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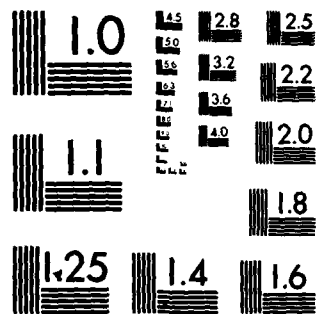
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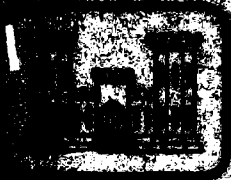
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EVALUATION OF COMPUTER PROGRAMS FOR THE DESIGN / ANALYSIS OF HIGHWAY AND RAILWAY BRIDGES

January 1980

Final Report

A report under the Computer-Aided Structural
Engineering (CASE) Project

Approved For Public Release; Distribution Unlimited

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Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Submitted to Automatic Data Processing Center
U. S. Army Engineer Waterways Experiment Station
P. O. Box 601, Vicksburg, Miss. 39180

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The purpose of this report is to recommend computer programs for Corps-wide application in the design/analysis of highway and railway bridges. The CASE Task Group on Bridges compiled a list of bridge programs presently in use by Corps designers and various state highway departments and then evaluated and selected the most appropriate ones for Corps-wide use. The programs were evaluated based on the following considerations: (a) Corps designers should be familiar with use of the program; (b) highway programs should be acceptable to (continued)		

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the various state departments of transportation; (c) highway programs should conform to AASHTO (American Association of State Highway and Transportation Officials) specifications; (d) railway programs should be acceptable to the various railroad companies; and (e) railway programs should conform to AREA (American Railroad Engineering Association) specifications.

This report describes four highway and three railway computer programs selected by the Task Group, lists their capabilities and limitations, and shows example runs.

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Preface

In November 1976, the Office, Chief of Engineers, U. S. Army (OCE), funded the Computer-Aided Structural Engineering (CASE) Project to examine, evaluate, and propose steps to overcome problems in computer-aided structural engineering throughout the Corps and to coordinate and guide long-term computer-aided design efforts on a Corps-wide basis. As part of this effort, several technical task groups were established to coordinate program development in specific areas of computer applications. The CASE Task Group on Bridges was one of the first six task groups formed for this purpose.

The primary function of the CASE Task Group on Bridges has been to compile a list of bridge computer programs presently in use and to evaluate and select the most appropriate ones for Corps-wide use. This report is a summary of the results of the program evaluations and contains the recommendations and conclusions of the Task Group.

Subsequent to the start of the CASE Project, the National Cooperative Highway Research Program (NCHRP) funded a comprehensive survey study on available highway bridge programs and recommendations for developing an integrated bridge design program. The U. S. Army Engineer Waterways Experiment Station (WES) awarded a contract to Dr. David R. Schelling of the University of Maryland, who was one of the investigators in the NCHRP study, to summarize the study findings. [A report prepared by Dr. Schelling has been published by WES under separate cover as a companion to this report.] The appendices to Dr. Schelling's report contain raw survey data and are available from the CASE Project Manager, Dr. N. Radhakrishnan, Special Technical Assistant, Automatic Data Processing (ADP) Center, WES. 4081501

The following were members of the Task Group on Bridges:

William E. Galyean, Huntington District (Chairman)
Richard M. Chun, Pacific Ocean Division
James Gibson, Mobile District
Gregory Griffith, Wilmington District
Arthur T. Shak, Pacific Ocean Division

Mr. William D. Ashton, formerly with the Rock Island District, served as the first Chairman of the Task Group. Messrs. David Shaw and Carlton E. Smith, St. Louis District, were also members of the Task Group during

the survey preparation and evaluation phases of the work.

Mr. Donald R. Dressler, Structures Branch, Civil Works Directorate, was OCE's point of contact. Dr. Radhakrishnan, as CASE Project Manager, coordinated and monitored the work. Messrs. Paul K. Senter and H. Wayne Jones, Computer-Aided Design Group, ADP Center, WES, converted all the programs to the WES, Macon, and Boeing computers and supported the Task Group in the preparation of this report. Mr. Galyean compiled this report for the Task Group. Mr. D. L. Neumann was Chief of the ADP Center, WES, during the study and the preparation of the report.

Directors of WES during this period were COL J. L. Cannon, CE, and COL N. P. Conover, CE. Technical Director was Mr. F. R. Brown.

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Conversion Factors, U. S. Customary to Metric (SI)
Units of Measurement

U. S. customary units of measurement used in this report can be converted to metric (SI) as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
feet	0.3048	metres
foot-kips (force)	1.355818	metre-kilonewtons
inches	2.54	centimetres
kips (1000 lb force)	4.448222	kilonewtons
kips (force) per square inch	6.894757	megapascals
miles (U. S. statute) per hour	1.609344	kilometres per hour
pounds (force) per foot	14.5939	newtons per metre
pounds (force) per square inch	6.894757	kilopascals
tons (2000 lb mass)	907.18474	kilograms

EVALUATION OF COMPUTER PROGRAMS FOR THE DESIGN/ANALYSIS
OF HIGHWAY AND RAILWAY BRIDGES

Purpose

1. The purpose of this report is to recommend computer programs for Corps-wide applications in the design/analysis of highway and railway bridges. Since bridge programs cover a wide range of capabilities, only those programs that are likely to address applications which are expected to have wide use are covered. It is not justified to utilize computer storage space for programs which are infrequently used. Also, such programs will require maintenance. In most instances, alternate programs which can solve these problems are available.

Types of Programs

2. Bridge programs in this report are divided into two broad classifications, highway and railway. For evaluation, each classification in turn is divided into several areas of application. Programs recommended for Corps-wide application are based on need in each area of application. Each Corps office was contacted to determine its needs and preferences.

Evaluation

3. The primary function of the CASE Task Group on Bridges was to compile a list of bridge programs presently in use by Corps designers and the state highway departments and to evaluate and select the most appropriate ones for Corps-wide use. The programs were evaluated based on the following considerations:

- a. Corps designers should be familiar with use of the program.
- b. Highway programs should be acceptable to the various State Departments of Transportation.

- c. Highway programs should conform to AASHTO (American Association of State Highway and Transportation Officials) specifications.
- d. Railway programs should be acceptable to the various railroad companies.
- e. Railway programs should conform to AREA (American Railroad Engineering Association) specifications.

Scope of Report

4. This report describes four highway and three railway computer programs selected by the Task Group and lists their capabilities and limitations. Example computer runs for each of the programs are included in Appendix A. Documentation of these programs may be obtained from the Engineering Computer Programs Library (ECPL) of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. This report refers to a more comprehensive survey and recommendations made in a project funded by the National Cooperative Highway Research Program (NCHRP). The NCHRP project findings are published separately in another WES report ("Survey of Bridge-Oriented Design Software," Technical Report K-80-1, Jan 1980, by David R. Schelling).

Programs Selected

General

5. The Task Group, based on a wide search that included queries to all field offices, selected four highway and three railway computer programs as best suited to meet the Corps' needs. One highway program was selected that also can be used for railway-type structures. The highway programs were recommended by the Highway Engineers Exchange Program (HEEP) and are used by many states. (HEEP has plans to develop an integrated bridge design program for highway bridge design.) The railway programs were developed by the Association of American Railroads Research Center (AARRC). These programs are acceptable to the various railroad companies. The applications of each program are indicated in Table 1,

Table 1
Programs and Applications

<u>Program</u>	<u>Classification</u>		<u>Application</u>
	<u>Highway</u>	<u>Railway</u>	
BRHPSG	X	X	Prestressed concrete
BRHCBA	X		Continuous beam analysis (composite or noncomposite)
BRHMCP	X		Multiple column pier analysis
BRHGEO	X		Geometric solution of highway bridges
BRRPLG		X	Analysis and rating of plate girders and beams
BRRTRU		X	Analysis of trusses
BRRTRR		X	Rating of trusses

and their salient features are described below. These programs are not intended to cover nonstandard highway or railway loadings consisting of special wheel loads. For such applications of unusual loads, programs "INFORD" and "WTRAIN" are available as part of the CORPS (Conversationally Oriented Real-Time Program-Generating System) library maintained by WES on the WES, Macon, and Boeing computers.

BRHPSG (Analysis
and Design of Simple
Span Precast-Prestressed
Highway or Railway Bridges)

6. This computer program was developed by the Portland Cement Association for the analysis and design of simple span, composite and non-composite, precast-prestressed highway or railway bridges. The program is based on conventional design procedures and on appropriate sections of the 1977 AASHTO specifications and 1968 AREA specifications. The program is limited to the analysis and design of simple span, precast-prestressed highway or railway bridges. It will accommodate any section for which section properties are known and can be adequately described by the input variables. This program is now part of the CORPS library at WES. The timesharing version provides the user with a free field

read format and an interactive question/response option for inputting data. The program calculates section properties for single or double-cell box beams. The standard AASHTO loadings are used for highway bridges. Coopers "E" loading is used for railway bridges.

7. Some capabilities of the program are summarized below:
 - a. Section properties for standard precast sections.
 - b. Dead and live load shears and moments.
 - c. Stresses for various loading conditions.
 - d. Ultimate design (load factor) moments and resisting moments.
 - e. Spacing of shear reinforcement.
 - f. Horizontal shear stress between composite slabs and precast members.
 - g. Midspan elastic deflections for various loading conditions.
 - h. Number and center of gravity of prestressing strands required.

Other capabilities are fully described in the User's Manual.

BRHCBA (Analysis of Continuous Beams for Highway Bridges)

8. This program was developed by the Georgia Department of Transportation for the analysis of continuous beams for highway bridges. Data are input from a free field previously saved data file.

9. The program performs the complete analysis of a continuous beam for a highway bridge and reports the moments, stresses, shears, reactions, deflections, and shear connector spacings produced by the dead loads and the standard highway live loads (including the special military loading and the sidewalk live load) defined by the AASHTO "Standard Specifications for Highway Bridges" (1969, 1970 interims, and 1971).

10. The beam may be of concrete, steel, or composite concrete-steel construction. The number of spans may vary from two to eight, with any combination of lengths. The program recognizes practically any type of variation of the cross section. All possible live loading conditions are considered to insure that a maximum is obtained for each value under consideration.

11. The input information required for solution consists basically

of the loads to be considered, the properties of the material, and the actual dimensions of the beam to be analyzed. The program will perform the following operations during each computer run:

- a. Compute physical properties of the cross section along the beam.
- b. Compute elastic properties of the beam, such as stiffness and carry-over factors, etc.
- c. Solve for dead load moments, stresses, shears, etc.
- d. Develop influence lines for moments, shears, etc.
- e. Place live loads as required to select maximum moments, shears, reactions, etc.
- f. Compute maximum actual stresses and allowable fatigue stresses.
- g. Compute dead load deflections and maximum live load deflections.

12. The program has the following limitations:

- a. Intermediate hinges are not permitted.
- b. It will not analyze a beam that acts as a frame with the substructure.
- c. Load factor design is not provided for.
- d. Certain fatigue stresses are not in accordance with the 1977 AASHTO specifications.

13. The output data contain a listing of input data fully edited with headings for ease in reading and interpreting. If an error is detected by the program, processing is terminated and an "Error Message" is printed. Output is processed to a output file. This file in turn can be listed by either a remote terminal or a high-speed printer.

BRHMCP (Analysis of Multiple
Column Piers for Highway Bridges)

14. This computer program was developed by the Georgia Department of Transportation for the analysis and design of substructures for highway bridges. Data are input from a free field previously saved data file.

15. The program combines the effects of the various loads that are applied to the pier according to the AASHTO specifications to determine

the critical loading conditions. The program performs the following functions:

- a. Computes the moments, shears, and reactions in the top and bottom of each column.
 - b. Computes a moment envelope of the cap with reinforcing steel requirements, maximum shear with stirrup spacings, and the maximum concrete stresses in the cap.
 - c. Computes the concrete and reinforcing steel stresses in the top and bottom of each column.
 - d. Designs or analyzes a spread footing.
16. The program has the following limitations:
- a. Single column piers cannot be handled by the program.
 - b. Load factor design required by the 1977 AASHTO specifications is not provided for.

In order to obtain a load factor design of pier columns, output for critical load conditions can be used in input for program "PCAUC." Program "PCAUC" furnishes a load factor design. It is part of the WES on-line computer programs library (WESLIB) available on the WES and Macon computers.

17. The output data contain a listing of input data fully edited with headings for ease in reading and interpreting. If an error is detected by the program, processing is terminated and an "Error Message" is printed. Output is processed to a output file. This file in turn can be listed by either a remote terminal or a high-speed printer.

BRHGEO (Geometric
Solution of Highway Bridges)

18. This computer program was developed by the Georgia Department of Transportation for the geometric solution of highway bridges. It is more commonly referred to as the skewed bridge program. Data are input from a free field previously saved data file.

19. The purpose of this program is to solve the geometrics that are required in the design, detailing, and construction of highway bridges. The program solves the geometrics by intersecting a series of longitudinal lines that run basically parallel to the bridge with a series of transverse lines that lie basically across the bridge. The

computed data (including the finished grade elevation) at each intersection point are reported as the output data.

20. The bridge may be located in one, two, or three combinations of horizontal curves and tangents. The survey line cannot be a spiral for the purpose of computing stations. Vertical alignment is limited to two vertical curves with corresponding tangents. The maximum number of longitudinal lines is 30, and the maximum number of transverse lines is 20 per span with no limitation on the number of spans.

21. The program will handle the following types of longitudinal lines:

- a. Chord.
- b. Arc.
- c. Railing.
- d. Parallel.
- e. Parallel through intersect ahead.
- f. Parallel through intersect back.
- g. Curve offset.
- h. Straight taper.
- i. Curve taper.
- j. Coordinate.

22. Transverse lines are used to represent most any type of transverse line in addition to the bent lines. The following are most often used and can be at any angle:

- a. Center-line bearings.
- b. Diaphragms.
- c. Substructure lines.
- d. Construction joints.
- e. Span division lines.
- f. Road underneath lines.

23. The output data contain a listing of the input data fully edited with numerous headings for ease in interpretation. Output is processed to an output file. This file in turn can be listed by either a remote terminal or a high-speed printer.

BRRPLG (Analysis and Rating
of Plate Girder Railway Bridges)

24. This program was developed by the Association of American Railroads Technical Center for the design and rating of single span plate girder railway bridges. It was written in accordance with the 1969 AREA specifications and updated in 1975. The girders may be deck or through and may be ballasted. Data are input from a free field previously saved data file.

25. Seven common types of girder cross sections are considered. Each may have cover plates both top and bottom. Loads include a total uniform dead load for girder weight, track weight, and other dead loads, various live loads, impact, and wind. For rating purposes, the girders are analyzed for a Cooper E80 load. For analysis the following live loads may be considered:

- a. Type 1--Special box cars preceded and followed by loaded or unloaded 50-ton* box cars.
- b. Type 1A--Special box cars preceded and followed by any box cars in a train.
- c. Type 2--An entire train of special cars.
- d. Type 3--Cooper E loading.
- e. Type 4--Any general system of moving loads.
- f. Type 5--Locomotive units followed by a train of loaded 50-ton cars.
- g. Type 5A--Locomotive units followed by a train of any specified cars.

The computer output includes a listing of member sections used and a listing of dead load shears and moments. If the girder is to be rated, moments, shears, and stresses are output for an E80 loading. Train speeds of 10, 20, 30, and 40 mph are rated. If the girder is to be analyzed, the live load moments, shears, and stresses are output.

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

BRRTRU (Analysis of
Railway Truss Bridges)

26. This program was developed by the Association of American Railroads Technical Center for use in the design of railway truss bridges. It was written in accordance with the 1970 AREA specifications. Trusses may be of any configuration, simply supported, continuous over several supports, internally indeterminate, or contain counter diagonals. Data are input from a free field previously saved data file.

27. Maximum bar forces and reactions are computed for trusses subject to stationary or moving loads. The following live loads can be used:

- a. Type 1--Special car preceded and followed by standard box cars.
- b. Type 2--An entire train of special cars.
- c. Type 3--Cooper E Loading.
- d. Type 4--Any general system of moving loads.
- e. Type 5--Locomotive units followed by loaded box cars.

28. The program has the following limitations:

- a. Maximum span is 600 ft for type 3 loading.
- b. Maximum span is 1000 ft for other loadings.
- c. Maximum number of joints is 50.
- d. Maximum number of members is 100.
- e. Maximum number of panels is 25.
- f. Maximum number of panels with counters is 10.

Certain restrictions are applied on trusses containing counters such as subdivided trusses, etc.

29. The computer output includes a listing of member sections with maximum axial loads due to dead, live, impact, and reversal for each member.

BRRTRR (Rating of
Railway Truss Bridges)

30. This program was developed by the Association of American Railroads Technical Center for use in computing the Cooper Rating of each bar in trusses of any configuration. This program is a companion

program to the truss analysis program (BRRTRU). All rating is in accordance with the 1975 AREA specifications, except that lateral forces are not included. Data are input from a free field previously saved data file.

31. The program has the following limitations:

- a. Maximum span is 600 ft.
- b. No compression member may have a slenderness ratio (L/r) greater than 200.
- c. Other limitations are the same as in the truss analysis program (BRRTRU).

32. The computer output includes a listing of member sections with total capacity and Cooper Ratings for each member.

The NCHRP Project

33. In 1978, the NCHRP awarded a contract to Multisystems, Incorporated, of Cambridge, Mass., to survey computer programs available in the field for various components of bridge design and to recommend the rationale and mechanics for developing an integrated bridge design program. Dr. David R. Schelling of the Department of Civil Engineering, University of Maryland, who participated in this study, prepared under contract to WES a summary of the findings of this project. A summary of this report is included below. The appendices cited in his report contain raw data from the extensive surveys made in the evaluations; they are available for loan or inspection from the CASE Project Manager at WES.

