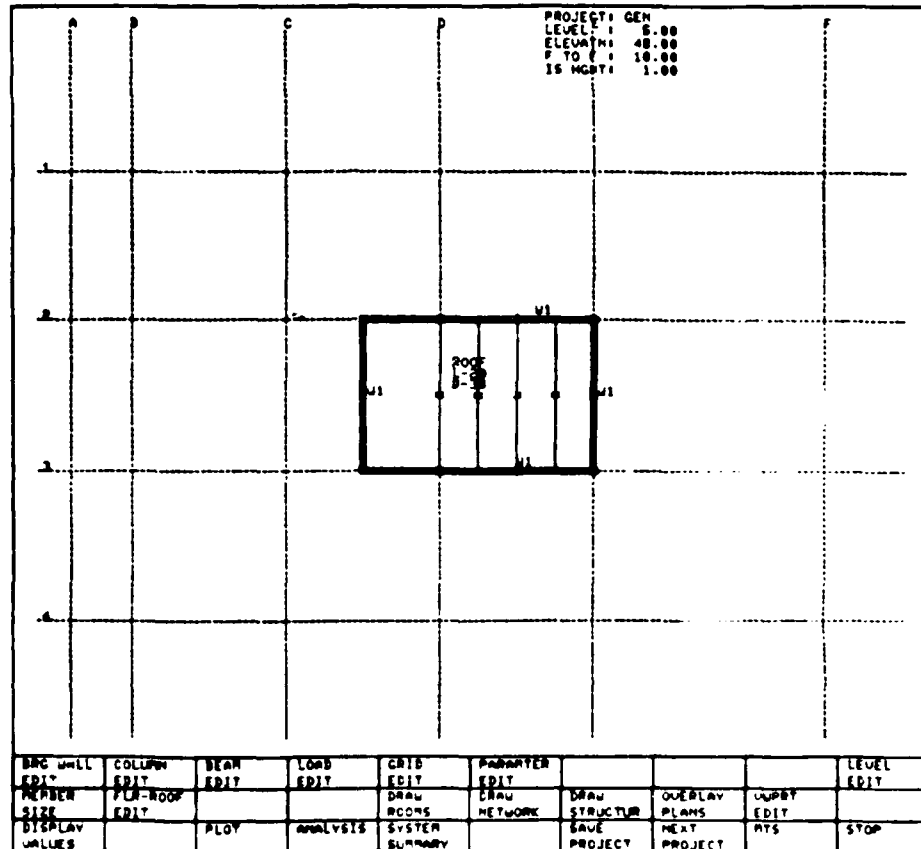


Figure 3. ANALYSIS MODE options

- c. Move the cross hairs to the reference line containing the frame desired for further analysis/design and push any key. The program will respond with "FRAME X OK?" (Figure 4) where "X" is the selected reference line. A "YES" answer will cause the frame elevation to be drawn. A "NO" response will result in the user being prompted to "LOCATE REFERENCE LINE".
- d. After the frame elevation is drawn, move the cross hairs to the menu area box labeled "PREPARE DECK" and press any key (Figure 5). The system will respond with "ENTER FILE NAME:".
- e. Type in the name of the file for the 2-D frame data and press return key (Figure 6). The program will update the user regarding what data are currently being generated. When all data have been generated for the selected frame, the program responds with "===== DATAFILE COMPLETED AND SAVED. =====".
- f. Move the cross hairs to the menu area box labeled "RETURN" and press any key.

ANALYSIS MODE
 L - LIST COMMANDS
 F - 2-D FRAME ANALYSIS
 D - 3-D FRAME ANALYSIS
 R - REDRAW
 T - STOP
 C - BACK UP
 ANALYSIS MODE
 LOCATE REFERENCE LINE.
 FRAME A QETV

