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Department of Transportation

Office of Research and Special Studies

USER'S MANUAL
FOR
PROGRAM BOVAC

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Research Project 77 - 2: Implementation of Program BOVA

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Earlier release of program BOVAC (May 1980) is superseded by the version described herein (April 1982). The principal investigator will maintain the current version of the software.

Abstract (Limit: 200 words)

This user's manual contains the description of the input of program BOVAC (Bridge OVerload Analysis-Concrete). The program is designed to compute the elastic and inelastic behavior of simple span beam-slab bridges with reinforced concrete deck slab and prestressed concrete I-beams. The program could be used in the determination of the overload response of bridges or in the rating of bridges with the above characteristics. The program can predict the damage to the bridge superstructure, if any, in the form of cracking and crushing of concrete and yielding of steel.

The report contains sections describing the overload related activities as an introduction to the use of BOVAC. Three example problems are also included to illustrate the input of the program. The computer printouts of these examples are also included.

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Project 77-2: Implementation of Program BOVA

USER'S MANUAL FOR PROGRAM BOVAC

by

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LEHIGH UNIVERSITY

Office of Research

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ABSTRACT

This user's manual contains the description of the input of program BOVAC (Bridge OVerload Analysis-Concrete). The program is designed to compute the elastic and inelastic behavior of simple span beam-slab bridges with reinforced concrete deck slab and prestressed concrete I-beams. The program could be used in the determination of the overload response of bridges or in the rating of bridges with the above characteristics. The program can predict the damage to the bridge superstructure, if any, in the form of cracking and crushing of concrete and yielding of steel.

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FOREWORD

Program BOVAC (Bridge OVerload Analysis-Concrete) is the result of an extremely sophisticated analytical investigation that has been carried out to predict the inelastic behavior of beam-slab bridges. This research program had resulted in a computer program, acronymed BOVA (Bridge OVerload Analysis). However, the use of program BOVA required substantial skills and patience. In order to make the program accessible to individuals with limited technical skills, it was deemed necessary to simplify BOVA, at the expense of loss of some of the generality. This selective simplification has resulted in program BOVAC, which is described in this manual.

Surveys conducted by the researcher have indicated that there still exist some ambiguities among the engineers in the definition of the methods, and especially their limitations, that are available for the rating of bridges and the activities related to overload permit operations. The early chapters of this manual provide a general overview of the rating and overload activities. In the development of these chapters it is assumed that the reader's familiarity with the subject matter is limited. The main emphasis of the manual is directed towards the collection of the data to be used in program BOVAC. Three example problems have been provided. The input data for program BOVAC for these examples, and the output of the program for these examples, are included in the manual.

It is recognized that the manual does not contain all the information, observations and experiences that have been accumulated on the inelastic behavior, serviceability limits of highway bridges, effects of overload and many other similar tributary fields. Consequently, this document should be considered in its intended mission, which is, introduction to the use of program BOVAC. Based on the researcher's experience with BOVAC, and other similar tools in the rating of highway bridges and overload response of these bridges, a number of other chapters could have been added to this manual. However, the technical depth of these additional chapters would have corresponded to a sudden requirement on the technical background of the readers. The transfer of information of this nature could best be accomplished through interaction, where there will be a dialogue between the researcher and the prospective users of BOVAC. However, the manual as it stands can very well be studied, without the need for outside assistance, by the prospective users.

The reader of the manual, and especially the prospective users of BOVAC, are strongly recommended to study the examples provided in detail. Even though the examples may seem rather routine, they are designed to transmit all the pertinent aspects of BOVAC to the users.

1. INTRODUCTION

Program BOVAC (Bridge OVerload Analysis-Concrete) is a major sophisticated computer program to predict the elastic and inelastic behavior of simple span multi-girder beam slab bridges. The program is capable of analyzing solid prestressed concrete beams having cross sections of either standard AASHTO (American Association of State Highway and Transportation Officials) or Standard Pennsylvania Department of Transportation (Refs. 25 and 27). The bridge deck must be monolithic reinforced concrete slab. Full composite interaction between the bridge deck and the beams is assumed. The computer program includes provisions for the nonlinearity of stress-strain relationships for concrete, reinforcing bars, and prestressing strands. The program is also capable of predicting the type of damage (cracking or crushing of concrete, yielding of reinforcement bars and prestressing strands), its location, and its approximate severity.

Program BOVAC considers only the static loading of the bridge superstructure. Each set of analyses, or simulation of the bridge superstructure, can consider only one load positioning. If, for example, the effects of a given vehicular loading on a bridge superstructure is to be determined for maximum flexure by positioning the vehicle at mid-span of the bridge, and for maximum shear by positioning the vehicle near the support of the bridge, two different sets of analyses will be required.

Program BOVAC was developed for use in two specific areas:

(a) rating of highway bridges, and especially,

(b) overload permit activities.

In these areas of activities the bridges may either be existing bridges or may exist only in design drawings. The bridges may also contain some imperfections or deterioration. Through the careful input of the design dimensions and parameters these characteristics could be simulated. The vehicular loading must be predefined by the user. The placement of the vehicle on the bridge also needs to be defined by the user.