34. The program recommended by the CASE Task Group on Bridges for geometry and pier design is also recommended by the NCHRP study. While the Task Group recommended the Georgia Department of Transportation program (BRHCBA) for superstructure design, the NCHRP study recommended the Maryland, Texas, California, or Wyoming Department of Transportation programs. The Maryland program, which appears to be the most comprehensive and promising, will be available in a production mode in late 1979.

35. The objective of the initial phase of the NCHRP study was to survey and review available bridge-oriented application software. The

study included comprehensive evaluation of current practice and computer programs relating to the design of bridge and bridge-related structures. As a result of the study, a classified inventory of bridge design software was compiled which can be used for general reference. In order to accomplish this, two steps were involved. The first step was the collection (through a first mailing) of the application software documentation, its evaluation, and the utilization of the findings in establishing fundamental selection criteria. The second step was to design a questionnaire containing fundamental selection criteria in the form of a set of design features and to have the questionnaire evaluated by the user. In addition to the bridge analysis and design features, the questionnaire also included queries concerning the system software and organizational data.

36. The areas of interest were broken down into superstructure, geometry, substructures, piles, and system.

37. In the area of superstructure, documentation was received for 109 bridge superstructure programs in response to the initial mailing. The programs were evaluated using 180 feature requirements. The status (mandatory, desired, etc.) of each of the features was determined from the responses to the questionnaire. Five programs were selected for an in-depth review in Phase II, using criteria based on overall rating and generality, documentation, modularity, and current status. The programs selected for further study were:

- a. The Maryland SHA Bridge Design, Rating and Routing System, by the Maryland State Highway Administration, Department of Transportation.
- b. Design of Prestressed Concrete Girders, by the Texas State Department of Highway and Public Transportation.
- c. Analysis of Prestressed Concrete Box Girder Bridges (GIRDER PC), by the California Department of Transportation.
- d. Bridge Rating and Analysis of Structural Systems (BRASS), by the Wyoming State Highway Department.
- e. Design of Reinforced Concrete Box Girder Bridges, by the California Department of Transportation.

38. In the geometry area, documentation was received for 25 bridge geometry programs in response to the initial mailing. The programs were evaluated using 36 feature requirements. The status of each of the

features was determined from the responses to the questionnaire. Two programs were selected for an in-depth review in Phase II, using criteria based on overall rating and generality, documentation, modularity, and current status. The programs selected for further study were:

- a. Geometry Solution of Highway Bridges, by the Georgia Department of Transportation.
- b. BELEV, by the Kentucky Department of Transportation.

39. In the area of substructures, documentation for 45 computer programs was received in response to the initial mailing. The programs were evaluated using 146 feature requirements. The status of each of the features was again determined from the questionnaire responses. None of the programs were found to adequately satisfy the criteria based on generality, documentation, modularity, 1977 code requirements, and current status. However, three of the programs were selected for review in order to satisfy the less stringent criteria as stated in the original proposal requirements for functional modules. The three programs selected for an in-depth review were:

- a. Pier Design, by the Michigan Department of Transportation.
- b. Analysis of Multiple Column Piers for Highway Bridges, by the Georgia Department of Transportation.
- c. Pier Design for Bridges, by Century Engineering, Inc.

40. In the area of pile group foundations, documentation for only nine computer programs was received as a result of the request made in the initial mailing. The programs were evaluated using 80 feature requirements, and the status of each of the features was again determined from the questionnaire responses. Four out of nine programs rated above average, and two of the four programs were selected for a more detailed review in Phase II. Neither of these two programs utilizes the flexure formula, and both of them employ the very general stiffness matrix analysis technique. The programs selected for further study were:

- a. Analysis of Pile Group Foundations, by the Maryland State Highway Administration, Department of Transportation.
- b. Analysis of Pile Group Footings, by the State of Maine, Department of Transportation.

Listing of Information File: BRIDGE

READY LIST

*LIST

10C INFORMATION FILE: BRIDGE

20C

30C THIS INFORMATION FILE CONTAINS THE NAMES OF COMPUTER PROGRAMS
40C RECOMMENDED BY THE CASE COMMITTEE FOR USE IN DESIGN OF
50C HIGHWAY AND BRIDGES.

60C

70C EACH PROGRAM IS APPLICABLE FOR THE APPLICATIONS CONTAINED
80C IN THE FOLLOWING SCHEDULE:

90C

100C *****

110C PROGRAM CLASSIFICATION APPLICATION

120C NAME HIGHWAY RAILWAY

130C *****

140C

150C BRHPSG X X PRESTRESSED CONCRETE

160C

170C BRHCBA X CONTINUOUS BEAM ANALYSIS
180C COMPOSITE OR NON-COMPOSITE

190C

200C BRHMCP X MULTIPLE COLUMN PIER ANALYSIS

210C

220C BRHGEO X GEOMETRIC SOLUTION OF
230C HIGHWAY BRIDGES

240C

250C BRRPLG X ANALYSIS AND RATING OF PLATE
260C GIRDERS AND BEAMS

270C

280C BRRTRU X ANALYSIS OF TRUSSES

290C

300C BRRTRR X RATING OF TRUSSES

310C

320C *****

330C

340C

350C FOR DOCUMENTATION OF ANY OF THE ABOVE PROGRAMS

360C CONTACT: WAYNE JONES, COMPUTER ANALYSIS BR. WES

370C FTS: 542-3758 OR 601-636-43111 EXT 3758

ready

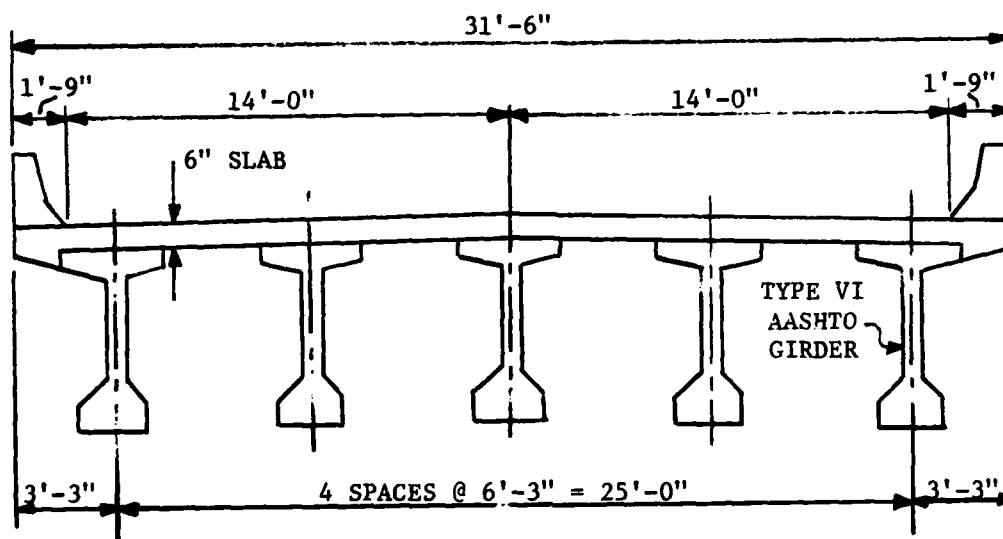
*

Appendix A: Example Computer Runs

Example Problem for BRHPSC

SAMPLE PRESTRESSED CONCRETE

COMPOSITE HIGHWAY BRIDGE FOR BRHPSG--WITH AASHTO GIRDERS



LOADING HS20-44

SPAN = 140 ft center-to-center bearings

CONCRETE STRENGTH:

Girders at release $f_{ci} = 4000$ psi

Girders at 28 days $f'c = 5000$ psi

Composite slab $f'_a = 3000$ psi

$$\frac{E \text{ COMPOSITE SLAB}}{E \text{ GIRDER}} = 0.80$$

INPUT DATA FILE

*LIST FIG3

10 SAMPLE PROBLEM NO. 1 - TYPE VI AASHTO GIRDER ORIGINAL
20 10 4 0 2 72. 140. .469 0. .569 0. 0.
30 72. 1086. 733400. 35.58 36.42 42. 5. 8.
40 .5 0. 25. .153 270. .7 .814 5.4 .93
50 5. 4. 3. .380 .19 20. 40. .62
60 4 -1 .5 .33 .25 .0 0. 0. 0.
70 75. 7. .8

*

*RUN BRHPSG

IS DATA TO BE INPUT FROM
EXISTING FILE(Y OR N) ?
=Y

NOTE# TO RETURN TO PREVIOUS QUESTION ENTER THE
LETTER R AS A QUESTION RESPONSE.

ENTER NAME OF INPUT FILE
(MAX. 8 CHAR.) -
=FIG3

10 SAMPLE PROBLEM NO. 1 - TYPE VI AASHTO GIRDER ORIGINAL

ASECT	=	1086.000IN**2
SECTI	=	733400.000IN**4
YT	=	35.580IN
TB	=	36.420IN
WTS	=	42.000IN
BB	=	8.000IN
SB	=	20137.287IN**3
ST	=	20612.704IN**3
WCS	=	75.000IN
TCS	=	7.000IN
XNCS	=	0.800IN

ACMP	=	1506.000IN**2
CMPI	=	1197669.859IN**4
YTC	=	24.681IN
YBC	=	47.319IN
YTSC	=	31.681IN
STC	=	48525.602IN**3
SBC	=	25310.653IN**3
STSC	=	37803.809IN**3
QTSC	=	11836.102IN**3

MAX LL+I MOMENT	=	1516.9FT KIPS
LL+I SHEAR AT 1/4 PT	=	34.1KIPS
LL+I SHEAR AT 1/3 PT	=	30.2KIPS
LL+I REACTION	=	47.9KIPS

STRESSES IN EXTREME FIBERS DUE TO EXTERNAL LOADS -				KIPS PER SQ.IN.	
		1	2	3	4
NSEC	-				
DIST	-	0.500L	0.250L	0.	0.
BEAM WT	TOP	1.614	1.210	0.	0.
	BOTTOM	-1.652	-1.239	0.	0.
SDL	TOP	0.669	0.502	0.	0.
	BOTTOM	-0.685	-0.514	0.	0.
CDL	TOP	0.	0.	0.	0.
	BOTTOM	0.	0.	0.	0.
LL	TOP	0.375	0.288	0.	0.
	BOTTOM	-0.719	-0.552	0.	0.
TOTAL	TOP	2.658	2.000	0.	0.
	BOTTOM	-3.056	-2.334	0.	0.

COMPOSITE STRESS IN SLAB = 0.482 KIPS PER SQ. IN.
 MINIMUM STRANDS = 49.462 YM = 5.400 IN. YE = 21.370 IN.

STRESSES DUE TO EXTERNAL LOADS AND PRESTRESS - KIPS'PER SQ. IN.

NSEC -	1	2	3	4
DIST -	0.500L	0.250L	0. L	0. L
INITIAL PRESTRESS				
TOP-	-0.777	-0.548	0.254	0.254
BOTTOM	3.274	3.039	2.219	2.219
BEAM WT +				
INITIAL PRESTRESS				
TOP-	0.837	0.662	0.254	0.254
BOTTOM	1.622	1.801	2.219	2.219
BEAM WT + SDL +				
FINAL PRESTRESS				
TOP-	1.602	1.232	0.222	0.222
BOTTOM	0.529	0.908	1.942	1.942
ALL LOADS +				
FINAL PRESTRESS				
TOP-	1.978	1.520	0.222	0.222
BOTTOM	-0.190	0.356	1.942	1.942

ULTIMATE MOMENT REQUIRED = 8384. FT.KIPS

DEPTH OF COMP BLOCK MORE THAN TCS+ TTS, UMP CALC APPROXIMATE
 FOR FCPC = 3.000 PSI AND 50. STRANDS
 ULTIMATE MOMENT PROVIDED = 10986. FT.KIPS

CASE# 1

NO. OF STRANDS = 50.

YM= 5.400

YE= 21.370

NSEC -	1	2	3	4
DIST -	0.500L	0.250L	0. L	0. L
INITIAL PRESTRESS				
TOP-	-0.785	-0.554	0.256	0.256
BOTTOM	3.309	3.073	2.243	2.243
BEAM WT +				
INITIAL PRESTRESS				
TOP-	0.828	0.656	0.256	0.256
BOTTOM	1.658	1.834	2.243	2.243
BEAM WT + SDL +				
FINAL PRESTRESS				
TOP-	1.595	1.227	0.224	0.224
BOTTOM	0.560	0.937	1.963	1.963
ALL LOADS +				
FINAL PRESTRESS				
TOP-	1.970	1.515	0.224	0.224
BOTTOM	-0.159	0.385	1.963	1.963

DEPTH OF COMP BLOCK MORE THAN TCS+TTS,UMP CALC APPROX

ULTIMATE MOMENT REQUIRED = 8384. FT.KIPS
 ULTIMATE MOMENT PROVIDED = 10986. FT.KIPS
 AT 1/4 PT,REQUIRED STIRRUP SPACING = 31.00 IN.
 AT 1/3 PT,REQUIRED STIRRUP SPACING = 31.00 IN.
 DL+LL+I REACTION PER BEAM = 159.93 KIPS
 ULT SHEAR STRESS BETWEEN SLAB AND BEAM AT REACTION ' = 27.155 PSI

DEFLECTIONS
 BEAM WEIGHT + PRESTRESS = -1.457 IN.
 TOTAL DEAD LOAD + PRESTRESS = 0.538 IN.
 LIVE LOAD + IMPACT = 1.039 IN.

IS JOB COMPLETED? Y OR N
 =Y

*

Example Problem for BRHCBA

82-104-82 COMPOSITE CONTINUOUS UNIT (WF WITH C.R.S.)

INVESTIGATE FIRST INTERIOR BEAM

GIVEN: $W_{DLSC} = 555 \text{ LB/FT}$, $W_{DLc} = 300 \text{ LB/FT}$

$$D^F_{V_0} = D^F_M$$

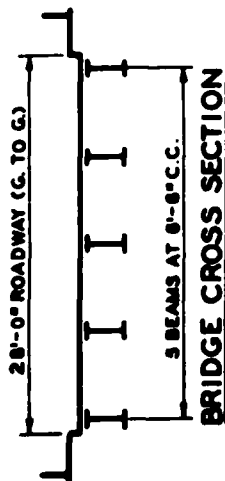
$$D^F_0 = 0.80$$

$$W_{SW} = \text{NONE}$$

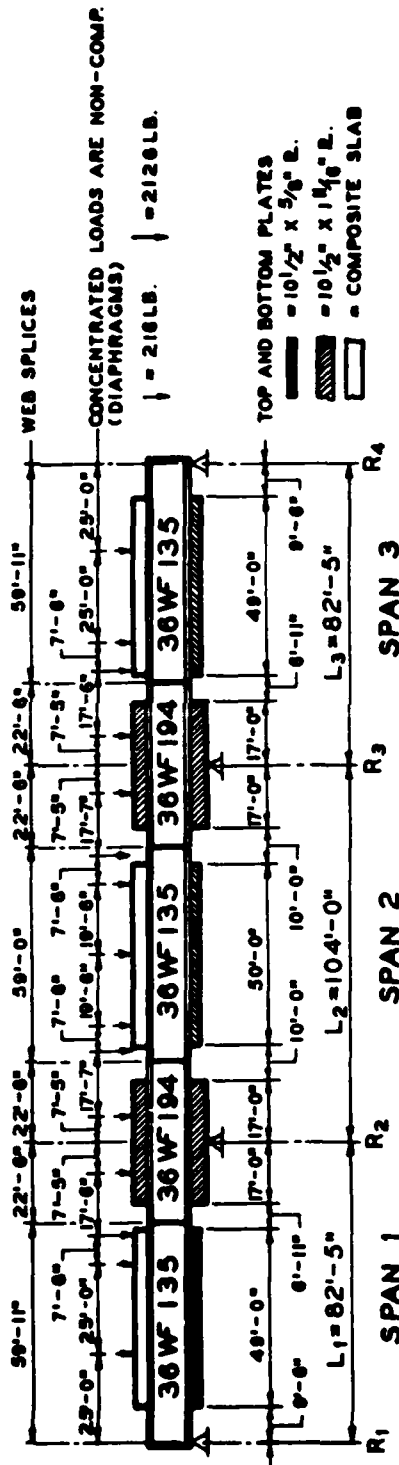
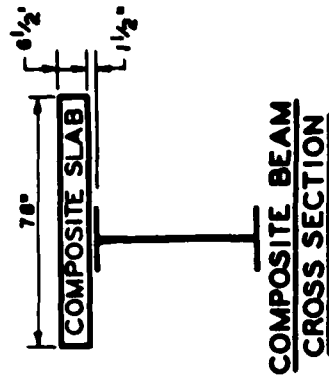
$$W_G = 490.0 \text{ LB/FT}^2$$

$$E = 29.00 \times 10^6 \text{ LB/IN}^2$$

$$\Sigma Z_r = 10.6(.75)^2(4) = 23.85 \text{ ft}$$



LIVE LOAD = HS 20 and Military
A36 steel
 $n = 10$
500,000 stress cycles



INPUT DATA FILE

*OLD DATACBA5
READY
*LIST

11 *B01EX.5 EXAMPLE NO.5 82-104-82 COMPOSITE CONTINUOUS UNIT WF WITH COVER PLATE
12 * NOT AN ACTUAL DESIGN --- FOR CASE PROJECT - TASK GROUP BRIDGES
13 1EXAMPLE NO.53HS20000 555 300 49902900 65000 23850
14 2 08000
15 31 82417 2 2 4 3 4 1
16 400 59917 82417
17 401W36X135W36X194
18 431 65417 82417
19 432 0000 10500
20 433 0000 1688
21 441 9500 58500 65417 82417
22 442 0000 10500 2000 10500
23 443 0000 625 0000 1688
24 451 9500 58500 82417
25 452 0000 78000 0000
26 453 0000 6500 0000
27 454 0000 1500 0000
28 455 0000 0000 0000
29 461 25000 50000 57500 75000
30 462 216 216 2126 216
31 32 104000 3 3 5 3 7 1
32 400 22500 81500 104000
33 401W36X194W36X135W36X194
34 431 17000 37000 104000
35 432 10500 0000 10500
36 433 1688 0000 1688
37 441 17000 27000 77000 87000 104000
38 442 10500 0000 10500 0000 10500
39 443 1688 0000 625 0000 1688
40 451 27000 77000 104000
41 452 0000 78000 0000
42 453 0000 6500 0000
43 454 0000 1500 0000
44 455 0000 0000 0000
45 461 7417 25000 32500 52000 71500 79000 96583
46 462 216 2126 216 216 216 2126 216
47 331

ready

IRUN BRHCBA

**THE ANALYSIS OF CONTINUOUS BEAMS FOR HIGHWAY BRIDGES
DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION**

INPUT NAME OF DATA FILE. - DATACBAS

**INPUT NAME OF OUTPUT FILE (1-8 CHARACTERS) OR
GIVE CARRIAGE RETURN IF OUTPUT IS TO COME TO TERMINAL. - OUTCBA**

12/06/79

FILE - OUTCBA

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THE ANALYSIS OF CONTINUOUS BEAMS FOR HIGHWAY BRIDGES
DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

PROB. NO. EX.5

*** 05/29/79***
10.85

EXAMPLE NO.5 82-104-82 COMPOSITE CONTINUOUS UNIT WF WITH COVER PLATE
NOT AN ACTUAL DESIGN --- FOR CASE PROJECT - TASK GROUP BRIDGES

BEAM IDENTITY	NO. OF SPANS	LIVE LOAD CLASS	BEAM TYPE	MDLNC	MDLC	MSW	WG	E	BM.SPAC.	SZR	ILO
EXAMPLE NO.5	3	HS20	COMP.ST'L.INT.	0.555	0.300	0.	490.0	29.00	6.5000	23.850	0

BEAM CONSTANTS

OPTIONAL BEAM CONSTANTS

DFM	DFVE	DFD	N	3N	LIVE LOAD USED	STRESS CYCLES	FY	FU	FC	FS
1.1818	1.1818	0.8000	10	30	TRIK LANE MIL.	500000	36.000	58.000	0.	0.