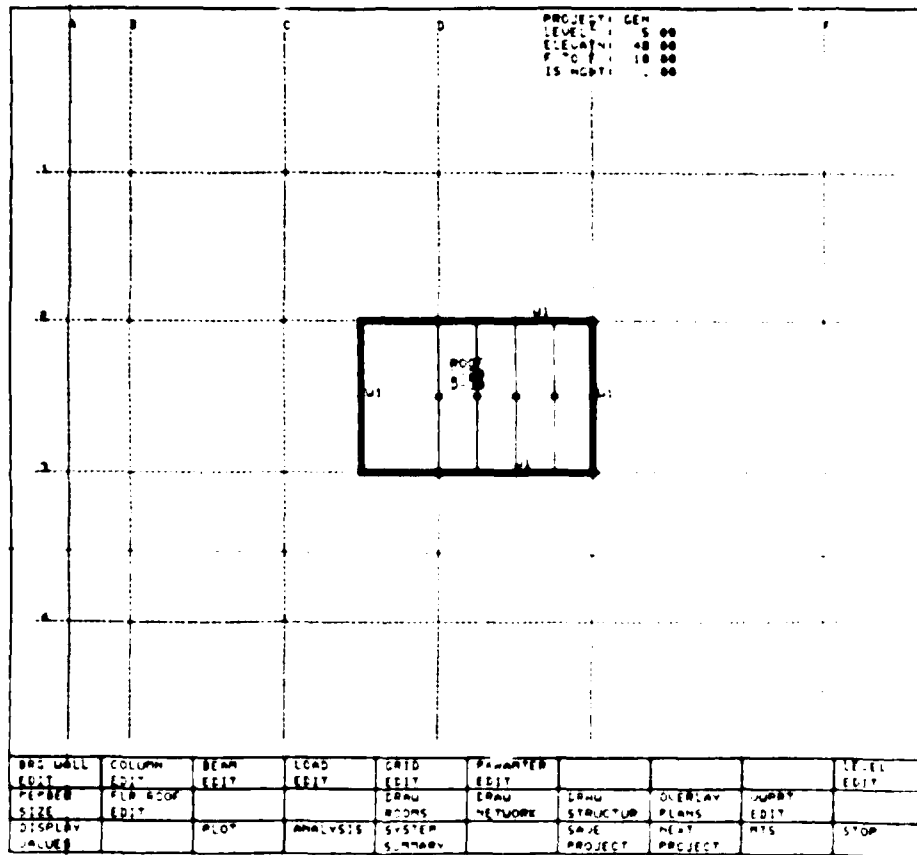


Figure 4. REFERENCE LINE selection

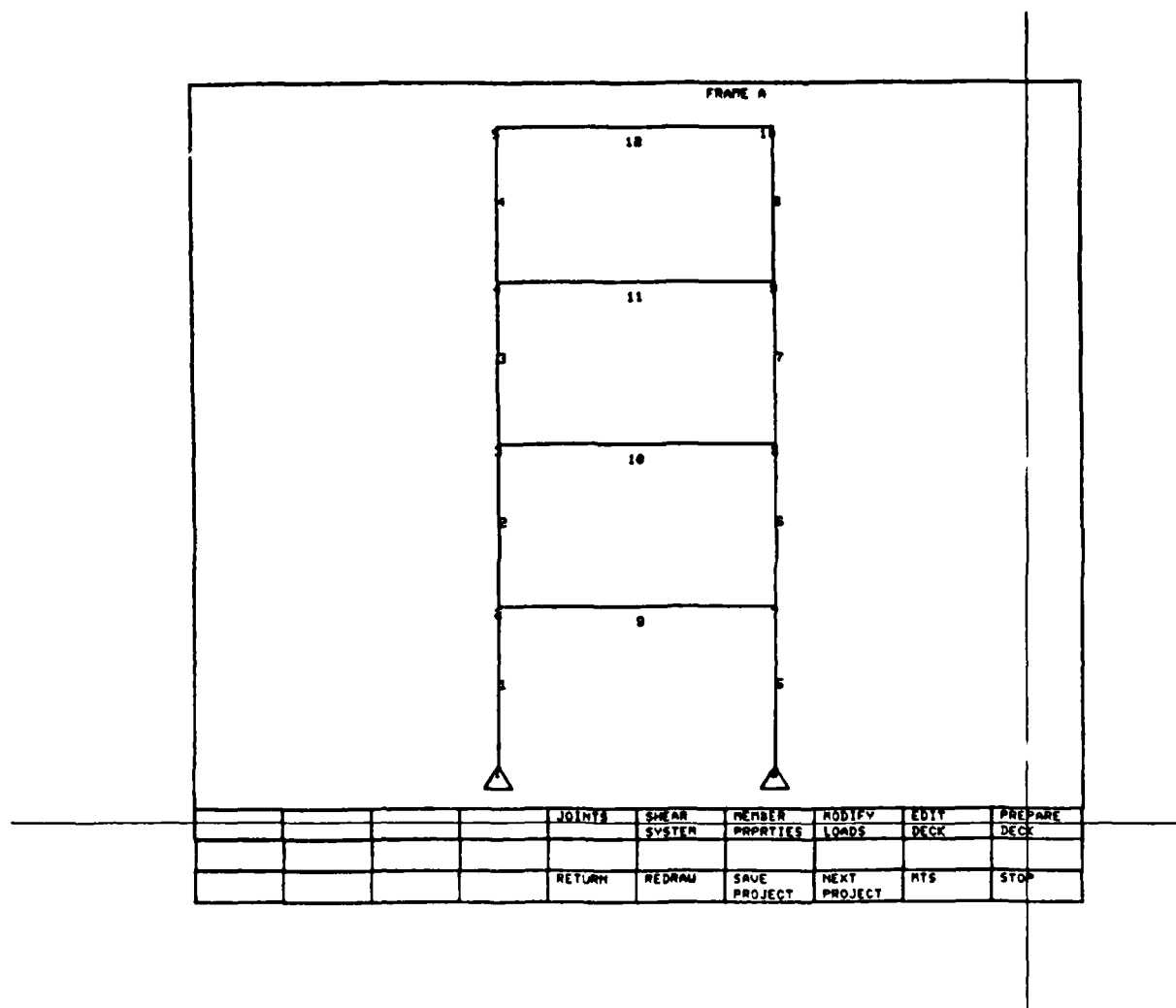


Figure 5. PREPARE DECK selection

ENTER FILE NAME: FRAME1
 GENERATING JOINT COORDINATES
 GENERATING MEMBER PROPERTIES
 GENERATING MEMBER PROPERTIES
 GENERATING LOADS
 ***** DATAFILE COMPLETED AND SAVED. (*****

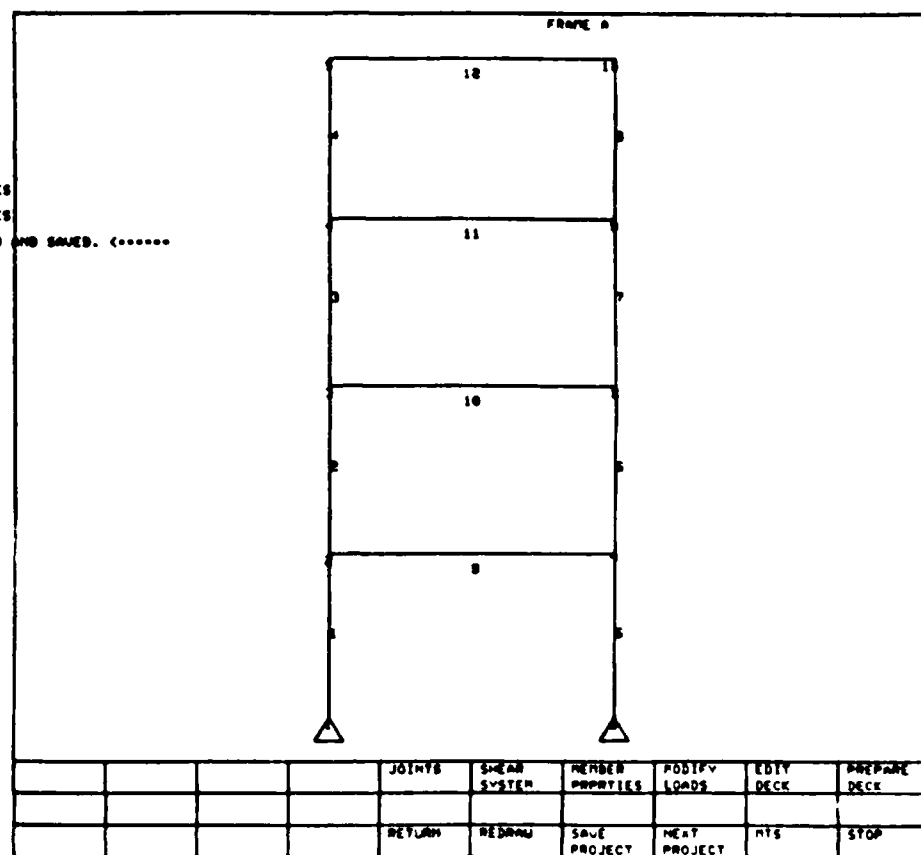


Figure 6. Generating frame data

- g. The current level floor plan will be drawn. Since the program is still in "*ANALYSIS MODE", other reference lines may be selected for frame data generation or the program may be stopped.

6. The result of the steps in paragraph 5, a typical data file created from STRUCTURE, is shown in Appendix A.

LINK2D Usage

Overview

7. Data files created in STRUCTURE are input files for LINK2D. Not all information required by CFRAME and GTSTRUDL can be extracted from the STRUCTURE data base. LINK2D has default values for these items or the user may interactively supply these data. Interactive data input must be in the proper format of the target frame analysis program. Refer to the appropriate frame analysis user's guide for the data format.

8. The default values for LINK2D are shown as follows:

- a. YES/NO questions without a response default to NO.
- b. Flange area is excluded from the shear area.
- c. Young's modulus is 29×10^6 psi* and Poisson's ratio is 0.3.
- d. Supports are pinned.
- e. Load case combinations with combination factors of one are assumed to combine the three load cases extracted from the STRUCTURE data base. The three load cases are dead loads, live loads, and structural loads.
- f. Force units are assumed to be pounds with moments in foot-pounds. Specified joint displacements and member properties are in inches. GTSTRU DL (sometimes referred to as STRU DL) allows changes in units while CFRAME does not.