SPAN 1 INPUT DATA

M	S	L	W	NUMBER OF RANGES								W	BEAM SECTION TYPE
				BPL	CS	PN	PC	PNW	PHC	0	WFLG		
1	0	82.417	2	2	4	3	4	0	0	0	0	WFLG	

BEAM SECTION AND LOADS

CODE	RANGE 1	RANGE 2	RANGE 3	RANGE 4	RANGE 5	RANGE 6	RANGE 7	RANGE 8	RANGE 9	RANGE 10
400	59.917	82.417								
401	W36X135	W36X194								
431	65.417	82.417								
432	0.	10.500								
433	0.	1.688								
441	9.500	58.500	65.417	82.417						
442	0.	10.500	0.	10.500						
443	0.	0.625	0.	1.688						
451	9.500	58.500	82.417							

452	0.	78.000	0.
453	0.	6.500	0.
454	0.	1.500	0.
455	0.	0.	0.
461	25.000	50.000	75.000
462	0.216	0.216	0.216

EXAMPLE NO.5

SPAN 2 INPUT DATA

M	S	L	*	NUMBER OF RANGES				* BEAM SECTION TYPE				
				BPL	CS	PN	PC	PN	PC	PN	PC	
2	0	104.000	3	3	5	3	7	0	0	0	0	WFLG

BEAM SECTION AND LOADS

CODE	RANGE 1	RANGE 2	RANGE 3	RANGE 4	RANGE 5	RANGE 6	RANGE 7	RANGE 8	RANGE 9	RANGE 10
400	22.500	81.500	104.000							
401	W36X194	W36X135	W36X194							
431	17.000	87.000	104.000							
432	10.500	0.	10.500							
433	1.688	0.	1.688							
441	17.000	27.000	77.000	87.000	104.000					
442	10.500	0.	10.500	0.	10.500					
443	1.688	0.	0.625	0.	1.688					
451	27.000	77.000	104.000							
452	0.	78.000	0.							
453	0.	6.500	0.							
454	0.	1.500	0.							
455	0.	0.	0.							
461	7.417	25.000	32.500	52.000	71.500	79.000	96.583			
462	0.216	2.126	0.216	0.216	0.216	2.126	0.216			

SPAN 3 INPUT DATA SAME AS SPAN 1 INPUT DATA

EXAMPLE NO.5

BEAM SECTION PROPERTIES AT SPAN TWENTIETH POINTS
NON-COMPOSITE

S.P.T	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I	S.P.T	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I
-------	-------	---	-------	-------	-------	-----	-------	-------	---	-------	-------	-------	-----

SPAN	DL	KL	KLM	CLR	CLRM	CRL	KRM	KR	DR	SM.TS	SM.TC	Q/I
1.00	35.55	7820.0	439.9	439.9	0.	1.05	35.55	7820.0	439.9	439.9	0.	0.
1.10	35.55	7820.0	439.9	439.9	0.	1.15	35.55	9663.3	610.1	475.2	0.	0.
1.20	35.55	9663.3	610.1	475.2	0.	1.25	35.55	9663.3	610.1	475.2	0.	0.
1.30	35.55	9663.3	610.1	475.2	0.	1.35	35.55	9663.3	610.1	475.2	0.	0.
1.40	35.55	9663.3	610.1	475.2	0.	1.45	35.55	9663.3	610.1	475.2	0.	0.
1.50	35.55	9663.3	610.1	475.2	0.	1.55	35.55	9663.3	610.1	475.2	0.	0.
1.60	35.55	9663.3	610.1	475.2	0.	1.65	35.55	9663.3	610.1	475.2	0.	0.
1.70	35.55	9663.3	610.1	475.2	0.	1.75	36.48	12100.0	663.4	663.4	0.	0.
1.80	36.48	25018.5	1255.4	1255.4	0.	1.85	36.48	25018.5	1255.4	1255.4	0.	0.
1.90	36.48	25018.5	1255.4	1255.4	0.	1.95	36.48	25018.5	1255.4	1255.4	0.	0.
2.00	36.48	25018.5	1255.4	1255.4	0.							
2.10	36.48	25018.5	1255.4	1255.4	0.	2.05	36.48	25018.5	1255.4	1255.4	0.	0.
2.20	36.48	12100.0	663.4	663.4	0.	2.15	36.48	25018.5	1255.4	1255.4	0.	0.
2.30	35.55	9663.3	610.1	475.2	0.	2.25	35.55	7820.0	439.9	439.9	0.	0.
2.40	35.55	9663.3	610.1	475.2	0.	2.35	35.55	9663.3	610.1	475.2	0.	0.
2.50	35.55	9663.3	610.1	475.2	0.	2.45	35.55	9663.3	610.1	475.2	0.	0.
2.60	35.55	9663.3	610.1	475.2	0.	2.55	35.55	9663.3	610.1	475.2	0.	0.
2.70	35.55	9663.3	610.1	475.2	0.	2.65	35.55	9663.3	610.1	475.2	0.	0.
2.80	36.48	12100.0	663.4	663.4	0.	2.75	35.55	7820.0	439.9	439.9	0.	0.
2.90	36.48	25018.5	1255.4	1255.4	0.	2.85	36.48	25018.5	1255.4	1255.4	0.	0.
3.00	36.48	25018.5	1255.4	1255.4	0.	2.95	36.48	25018.5	1255.4	1255.4	0.	0.
3.10	36.48	25018.5	1255.4	1255.4	0.	3.05	36.48	25018.5	1255.4	1255.4	0.	0.
3.20	36.48	25018.5	1255.4	1255.4	0.	3.15	36.48	25018.5	1255.4	1255.4	0.	0.
3.30	35.55	9663.3	610.1	475.2	0.	3.25	36.48	12100.0	663.4	663.4	0.	0.
3.40	35.55	9663.3	610.1	475.2	0.	3.35	35.55	9663.3	610.1	475.2	0.	0.
3.50	35.55	9663.3	610.1	475.2	0.	3.45	35.55	9663.3	610.1	475.2	0.	0.
3.60	35.55	9663.3	610.1	475.2	0.	3.55	35.55	9663.3	610.1	475.2	0.	0.
3.70	35.55	9663.3	610.1	475.2	0.	3.65	35.55	9663.3	610.1	475.2	0.	0.
3.80	35.55	9663.3	610.1	475.2	0.	3.75	35.55	9663.3	610.1	475.2	0.	0.
3.90	35.55	7820.0	439.9	439.9	0.	3.85	35.55	9663.3	610.1	475.2	0.	0.
4.00	35.55	7820.0	439.9	439.9	0.	3.95	35.55	7820.0	439.9	439.9	0.	0.

SPAN PROPERTIES

SPAN	DL	KL	KLM	CLR	CLRM	CRL	KRM	KR	DR
1	1.000000	0.004933	0.004031	0.683730	0.328931	0.	0.440870	0.007650	0.518917
2	0.481083	0.006223	0.004955	0.615546	0.357201	0.357201	0.615546	0.006223	0.481083
3	0.518917	0.007650	0.005344	0.440870	0.	0.328931	0.683730	0.004031	1.000000

EXAMPLE NO. 5 BEAM SECTION PROPERTIES AT SPAN TWENTIETH POINTS
COMPOSITE N = 30

S.P.T	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I	S.P.T	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I
-------	-------	---	-------	-------	-------	-----	-------	-------	---	-------	-------	-------	-----

SPAN PROPERTIES

EXAMPLE NO. 5

BEAM SECTION PROPERTIES AT SPAN TWENTIETH POINTS
COMPOSITE N = 10

12/06/79

FILE - OUTCBA

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S.P.T	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I	S.P.T	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I
1.00	35.55	7820.0	439.9	439.9	0.	0.	1.05	35.55	7820.0	439.9	439.9	0.	0.
1.10	35.55	7820.0	439.9	439.9	0.	0.	1.15	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.20	35.55	25080.9	866.6	3468.0	1646.6	0.024221	1.25	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.30	35.55	25080.9	866.6	3468.0	1646.6	0.024221	1.35	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.40	35.55	25080.9	866.6	3468.0	1646.6	0.024221	1.45	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.50	35.55	25080.9	866.6	3468.0	1646.6	0.024221	1.55	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.60	35.55	25080.9	866.6	3468.0	1646.6	0.024221	1.65	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.70	35.55	25080.9	866.6	3468.0	1646.6	0.024221	1.75	36.48	12100.0	663.4	663.4	0.	0.
1.80	36.48	25018.5	1255.4	1255.4	0.	0.	1.85	36.48	25018.5	1255.4	1255.4	0.	0.
1.90	36.48	25018.5	1255.4	1255.4	0.	0.	1.95	36.48	25018.5	1255.4	1255.4	0.	0.
2.00	36.48	25018.5	1255.4	1255.4	0.	0.							
2.10	36.48	25018.5	1255.4	1255.4	0.	0.	2.05	36.48	25018.5	1255.4	1255.4	0.	0.
2.20	36.48	12100.0	663.4	663.4	0.	0.	2.15	36.48	25018.5	1255.4	1255.4	0.	0.
2.30	35.55	25080.9	866.6	3468.0	1646.6	0.024221	2.25	35.55	7820.0	439.9	439.9	0.	0.
2.40	35.55	25080.9	866.6	3468.0	1646.6	0.024221	2.35	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.50	35.55	25080.9	866.6	3468.0	1646.6	0.024221	2.45	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.60	35.55	25080.9	866.6	3468.0	1646.6	0.024221	2.55	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.70	35.55	25080.9	866.6	3468.0	1646.6	0.024221	2.65	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.80	36.48	12100.0	663.4	663.4	0.	0.	2.75	35.55	7820.0	439.9	439.9	0.	0.
2.90	36.48	25018.5	1255.4	1255.4	0.	0.	2.85	36.48	25018.5	1255.4	1255.4	0.	0.
3.00	36.48	25018.5	1255.4	1255.4	0.	0.	2.95	36.48	25018.5	1255.4	1255.4	0.	0.
3.10	36.48	25018.5	1255.4	1255.4	0.	0.	3.05	36.48	25018.5	1255.4	1255.4	0.	0.
3.20	36.48	25018.5	1255.4	1255.4	0.	0.	3.15	36.48	25018.5	1255.4	1255.4	0.	0.
3.30	35.55	25080.9	866.6	3468.0	1646.6	0.024221	3.25	36.48	12100.0	663.4	663.4	0.	0.
3.40	35.55	25080.9	866.6	3468.0	1646.6	0.024221	3.35	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.50	35.55	25080.9	866.6	3468.0	1646.6	0.024221	3.45	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.60	35.55	25080.9	866.6	3468.0	1646.6	0.024221	3.55	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.70	35.55	25080.9	866.6	3468.0	1646.6	0.024221	3.65	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.80	35.55	25080.9	866.6	3468.0	1646.6	0.024221	3.75	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.90	35.55	7820.0	439.9	439.9	0.	0.	3.85	35.55	25080.9	866.6	3468.0	1646.6	0.024221
4.00	35.55	7820.0	439.9	439.9	0.	0.	3.95	35.55	7820.0	439.9	439.9	0.	0.

SPAN PROPERTIES

SPAN	DL	KL	KLM	CLR	CLRM	CRL	KRM	KR	DR
1	1.000000	0.006976	0.006223	0.501201	0.230290	0.	0.007829	0.009582	0.540524
2	0.459476	0.007401	0.006655	0.502574	0.291240	0.366895	0.006655	0.007601	0.459476
3	0.540524	0.009582	0.007829	0.366895	0.	0.230290	0.006223	0.006976	1.000000

EXAMPLE NO.5

MOMENTS(KIP-Feet) AT SPAN TENTH AND MISC. POINTS

* NON-COMPOSITE DEAD LOADS	* COMPOSITE DEAD LOADS	* LIVE LOADS	* TOTALS
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12/06/79			FILE - OUTCBA			12:35			PAGE 6				
S.P	BEAM	PN	MDLNC	MPN	TOT.NC * PC	WDLC	NPC	TOT.C * SHK.+	SHK.-	LL+I +	LL+I - *	MAX.+	MAX.-
1.1	31.2	2.0	111.5	0.	144.7	0.	63.3	0.	63.3	0.	323.5 T	-48.3 T	531.4
1.2	52.6	4.0	185.2	0.	241.8	0.	106.2	0.	106.2	0.	545.2 T	-96.5 T	893.3
1.3	63.4	6.0	221.3	0.	290.6	0.	128.7	0.	128.7	0.	670.5 T	-144.8 T	1089.9
1.4	63.4	6.2	219.6	0.	289.3	0.	130.9	0.	130.9	0.	727.5 T	-193.1 T	1147.7
1.5	52.7	6.5	180.3	0.	239.4	0.	112.7	0.	112.7	0.	715.6 T	-241.3 T	1067.7
1.6	31.3	6.7	103.3	0.	141.2	0.	74.1	0.	74.1	0.	646.1 T	-289.6 T	861.4
1.7	30.9	4.8	111.5	0.	77.5	0.	15.1	0.	15.1	0.	506.6 T	-337.9 T	514.1
1.8	-44.0	-14.3	-163.9	0.	-222.2	0.	-64.3	0.	-64.3	0.	318.4 T	-386.2 T	31.9
1.9	-105.2	-33.4	-354.0	0.	-492.6	0.	-164.0	0.	-164.0	0.	127.8 M	-440.4 L	-528.8
2.0	-187.7	-54.1	-581.9	0.	-823.6	0.	-284.1	0.	-284.1	0.	106.9 T	-688.0 L	-1000.9
2.1	-91.0	-27.0	-311.7	0.	-429.7	0.	-138.1	0.	-138.1	0.	133.9 M	-367.0 L	-433.9
2.2	-27.4	-1.5	-101.6	0.	-130.5	0.	-24.5	0.	-24.5	0.	343.0 T	-272.3 T	188.0
2.3	14.9	10.8	48.4	0.	74.1	0.	56.6	0.	56.6	0.	556.7 T	-224.9 T	685.4
2.4	40.5	12.2	138.5	0.	191.2	0.	105.2	0.	105.2	0.	686.4 T	-198.2 L	982.8
2.5	49.0	13.3	168.5	0.	230.8	0.	121.5	0.	121.5	0.	720.9 T	-198.2 L	1073.2
2.6	40.5	12.2	138.5	0.	191.2	0.	105.2	0.	105.2	0.	686.4 T	-198.2 L	982.8
2.7	14.9	10.8	48.4	0.	74.1	0.	56.6	0.	56.6	0.	556.7 T	-224.9 T	685.4
2.8	-27.4	-1.5	-101.6	0.	-130.5	0.	-24.5	0.	-24.5	0.	343.0 T	-272.3 T	188.0
2.9	-91.0	-27.0	-311.7	0.	-429.7	0.	-138.1	0.	-138.1	0.	133.9 M	-367.0 L	-433.9
3.0	-187.7	-54.1	-581.9	0.	-823.6	0.	-284.1	0.	-284.1	0.	106.9 T	-688.0 L	-1000.9
3.1	-105.2	-33.4	-354.0	0.	-492.6	0.	-164.0	0.	-164.0	0.	127.8 M	-440.4 L	-528.8
3.2	-44.0	-14.3	-163.9	0.	-222.2	0.	-64.3	0.	-64.3	0.	318.4 T	-386.2 T	31.9
3.3	-0.9	4.8	111.5	0.	-7.5	0.	15.1	0.	15.1	0.	506.6 T	-337.9 T	514.1
3.4	31.3	6.7	103.3	0.	141.2	0.	74.1	0.	74.1	0.	646.1 T	-289.6 T	861.4
3.5	52.7	6.5	180.3	0.	239.4	0.	112.7	0.	112.7	0.	715.6 T	-241.3 T	1067.7
3.6	63.4	6.2	219.6	0.	289.3	0.	130.9	0.	130.9	0.	727.5 T	-193.1 T	1147.7
3.7	63.4	6.0	221.3	0.	290.6	0.	128.7	0.	128.7	0.	670.5 T	-144.8 T	1089.9
3.8	52.6	4.0	185.2	0.	241.8	0.	106.2	0.	106.2	0.	545.2 T	-96.5 T	893.3
3.9	31.2	2.0	111.5	0.	144.7	0.	63.3	0.	63.3	0.	323.5 T	-48.3 T	531.4
1.115					162.7								178.2
1.710					-27.1								-360.7
1.727					-60.2								-414.8
1.794					-205.6								-648.2
2.163					-228.8								-574.9
2.216					-91.5								-288.0
2.260					2.6								-208.8
2.740					2.6								-208.8
2.784					-91.5								-365.5
2.837					-228.8								-574.9
2.206					-205.6								-648.2