Program usage

9. The initial and general steps for using LINK2D are listed and described in the following subparagraphs.

- a. ENTER DESIRED 2-D FRAME FORMAT (CFRAME/STRU DL):
Enter the program name of the desired 2-D structural analysis/design program. Currently, only CFRAME and GTSTRU DL are available.
- b. DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY? (Y/N).
Provide a "YES" answer for interactive prompting or a "NO" answer to accept all program defaults. Note the user can also use the computer system editor to modify a data file.
- c. ENTER INPUT FILE NAME:
Enter the name given to the file containing the 2-D frame data extracted from STRUCTURE (paragraph 5e of this guide).
- d. ENTER OUTPUT FILE NAME:
Enter the name for the file that will contain the output from LINK2D. This will be the selected analysis/design program input file.
- e. If a "NO" response was given in paragraph 9b, the program will indicate the output file has been saved. If "YES" was given, see paragraph 10 for additional information.
- f. DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE? (Y/N)
A "YES" response will cycle through, beginning with paragraph 9a. A "NO" response will terminate LINK2D. The LINK2D output data file may then be used as input to the appropriate 2-D frame analysis/design computer program.

* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 4.

10. Interactive input for the CFRAME and GTSTRU DL programs is possible through LINK2D and is described in the following subparagraphs.

- a. Use integer data for integer variables (variables beginning with I through N) and real data for real variables.
- b. To end data entry for an item, push the carriage return. If no data were on the line when pushed, data for that particular entry will stop.
- c. Data entered must be in the appropriate 2-D frame format. For assistance, refer to the appropriate 2-D frame user's guide.
- d. For GTSTRU DL format, it is not necessary to enter the STIFFNESS ANALYSIS command interactively.
- e. Sample input for CFRAME and GTSTRU DL are shown in Appendixes B and C, respectively.

11. The limitations to LINK2D are listed and discussed in the subparagraphs that follow.

- a. Only major axis moments of inertia are used. If minor axis properties are needed, the data file must be edited to reflect the desired values.
- b. A sketch or hardcopy of the frame will be helpful if data are to be added to a specific node or member. This will allow correct node identification when adding loads or releasing members or joints.
- c. Although the input is free-field, integer numbers are required for integer variables and real numbers are required for real variables.

APPENDIX A: FRAME DATA EXTRACTED FROM STRUCTURE MODULE

1. After the programs (STRUCTURE, LINK2D, CFRAME, and GTSTRUDL) have been meshed together a data file results. A typical data file extracted from STRUCTURE is shown as Figure A1.

```

10 12 8
1 20.0000 -12.0000
2 20.0000 0.0000
3 20.0000 12.0000
4 20.0000 24.0000
5 20.0000 36.0000
6 40.0000 -12.0000
7 40.0000 0.0000
8 40.0000 12.0000
9 40.0000 24.0000
10 40.0000 36.0000
2
1
6
1 1 2
2 2 3
3 3 4
4 4 5
5 6 7
6 7 8
7 8 9
8 9 10
9 2 7
10 3 8
11 4 9
12 5 10
12
1 W14X 48
2 W10X 33
3 W 4X 13
4 W 6X 9
5 W10X 33
6 W14X 48
7 W10X 33
8 W 4X 13
9 W14X 22
10 W10X 15
11 W12X 14
12 W10X 12
DD 9 0.00 660.00 2.00 690.00
DD 2.00 690.00 18.00 690.00
DD 18.00 690.00 20.00 660.00
DD
LD 9 0.00 0.00 2.00 200.00
LD 2.00 200.00 18.00 200.00
LD 18.00 200.00 20.00 0.00
LD
SD 9 0.00 15.00 2.00 95.00
SD 2.00 95.00 18.00 95.00
SD 18.00 95.00 20.00 15.00
SD
DD 10 0.00 660.00 2.00 690.00
DD 2.00 690.00 18.00 690.00
DD 18.00 690.00 20.00 660.00
DD
LD 10 0.00 0.00 2.00 200.00
LD 2.00 200.00 18.00 200.00
LD 18.00 200.00 20.00 0.00
LD

```

Figure A1. STRUCTURE 2-D frame data (Continued)

SD	10	0.00	15.00	2.00	95.00	
SD		2.00	95.00	18.00	95.00	
SD		18.00	95.00	20.00	15.00	
SD						
DD	11	0.00	660.00	2.75	701.25	
DD		2.75	701.25	17.25	701.25	
DD		17.25	701.25	20.00	660.00	
DD						
LD	11	0.00	0.00	2.75	275.00	
LD		2.75	275.00	17.25	275.00	
LD		17.25	275.00	20.00	0.00	
LD						
SD	11	0.00	15.00	2.75	125.00	
SD		2.75	125.00	17.25	125.00	
SD		17.25	125.00	20.00	15.00	
SD						
DD	12	0.00	660.00	2.00	720.00	
DD		2.00	720.00	18.00	720.00	
DD		18.00	720.00	20.00	660.00	
DD						
LD	12	0.00	0.00	2.00	40.00	
LD		2.00	40.00	18.00	40.00	
LD		18.00	40.00	20.00	0.00	
LD						
SD	12	0.00	15.00	2.00	95.00	
SD		2.00	95.00	18.00	95.00	
SD		18.00	95.00	20.00	15.00	
SD						
JL	1	5.10	9.40	4.45	20.00	0.00
JL	1	3.73	4.56	2.16	20.00	12.00
JL	1	3.70	3.63	1.71	20.00	24.00
JL	1	3.30	0.44	1.07	20.00	36.00
JL	1	0.00	0.00	0.06	20.00	48.00
JL	1	5.08	9.34	4.39	40.00	0.00
JL	1	3.73	4.60	2.10	40.00	12.00
JL	1	3.69	3.69	1.65	40.00	24.00
JL	1	3.30	0.44	1.01	40.00	36.00
JL	1	0.00	0.00	0.06	40.00	48.00

Figure A1. (Concluded)

APPENDIX B: LINK2D-CFRAME USAGE AND FILES

1. By externally linking STRUCTURE design level data with those of program CFRAME, LINK2D makes it possible to create input data for CFRAME. An example of such input is shown as Figure B1.

LINK2D

THIS PROGRAM WILL,ALONG WITH ADDITIONAL INPUT,
CONVERT THE CAEADS OUTPUT FILE INTO
A CFRAME OR STRUDL 2-D INPUT FILE.

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
CFRAME

DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)
NO

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMAC1

OUTPUT FILE SAVED = FRAMAC1
DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
Y

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
C

DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)
Y

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMAC2

WHEN ENTERING DATA,AN * CAN BE USED
FOR LINE CONTINUATION. TO TERMINATE
DATA ENTRY FOR AN ITEM PUSH THE RETURN
KEY. Y/N QUESTIONS WILL DEFAULT TO NO
IF A RESPONSE IS NOT ENTERED. FOR MORE
ASSISTANCE CONSULT THE CFRAME USER'S GUIDE.

I. TITLE. AT LEAST ONE LINE MUST BE USED FOR A PROBLEM TITLE.
A MAXIMUM OF 3 TITLE LINES MAY BE USED.
FRAME A TEST *
INTERACTIVE RESPONSE

II. UNITS. UE UJ UM UD UF
DEFAULT PARAMETERS ARE: KSI FT IN IN LBS
DO YOU WISH TO CHANGE ANY OF THESE PARAMETERS?(Y/N)

III. MASTER CONTROL. NJ NM NLC E POI
ENTER : NUMBER OF LOAD CASES TO BE ADDED.

Figure B1. LINK2D-CFRAME Input (Continued)

1
 DEFAULT VALUES ARE:
 E = 29000. KSI
 POI = .3
 DO YOU WISH TO MODIFY THESE PARAMETERS?(Y/N)

IV. JOINT COORDINATES. JN X Y
 ** AUTOMATICALLY EXTRACTED FROM CAEADS. **

VI. JOINT FIXITY. 'FIX X' LIST,'FIX Y'LIST,'FIX R',LIST
 FIX KX' KX LIST,'FIX KY' KY LIST, 'FIX KR' KR LIST

JOINTS 1 6
 ARE ASSUMED TO BE PINNED SUPPORTS.
 DO YOU WISH TO MODIFY SUPPORT FIXITY ? (Y/N)

VII. SPECIFIED JOINT DISPLACEMENTS. 'SD' DX DY DR LIST.
 ENTER DISPLACEMENTS :

VIII. MEMBER INCIDENCES. MN JNA JNB,MN JNA JNB,...
 ** AUTOMATICALLY EXTRACTED FROM CAEADS. **

X. PINNED END MEMBERS. 'PINA' LIST,'PINB',LIST
 ENTER PINNED END DATA :

XI. MEMBER PROPERTIES. I A AS LIST
 IS THE FLANGE AREA TO BE INCLUDED
 IN THE SHEAR AREA ? (Y/N):
 NO
 ** AUTOMATICALLY EXTRACTED FROM CAEADS. **

XII. MATERIAL PROPERTIES. 'E' E POI LIST,...
 ENTER MATERIAL PROPERTIES :

XIII.THRU XVII. LOADING DATA
 ** LOAD CASES 1 THRU 3 WERE AUTOMATICALLY EXTRACTED FROM CAEADS. **
 YOU HAVE SPECIFIED 1 ADDITIONAL LOAD CASE.
 ENTER LOAD CASE DATA : BEGINNING WITH LOAD CASE 4 AND ENDING WITH LOAD CASE 4.
 LOAD CASE 4 0 0 0 1 HORIZONTAL LOAD
 5000. 0. 0. 5

XIX. LOAD CASE COMBINATION. 'COMBINATION' LCN LCN1 C1,LCN2 C2,...,TITLE
 ENTER COMBINATION DATA : (BEGIN WITH LCN= 5)
 COMBINATION 5 1 1 2 1 3 1 4 1 ALL LOADS COMBINED

OUTPUT FILE SAVED = FRAMAC2
 DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
 NO
 STOP
 LINK2D COMPLETE

Figure B1. (Concluded)

2. The LINK2D default values for information required by CFRAME that cannot be extracted from the STRUCTURE data base can be seen as Figure B2.

1000	TITLE					
1010	KSI	FT	IN	IN	LBS	
1020	10	12	3	29000.00	0.30	
1030	1	20.00		-12.00		
1040	2	20.00		0.00		
1050	3	20.00		12.00		
1060	4	20.00		24.00		
1070	5	20.00		36.00		
1080	6	40.00		-12.00		
1090	7	40.00		0.00		
1100	8	40.00		12.00		
1110	9	40.00		24.00		
1120	10	40.00		36.00		
1130	FIX X	1	6			
1140	FIX Y	1	6			
1150	1	1	2			
1160	2	2	3			
1170	3	3	4			
1180	4	4	5			
1190	5	6	7			
1200	6	7	8			
1210	7	8	9			
1220	8	9	10			
1230	9	2	7			
1240	10	3	8			
1250	11	4	9			
1260	12	5	10			
1270	485.0	14.10	4.69	1		
1280	170.0	9.71	2.82	2		
1290	11.3	3.83	1.16	3		
1300	16.4	2.68	1.00	4		
1310	170.0	9.71	2.82	5		
1320	485.0	14.10	4.69	6		
1330	170.0	9.71	2.82	7		
1340	11.3	3.83	1.16	8		
1350	199.0	6.49	3.16	9		
1360	68.9	4.41	2.30	10		
1370	88.6	4.16	2.38	11		
1380	53.8	3.54	1.88	12		
1390	LOAD CASE	1	0	20	0	8 DEAD LOADS
1400	0.	48	12.00	48	90.	1
1410	0.	33	12.00	33	90.	2
1420	0.	13	12.00	13	90.	3
1430	0.	9	12.00	9	90.	4
1440	0.	33	12.00	33	90.	5
1450	0.	48	12.00	48	90.	6
1460	0.	33	12.00	33	90.	7
1470	0.	13	12.00	13	90.	8
1480	0.00	660.00	2.00	690.00	0.	9
1490	2.00	690.00	18.00	690.00	0.	9
1500	18.00	690.00	20.00	660.00	0.	9
1510	0.00	660.00	2.00	690.00	0.	10
1520	2.00	690.00	18.00	690.00	0.	10
1530	18.00	690.00	20.00	660.00	0.	10
1540	0.00	660.00	2.75	701.25	0.	11
1550	2.75	701.25	17.25	701.25	0.	11
1560	17.25	701.25	20.00	660.00	0.	11
1570	0.00	660.00	2.00	720.00	0.	12

Figure B2. CFRAME default data file (Continued)