-60.2
-27.1
162.7

STRESSES AT SPAN TENTH AND MISCELLANEOUS POINTS

ESSES (	L. POS	BO	ST
94	-14	-14	94
85	-13	-13	85
85	-16	-16	85
66	-17	-17	66
64	-16	-16	64
74	-16	-16	74
92	-12	-12	92
93	-7	-7	93
05	-	-	05
54	5	5	54
66	9	9	66
47	4	4	47
00	-3	-3	00
19	-10	-10	19
85	-14	-14	85
57	-16	-16	57
85	-17	-17	85
19	-10	-10	19
00	-3	-3	00
47	4	4	47
66	9	9	66
54	5	5	54
05	-	-	05
03	-7	-7	03
92	-12	-12	92
74	-16	-16	74
64	-17	-17	64
66	-16	-16	66
85	-14	-14	85
94	-13	-13	94

EXAMPLE NO.5

STRESSES AT SPAN TENTH AND MISCELLANEOUS POINTS

S.P.T.	CONC.	STEEL	TOTAL DEAD LOAD		* ACTUAL STRESSES(P.SI)		* ALLOWABLE FATIGUE STRESSES(P.SI)		* BASE M. ADJ.		* BASE M. ADJ.		* BASE M. ADJ.		* BUTT WELD		* FLANGE	
			TOP	BOT.	TOP	BOT.	TOP	BOT.	TOP	BOT.	TOP	BOT.	TOP	BOT.	TOP	BOT.	TOP	BOT.
1.115	0	6378	-6378	0	16284	-16284	0	4860	-4860	20000	20000	17818	17818	20000	20000	20000	-20000	20000
1.115	35	4773	-4299	299	6029	-9328	-5	4580	-3528	20000	20000	20000	20000	20000	20000	20000	-20000	20000
1.710	4	-608	607	356	1084	-6290	-245	-1791	5139	20000	19812	7839	6879	17246	15134	-12567	-11416	11900
1.710	0	-516	516	0	12676	-12676	0	-9838	9838	20000	20000	7037	7037	15483	15483	11846	-11612	20000
1.727	0	-1760	1760	0	10653	-10653	0	-11313	11313	18540	18540	6437	6437	14163	14163	-10859	10898	20000
1.727	0	-1167	1167	0	7065	-7065	0	-7502	7502	18540	18540	6437	6437	14163	14163	-10859	10898	20000
1.794	0	-4781	4781	0	1314	-1314	0	-11724	11724	20000	20000	11239	11239	20000	20000	-16081	18190	20000
1.794	0	-2526	2526	0	694	-694	0	-6195	6195	20000	20000	11239	11239	20000	20000	-16081	18190	20000
2.163	0	-2782	2782	0	-405	405	0	-5495	5495	20000	20000	13496	13496	20000	20000	-18025	20000	20000
2.163	0	-5266	5266	0	-767	767	0	-10399	10399	20000	20000	13496	13496	20000	20000	-18025	20000	20000
2.216	0	-1819	1819	0	5209	-5209	0	-6611	6611	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.216	0	-2744	2744	0	7855	-7855	0	-9969	9969	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.260	0	828	-828	0	13688	-13688	0	-5694	5694	20000	20000	8827	8827	19420	19420	14609	-13673	20000
2.260	13	325	-479	357	1956	-7008	-160	-501	2831	20000	20000	9948	8903	20000	19586	16294	-13754	14142
2.740	0	828	-828	0	13688	-13688	0	-5694	5694	20000	20000	8827	8827	19420	19420	14609	-13673	20000
2.784	0	-2744	2744	0	7855	-7855	0	-9969	9969	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.784	0	-1819	1819	0	5209	-5209	0	-6611	6611	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.837	0	-5266	5266	0	-767	767	0	-10399	10399	20000	20000	13496	13496	20000	20000	-18025	20000	20000
2.837	0	-2782	2782	0	-405	405	0	-5495	5495	20000	20000	13496	13496	20000	20000	-18025	20000	20000
3.206	0	-2526	2526	0	694	-694	0	-6195	6195	20000	20000	11239	11239	20000	20000	-16081	18190	20000
3.206	0	-4781	4781	0	1314	-1314	0	-11724	11724	20000	20000	11239	11239	20000	20000	-16081	18190	20000
3.273	0	-1167	1167	0	7065	-7065	0	-7502	7502	18540	18540	6437	6437	14163	14163	-10859	10898	20000
3.273	0	-1760	1760	0	10653	-10653	0	-11313	11313	18540	18540	6437	6437	14163	14163	-10859	10898	20000
3.290	0	-516	516	0	12676	-12676	0	-9838	9838	20000	20000	7037	7037	15483	15483	11846	-11612	20000
3.290	4	-608	607	356	1084	-6290	-245	-1791	5139	20000	19812	7839	6879	17246	15134	-12567	-11416	11900
3.885	35	4773	-4299	299	6029	-9328	-5	4580	-3528	20000	20000	20000	20000	20000	20000	20000	-20000	20000
3.885	0	6378	-6378	0	16284	-16284	0	4860	-4860	20000	20000	17818	17818	20000	20000	20000	-20000	20000

EXAMPLE NO.5

SHEARS(KIPS) AND SHEAR CONNECTOR SPACINGS(INCHES) AT SPAN TENTH POINTS AND REACTIONS(KIPS)

S.P.T.	BEAM	PN	WN	WPN	* DEAD LOADS		* LIVE LOADS		* MAXIMUM LL SHEAR		* RANGE		* SHEAR		* CON.SP.	
					TOT.C	TOT.DL	SKW.+	SKW.-	LL+I	LL+I	V	OR	R	RANGE	CON.SP.	CON.SP.
1.00	4.345	0.242	15.811	0.	8.915	29.313	0.	0.	45.569	T	-6.194	T	74.881	51.763	0.	0.
1.10	3.229	0.242	11.237	0.	6.443	21.150	0.	0.	39.562	T	-6.332	L	60.712	45.895	0.	0.

SPAN 1	V LANE = 17.751	V 14 FT. = 18.620
SPAN 3	V LANE = 17.751	V 14 FT. = 18.620

DEAD LOAD DEFLECTIONS(INCHES) AT SPAN TWENTIETH POINTS

EXAMPLE NO. 5

	S.P.T	BEAM	PN	WN	MPN	TOT.NC	TOT.C	TOP.DL
0.004	0.039	0.004	0.136	0.	0.178	0.058	0.227	
0.010	0.109	0.010	0.379	0.	0.498	0.130	0.629	
0.016	0.150	0.016	0.557	0.	0.734	0.190	0.924	
0.025	0.225	0.025	0.851	0.	1.062	0.262	1.324	
0.039	0.355	0.039	1.385	0.	1.658	0.412	2.070	
0.050	0.440	0.050	1.750	0.	2.122	0.522	2.644	
0.061	0.535	0.061	2.151	0.	2.566	0.616	3.182	
0.072	0.629	0.072	2.579	0.	2.990	0.702	3.692	
0.081	0.709	0.081	2.939	0.	3.390	0.782	4.172	
0.087	0.772	0.087	3.222	0.	3.666	0.846	4.512	
0.093	0.829	0.093	3.469	0.	3.919	0.899	4.818	
0.102	0.881	0.102	3.690	0.	4.140	0.942	5.082	
0.109	0.920	0.109	3.885	0.	4.335	0.974	5.309	
0.115	0.957	0.115	4.057	0.	4.507	1.006	5.515	
0.125	1.016	0.125	4.325	0.	4.775	1.059	5.834	
0.136	1.062	0.136	4.579	0.	4.990	1.102	6.056	
0.150	1.122	0.150	4.851	0.	5.222	1.155	6.377	
0.165	1.179	0.165	5.115	0.	5.444	1.207	6.684	
0.179	1.240	0.179	5.369	0.	5.644	1.259	6.978	
0.190	1.292	0.190	5.600	0.	5.822	1.311	7.259	
0.202	1.335	0.202	5.800	0.	5.974	1.363	7.518	
0.216	1.379	0.216	6.000	0.	6.116	1.415	7.754	
0.225	1.400	0.225	6.150	0.	6.266	1.467	7.976	
0.235	1.420	0.235	6.300	0.	6.400	1.519	8.182	
0.244	1.440	0.244	6.420	0.	6.520	1.571	8.374	
0.254	1.459	0.254	6.540	0.	6.630	1.623	8.554	
0.264	1.478	0.264	6.660	0.	6.740	1.675	8.722	
0.274	1.497	0.274	6.780	0.	6.850	1.727	8.878	
0.284	1.516	0.284	6.900	0.	6.960	1.779	9.022	
0.294	1.535	0.294	7.020	0.	7.070	1.831	9.154	
0.304	1.554	0.304	7.140	0.	7.180	1.883	9.286	
0.314	1.573	0.314	7.260	0.	7.290	1.935	9.418	
0.324	1.592	0.324	7.380	0.	7.400	1.987	9.540	
0.334	1.611	0.334	7.500	0.	7.510	2.039	9.662	
0.344	1.630	0.344	7.620	0.	7.620	2.091	9.784	
0.354	1.649	0.354	7.740	0.	7.730	2.143	9.906	
0.364	1.668	0.364	7.860	0.	7.840	2.195	10.028	
0.374	1.687	0.374	7.980	0.	7.950	2.247	10.150	
0.384	1.706	0.384	8.100	0.	8.060	2.299	10.272	
0.394	1.725	0.394	8.220	0.	8.170	2.351	10.394	
0.404	1.744	0.404	8.340	0.	8.280	2.403	10.516	
0.414	1.763	0.414	8.460	0.	8.390	2.455	10.638	
0.424	1.782	0.424	8.580	0.	8.500	2.507	10.760	
0.434	1.801	0.434	8.700	0.	8.610	2.559	10.882	
0.444	1.820	0.444	8.820	0.	8.720	2.611	11.004	
0.454	1.839	0.454	8.940	0.	8.830	2.663	11.126	
0.464	1.858	0.464	9.060	0.	8.940	2.715	11.248	
0.474	1.877	0.474	9.180	0.	9.050	2.767	11.370	
0.484	1.896	0.484	9.300	0.	9.160	2.819	11.492	
0.494	1.915	0.494	9.420	0.	9.270	2.871	11.614	
0.504	1.934	0.504	9.540	0.	9.380	2.923	11.736	
0.514	1.953	0.514	9.660	0.	9.490	2.975	11.858	
0.524	1.972	0.524	9.780	0.	9.600	3.027	11.980	
0.534	1.991	0.534	9.900	0.	9.710	3.079	12.102	
0.544	2.010	0.544	10.020	0.	9.820	3.131	12.224	
0.554	2.029	0.554	10.140	0.	9.930	3.183	12.346	
0.564	2.048	0.564	10.260	0.	10.040	3.235	12.468	
0.574	2.067	0.574	10.380	0.	10.150	3.287	12.590	
0.584	2.086	0.584	10.500	0.	10.260	3.339	12.712	
0.594	2.105	0.594	10.620	0.	10.370	3.391	12.834	
0.604	2.124	0.604	10.740	0.	10.480	3.443	12.956	
0.614	2.143	0.614	10.860	0.	10.590	3.495	13.078	
0.624	2.162	0.624	10.980	0.	10.700	3.547	13.200	
0.634	2.181	0.634	11.100	0.	10.810	3.599	13.322	
0.644	2.200	0.644	11.220	0.	10.920	3.651	13.444	
0.654	2.219	0.654	11.340	0.	11.030	3.703	13.566	
0.664	2.238	0.664	11.460	0.	11.140	3.755	13.688	
0.674	2.257	0.674	11.580	0.	11.250	3.807	13.810	
0.684	2.276	0.684	11.700	0.	11.360	3.859	13.932	
0.694	2.295	0.694	11.820	0.	11.470	3.911	14.054	
0.704	2.314	0.704	11.940	0.	11.580	3.963	14.176	
0.714	2.333	0.714	12.060	0.	11.690	4.015	14.298	
0.724	2.352	0.724	12.180	0.	11.800	4.067	14.420	
0.734	2.371	0.734	12.300	0.	11.910	4.119	14.542	
0.744	2.390	0.744	12.420	0.	12.020	4.171	14.664	
0.754	2.409	0.754	12.540	0.	12.130	4.223	14.786	
0.764	2.428	0.764	12.660	0.	12.240	4.275	14.908	
0.774	2.447	0.774	12.780	0.	12.350	4.327	15.030	
0.784	2.466	0.784	12.900	0.	12.460	4.379	15.152	
0.794	2.485	0.794	13.020	0.	12.570	4.431	15.274	
0.804	2.504	0.804	13.140	0.	12.680	4.483	15.396	
0.814	2.523	0.814	13.260	0.	12.790	4.535	15.518	
0.824	2.542	0.824	13.380	0.	12.900	4.587	15.640	
0.834	2.561	0.834	13.500	0.	13.010	4.639	15.762	
0.844	2.580	0.844	13.620	0.	13.120	4.691	15.884	
0.854	2.599	0.854	13.740	0.	13.230	4.743	16.006	
0.864	2.618	0.864	13.860	0.	13.340	4.795	16.128	
0.874	2.637	0.874	13.980	0.	13.450	4.847	16.250	
0.884	2.656	0.884	14.100	0.	13.560	4.899	16.372	
0.894	2.675	0.894	14.220	0.	13.670	4.951	16.494	
0.904	2.694	0.904	14.340	0.	13.780	5.003	16.616	
0.914	2.713	0.914	14.460	0.	13.890	5.055	16.738	
0.924	2.732	0.924	14.580	0.	14.000	5.107	16.860	
0.934	2.751	0.934	14.700	0.	14.110	5.159	16.982	
0.944	2.770	0.944	14.820	0.	14.220	5.211	17.104	
0.954	2.789	0.954	14.940	0.	14.330	5.263	17.226	
0.964	2.808	0.964	15.060	0.	14.440	5.315	17.348	
0.974	2.827	0.974	15.180	0.	14.550	5.367	17.470	
0.984	2.846	0.984	15.300	0.	14.660	5.419	17.592	
0.994	2.865	0.994	15.420	0.	14.770	5.471	17.714	
1.004	2.884	1.004	15.540	0.	14.880	5.523	17.836	

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SPAN	AT	LANE	TRUCK	MIL.	SIDENALK	L/800
1	0.500 L	0.607	0.742	0.532	0.	1.236
2	0.500 L	0.881	1.036	0.729	0.	1.560
3	0.500 L	0.607	0.742	0.532	0.	1.236

1.45	0.190	0.020	0.650	0.	0.859	0.224	1.083	1.50	0.181	0.019	0.617	0.	0.817	0.214	1.030
1.55	0.166	0.018	0.565	0.	0.749	0.197	0.946	1.60	0.147	0.016	0.498	0.	0.661	0.175	0.836
1.65	0.125	0.013	0.420	0.	0.558	0.149	0.707	1.70	0.101	0.010	0.337	0.	0.448	0.120	0.568
1.75	0.077	0.006	0.256	0.	0.339	0.090	0.429	1.80	0.055	0.003	0.182	0.	0.240	0.062	0.303
1.85	0.036	0.000	0.117	0.	0.153	0.038	0.191	1.90	0.019	-0.001	0.062	0.	0.080	0.018	0.098
1.95	0.007	-0.002	0.022	0.	0.027	0.004	0.031								
2.05	0.002	0.005	0.004	0.	0.010	0.009	0.019	2.10	0.012	0.012	0.036	0.	0.060	0.032	0.092
2.15	0.028	0.021	0.088	0.	0.137	0.064	0.201	2.20	0.049	0.032	0.156	0.	0.236	0.102	0.338
2.25	0.074	0.042	0.240	0.	0.355	0.143	0.498	2.30	0.099	0.051	0.328	0.	0.478	0.182	0.660
2.35	0.123	0.058	0.408	0.	0.589	0.216	0.804	2.40	0.141	0.064	0.471	0.	0.676	0.242	0.917
2.45	0.153	0.067	0.512	0.	0.731	0.258	0.989	2.50	0.157	0.068	0.526	0.	0.751	0.263	1.014
2.55	0.153	0.067	0.512	0.	0.731	0.258	0.989	2.60	0.141	0.064	0.471	0.	0.676	0.242	0.917
2.65	0.123	0.058	0.408	0.	0.589	0.216	0.804	2.70	0.099	0.051	0.328	0.	0.478	0.182	0.660
2.75	0.074	0.042	0.240	0.	0.355	0.143	0.498	2.80	0.049	0.032	0.156	0.	0.236	0.102	0.338
2.85	0.028	0.021	0.088	0.	0.137	0.064	0.201	2.90	0.012	0.012	0.036	0.	0.060	0.032	0.092
2.95	0.002	0.005	0.004	0.	0.010	0.009	0.019								
3.05	0.007	-0.002	0.022	0.	0.027	0.004	0.031	3.10	0.019	-0.001	0.062	0.	0.080	0.018	0.098
3.15	0.036	0.000	0.117	0.	0.153	0.038	0.191	3.20	0.055	0.003	0.182	0.	0.240	0.062	0.303
3.25	0.077	0.006	0.256	0.	0.339	0.090	0.429	3.30	0.101	0.010	0.337	0.	0.448	0.120	0.568
3.35	0.125	0.013	0.420	0.	0.558	0.149	0.707	3.40	0.147	0.016	0.498	0.	0.661	0.175	0.836
3.45	0.166	0.018	0.565	0.	0.749	0.197	0.946	3.50	0.181	0.019	0.617	0.	0.817	0.214	1.030
3.55	0.190	0.020	0.650	0.	0.859	0.224	1.083	3.60	0.193	0.020	0.661	0.	0.874	0.226	1.100
3.65	0.189	0.019	0.650	0.	0.858	0.222	1.080	3.70	0.179	0.018	0.615	0.	0.811	0.209	1.021
3.75	0.162	0.016	0.557	0.	0.734	0.190	0.924	3.80	0.138	0.013	0.478	0.	0.629	0.163	0.792
3.85	0.109	0.010	0.379	0.	0.498	0.130	0.629	3.90	0.076	0.007	0.264	0.	0.347	0.093	0.440
3.95	0.039	0.004	0.136	0.	0.178	0.048	0.227								