1580	2.00	720.00	18.00	720.00	0.	12
1590	18.00	720.00	20.00	660.00	0.	12
1600	0.	-5.10 0.	2			
1610	0.	-3.73 0.	3			
1620	0.	-3.70 0.	4			
1630	0.	-3.30 0.	5			
1640	0.	-5.08 0.	7			
1650	0.	-3.73 0.	8			
1660	0.	-3.69 0.	9			
1670	0.	-3.30 0.	10			
1680	LOAD CASE 2	0	12	0	8 LIVE LOADS	
1690	0.00	0.00	2.00	200.00	0.	9
1700	2.00	200.00	18.00	200.00	0.	9
1710	18.00	200.00	20.00	0.00	0.	9
1720	0.00	0.00	2.00	200.00	0.	10
1730	2.00	200.00	18.00	200.00	0.	10
1740	18.00	200.00	20.00	0.00	0.	10
1750	0.00	0.00	2.75	275.00	0.	11
1760	2.75	275.00	17.25	275.00	0.	11
1770	17.25	275.00	20.00	0.00	0.	11
1780	0.00	0.00	2.00	40.00	0.	12
1790	2.00	40.00	18.00	40.00	0.	12
1800	18.00	40.00	20.00	0.00	0.	12
1810	0.	-9.40 0.	2			
1820	0.	-4.56 0.	3			
1830	0.	-3.63 0.	4			
1840	0.	-0.44 0.	5			
1850	0.	-9.34 0.	7			
1860	0.	-4.60 0.	8			
1870	0.	-3.69 0.	9			
1880	0.	-0.44 0.	10			
1890	LOAD CASE 3	0	12	0	8 STRUCTURAL LOADS	
1900	0.00	15.00	2.00	95.00	0.	9
1910	2.00	95.00	18.00	95.00	0.	9
1920	18.00	95.00	20.00	15.00	0.	9
1930	0.00	15.00	2.00	95.00	0.	10
1940	2.00	95.00	18.00	95.00	0.	10
1950	18.00	95.00	20.00	15.00	0.	10
1960	0.00	15.00	2.75	125.00	0.	11
1970	2.75	125.00	17.25	125.00	0.	11
1980	17.25	125.00	20.00	15.00	0.	11
1990	0.00	15.00	2.00	95.00	0.	12
2000	2.00	95.00	18.00	95.00	0.	12
2010	18.00	95.00	20.00	15.00	0.	12
2020	0.	-4.45 0.	2			
2030	0.	-2.16 0.	3			
2040	0.	-1.71 0.	4			
2050	0.	-1.07 0.	5			
2060	0.	-4.39 0.	7			
2070	0.	-2.10 0.	8			
2080	0.	-1.65 0.	9			
2090	0.	-1.01 0.	10			
2100	COMBINATION 4	1 1 2 1 3 1				

Figure B2. (Concluded)



1580	0.00	660.00	2.00	720.00	0.	12
1590	2.00	720.00	18.00	720.00	0.	12
1600	18.00	720.00	20.00	660.00	0.	12
1610	0.	-5.10	0.			2
1620	0.	-3.73	0.			3
1630	0.	-3.70	0.			4
1640	0.	-3.30	0.			5
1650	0.	-5.08	0.			7
1660	0.	-3.73	0.			8
1670	0.	-3.69	0.			9
1680	0.	-3.30	0.			10
1690	LOAD CASE 2 0 12 0 8 LIVE LOAD					
1700	0.00	0.00	2.00	200.00	0.	9
1710	2.00	200.00	18.00	200.00	0.	9
1720	18.00	200.00	20.00	0.00	0.	9
1730	0.00	0.00	2.00	200.00	0.	10
1740	2.00	200.00	18.00	200.00	0.	10
1750	18.00	200.00	20.00	0.00	0.	10
1760	0.00	0.00	2.75	275.00	0.	11
1770	2.75	275.00	17.25	275.00	0.	11
1780	17.25	275.00	20.00	0.00	0.	11
1790	0.00	0.00	2.00	40.00	0.	12
1800	2.00	40.00	18.00	40.00	0.	12
1810	18.00	40.00	20.00	0.00	0.	12
1820	0.	-9.40	0.			2
1830	0.	-4.56	0.			3
1840	0.	-3.63	0.			4
1850	0.	-0.44	0.			5
1860	0.	-9.34	0.			7
1870	0.	-4.60	0.			8
1880	0.	-3.69	0.			9
1890	0.	-0.44	0.			10
1900	LOAD CASE 3 0 12 0 8 STRUCTURAL LOADS					
1910	0.00	15.00	2.00	95.00	0.	9
1920	2.00	95.00	18.00	95.00	0.	9
1930	18.00	95.00	20.00	15.00	0.	9
1940	0.00	15.00	2.00	95.00	0.	10
1950	2.00	95.00	18.00	95.00	0.	10
1960	18.00	95.00	20.00	15.00	0.	10
1970	0.00	15.00	2.75	125.00	0.	11
1980	2.75	125.00	17.25	125.00	0.	11
1990	17.25	125.00	20.00	15.00	0.	11
2000	0.00	15.00	2.00	95.00	0.	12
2010	2.00	95.00	18.00	95.00	0.	12
2020	18.00	95.00	20.00	15.00	0.	12
2030	0.	-4.45	0.			2
2040	0.	-2.16	0.			3
2050	0.	-1.71	0.			4
2060	0.	-1.07	0.			5
2070	0.	-4.39	0.			7
2080	0.	-2.19	0.			8
2090	0.	-1.65	0.			9
2100	0.	-1.01	0.			10
2110	LOAD CASE 4 0 0 0 1 HORIZONTAL LOAD					
2120	5000.	0.	0.	5		
2130	COMBINATION 5 1 1 2 1 3 1 4 1 ALL LOADS COMBINED					

Figure B3. (Concluded)

APPENDIX C: LINK2D-GTSTRUDL USAGE AND FILES

1. The LINK2D-GTSTRU DL input generated from STRUCTURE is shown as Figure C1.

```
LINK 2D

THIS PROGRAM WILL, ALONG WITH ADDITIONAL INPUT,
CONVERT THE CAEADS OUTPUT FILE INTO
A CFRAME OR STRUDL 2-D INPUT FILE.

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
STRUDL

DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMA1

OUTPUT FILE SAVED = FRAMA1
DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
Y

ENTER DESIRED 2-D FRAME FORMAT.(CFRAME/STRUDL)
S

DO YOU WISH TO PROVIDE ADDITIONAL INPUT INTERACTIVELY?(Y/N)
Y

ENTER INPUT FILE NAME:
(THIS FILE MUST HAVE BEEN CREATED IN CAEADS.)
FRAMEA
ENTER OUTPUT FILE NAME:
(THIS WILL BE THE 2-D FRAME INPUT FILE.)
FRAMA2

TO END DATA ENTRY FOR AN ITEM PUSH
RETURN. Y N QUESTIONS WILL DEFAULT
TO NO IF A RESPONSE IS NOT ENTERED.
FOR MORE ASSISTANCE CONSULT THE
STRU DL USER'S MANUALS.

ENTER TITLE LINE.
STRU DL * INTERACTIVE RESPONSE

DEFAULT INPUT UNITS ARE POUNDS FEET FAHRENHEIT.
DO YOU WISH TO CHANGE UNITS?(Y/N)

STRU DL ASSUMES ALL SUPPORTS ARE FIXED.
ARE SUPPORT CONDITIONS TO BE MODIFIED? Y N
Y
SUPPORTS ARE:      1      6
ENTER JOINT RELEASE COMMAND.
JOINT RELEASES
1 6 MOMENT 7
```

Figure C1. LINK2D-GTSTRU DL input (Continued)

DEFAULT CONSTANTS ARE:
 DENSITY = 490. PCF
 E = 29000000. PSI
 POI = .3
 DO YOU WISH TO MODIFY OR ADD ANY OTHER CONSTANTS? (Y/N)

 ALL REQUIRED DATA HAS BEEN ASSEMBLED.
 ENTER ANY ADDITIONAL STRUDL COMMANDS PRIOR TO ANALYSIS.
 LOADING 4 ' HORIZONTAL LOADS '
 JOINT LOADS
 5 FORCE X 5000.