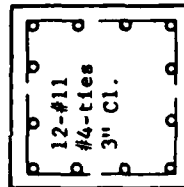
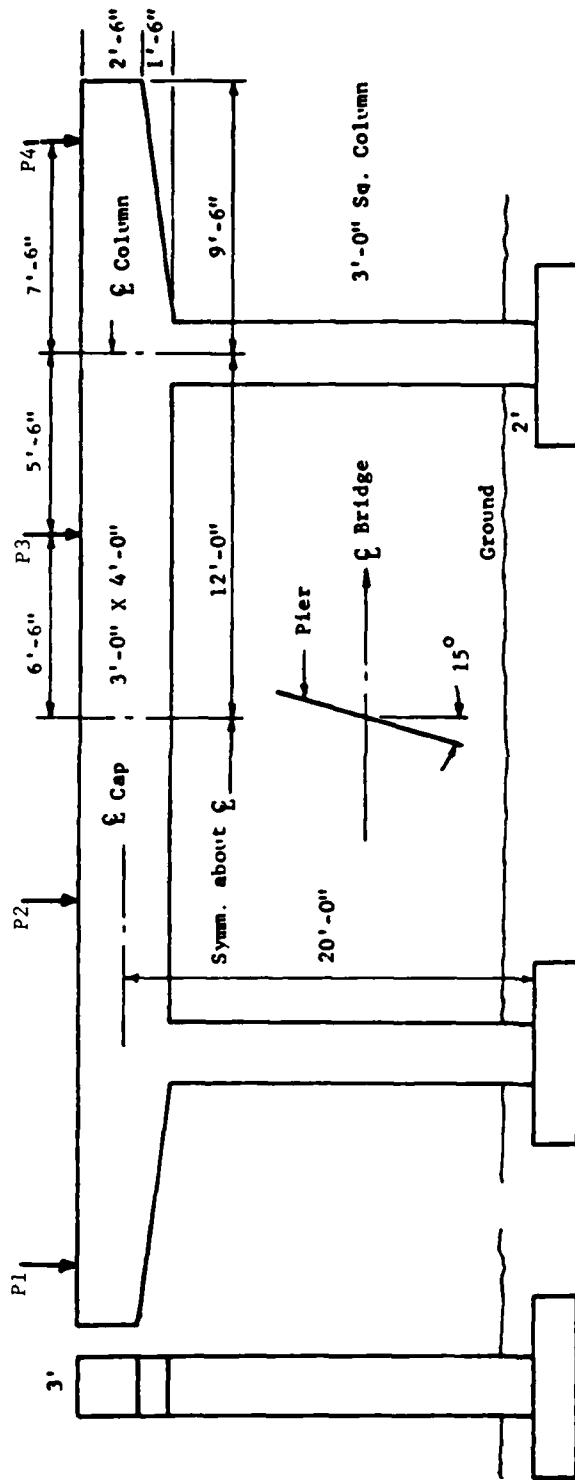
LIVE LOAD DEFLECTIONS(INCHES)

Example Problem for BRHMCP

This example is for illustrative purposes only and does not represent an actual design. It is a rather simple example; yet, it is also typical of most piers. First the pier description and loads are given or assumed. The input requirements are shown on the input data forms on page A24. The output data in reduced scale is given on pages A26-A29. Finally, a commentary is given following the output data. The following page contains a sketch of the pier.

Given Data

Column and cap members have a constant moment of inertia.
Columns are assumed fixed at bottom.
Footings are spread with a 5'-0" X 5'-0" X 2'-0" minimum size.
Soil bearing capacity is 8.0 kips per square foot.
Use 3" increments in footing design and limit either width to a maximum of $1\frac{1}{2}$ times the other width.
Soil weighs 120 pounds per cubic foot.
A column stress analysis and footing design are desired.
Centroid of superstructure area is 6'-0" above center line of cap.
For Group II Wind, Group III Wind, and Wind on Live Load use 0° and 60° wind skew angles.
Expansion coefficient equals 3.0×10^{-4} .
Shrinkage coefficient equals 4.4×10^{-4} .
Wind on substructure (equivalent at center line of cap) is 2.424 kips in transverse direction, and 8.360 kips in longitudinal direction.
Longitudinal Force (Traction) is 4.9 kips (one lane).
Centrifugal and Friction forces are not applicable.
Dead load from superstructure and live load cases are given on following page.
Live load impact is 20%.
Lengths for Wind on Live Load are 100.0 (transverse) and 200.0 (longitudinal) feet.
Location of Wind on Live Load and Traction is 11.500 feet above center line of cap.



Column Cross Section

Gravity Load	P ₁	P ₂	P ₃	P ₄	No. Lanes
Dead Load Superstructure	100.0	100.0	100.0	100.0	-
Live Load 1001	45.0	15.0	15.0	45.0	2
Live Load 0110	10.0	50.0	50.0	10.0	2
Live Load 1010	45.0	25.0	40.0	10.0	2
Live Load 0101	10.0	40.0	25.0	45.0	2
Live Load 010	0.0	30.0	30.0	0.0	1

INPUT DATA FILE

*OLD DATAMCP
READY
*LIST

100 *EX.1 EXAMPLE PIER PROBLEM NO. 1 TWO COLUMN PIER
110 122 5 15 0 02000 - FOR CASE PROJECT - TASK GROUP BRIDGES
120 21 01 20000 3000 3000 2000000002156 44205
130 22 1
140 31001 95001500 2500 3000 1500 8000 7500
150 321
160 4101 24000 4000 3000 550013000
170 510 5000 5000 2000 0250 0250 0250 1500 1500 8000 2000 0120
180 521
190 61 5000 1000050 01719 6000 6000 2424 8360
200 6250 01719 100 03438 1000 2000
210 63 4900 1150011500 30000 44000
220 7100D.L.100000100000100000100000
230 81 21001 45000 15000 15000 45000
240 81 20110 10000 50000 50000 10000
250 81 21010 45000 25000 40000 10000
260 81 20101 10000 40000 25000 45000
270 81 1010 0000 30000 30000 0000

ready

*

IRUN BRHMCP

**THE ANALYSIS OF MULTIPLE COLUMN PIERS FOR HIGHWAY BRIDGES
DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION**

INPUT NAME OF DATA FILE. - DATAMCP

**INPUT NAME OF OUTPUT FILE (1-8 CHARACTERS) OR
GIVE CARRIAGE RETURN IF OUTPUT IS TO COME TO TERMINAL. - OUTMCP**

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FILE - OUTMCP

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PAGE 1

THE ANALYSIS OF MULTIPLE COLUMN PIERS FOR HIGHWAY BRIDGES

PROB. NO. EX.1

12/05/79

DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

EXAMPLE PIER PROBLEM NO. 1 TWO COLUMN PIER

NC = 2, CA = 0, FD = 0, NLC = 5, SKEW ANGLE = 15 0 0, I = 20.00% - FOR CASE PROJECT - TASK GROUP BRIDGES

COLUMN DATA

N	P	S	C	V	R	HT	A	DT	BT	DB	BB	DL	FLEX	ND	AS	MB	T	ND	AS	MB	T	SL
1	0	0	1	0	0	20.000	0.	3.000	3.000	0.	0.	2.000	0.	2	1.56	4	4.205	0	0.	0	0.	0.
2	0	1	0	0	0	0.	0.	0.	0.	0.	0.	0.	0.	0	0.	0	0.	0	0.	0	0.	0.

CANTILEVER DATA

N	S	C	L	P	C	A	DE	B	DM	LH	X1	X2	X3	X4	X5
1	0	0	1	0	0	9.500	1.500	3.000	1.500	8.000	7.500	0.	0.	0.	0.
2	1	0	0	0	0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

CAP DATA

N	S	C	L	P	S	A	DC	B	DH	LH	X1	X2	X3	X4	X5	X6	X7	X8
1	0	1	0	0	0	24.000	4.000	3.000	0.	0.	5.500	13.000	0.	0.	0.	0.	0.	0.

FOOTING DATA

N	S	B	D	TF	DEL	DEL	R	B/D	R	D/B	SBC	HS	WS	DELS
1	0	5.000	5.000	2.000	0.250	0.250	0.250	1.500	1.500	1.500	8.000	2.000	0.120	0.
2	1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

GROUP II WIND

SUPERSTRUCTURE AREA *		WIND ON SUPERSTRUCTURE INTENSITIES										* WIND FORCE ARM				* WIND ON PIER	
TRANS.	LONG.	FT1	FL1	FT2	FL2	FT3	FL3	FT4	FL4	FT5	FL5	APT	APL	PT	PL		
500.0	1000.0	50	0	17	19	0	0	0	0	0	0	6.000	6.000	2.424	8.360		

GROUP II WIND

WIND ON SUPERSTRUCTURE INTENSITIES * WIND ON LIVE LOAD INTENSITIES * L.L. LENGTHS

FT1 FL1	FT2 FL2	FT3 FL3	FT4 FL4	FT5 FL5	FT1 FL1	FT2 FL2	FT3 FL3	FT4 FL4	FT5 FL5	TRANS.	LONG.				
50	0	17	19	0	0	0	0	34	38	0	0	0	0	100.0	200.0

MISCELLANEOUS FORCES

TRACTION * CENTRIFUGAL * T.F..C.F..M.ON L.L.ARM * FRICTION * FRICTION FORCE ARM * EXPANSION * SHRINKAGE

FL	FT	APT	APL	FL	APT	APL	COEFF.
4.900	0.	11.500	11.500	0.	0.	0.	4.4000

DEAD LOAD SUPERSTRUCTURE AND LIVE LOAD CASES

LOAD CASE	NL	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
D.L. SUP.	100.000	100.000	100.000	100.000	100.000	0.	0.	0.	0.	0.	0.	0.
L.L. 1001	2	45.000	15.000	15.000	45.000	0.	0.	0.	0.	0.	0.	0.
L.L. 0110	2	10.000	50.000	50.000	10.000	0.	0.	0.	0.	0.	0.	0.
L.L. 1010	2	45.000	25.000	40.000	10.000	0.	0.	0.	0.	0.	0.	0.
L.L. 0101	2	10.000	40.000	25.000	45.000	0.	0.	0.	0.	0.	0.	0.
L.L. 010	1	0.	30.000	30.000	0.	0.	0.	0.	0.	0.	0.	0.

MULTIPLE COLUMN PIER PROBLEM EX.1 OUTPUT DATA EXAMPLE PIER PROBLEM NO. 1 TWO COLUMN PIER

COLUMN MOMENTS(KIP-Feet), SHEARS(KIPS), REACTIONS(KIPS)

LOAD	CN	PT	TRANVERSE						LONGITUDINAL					
			MT	V	PB	MB	R	MT	V	MB	MF			
UNIT F.A.T CL.CAP	1	0.384	4.611	0.500	0.384	5.389	0.384	1.000	0.500	10.000	10.000	10.000		
EXPANSION OF CAP	2	-0.384	4.611	0.500	-0.384	5.389	-0.384	1.000	0.500	10.000	10.000	10.000		
SHRINKAGE OF CAP	1	0.000	78.243	9.805	0.000	-117.853	0.000	0.000	0.000	0.000	0.000	0.000		
DEAD LOAD TOTAL	2	0.000	-114.756	-14.380	0.000	-172.852	0.000	0.000	0.000	0.000	0.000	0.000		
GROUP 2 WIND 1 1	1	16.247	122.523	13.286	-16.247	143.199	-16.247	34.242	7.415	167.716	167.716	167.716		
GROUP 2 WIND 1 2	2	-16.247	122.523	13.286	-16.247	143.199	-16.247	34.242	7.415	167.716	167.716	167.716		
GROUP 2 WIND 2 1	1	9.258	71.709	7.776	9.258	83.810	9.258	72.971	12.256	293.584	293.584	293.584		

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GROUP	WIND	2	2	2	2	2	2
GROUP 2 WIND 2 2	1	-9.258	71.709	7.776	-9.258	83.010	-9.258
TRACTION (1 LANE)	2	3.020	26.360	2.858	3.020	30.808	3.020
	2	-3.020	26.360	2.858	-3.020	30.808	-3.020
	2	1.095	5.848	0.634	1.095	6.834	1.095
	2	-1.095	5.848	0.634	-1.095	6.834	-1.095
GROUP 3 WIND 1 1	1	13.214	81.295	8.815	13.214	95.014	13.214
	2	-13.214	81.295	8.815	-13.214	95.014	-13.214
GROUP 3 WIND 1 2	1	13.214	81.295	8.815	13.214	95.014	13.214
	2	-13.214	81.295	8.815	-13.214	95.014	-13.214
GROUP 3 WIND 2 1	1	7.311	45.726	4.958	7.311	53.442	7.311
	2	-7.311	45.726	4.958	-7.311	53.442	-7.311
GROUP 3 WIND 2 2	1	2.043	13.981	1.516	2.043	16.340	2.043
	2	-2.043	13.981	1.516	-2.043	16.340	-2.043
LIVE LOAD 1001	1	60.000	-137.804	-10.335	60.000	-68.902	60.000
	2	60.000	137.804	10.335	60.000	68.902	60.000
LIVE LOAD 0110	1	60.000	68.915	-5.169	60.000	34.457	60.000
	2	60.000	-68.915	5.169	60.000	-34.457	60.000
LIVE LOAD 1010	1	83.412	-45.997	-2.583	83.412	-5.670	83.412
	2	36.588	22.892	2.583	36.588	28.775	36.588
LIVE LOAD 0101	1	83.412	-45.997	-2.583	83.412	-5.670	83.412
	2	36.588	22.892	2.583	36.588	28.775	36.588
LIVE LOAD 010	1	30.000	63.989	4.799	30.000	31.994	30.000
	2	-30.000	-63.989	-4.799	-30.000	-31.994	-30.000

CAP DATA

* AS(SQ.IN.) * SHEARS(KIPS) * SRP.SP.(IN.)* P * FC															
MOMENTS(KIP-FEET)															
POINT	D.L.	GR.1 +	GR.1 -	GR.3 +	GR.3 -	TOP	BOT.	D.L. LT.	D.L. RT.	GR.1 LT.	GR.1 RT.	LT.	RT.	IN.	PSD
C 1L	-812.775	-812.775	-1150.275	-812.775	-1150.275	17.80	3.12	-114.400	0.	-159.400	0.	14.23	36.00	31.15	1146
C 1R	-660.627	-660.627	-952.130	-619.745	-1045.121	14.59	3.12	0.	121.600	0.	171.600	36.00	10.85	33.20	1013
P 2	-19.052	112.033	-136.249	162.402	-186.619	3.12	3.12	111.700	11.700	161.700	25.112	18.55	36.00	29.61	286
P 3	-19.052	112.033	-136.249	162.402	-186.619	3.12	3.12	-111.700	-11.700	-25.112	-161.700	36.00	18.55	29.61	286
C 2L	-660.627	-660.627	-952.130	-619.745	-1045.121	14.59	3.12	-121.600	0.	-171.600	0.	10.85	36.00	33.20	1013
C 2R	-812.775	-812.775	-1150.275	-812.775	-1150.275	17.80	3.12	0.	114.400	0.	159.400	36.00	14.23	31.15	1146

COLUMN STRESS ANALYSIS DATA

POINT	CASE	GR	LLC	WD	WC	M	ML	MT	P	EL	ET	FS	F3	F4	F2	F1	FE	R
TOP 1 MAX.FC	3	1001	2	1R	C	129.399	347.372	286.499	0.151	0.504	-8020	-1054	-464	-464	513	1103	1500	0.736
TOP 1 MAX.FS	5	5	1R	C	34.242	-389.427	219.753	257.280	0.032	0.362	-11191	-1402	-1219	-1219	840	1023	28000	0.400
BOT.1 MAX.FC	5	5	2R	C	350.783	-279.734	257.280	0.454	0.390	0.362	-14427	-1837	63	63	-358	1543	1680	0.918
BOT.1 MAX.FS	5	5	2R	C	293.584	-332.736	251.742	0.151	0.504	-8020	-1054	-464	-464	-464	513	1103	1500	0.736
TOP 2 MAX.FC	3	1001	2	1C	129.399	347.372	286.499	0.151	0.504	-8020	-1054	-464	-464	-464	513	1103	1500	0.736
TOP 2 MAX.FS	5	5	1C	C	34.242	-389.427	219.753	0.032	0.362	-11191	-1402	-1219	-1219	-1219	840	1023	28000	0.400
BOT.2 MAX.FC	5	5	2C	C	350.783	-279.734	257.280	0.454	0.390	0.362	-14427	-1837	63	63	-358	1543	1680	0.918

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801.2 MAX.FS 5 S 2 1 C 293.584 332.736 251.042 0.390 0.442 -14445 -1838 -269 -32 1536 28000 0.516

FOOTING DESIGN LOADS

FOOT GR	LLC	MD	MC	ML	MT	P	VL	VT	SBC	F3	F4	F2	F1	M/FT.	V/FT.
1 MT 3	1010	2	2R	383.807	-83.470	329.957	13.180	-13.812	10000	152	7500	2142	9489	29.551	10.328
1 ML 4	S	1001	0	0.	-306.344	310.300	0.	-34.404	10000	1204	1204	7924	7924	27.478	9.596
1 UL 5	S	2	1	293.584	332.736	251.042	12.256	33.567	11200	-3358	2908	4413	10680	23.013	8.077

FOOTING 2 IDENTICAL TO FOOTING 1

FOOTING DESIGN DATA

FOOTING DIMENSIONS				LONGITUDINAL				TRANSVERSE					
FOOT	B	D	T	AS/FT	P/FT	JD	FC	FS	AS/FT	P/FT	JD	FC	FS
1	8.750	8.750	2.000	0.75	2.33	19.012	696	25000	0.73	2.27	18.191	702	25000

FOOTING 2 IDENTICAL TO FOOTING 1

Example Problem for BRHGEO

Example 1 shows a two-span bridge located in a 3° curve. The four beams of each span are placed parallel to a centerline chord of that span, and the beams in the adjacent spans meet at a common point (concentric arc intersection) at the centerline of Bent 2. Bents 1 and 3 are parallel to Bent 2 and located by the known normal distances from Bent 2.