 ENTER DESIRED OUTPUT CONTROL DATA
 AND DESIGN DATA:
 LOADING COMBINATION 5
 COMBINE 5 1 1 2 1 3 1 4 1
 OUTPUT DECIMAL 5
 LIST REACTIONS FORCES DISPLACEMENTS ALL

 OUTPUT FILE SAVED = FRAMAS2
 DO YOU WISH TO BUILD ANOTHER 2-D FRAME INPUT FILE?(Y/N)
 NO
 STOP
 LINK2D COMPLETE

Figure C1. (Concluded)

2. LINK2D default values for information required by GTSTRU DL that cannot be extracted from the STRUCTURE data base can be seen as Figure C2.

```

STRU DL  'CAEADS' 'TITLE'
UNITS POUNDS FEET FAHRENHEIT
TYPE PLANE FRAME
JOINT COORDINATES
  1      20.00  -12.00  S
  2      20.00   0.00
  3      20.00  12.00
  4      20.00  24.00
  5      20.00  36.00
  6      40.00  -12.00  S
  7      40.00   0.00
  8      40.00  12.00
  9      40.00  24.00
 10      40.00  36.00
JOINT RELEASES
  1      6 MOMENT Z
MEMBER INCIDENCES
  1      1      2
  2      2      3
  3      3      4
  4      4      5
  5      6      7
  6      7      8
  7      8      9
  8      9     10
  9      2      7
 10      3      8
 11      4      9
 12      5     10
UNITS INCHES
MEMBER PROPERTIES TABLE STEELW78
  1 TABLE 'W14X48'
  2 TABLE 'W10X33'
  3 TABLE 'W4X13'
  4 TABLE 'W6X9'
  5 TABLE 'W10X33'
  6 TABLE 'W14X48'
  7 TABLE 'W10X33'
  8 TABLE 'W4X13'
  9 TABLE 'W14X22'
 10 TABLE 'W10X15'
 11 TABLE 'W12X14'
 12 TABLE 'W10X12'
UNITS LBS FEET
CONSTANTS DENSITY 490. ALL
UNITS LBS INCHES
CONSTANTS
E 29000000. ALL
POI .3 ALL
UNIT LBS FEET
DEAD LOADING 1 DIR -Y MEM 1 TO 8
MEMBER LOADS
  9 FOR Y GLO LINEAR WA -660.00 WB -690.00 LA 0.00 LB 2.00
  9 FOR Y GLO LINEAR WA -690.00 WB -690.00 LA 2.00 LB 18.00
  9 FOR Y GLO LINEAR WA -690.00 WB -660.00 LA 18.00 LB 20.00
 10 FOR Y GLO LINEAR WA -660.00 WB -690.00 LA 0.00 LB 2.00
 10 FOR Y GLO LINEAR WA -690.00 WB -690.00 LA 2.00 LB 18.00
 10 FOR Y GLO LINEAR WA -690.00 WB -660.00 LA 18.00 LB 20.00

```

Figure C2. GTSTRU DL default data file (Sheet 1 of 3)

11	FOR Y GLO LINEAR WA	-660.00	WB	-701.25	LA	0.00	LB	2.75
11	FOR Y GLO LINEAR WA	-701.25	WB	-701.25	LA	2.75	LB	17.25
11	FOR Y GLO LINEAR WA	-701.25	WB	-660.00	LA	17.25	LB	20.00
12	FOR Y GLO LINEAR WA	-660.00	WB	-720.00	LA	0.00	LB	2.00
12	FOR Y GLO LINEAR WA	-720.00	WB	-720.00	LA	2.00	LB	18.00
12	FOR Y GLO LINEAR WA	-720.00	WB	-660.00	LA	18.00	LB	20.00
JOINT LOADS								
2	FORCE Y	-5.10						
3	FORCE Y	-3.73						
4	FORCE Y	-3.70						
5	FORCE Y	-3.30						
7	FORCE Y	-5.08						
8	FORCE Y	-3.73						
9	FORCE Y	-3.69						
10	FORCE Y	-3.30						
LOADING 2 'LIVE LOAD'								
MEMBER LOADS								
9	FOR Y GLO LINEAR WA	0.00	WB	-200.00	LA	0.00	LB	2.00
9	FOR Y GLO LINEAR WA	-200.00	WB	-200.00	LA	2.00	LB	18.00
9	FOR Y GLO LINEAR WA	-200.00	WB	0.00	LA	18.00	LB	20.00
10	FOR Y GLO LINEAR WA	0.00	WB	-200.00	LA	0.00	LB	2.00
10	FOR Y GLO LINEAR WA	-200.00	WB	-200.00	LA	2.00	LB	18.00
10	FOR Y GLO LINEAR WA	-200.00	WB	0.00	LA	18.00	LB	20.00
11	FOR Y GLO LINEAR WA	0.00	WB	-275.00	LA	0.00	LB	2.75
11	FOR Y GLO LINEAR WA	-275.00	WB	-275.00	LA	2.75	LB	17.25
11	FOR Y GLO LINEAR WA	-275.00	WB	0.00	LA	17.25	LB	20.00
12	FOR Y GLO LINEAR WA	0.00	WB	-40.00	LA	0.00	LB	2.00
12	FOR Y GLO LINEAR WA	-40.00	WB	-40.00	LA	2.00	LB	18.00
12	FOR Y GLO LINEAR WA	-40.00	WB	0.00	LA	18.00	LB	20.00
JOINT LOADS								
2	FORCE Y	-9.40						
3	FORCE Y	-4.56						
4	FORCE Y	-3.63						
5	FORCE Y	-0.44						
7	FORCE Y	-9.34						
8	FORCE Y	-4.60						
9	FORCE Y	-3.69						
10	FORCE Y	-0.44						
LOADING 3 'STRUCTURAL LOADS'								
MEMBER LOADS								
9	FOR Y GLO LINEAR WA	-15.00	WB	-95.00	LA	0.00	LB	2.00
9	FOR Y GLO LINEAR WA	-95.00	WB	-95.00	LA	2.00	LB	18.00
9	FOR Y GLO LINEAR WA	-95.00	WB	-15.00	LA	18.00	LB	20.00
10	FOR Y GLO LINEAR WA	-15.00	WB	-95.00	LA	0.00	LB	2.00
10	FOR Y GLO LINEAR WA	-95.00	WB	-95.00	LA	2.00	LB	18.00
10	FOR Y GLO LINEAR WA	-95.00	WB	-15.00	LA	18.00	LB	20.00
11	FOR Y GLO LINEAR WA	-15.00	WB	-125.00	LA	0.00	LB	2.75
11	FOR Y GLO LINEAR WA	-125.00	WB	-125.00	LA	2.75	LB	17.25
11	FOR Y GLO LINEAR WA	-125.00	WB	-15.00	LA	17.25	LB	20.00
12	FOR Y GLO LINEAR WA	-15.00	WB	-95.00	LA	0.00	LB	2.00
12	FOR Y GLO LINEAR WA	-95.00	WB	-95.00	LA	2.00	LB	18.00
12	FOR Y GLO LINEAR WA	-95.00	WB	-15.00	LA	18.00	LB	20.00