The Station of Bent 2 will be chosen as the Reference Point Station. Bents are placed parallel to the Y-axis by using a Reference Angle of 72° . The Limiting Stations are arbitrarily chosen as 19+00 and 21+00. The roadway surface is at a constant rate of superelevation. The curb faces and sidewalks are set up as lanes of superelevation. This requires that six lanes of superelevation be defined. The Vertical Curve Data and dimensions for defining the lanes of superelevation are given in the sketch along with the superelevation rates.

Two sets of Longitudinal Lines are defined in the problem. The beams of Span 1 are defined as PIA, and the beams of Span 2 are defined as PIB. Note that the centerline chord and beam lines are from the centerline of Bent 2 to the B.F.P.R. (Back Face Paving Rest) line of the end bents. The centerlines of the railings are defined for the purpose of computing lengths for rail spacings. In addition, the finished grade elevations at the intersection of the railing lines with the bents will be given. Since the centerline chord and gutter lines are used only as reference lines in this problem, these lines are coded to be skipped in the output data.

The centerline-of-bearings and diaphragms are set up as T-Lines in each span. The diaphragms of Span 1 are located at the one-third points of the centerline chord. The positions of the diaphragms in Span 2 are detailed in the sketch. The centerline-of-bearings in Span 1 are defined as "CONS/DIST" T-Lines. In Span 2 the centerline-of-bearings are defined as "PARL/DIST" T-Lines. Note that in many instances a T-Line can be defined by several combinations of T-Line Codes.

The purpose of this problem, in addition to the ones already stated, is to compute the following data.

1. Finished grade elevations at centerline-of-bearings.
2. Lengths of beams and diaphragms.
3. Position of diaphragms along each beam.
4. Distance between beams along bent lines.

Diaphragms are perpendicular to beams.
Beams are placed parallel to the centerline chord.
Beam spacings shown are concentric arc dimensions.
Entire bridge is in 3° curve.



INPUT DATA FILE

*OLD DATGEOM1
READY
*LIST

```

1 *EX.1 BRIDGE GEOMETRY - EXAMPLE PROBLEM NUMBER 1
2 *FOR CASE PROJECT - TASK GROUP BRIDGES
3 1 19000000 21000000 20000000 72000000
4 2 30000000
5 3 18000000
6 4 72000000 15000000
7 5 -16.5, -140833 10., -14., 10., 10., 14., 10., 140833 165000
8 6CONST -02500-120.0 06000 06000 120.00 02500
9 701RLG 8 25000 LT. RAILING
10 702PIA 9 120000 BEAM A
11 703PIA 9 40000 BEAM B
12 704ARC 00000 CENTERLINE
13 705PIA 9 -40000 BEAM C
14 706PIA 9 -120000 BEAM D
15 707RLG10 -25000 RT. RAILING
16 708ARC 140000 1LT. GUTTER
17 709CRD 00000 1CENTERLINE CHORD
18 710ARC -140000 1RT. GUTTER
19 711END
20 8SPAN 1 4 FIRST SPAN OF TWO SPAN BRIDGE YES
21 B1 1PARL 20000000 18000000 -6000000BFPR BT. 1
22 A 2PREV 20000000 CL. BT. 2
23 T01CONSDISTB 15000 CL. BRGS. BT.11 1 1
24 T02ANGLPROP 03333 9 9000000 DIAPHRAGM 1-1 1 1
25 T03ANGLPROP 06667 9 9000000 DIAPHRAGM 2-1 1 1
26 T04CONSDISTA -05000 CL.BRGS.BT.2BK1 1 1
27 701RLG 8 25000 LT. RAILING
28 702PIB 9 120000 BEAM A
29 703PIB 9 40000 BEAM B
30 704ARC 00000 CENTERLINE
31 705PIB 9 -40000 BEAM C
32 706PIB 9 -120000 BEAM D
33 707RLG10 -25000 RT. RAILING
34 708ARC 140000 1LT. GUTTER
35 709CRD 00000 1CENTERLINE CHORD
36 710ARC -140000 1RT. GUTTER
37 711END
38 8SPAN 2 4 LAST SECOND SPAN OF TWO SPAN BRIDGE
39 B SAME
40 A1 3PREV 6500000BFPR BT. 3
41 T01PARLDISTB 05000 9 CL.BRGS.BT.2AH1 1 1
42 T02ANGLDISTB 255000 2 9000000 DIAPHRAGM 1-2 1 1
43 T03ANGLDISTA -265000 6 9000000 DIAPHRAGM 2-2 1 1
44 T04PARLDISTA -15000 9 CL.BRGS. BT. 31 1 1
45 9

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ready

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BRUN BRHGE0

THE GEOMETRIC SOLUTION OF HIGHWAY BRIDGES
DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

INPUT NAME OF DATA FILE. - DATGEOM1

INPUT NAME OF OUTPUT FILE (1-8 CHARACTERS) OR
GIVE CARRIAGE RETURN IF OUTPUT IS TO COME TO TERMINAL. - OUTGEOM

8

12/05/79

BRIDGE GEOMETRY - EXAMPLE PROBLEM NUMBER 1
 FORCASE PROJECT - TASK GROUP BRIDGES

LOCATION DATA
 BACK STA. AHEAD STA. REF. STA. REF. ANGLE REF. DIST.
 1900.0000 2100.0000 2000.0000 72- 0- 0. 0.

HORIZONTAL CURVE DATA
 CURVE NO. 1 P.C. STA. CURVE NO. 2 P.T. STA. CURVE NO. 3
 0- 0- 0. 0. 3- 0- 0. 0. 0- 0- 0.

VERTICAL CURVE DATA
 PVI 1 STA. PVI 2 STA.
 1800.0000 0.
 EL. PVI 2 % GR. 2-1 LVC 1 % GR. 1-2 LVC 2 % GR. 2-3
 720.0000 1.500000 0. 0. 0. 0.

CROWN AND LANE DEFINITIONS
 CODE S.R.INS. S.R. 1 INS.PIV. S.R. 2 S.R. 3 S.R.4 S.R. 5 S.R. 6
 -16.5000 -14.0833 10.0000 -14.0000 10.0000 10.0000 14.0000 10.0000 14.0833 16.5000

SUPERELEVATION DATA
 DESC. AT STATION S.E. 1 S.E. 2 S.E. 3 S.E. 4 S.E. 5 S.E. 6
 CONST 0. -0.2500-120.0000 0.6000 0.6000 120.0000 0.2500

NO.	TYPE	REF.	LONGITUDINAL LINES				SK.	REMARKS
			DR / X1	STA. / Y1	TR / R	X2		
1	RLG	8	2.5000	0.	0.	0.	0	LT. RAILING
2	PIA	9	12.0000	0.	0.	0.	0	BEAM A
3	PIA	9	4.0000	0.	0.	0.	0	BEAM B
4	ARC	0	0.	0.	0.	0.	0	CENTERLINE
5	PIA	9	-4.0000	0.	0.	0.	0	BEAM C
6	PIA	9	-12.0000	0.	0.	0.	0	BEAM D
7	RLG	10	-2.5000	0.	0.	0.	0	RT. RAILING
8	ARC	0	14.0000	0.	0.	0.	1	LT. GUTTER
9	CRD	0	0.	0.	0.	0.	1	CENTERLINE CHORD

10 ARC 0 -14.0000 0. 0. 0. 1 RT. GUTTER
11 END

4 T-LINES				SPAN 1 INPUT DATA				BENT DATA				YES				
				FIRST SPAN OF TWO SPAN BRIDGE												
C NO.	TYPE	STATION	SKW ANGLE	STA./NORM.	REMARKS											
B 1	1	PARL	2000.0000	18- 0- 0.	-60.0000	BFR BT. 1	0	0	0	0	0	0	0	0	0	0
A 0	2	PREV	2000.0000	0- 0- 0.	0.	CL. BT. 2	0	0	0	0	0	0	0	0	0	0

				T-LINE DATA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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NO.	LINE CODE	B	S/N/D/P/X	RL	A/S/D/P/Y	B	RL	C																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
1	CONS/DIST	B	1.5000	0	0.	0	0	0	CL. BRGS. BT.1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

T-LINE DATA				LONGITUDINAL LINE SKIPS			
NO. LINE CODE	B	S/N/D/P/X	RL	A/S/D/P/Y	B	RL	C
1	CONS/DIST	B	1.5000	0	0.	0	0
2	ANGL/PROP	B	0.3333	9	90- 0- 0.	0	0
3	ANGL/PROP	B	0.6667	9	90- 0- 0.	0	0
4	CONS/DIST	A	-0.5000	0	0.	0	0

PROB. NO. EX.1

SPAN 1 OUTPUT DATA FIRST SPAN OF TWO SPAN BRIDGE

BT. NO.				BENT DATA				REMARKS				TYPE			
				STATION				SKW ANGLE							
B 1	1	19+37.2360	16-07-01.5	BFR BT. 1	1	PARL									
A 2	20+00.	18-00-00.	CL. BT. 2			PREV									

T-LINE				LONG. LINE 1 RLG LT. RAILING				ANGLE				REMARKS			
				STATION				ELEVATION							
B 1	1	19+32.5107	723.0710*	ST TO ML	DT TO BT	DT TO PP		16.5000	0.	0.	15-58-31.2	530.1790	1851.9639	BFR BT. 1	PARL
B 2	1	19+95.4860	724.0156*	ST TO ML	DT TO BT	DT TO PP		16.5000	63.5193	0.	0-00-00.	590.9459	1833.4784	CL. BT. 2	PREV

T-LINE				LONG. LINE 2 PIA BEAM A				ANGLE				REMARKS			
				STATION				ELEVATION							
B 1	1	19+33.7566	722.1124	ST TO ML	DT TO BT	DT TO PP		12.1208	0.	4.5555	-72-56-29.3	530.1790	1847.4084	BFR BT. 1	PARL
T 1	1	19+35.2669	722.1334	ST TO ML	DT TO BT	DT TO PP		12.0940	1.5000	0.	0-00-00.	531.6130	1846.9684	CL. BRGS. BT. 1	CONS/DIST
T 2	1	19+58.2201	722.4648	ST TO ML	DT TO BT	DT TO PP		11.8291	24.6184	0.	90-00-00.	553.7143	1860.1867	DIAPHRAGM 1-1	ANGL/PROP
T 3	1	19+79.0159	722.7767	ST TO ML	DT TO BT	DT TO PP		11.8291	45.5430	0.	90-00-00.	573.7183	1834.9485	DIAPHRAGM 2-1	ANGL/PROP
T 4	1	19+95.6298	723.0341	ST TO ML	DT TO BT	DT TO PP		11.9929	62.2611	0.	0-00-00.	589.7010	1829.1442	CL. BRGS. BT. 2BK	CONS/DIST
B 2	1	19+96.1266	723.0419	ST TO ML	DT TO BT	DT TO PP		12.0000	62.7611	4.5460	-72-56-29.3	590.1790	1828.9975	CL. BT. 2	PREV

T-LINE				LONG. LINE 3 PIA BEAM B				ANGLE				REMARKS			
				STATION				ELEVATION							
B 1	1	19+36.0711	721.7431	ST TO ML	DT TO BT	DT TO PP		4.0405	0.	8.4080	-72-56-29.3	530.1790	1839.0004	BFR BT. 1	PARL
T 1	1	19+37.5677	721.7643	ST TO ML	DT TO BT	DT TO PP		4.0155	1.5000	0.	0-00-00.	531.6130	1838.5604	CL. BRGS. BT. 1	CONS/DIST
T 2	1	19+58.1764	722.0622	ST TO ML	DT TO BT	DT TO PP		3.7911	22.1519	8.0381	90-00-00.	551.3564	1832.5022	DIAPHRAGM 1-1	ANGL/PROP
T 3	1	19+79.0596	722.3755	ST TO ML	DT TO BT	DT TO PP		3.7911	43.0765	8.0381	90-00-00.	571.3604	1826.3640	DIAPHRAGM 2-1	ANGL/PROP
T 4	1	19+98.2043	722.6727	ST TO ML	DT TO BT	DT TO PP		3.9922	62.2611	0.	0-00-00.	589.7010	1820.7362	CL. BRGS. BT. 2BK	CONS/DIST

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FILE - OUTGEO

.2:35

PAGE 3

B 2	19+98.7032	722.6805	4.0000	62.7611	8.4080	-72-56-29.3	590.1790	1820.5895	CL. BT. 2	PREV
T-LINE										
B 1	19+37.2360	721.5585	0.0000	0.	4.2054	16-07-01.5	530.1790	1834.7950	BFPR BT. 1	TYPE LINE
B 2	20+00.	722.5000	0.0000	62.7640	4.2054	18-00-00.	590.1790	1816.3841	CL. BT. 2	PREV
LONG. LINE 4 ARC CENTERLINE										
ST TO ML DT TO BT DT TO PP										
B 1	19+38.4062	721.3741	-4.0406	0.	4.2063	-72-56-29.3	530.1790	1830.5887	BFPR BT. 1	TYPE LINE
T 1	19+39.9092	721.3954	-4.0638	1.5000	0.	0-00-00.	531.6130	1830.1687	CL. BRGS. BT. 1	CONS/DIST
T 2	19+58.1323	721.6595	-4.2504	19.6844	0.	90-00-00.	546.9974	1824.8143	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.1037	721.9740	-4.2504	40.6089	0.	90-00-00.	569.0014	1818.9849	DIAPHRAGM 2-1	ANGL/PROP
T 4	20+00.8016	722.3116	-4.0085	62.2611	0.	0-00-00.	589.7010	1812.3245	CL. BRGS. BT. 2BK	CONS/DIST
B 2	20+01.3026	722.3195	-4.0000	62.7611	4.2063	-72-56-29.3	590.1790	1812.1778	CL. BT. 2	PREV
LONG. LINE 5 PIA BEAM C										
ST TO ML DT TO BT DT TO PP										
B 1	19+40.7622	721.0053	-12.1224	0.	8.4154	-72-56-29.3	530.1790	1822.1733	BFPR BT. 1	TYPE LINE
T 1	19+42.2717	721.0269	-12.1437	1.5000	0.	0-00-00.	531.6130	1821.7333	CL. BRGS. BT. 1	CONS/DIST
T 2	19+58.0879	721.2565	-12.2955	17.2157	8.0452	90-00-00.	546.6373	1817.1231	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.1481	721.5724	-12.2955	38.2403	8.0452	90-00-00.	566.6413	1810.9849	DIAPHRAGM 2-1	ANGL/PROP
T 4	20+03.4219	721.9509	-12.0092	62.2611	0.	0-00-00.	589.7010	1803.9091	CL. BRGS. BT. 2BK	CONS/DIST
B 2	20+03.9250	721.9589	-12.0000	62.7611	8.4154	-72-56-29.3	590.1790	1803.7624	CL. BT. 2	PREV
LONG. LINE 6 PIA BEAM D										
ST TO ML DT TO BT DT TO PP										
B 1	19+40.7622	721.0053	-12.1224	0.	8.4154	-72-56-29.3	530.1790	1822.1733	BFPR BT. 1	TYPE LINE
T 1	19+42.2717	721.0269	-12.1437	1.5000	0.	0-00-00.	531.6130	1821.7333	CL. BRGS. BT. 1	CONS/DIST
T 2	19+58.0879	721.2565	-12.2955	17.2157	8.0452	90-00-00.	546.6373	1817.1231	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.1481	721.5724	-12.2955	38.2403	8.0452	90-00-00.	566.6413	1810.9849	DIAPHRAGM 2-1	ANGL/PROP
T 4	20+03.4219	721.9509	-12.0092	62.2611	0.	0-00-00.	589.7010	1803.9091	CL. BRGS. BT. 2BK	CONS/DIST
B 2	20+03.9250	721.9589	-12.0000	62.7611	8.4154	-72-56-29.3	590.1790	1803.7624	CL. BT. 2	PREV
LONG. LINE 7 RLG RT. RAILING										
ST TO ML DT TO BT DT TO PP										
B 1	19+42.0471	721.8141	-16.5000	0.	4.5595	16-15-41.1	530.1790	1817.6138	BFPR BT. 1	TYPE LINE
B 2	20+06.5843	722.7521	-16.5000	61.9968	4.5473	0-00-00.	589.4007	1799.2822	CL. BT. 2	PREV

LONGITUDINAL LINES										
NO.	TYPE	REF.	DR / X1	STA. / Y1	TR / R / X2	Y2	SK.	REMARKS		
1	RLG	8	2.5000	0.	0.	0.	0	LT. RAILING		
2	P1B	9	12.0000	0.	0.	0.	0	BEAM A		
3	P1B	9	4.0000	0.	0.	0.	0	BEAM B		
4	ARC	0	0.	0.	0.	0.	0	CENTERLINE		
5	P1B	9	0.	0.	0.	0.	0	BEAM C		
6	P1B	9	-4.0000	0.	0.	0.	0	BEAM D		
7	RLG	10	-12.0000	0.	0.	0.	0	RT. RAILING		
8	ARC	0	-2.5000	0.	0.	0.	0	LT. GUTTER		
9	CRD	0	0.	0.	0.	0.	1	CENTERLINE CHORD		
10	ARC	0	0.	0.	0.	0.	1	RT. GUTTER		
11	END		-14.0000	0.	0.	0.				

PLAN OF TWO SPAN BRIDGE

CONSTITUTIONAL TYPE SKYPES

PROB. NO. EX-1

REF ID: A66096

LONG LINE, BIG IT PAYING

LONG LINE 3 PYR BEAM A

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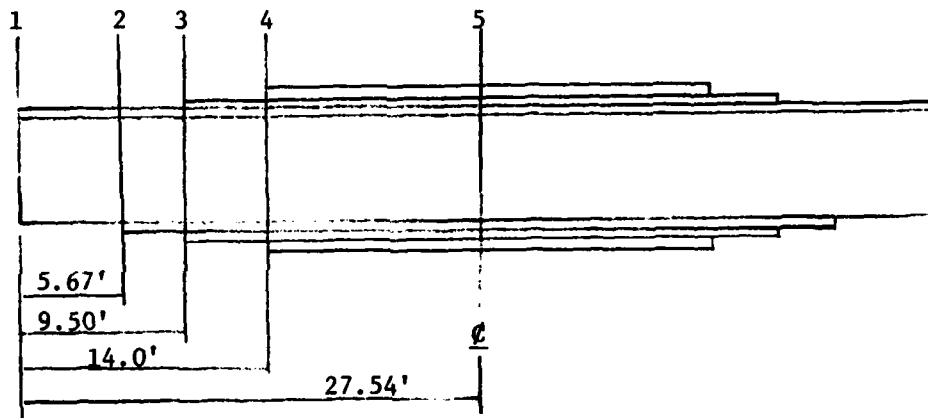
LINE 6 ABC CENTERLINE

12/06/79		FILE - OUTGEO		12:35		PAGE 5	
T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	
B 2	20+00.	722.5000	0.0000	0.	4.2054	18-00-00.	
B 3	20+68.7621	723.5314	0.0000	68.7621	4.2054	20-03-46.3	
							X
							590.1790
							655.1790
							1816.3841
							1793.9650
							CL. BT. 2
							BFR BT. 3
							TYPE LINE
							SAME
							PREV
T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	
B 2	20+01.3026	722.3195	-4.0000	0.	4.2063	-70-58-06.8	
T 1	20+01.8035	722.3266	-4.0086	0.5000	0.	-70-58-06.8	
T 2	20+21.3598	722.6083	-4.2416	20.0153	0.	90-00-00.	
T 3	20+46.4028	722.9836	-4.2481	45.0025	0.	90-00-00.	
T 4	20+68.7052	723.3317	-3.9781	67.2583	0.	-70-58-06.8	
B 3	20+70.2080	723.3556	-3.9505	68.7583	4.2063	-70-58-06.8	
							X
							590.1790
							590.6517
							609.1003
							632.7216
							653.7610
							1812.1778
							1805.6511
							1797.5031
							1790.2458
							1789.7566
							CL. BT. 2
							CL. BRGS. BT. 2AH
							DIAPHRAGM 1-2
							DIAPHRAGM 2-2
							CL. BRGS. BT. 3
							BFR BT. 3
							TYPE LINE
							SAME
							PREV
T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	
B 2	20+03.9250	721.9589	-12.0000	0.	8.4154	-70-58-06.8	
T 1	20+04.4281	721.9660	-12.0079	0.5000	8.4154	-70-58-06.8	
T 2	20+21.3052	722.2097	-12.1968	17.2712	7.9555	90-00-00.	
T 3	20+46.4532	722.5866	-12.2034	42.2583	7.9555	90-00-00.	
T 4	20+71.6099	722.9801	-11.8807	67.2583	8.4154	-70-58-06.8	
B 3	20+73.1190	723.0042	-11.8509	68.7583	8.4154	-70-58-06.8	
							X
							590.1790
							590.6517
							606.5061
							630.1275
							653.7610
							1803.7624
							1803.5993
							1798.1305
							1789.9625
							1781.8303
							1781.3412
							CL. BT. 2
							CL. BRGS. BT. 2AH
							DIAPHRAGM 1-2
							DIAPHRAGM 2-2
							CL. BRGS. BT. 3
							BFR BT. 3
							TYPE LINE
							SAME
							PREV
T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	
B 2	20+04.5843	722.7521	-16.5000	0.	4.5473	0-00-00.	
B 3	20+74.8441	723.8060	-16.5000	69.6529	4.9544	20-14-43.2	
							X
							589.4007
							655.1790
							1799.2822
							1776.3868
							CL. BT. 2
							BFR BT. 3
							TYPE LINE
							SAME
							PREV

Example Problem for BRRPLG

SAMPLE PLATE GIRDER

FOR BRRPLG--ANALYSIS OF GIRDER



SPAN = 55.08 ft

CENTER-TO-CENTER GIRDERS 6.50 ft

DIESEL IMPACT

E 80 LOADING

WEB PLATE	54 by 1/2
FLANGE ANGLES	8 by 8 by 5/8
COVER PLATES	20 by 5/8
	and 20 by 1/2

A40

INPUT DATA FILE

*LIST DATR5