Figure C2. (Sheet 2 of 3)

JOINT LOADS
2 FORCE Y -4.45
3 FORCE Y -2.16
4 FORCE Y -1.71
5 FORCE Y -1.07
7 FORCE Y -4.39
8 FORCE Y -2.10
9 FORCE Y -1.65
10 FORCE Y -1.01
STIFFNESS ANALYSIS
LOAD COMBINATION 4
COMBINE 4 1 1 2 1 3 1
LIST REACTIONS FORCES DISPLACEMENTS ALL

Finish

Figure C2. (Sheet 3 of 3)

3. Properly formatted interactive data files for GTSTRU DL, via the LINK2D linkage, are shown as Figure C3.

```

STRU DL  'INTERACTIVE RESPONSE'
UNITS POUNDS FEET FAHRENHEIT
TYPE PLANE FRAME
JOINT COORDINATES
  1      20.00   -12.00   S
  2      20.00    0.00
  3      20.00   12.00
  4      20.00   24.00
  5      20.00   36.00
  6      40.00   -12.00   S
  7      40.00    0.00
  8      40.00   12.00
  9      40.00   24.00
 10      40.00   36.00
JOINT RELEASES
1 6 MOMENT 2
MEMBER INCIDENCES
  1      1      2
  2      2      3
  3      3      4
  4      4      5
  5      6      7
  6      7      8
  7      8      9
  8      9     10
  9      2      7
 10      3      8
 11      4      9
 12      5     10
UNITS INCHES
MEMBER PROPERTIES TABLE 'STEELW78'
  1 TABLE 'W14X48'
  2 TABLE 'W10X33'
  3 TABLE 'W4X13'
  4 TABLE 'W6X9'
  5 TABLE 'W10X33'
  6 TABLE 'W14X48'
  7 TABLE 'W10X33'
  8 TABLE 'W4X13'
  9 TABLE 'W14X22'
 10 TABLE 'W10X15'
 11 TABLE 'W12X14'
 12 TABLE 'W10X12'
UNITS LBS FEET
CONSTANTS DENSITY 490. ALL
UNITS LBS INCHES
CONSTANTS
E 29000000. ALL
POI .3 ALL
UNIT LBS FEET
DEAD LOADING 1 DIR -Y MEM 1 TO 8
MEMBER LOADS
  9 FOR Y GLO LINEAR WA -660.00 WB -690.00 LA 0.00 LB 2.00
  9 FOR Y GLO LINEAR WA -690.00 WB -690.00 LA 2.00 LB 18.00
  9 FOR Y GLO LINEAR WA -690.00 WB -660.00 LA 18.00 LB 20.00
 10 FOR Y GLO LINEAR WA -660.00 WB -690.00 LA 0.00 LB 2.00
 10 FOR Y GLO LINEAR WA -690.00 WB -690.00 LA 2.00 LB 18.00
 10 FOR Y GLO LINEAR WA -690.00 WB -660.00 LA 18.00 LB 20.00

```

Figure C3. GTSTRU DL interactive data file (Sheet 1 of 3)

11	FOR Y GLO LINEAR WA	-660.00	WB	-701.25	LA	0.00	LB	2.75
11	FOR Y GLO LINEAR WA	-701.25	WB	-701.25	LA	2.75	LB	17.25
11	FOR Y GLO LINEAR WA	-701.25	WB	-660.00	LA	17.25	LB	20.00
12	FOR Y GLO LINEAR WA	-660.00	WB	-720.00	LA	0.00	LB	2.00
12	FOR Y GLO LINEAR WA	-720.00	WB	-720.00	LA	2.00	LB	18.00
12	FOR Y GLO LINEAR WA	-720.00	WB	-660.00	LA	18.00	LB	20.00
JOINT LOADS								
2	FORCE Y	-5.10						
3	FORCE Y	-3.73						
4	FORCE Y	-3.70						
5	FORCE Y	-3.30						
7	FORCE Y	-5.08						
8	FORCE Y	-3.73						
9	FORCE Y	-3.69						
10	FORCE Y	-3.30						
LOADING 2 'LIVE LOAD'								
MEMBER LOADS								
9	FOR Y GLO LINEAR WA	0.00	WB	-200.00	LA	0.00	LB	2.00
9	FOR Y GLO LINEAR WA	-200.00	WB	-200.00	LA	2.00	LB	18.00
9	FOR Y GLO LINEAR WA	-200.00	WB	0.00	LA	18.00	LB	20.00
10	FOR Y GLO LINEAR WA	0.00	WB	-200.00	LA	0.00	LB	2.00
10	FOR Y GLO LINEAR WA	-200.00	WB	-200.00	LA	2.00	LB	18.00
10	FOR Y GLO LINEAR WA	-200.00	WB	0.00	LA	18.00	LB	20.00
11	FOR Y GLO LINEAR WA	0.00	WB	-275.00	LA	0.00	LB	2.75
11	FOR Y GLO LINEAR WA	-275.00	WB	-275.00	LA	2.75	LB	17.25
11	FOR Y GLO LINEAR WA	-275.00	WB	0.00	LA	17.25	LB	20.00
12	FOR Y GLO LINEAR WA	0.00	WB	-40.00	LA	0.00	LB	2.00
12	FOR Y GLO LINEAR WA	-40.00	WB	-40.00	LA	2.00	LB	18.00
12	FOR Y GLO LINEAR WA	-40.00	WB	0.00	LA	18.00	LB	20.00
JOINT LOADS								
2	FORCE Y	-9.40						
3	FORCE Y	-4.56						
4	FORCE Y	-3.63						
5	FORCE Y	-0.44						
7	FORCE Y	-9.34						
8	FORCE Y	-4.60						
9	FORCE Y	-3.69						
10	FORCE Y	-0.44						
LOADING 3 'STRUCTURAL LOADS'								
MEMBER LOADS								
9	FOR Y GLO LINEAR WA	-15.00	WB	-95.00	LA	0.00	LB	2.00
9	FOR Y GLO LINEAR WA	-95.00	WB	-95.00	LA	2.00	LB	18.00
9	FOR Y GLO LINEAR WA	-95.00	WB	-15.00	LA	18.00	LB	20.00
10	FOR Y GLO LINEAR WA	-15.00	WB	-95.00	LA	0.00	LB	2.00
10	FOR Y GLO LINEAR WA	-95.00	WB	-95.00	LA	2.00	LB	18.00
10	FOR Y GLO LINEAR WA	-95.00	WB	-15.00	LA	18.00	LB	20.00
11	FOR Y GLO LINEAR WA	-15.00	WB	-125.00	LA	0.00	LB	2.75
11	FOR Y GLO LINEAR WA	-125.00	WB	-125.00	LA	2.75	LB	17.25
11	FOR Y GLO LINEAR WA	-125.00	WB	-15.00	LA	17.25	LB	20.00
12	FOR Y GLO LINEAR WA	-15.00	WB	-95.00	LA	0.00	LB	2.00
12	FOR Y GLO LINEAR WA	-95.00	WB	-95.00	LA	2.00	LB	18.00
12	FOR Y GLO LINEAR WA	-95.00	WB	-15.00	LA	18.00	LB	20.00