```

10 SAMPLE PROBLEM - 55.08 FT. GIRDER - CASE TASK GROUP BRIDGES
20 1 0 1 0 0 6.500 0.500 11.580 0. 0.
30 5 55.080 0.812 0
40 0.
50 5.6700
60 9.5000
70 14.0000
80 27.5400
90 3 0
100 80.000
110 1 1 0 54.500 54.000 0.500
120 8.000 8.000 0.625 8.000 8.000 0.625
130 20.000 0.625
140 2.500 12.000 2.000 1.000 1.000
150 1.0000
160 1.0000
170 1.0000
180 1.0000
190 1.0000
200 1.0000
210 1.0000
220 1.0000
230 1.0000
240 1.0000
250 1.0000
260 1.0000
270 3.0000
280 6.5000
290 5.7500
300 3.0000
310 3.0000
320 3.0000
330 6.0000
340 3.0000
350 3.0000
360 3.0000
370 5.7500
380 6.5000
390 1 1 0 54.500 54.000 0.500
400 8.000 8.000 0.625 8.000 8.000 0.625
410 20.000 0.625
420 2.500 2.000 2.000 1.000 1.000
430 1.0000
440 1.0000
450 3.0000
460 51.5000
470 1 1 1 54.500 54.000 0.500
480 8.000 8.000 0.625 8.000 8.000 0.625
490 20.000 0.625
500 20.000 0.625
510 2.500 2.000 2.000 1.000 1.000
520 1.0000
530 1.0000
540 3.0000
550 51.5000
560 1 2 2 54.500 54.000 0.500
570 8.000 8.000 0.625 8.000 8.000 0.625

```

580	20.000	0.625				
590	20.000	0.500				
600	20.000	0.625				
610	20.000	0.500				
620	2.500	2.000	2.000	1.000	1.000	
630	1.0000					
640	1.0000					
650	3.0000					
660	51.5000					
670	1 3	3 54.500	54.000	0.500		
680	8.000	8.000	0.625	8.000	8.000	0.625
690	20.000	0.625				
700	20.000	0.500				
710	20.000	0.500				
720	20.000	0.625				
730	20.000	0.500				
740	20.000	0.500				
750	2.500	12.000	3.000	1.000	1.000	
760	1.0000					
770	1.0000					
780	1.0000					
790	1.0000					
800	1.0000					
810	1.0000					
820	1.0000					
830	1.0000					
840	1.0000					
850	1.0000					
860	1.0000					
870	1.0000					
880	3.0000					
890	6.5000					
900	5.7500					
910	3.0000					
920	3.0000					
930	3.0000					
940	6.0000					
950	3.0000					
960	3.0000					
970	3.0000					
980	5.7500					
990	6.5000					

ready

*

*RUN BRRPLG

INPUT DATA FILE NAME IN 8 CHARACTERS OR LESS.
HIT CARRIAGE RETURN IF DATA IS TO COME FROM TERMIANL.

=DATR5

INPUT A FILE NAME FOR OUTPUT IN 8 CHARACTERS OR LESS.
HIT A CARRIAGE RETURN IF OUTPUT IS TO BE PRINTED ON TERMINAL.

=OUTR5

*

12/06/79

FILE - QUTR5

12:35

PAGE 1

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
 CHICAGO, ILLINOIS
 REVISED DEC. 1975
SAMPLE PROBLEM - 55.00 FT. GIRDER - CASE TASK GROUP BRIDGES

GIRDER ANALYSIS

DECK PLATE GIRDER 55.08 FT SPAN

C-C GIRDERS 6.50 0.500 AXLE LOAD TO EACH GIRDER

UNIFORM DEAD LOAD 0.812 KIPS/FT

DIESEL LOCOMOTIVE

UNBALLASTED DECK
1969 AREA SPECIFICATIONS

LOADING E 80.0

SECTION PROPERTIES

SECTION 1 TYPE 1 0. FT FROM LEFT SUPPORT

WEB PLATE 54.000 X 0.500

TOP ANGLES 8.000 X 8.000 X 0.625

BOTTOM ANGLES 8.000 X 8.000 X 0.625

BACK-BACK ANGLES 54.500

TOP PLATES

20.000 X 0.625

OPEN HOLES

TOP FLANGE 2.5 1.000 IN. O.H.

BOT FLANGE 2.0 1.000 IN. O.H.

WEB 12.0 O.H.

SIZE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
------	-------	-------	-------	-------	-------	-------	-------

SIZE	1.000	1.000	1.000	1.000	1.000		
------	-------	-------	-------	-------	-------	--	--

SPACE	3.000	6.500	5.750	3.000	3.000	3.000	6.000
-------	-------	-------	-------	-------	-------	-------	-------

SPACE	3.000	3.000	3.000	5.750	6.500		
-------	-------	-------	-------	-------	-------	--	--

CENTROID 22.829

12/06/79

FILE - OUTR5

12:35

PAGE 2

GROSS MOMENT OF INERTIA 38831.81 SECTION MODULUS 1655.63
NET MOMENT OF INERTIA 32856.97 SECTION MODULUS 1037.46
RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS 3.90

SECTION 2 TYPE 1 5.67 FT FROM LEFT SUPPORT
WEB PLATE 54.000 X 0.500
TOP ANGLES 8.000 X 8.000 X 0.625
BOTTOM ANGLES 8.000 X 8.000 X 0.625
BACK-BACK ANGLES 54.500
TOP PLATES
20.000 X 0.625

OPEN HOLES
TOP FLANGE 2.5 1.000 IN. O.H.
BOT FLANGE 2.0 1.000 IN. O.H.
WEB 2.0 O.H.
SIZE 1.000 1.000
SPACE 3.000 51.500

CENTROID 22.829

GROSS MOMENT OF INERTIA 38831.81 SECTION MODULUS 1655.63
NET MOMENT OF INERTIA 33222.95 SECTION MODULUS 1049.02
RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS 3.90

SECTION 3 TYPE 1 9.50 FT FROM LEFT SUPPORT
WEB PLATE 54.000 X 0.500
TOP ANGLES 8.000 X 8.000 X 0.625
BOTTOM ANGLES 8.000 X 8.000 X 0.625
BACK-BACK ANGLES 54.500
TOP PLATES
20.000 X 0.625

BOTTOM PLATES
20.000 X 0.625

OPEN HOLES
TOP FLANGE 2.5 1.000 IN. O.H.
BOT FLANGE 2.0 1.000 IN. O.H.

12/06/79

FILE - OUTR5

12:35

PAGE 3

WEB 2.0 O.H.
SIZE 1.000 1.000
SPACE 3.000 51.500

CENTROID 27.250

GROSS MOMENT OF INERTIA 49851.40 SECTION MODULUS 1788.39
NET MOMENT OF INERTIA 43118.58 SECTION MODULUS 1546.85

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS 3.80

SECTION 4 TYPE 1 14.00 FT FROM LEFT SUPPORT

WEB PLATE 54.000 X 0.500
TOP ANGLES 8.000 X 8.000 X 0.625
BOTTOM ANGLES 8.000 X 8.000 X 0.625
BACK-BACK ANGLES 54.500
TOP PLATES
20.000 X 0.625
20.000 X 0.500

BOTTOM PLATES
20.000 X 0.625
20.000 X 0.500

OPEN HOLES

TOP FLANGE 2.5 1.000 IN. O.H.
BOT FLANGE 2.0 1.000 IN. O.H.
WEB 2.0 O.H.
SIZE 1.000 1.000
SPACE 3.000 51.500

CENTROID 27.250

GROSS MOMENT OF INERTIA 65601.89 SECTION MODULUS 2311.96
NET MOMENT OF INERTIA 57097.19 SECTION MODULUS 2012.24

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS 4.23

SECTION 5 TYPE 1 27.54 FT FROM LEFT SUPPORT

WEB PLATE 54.000 X 0.500
TOP ANGLES 8.000 X 8.000 X 0.625
BOTTOM ANGLES 8.000 X 8.000 X 0.625

12/06/79

FILE - OUTRS

12:35

PAGE 4

BACK-BACK ANGLES 54.500

TOP PLATES

20.000 X 0.625

20.000 X 0.500

20.000 X 0.500

BOTTOM PLATES

20.000 X 0.625

20.000 X 0.500

20.000 X 0.500

OPEN HOLES

TOP FLANGE 2.5 1.000 IN. O.H.

BOT FLANGE 3.0 1.000 IN. O.H.

WEB 12.0 O.H.

SIZE 1.000 1.000 1.000 1.000 1.000 1.000 1.000

SIZE 1.000 1.000 1.000 1.000 1.000

SPACE 3.000 6.500 5.750 3.000 3.000 3.000 6.000

SPACE 3.000 3.000 3.000 5.750 6.500

CENTROID 27.250

GROSS MOMENT OF INERTIA 81918.64 SECTION MODULUS 2837.01

NET MOMENT OF INERTIA 69987.20 SECTION MODULUS 2423.80

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS 4.50

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO, ILLINOIS
REVISED DEC. 1975

SAMPLE PROBLEM - 55.00 FT. GIRDER - CASE TASK GROUP BRIDGES

GIRDER ANALYSIS

DECK PLATE GIRDER 55.08 FT SPAN

C-C GIRDERS 6.50 0.500 AXLE LOAD TO EACH GIRDER

UNIFORM DEAD LOAD 0.812 KIPS/FT

DIESEL LOCOMOTIVE

UNBALLASTED DECK

1969 AREA SPECIFICATIONS

DEAD LOAD VALUES

UNIFORM DEAD LOAD 0.81 KIPS PER FT (EACH GIRDER)

12/06/79

FILE - OUTR5

12:35

PAGE 5

POINT	DIST FROM LEFT SUPPORT (FT)	DEAD MOMENT (FT-KIPS)	DEAD SHEAR (KIPS)	PANEL (FT)
1	0.	0.	22.	0.
2	5.67	114.	18.	0.
3	9.50	176.	15.	0.
4	14.00	233.	11.	0.
5	27.54	308.	0.	0.

LIVE LOAD
(NO IMPACT)

POINT	DIST FROM LEFT SUPPORT (FT)	MOMENT (FT-KIPS)	POSITIVE SHEAR (KIPS)	NEGATIVE SHEAR (KIPS)	GROSS I (IN-4)		
	MODULUS (COMP) (IN-3)	COMP STRESS (KSI)	NET I (IN-4)	MODULUS (TEN) (IN-3)	TEN STRESS (KSI)	WEB AREA (IN-2)	WEB SHEAR (KSI)
1	0. 1656.	0.	185. 32857.	0. 1037.	38832. 0.	27.00	6.87
2	5.67 1656.	881. 6.38	155. 33223.	-2. 1049.	38832. 10.07	27.00	5.75
3	9.50 1788.	1333. 8.94	136. 43119.	-5. 1547.	49851. 10.34	27.00	5.03
4	14.00 2312.	1756. 9.11	113. 57097.	-10. 2012.	65602. 10.47	27.00	4.17
5	27.54 2837.	2239. 9.47	53. 69987.	-53. 2424.	81919. 11.08	27.00	1.96

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO, ILLINOIS
REVISED DEC. 1975

SAMPLE PROBLEM - 55.00 FT. GIRDER - CASE TASK GROUP BRIDGES

GIRDER ANALYSIS

DECK PLATE GIRDER 55.08 FT SPAN

C-C GIRDERS 6.50 0.500 AXLE LOAD TO EACH GIRDER

12/06/79

FILE - OUTRS

12:35

PAGE 6

UNIFORM DEAD LOAD 0.812 KIPS/FT

DIESEL LOCOMOTIVE

UNBALLASTED DECK
1969 AREA SPECIFICATIONS

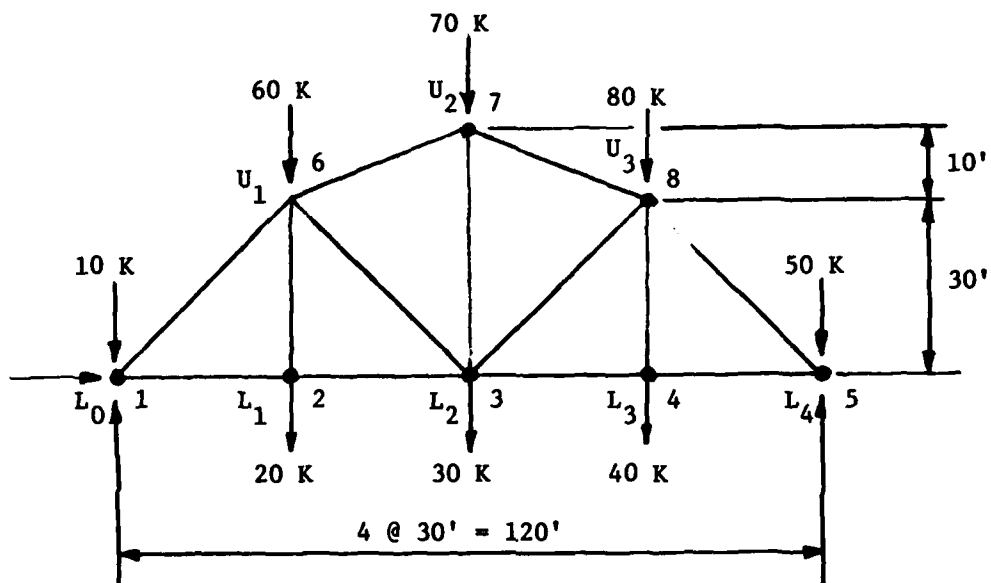
TOTALS

POINT	DIST FROM LEFT SUPPORT (FT)		DEAD MOMENT (FT-KIPS)	LIVE MOMENT (FT-KIPS)	IMPACT (FT-KIPS)	TOTAL MOMENT (FT-KIPS)		
	DEAD SHEAR (KIPS)	LIVE SHEAR (KIPS)	IMPACT (KIPS)	TOTAL SHEAR (KIPS)	COMP STRESS (KSI)	TEN STRESS (KSI)	SHEAR STRESS (KSI)	
1	0.		0.	0.	0.	0.	0.	
2	22.	185.	92.	300.	0.	0.	11.11	
	5.67		114.	881.	438.	1432.		
3	18.	155.	77.	250.	10.38	16.38	9.27	
	9.50		176.	1333.	662.	2171.		
4	15.	136.	67.	218.	14.57	16.84	8.07	
	14.00		233.	1756.	873.	2862.		
5	11.	113.	56.	179.	14.86	17.07	6.65	
	27.54		308.	2239.	1113.	3659.		
	0.	53.	26.	79.	15.48	18.12	2.93	

Example Problem for BRRTRU

SAMPLE TRUSS--8 JOINTS, 13 BARS

FOR BRTRU--ANALYSIS OF TRUSSES



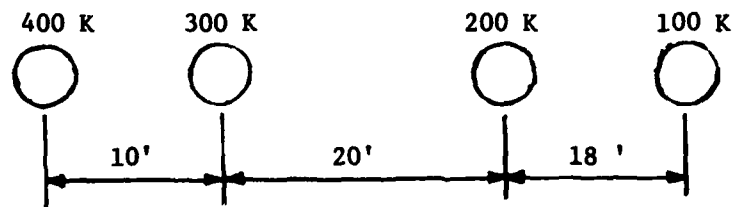
CENTER-TO-CENTER TRUSSES = 19.5 ft

SINGLE TRACK

STEAM IMPACT

HANGERS AT L_1U_1 , L_2U_2 , L_3U_3

For Type Four Loadings:



INPUT DATA FILE

*LIST DATR2

```

10  4
20  SAMPLE ANALYSIS PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES
30  8 13 0
40  120.
50  1 2 0. 0 L0L1 0
60  2 3 0. 0 L1L2 0
70  3 4 0. 0 L2L3 0
80  4 5 0. 0 L3L4 0
90  1 6 0. 0 L0U1 0
100 6 7 0. 0 L1U2 0
110 7 8 0. 0 U2U3 0
120 8 5 0. 0 U3L4 0
130 2 6 0. 1 L1U1 0
140 3 7 0. 1 L2U2 0
150 4 8 0. 1 L3U3 0
160 3 6 0. 0 U1L2 0
170 3 8 0. 0 L2U3 0
180 1 0. 0.
190 2 30.0 0.
200 3 60.0 0.
210 4 90.0 0.
220 5 120. 0.
230 6 30.0 30.0
240 7 60.0 40.0
250 8 90.0 30.0
260 3
270 1 1
280 1 2
290 5 2
300 8
310 1 2 10.0
320 2 2 20.0
330 3 2 30.0
340 4 2 40.0
350 5 2 50.0
360 6 2 60.0
370 7 2 70.0
380 8 2 80.0
390 1 5 4
400 100. 18.0
410 200. 20.0
420 300. 10.0
430 400. 0.
440 30.0
450 0 1 1 19.5 0. 0. 0

```

ready

*

*RUN BRRTRU

IS DATA TO BE INPUT FROM
EXISTING FILE(Y OR N) ?
=Y

NOTE# TO RETURN TO PREVIOUS QUESTION ENTER THE
LETTER R AS A QUESTION RESPONCE.

ENTER NAME OF INPUT FILE
(MAX. 8 CHAR.) -
=DATR2

SAMPLE ANALYSIS PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGE

8 JOINTS 13 BARS SPAN 120.000

MEMBER	AREA	
1 2	1.000	L0L1
2 3	1.000	L1L2
3 4	1.000	L2L3
4 5	1.000	L3L4
1 6	1.000	L0U1
6 7	1.000	L1U2
7 8	1.000	U2U3
8 5	1.000	U3L4
2 6	1.000	L1U1
3 7	1.000	L2U2
4 8	1.000	L3U3
3 6	1.000	U1L2
3 8	1.000	L2U3

JOINT	COORDINATES	
1	0.	0.
2	30.000	0.
3	60.000	0.
4	90.000	0.
5	120.000	0.
6	30.000	30.000
7	60.000	40.000
8	90.000	30.000

REACTIONS	
JOINT	DIRECTION
1	X
1	Y
5	Y

TRUSS IS STATICALLY DETERMINATE

DEAD LOAD	
JOINT	LOAD
1	-10.000 Y
2	-20.000 Y
3	-30.000 Y
4	-40.000 Y
5	-50.000 Y
6	-60.000 Y
7	-70.000 Y
8	-80.000 Y

ASSOCIATION OF AMERICAN RAILROADS RESEARC

H CENTER

SAMPLE ANALYSIS PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGE

LOADING IS TYPE FOUR

ONLY INPUT LOADS CONSIDERED

LOADED CHORD 1 5

	LOAD	SPACING
1	100.0000	18.0000
2	200.0000	20.0000
3	300.0000	10.0000
4	400.0000	0.

THROUGH TRUSS

SINGLE TRACK

STEAM LOADING

1967 AREA SPECIFICATIONS

C-C TRUSSES 19.500

FORCES IN KIPS, LENGTHS IN FT, AREAS IN SQ. INCHES

MEMBER REV	LENGTH	AREA	DEAD LOAD	LIVE LOAD	IMPACT	TOTAL
1 2	30.00	1.00	140.	318.	151.	609.
	L0L1					
2 3	30.00	1.00	140.	318.	151.	609.
	L1L2					
3 4	30.00	1.00	160.	318.	151.	629.
	L2L3					
4 5	30.00	1.00	160.	318.	151.	629.
	L3L4					
1 6	42.43	1.00	-198.	-449.	-214.	-861.
	L0U1					
6 7	31.62	1.00	-158.	-318.	-152.	-627.
	L1U2					
7 8	31.62	1.00	-158.	-318.	-152.	-627.
	U2U3					
8 5	42.43	1.00	-226.	-449.	-214.	-890.
	U3L4					
2 6	30.00	1.00	20.	317.	201.	537.
	L1U1	HANGER				
3 7	40.00	1.00	30.	201.	127.	358.
	L2U2	HANGER				
4 8	30.00	1.00	40.	317.	201.	557.
	L3U3	HANGER				
3 6	42.43	1.00	14.	-159.	-76.	-221.
	U1L2					

215.				136.	65.	
3 8	42.43	1.00	-14.	-159.	-76.	-249.
	L2U3			136.	65.	
187.						

REACTIONS

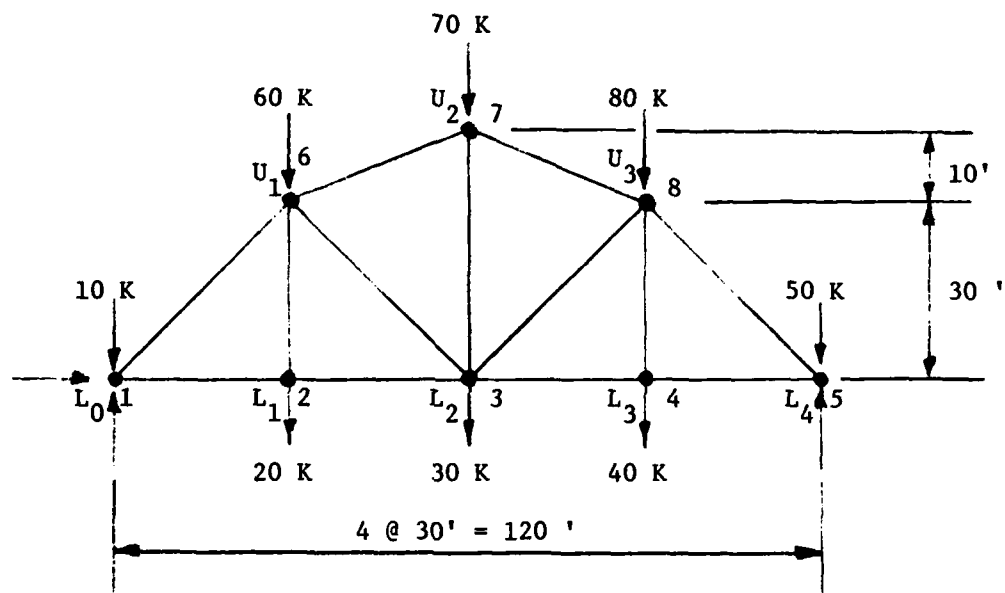
POINT	DEAD	LIVE	IMPACT	TOTAL
1X	-0.	0.	0.	0.
1Y	150.	443.	211.	804.
5Y	210.	443.	211.	864.

*

Example Problem for BRRTRR

SAMPLE TRUSS--8 JOINTS, 13 BARS

FOR BRTRR--RATING OF TRUSSES



CENTER-TO-CENTER TRUSSES = 19.5 ft

SINGLE TRACK

DIESEL IMPACT

RIVETED CONNECTIONS

HANGERS AT L_1U_1 , L_2U_2 , L_3U_3

INPUT DATA FILE

*LIST DATR4

10 SAMPLE RATING PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES

20 120. 0 13 0 0 0 1 0
30 1 2 0. 22.12 0. 1 0 L0L1 0
40 2 3 0. 25.31 0. 0 0 L1L2 0
50 3 4 0. 25.31 0. 0 0 L2L3 0
55 4 5 0. 22.12 0. 0 0 L3L4 0
60 1 6 50.12 0. 7.10 0 0 U0U1 0
70 6 7 55.33 0. 7.20 0 0 U1U2 0
80 7 8 55.33 0. 7.20 0 0 U2U3 0
90 8 5 50.12 0. 7.10 0 0 U3U4 0
100 2 6 0. 20.16 0. 0 1 L1U1 0
110 3 7 22.15 18.27 8.20 0 0 L2U2 0
120 4 8 0. 20.16 0. 0 1 L3U3 0
130 3 6 24.32 20.16 8.50 0 0 U1L2 0
140 3 8 24.32 20.16 8.50 0 0 U2L3 0
150 1 0. 0.
160 2 30. 0.
170 3 60. 0.
180 4 90. 0.
190 5 120. 0.
200 6 30. 30.
210 7 60. 40.
220 8 90. 30.
230 3
240 1 1
250 1 2
260 5 2
270 8
280 1 0 10.
290 2 0 20.
300 3 0 30.
310 4 0 40.
320 5 0 50.
330 6 0 60.
340 7 0 70.
350 8 0 80.
360 1 5
370 30.
380 0 1 1 1 19.5 0. 0. 0

ready

***RUN BRRTRR**

**INPUT DATA FILE NAME IN 8 CHARACTERS OR LESS.
ENTER A CARRIAGE RETURN IF DATA WILL BE ENTERED FROM A KEYBOARD.**

=DATR4

**INPUT A FILE NAME FOR OUTPUT IN 8 CHARACTERS OR LESS.
HIT A CARRIAGE RETURN IF OUTPUT IS TO BE PRINTED ON TERMINAL.**

=OUTR4

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
 CHICAGO, ILLINOIS
 REVISED DEC. 1975

SAMPLE RATING PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES

8 JOINTS 13 BARS SPAN 120.000

MEMBER	GROSS AREA	NET AREA	RADGR	MATL	
1 2	0.	22.12	0.	1	L0L1
2 3	0.	25.31	0.	1	L1L2
3 4	0.	25.31	0.	1	L2L3
4 5	0.	22.12	0.	1	L3L4
1 6	50.12	0.	7.10	1	U0U1
6 7	55.33	0.	7.20	1	U1U2
7 8	55.33	0.	7.20	1	U2U3
8 5	50.12	0.	7.10	1	U3U4
2 6	0.	20.16	0.	1	L1U1
3 7	22.15	18.27	8.20	1	L2U2
4 8	0.	20.16	0.	1	L3U3
3 6	24.32	20.16	8.50	1	U1L2
3 8	24.32	20.16	8.50	1	U2L3

JOINT	COORDINATES	
1	0.	0.
2	30.000	0.
3	60.000	0.
4	90.000	0.
5	120.000	0.
6	30.000	30.000
7	60.000	40.000
8	90.000	30.000

REACTIONS	
JOINT	DIRECTION
1	X
1	Y
5	Y

TRUSS IS STATICALLY DETERMINATE

DEAD LOAD
JOINT LOAD
1 10.000 Y
2 20.000 Y
3 30.000 Y
4 40.000 Y
5 50.000 Y
6 60.000 Y
7 70.000 Y
8 80.000 Y

1

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO, ILLINOIS
REVISED DEC. 1975
SAMPLE RATING PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES

THROUGH TRUSS
SINGLE TRACK
STEAM LOADING
1967 AREA SPECIFICATIONS
C-C TRUSSES 19.500
RIVETED CONNECTIONS
FLOOR BEAM CONNECTIONS BOLTED
MATERIAL 1 OPEN-HEARTH

MEMBER	CRITICAL AREA (SQ IN)	LENGTH (FT)	L/R	ALLOW STRESS (KSI)	TOTAL CAPACITY (KIPS)	DEAD FORCE (KIPS)	LIVE CAP (KIPS)
	E80 (KIPS) (NO IMP)	COOPER RATING (40 MPH)	COOPER RATING (30 MPH)	COOPER RATING (20 MPH)	COOPER RATING (10 MPH)	MATL	MEMBER
1 2	22.12 236.58	30.00 89.5	89.5	24.00 89.5	530.9 89.5	1	140.0 LOL1
2 3	25.31 236.58	30.00 107.0	107.0	24.00 107.0	607.4 107.0	1	140.0 L1L2
3 4	25.31	30.00		24.00	607.4		160.0 447.4

12/06/79

FILE - OUTR4

12:35

PAGE 3

		236.58	102.4	102.4	102.4	102.4	1	L2L3
4	5	22.12	30.00		24.00	530.9	160.0	370.9
		236.58	84.9	84.9	84.9	84.9	1	L3L4
1	6	50.12	42.43	71.71	-18.29	-916.5	-198.0	-718.5
		-334.58	116.3	116.3	116.3	116.3	1	U0U1
6	7	55.33	31.62	52.70	-19.07	-1055.4	-158.1	-897.3
		-242.26	200.6	200.6	200.6	200.6	1	U1U2
7	8	55.33	31.62	52.70	-19.07	-1055.4	-158.1	-897.3
		-242.26	200.6	200.6	200.6	200.6	1	U2U3
8	5	50.12	42.43	71.71	-18.29	-916.5	-226.3	-690.2
		-334.58	111.7	111.7	111.7	111.7	1	U3U4
2	6	20.16	30.00		24.00	483.8	20.0	463.8
		172.53	131.7	131.7	131.7	131.7	1	L1U1 H
3	7	18.27	40.00		24.00	438.5	30.0	408.5
		153.22	144.4	144.4	144.4	144.4	1	L2U2
4	8	20.16	30.00		24.00	483.8	40.0	443.8
		172.53	126.0	126.0	126.0	126.0	1	L3U3 H
3	6	24.32	42.43	59.90	-18.80	-457.3	14.1	-471.5
		-79.11	322.7	322.7	322.7	322.7	1	U1L2
		-115.03	222.0	222.0	222.0	222.0	1	R
3	8	24.32	42.43	59.90	-18.80	-457.3	-14.1	-443.2
		-79.11	303.4	303.4	303.4	303.4	1	U2L3
		-115.03	208.6	208.6	208.6	208.6	1	R

ALL STEAM RATINGS ARE FOR FULL IMPACT 47.71 PERCENT HANGERS 63.33 PERCENT

H IN LAST COLUMN INDICATES HANGER
BENDING STRESSES NOT INCLUDEDR IN LAST COLUMN INDICATES RATINGS ARE FOR MEMBERS HAVING STRESS
REVERSAL. ONE-HALF OF SMALLER STRESS ADDED TO LARGER STRESS

C IN LAST COLUMN INDICATES COUNTER

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

United States. Waterways Experiment Station, Vicksburg, Miss.

Evaluation of computer programs for the design/analysis of highway and railway bridges. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1980.

17, 63 p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; K-80-2)

Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C.

A report under the Computer-Aided Structural Engineering (CASE) Project.

1. Bridge design. 2. Computer-Aided Structural Engineering Project. 3. Computer programs. 4. Highway bridges. 5. Railroad bridges. I. United States. Army. Corps of Engineers. II. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; K-80-2.
TA7.W34 no.K-80-2

STATE OF TEXAS HIGHWAY DEPARTMENT STATION REPORTS UNDER THE COMPUTER AIDED DESIGN ENGINEERING (CASE) PROJECT

	Title	Date
Technical Report S-50-1	List of Computer Programs for Computer-Aided Design Engineering	Feb 1979
Technical Report S-50-2	User's Guide: Computer Program With Interactive Graphics for Analysis of Plane Frame Structures (CPFRAME)	Mar 1979
Technical Report S-50-3	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report S-50-4	Evaluation of Computer Programs for Highway and Railway Bridges	Jan 1980
Technical Report S-50-5	User's Guide: Computer Program for Design/Review of Cylindrical Conduits/Culverts (CURCON)	Feb 1980