Figure C3. (Sheet 2 of 3)

JOINT LOADS
 2 FORCE Y -4.45
 3 FORCE Y -2.16
 4 FORCE Y -1.71
 5 FORCE Y -1.07
 7 FORCE Y -4.39
 8 FORCE Y -2.10
 9 FORCE Y -1.65
 10 FORCE Y -1.01
 LOADING 4 ' HORIZONTAL LOADS '
 JOINTS LOADS
 5 FOR X 5000.
 STIFFNESS ANALYSIS
 LOAD COMBINATION 5
 COMBINE 5 1 1 2 1 3 1 4 1
 OUTPUT DECIMAL 5
 LIST REACTIONS FORCES DISPLACEMENTS ALL
 Finish

Figure C3. (Sheet 3 of 3)

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

	Title	Date
Technical Report K-78-1	List of Computer Programs for Computer-Aided Structural Engineering	Feb 1978
Instruction Report O-79-2	User's Guide Computer Program with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Mar 1979
Technical Report K-80-1	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report K-80-2	Evaluation of Computer Programs for the Design/Analysis of Highway and Railway Bridges	Jan 1980
Instruction Report K-80-1	User's Guide Computer Program for Design Review of Curvilinear Conduits/Culverts (CURCON)	Feb 1980
Instruction Report K-80-3	A Three-Dimensional Finite Element Data Edit Program	Mar 1980
Instruction Report K-80-4	A Three-Dimensional Stability Analysis Design Program (DOSAD)	
	Report 1 General Geometry Module	Jun 1980
	Report 3 General Analysis Module (CGAM)	Jun 1982
	Report 4 Special-Purpose Modules for Dams (CDAMS)	Aug 1983
Instruction Report K-80-6	Basic User's Guide Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Instruction Report K-80-7	User's Reference Manual Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Technical Report K-80-4	Documentation of Finite Element Analyses	
	Report 1 Longview Outlet Works Conduit	Dec 1980
	Report 2 Anchored Wall Monolith, Bay Springs Lock	Dec 1980
Technical Report K-80-5	Basic Pile Group Behavior	Dec 1980
Instruction Report K-80-2	User's Guide Computer Program for Design and Analysis of Inverted Pile Walls by Classical Methods (CSHTWA)	
	Report 1 Computational Processes	Feb 1981
	Report 2 Interactive Graphics Options	Mar 1981
Instruction Report K-81-1	User's Guide Computer Program for Design and Analysis of Inverted T Retaining Walls and Floodwalls (TWDA)	Feb 1981
Instruction Report K-81-1	User's Guide Computer Program for Design and Analysis of Inverted T Retaining Walls and Floodwalls (TWDA)	Mar 1981
Instruction Report K-81-2	User's Guide Computer Program for Design and Analysis of Inverted T Retaining Walls and Floodwalls (TWDA)	Mar 1981

These reports are available for review and copying at the following locations:

1. Waterways Experiment Station, 2215 River Road, Vicksburg, Mississippi 39180

2. National Technical Information Service, Springfield, Virginia 22161

3. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, Virginia 20191

4. American Institute of Steel Construction, Inc., 900 North Dearborn Street, Chicago, Illinois 60610

5. American Institute of Steel Construction, Inc., 900 North Dearborn Street, Chicago, Illinois 60610

6. American Institute of Steel Construction, Inc., 900 North Dearborn Street, Chicago, Illinois 60610

7. American Institute of Steel Construction, Inc., 900 North Dearborn Street, Chicago, Illinois 60610

8. American Institute of Steel Construction, Inc., 900 North Dearborn Street, Chicago, Illinois 60610

9. American Institute of Steel Construction, Inc., 900 North Dearborn Street, Chicago, Illinois 60610

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

(Concluded)

	Title	Date
Instruction Report K-83-1	User's Guide: Computer Program With Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Jan 1983
Instruction Report K-83-2	User's Guide: Computer Program for Generation of Engineering Geometry (SKETCH)	Jun 1983
Instruction Report K-83-5	User's Guide: Computer Program to Calculate Shear, Moment, and Thrust (CSMT) from Stress Results of a Two-Dimensional Finite Element Analysis	Jul 1983
Technical Report K-83-1	Basic Pile Group Behavior	Sep 1983
Technical Report K-83-3	Reference Manual: Computer Graphics Program for Generation of Engineering Geometry (SKETCH)	Sep 1983
Technical Report K-83-4	Case Study of Six Major General-Purpose Finite Element Programs	Oct 1983
Instruction Report K-84-2	User's Guide: Computer Program for Optimum Dynamic Design of Nonlinear Metal Plates Under Blast Loading (CSDOOR)	Jan 1984
Instruction Report K-84-7	User's Guide: Computer Program for Determining Induced Stresses and Consolidation Settlements (CSETT)	Aug 1984
Instruction Report K-84-8	Seepage Analysis of Confined Flow Problems by the Method of Fragments (CFRAG)	Sep 1984
Instruction Report K-84-11	User's Guide for Computer Program CGFAG, Concrete General Flexure Analysis with Graphics	Sep 1984
Technical Report K-84-3	Computer-Aided Drafting and Design for Corps Structural Engineers	Oct 1984
Technical Report ATC-86-5	Decision Logic Table Formulation of ACI 318-77 Building Code Requirements for Reinforced Concrete for Automated Constraint Processing, Volumes I and II	Jun 1986
Technical Report IT-87-2	A Case Committee Study of Finite Element Analysis of Concrete Flat Slabs	Jan 1987
Instruction Report IT-87-1	User's Guide: Computer Program for Two-Dimensional Analysis of D-Frame Structures (CUFRAM)	Apr 1987
Instruction Report IT-87-2	User's Guide: For Concrete Strength Investigation and Design (CASTIB) in Accordance with ACI 318-83	May 1987
Technical Report ATC-87-6	Finite Element Method Package for Solving Steady State Seepage Problems	May 1987
Instruction Report IT-87-3	User's Guide: A Three-Dimensional Static Analysis Design Program (SNA3D) Report 1, Release 1.0, General Version 1.0, Manual	Jun 1987
Instruction Report IT-87-4	User's Guide: 2-D Frame Analysis Using Program FRAM-2	Jun 1987

END

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