It is envisioned that program BOVAC should be used for rating or overload permit operations where the loading of bridge superstructure poses a challenge to the bridge engineer or the permit officer. This challenge may be due to the unique geometry of the bridge where the engineer or the permit officer can not easily extrapolate their past experience with bridges to the case on hand. If the bridge superstructure exhibits certain deterioration, then the rating or permit operations may require more precise results prior to rating or in the issuance of the overload permit. The major usage of the program would correspond to the case where the vehicle under consideration, because of uncommon axle loads and axle spacing, may not permit the bridge engineer or the permit officer to relate the vehicle under consideration to the vehicles that they might have previously encountered. In view of the continually increased gross vehiclular weights, and rearrangement of the axles, the vehicles that are being considered for rating and overload permit operations have been gradually deviating from the "standard design vehicle" (Ref. 1). Consequently the bridge designer's visualization of the structural behavior of the bridge subjected to standard design vehicle versus the actual behavior of the bridge when subjected to arbitrary overload vehicle are loosing their commonalities.

The use of program BOVAC would permit the bridge engineer or the permit officer to make realistic estimates, which will correspond to actual behavior of the bridge, and prediction of damages that the superstructure may experience, if any, when subjected to any given vehicular loading.

1.1 Development of Program BOVAC

A research program titled "Overloading Behavior of Beam-Slab Type Highway Bridges" sponsored by the National Science Foundation, Reinforced Concrete Research Council, Pennsylvania Department of Transportation (Research Project 71-12) and Federal Highway Administration was initiated in 1970 at Lehigh University (Ref. 4). This program has resulted in an extremely sophisticated analysis scheme and the pertinent computer program acronymed BOVA (Bridge OVerload Analysis) (Refs. 17 and 19). The demands placed on the development of the computer program inevitably led to a computer program where the input information for even simple bridge configurations taxed the technical background and the patience of the users. A decision was reached to simplify the input of program BOVA as much as possible, so that even a user with no technical background would be able to use the new version of program BOVA, i.e. BOVAC (Ref. 8). This led to the initiation of research program "Implementation of Program BOVA." This users manual, which is also one of the interim reports of the said project, summarizes one of the activities carried out in the project. It should be noted that all developmental research activities that have been carried out within the framework of Pennsylvania Department of Transportation Research Project 71-12 are fully applicable towards the technical developments leading to program BOVAC. More specifically, the research reports issued on inelastic analysis of beams (Refs. 11, 12 and 14), inelastic analysis of reinforced concrete slabs, (Ref. 16), inelastic analysis of beam-slab highway bridges (Refs. 6, 18, 20, 21 and 22), shear punching of bridge decks (Ref. 7), parametric investigation on the overloading behavior of highway bridges (Refs. 5 and 10), and the final report (Ref. 9) summarizing the observations on overloading of highway bridges form the basis of program BOVAC. These reports could be used as complimentary material for the readers who may wish to study the technical background of program BOVAC. However, the report titled "User's Manual for Program BOVA" (Refs. 18 and 19) issued for research project 71-12 can not be used in any form for this report or program BOVAC.

1.2 Disclaimer

The attainment of perfection in computer programs is an elusive goal. The use of program BOVAC for about 100 case studies and the comparisons and benchmarks, where possible, have indicated that the program is debugged. However, there may be problem areas that have not surfaced, and are thus unnoticed by the developers, which may be uncovered by the users. It is highly recommended that any unusual results be transmitted to the developer of the program for necessary actions. Neither the developers nor the sponsors assume any responsibility in regard to the use of the program.

A great deal of responsibility for sensible output from the program rests with the user. Preparation of the best possible input model will result in the best possible solution. In the same vein, incorrect input will result in a detailed solution by the program, however, this will not correspond to the problem on hand. Regardless of all the warnings in this manual and the program, the ultimate decision rests with the user through the profuse employment of common sense and technical judgment.

1.3 Rating of Bridges and Permit Operations

The current AASHTO Standard Specifications for Highway Bridges (Refs. 1 and 2), or for that matter, Commonwealth of Pennsylvania regulations (Ref. 26), do not specifically suggest a method of analysis that can be reliably employed in the rating of highway bridge superstructures. In the AASHTO Specifications the overload related activities are indirectly referred to through the increased allowable stresses and increased forces acting on the components of the superstructure. However, the method of analysis that can be employed for infrequent permit operations is not clearly defined.

In the overload permit related activities four important concepts need to be considered.

1. Under arbitrary loading conditions the bridge superstructure may have deformations and stresses quite different as compared to the designer's projections. Difference in actual and designer's estimated deformations and stresses do <u>not</u> necessarily indicate a distress in the superstructure.
2. The actual values of the stresses and deformations can be predicted

only if the full superstructure is analyzed as a monolithic unit. Due to the very high degree of internal statical indeterminacy, different bridge components will have a beneficial interaction towards the structural integrity of the superstructures. This interaction is not considered in full in the design phase.

3. Some bridge components may exhibit limited damage during the passage of the permit vehicle. In most instances due to the elastic rebound capability of the bridge components the bridge will return to its original position after the passage of the vehicle. The amount of permitted limited damage is a serviceability limit that could be defined by a policy decision. This approach could, and should, be considered for <u>infrequent</u> overloadings only.

4. If the load is heavy enough the stresses at certain points in the superstructures may be in excess of allowable limits. Even some limited damage may accrue due to this load. Even though this load may be in excess of the load level defined through "allowable stress" approach, the load is usually far below the so-called collapse load of the structure, which can be arrived at through the "ultimate strength" approach. In overload permit request cases the load level may be above the "working stress" load level but below the "ultimate strength" load level. At this time the only known method that relates the stresses and damage in the superstructure to the vehicular load at the above defined load range is the method which is employed in program BOVAC.

1.3.1 Reverse Design Procedure for Infrequent Overloadings

Because of the absence of clearly defined procedures that can be used in the rating of highway bridge superstructures and activities that deal with the overload permit operation, the engineering profession has traditionally employed the reverse design procedure to define the loads acting on individual beams (Refs. 9 and 23). This approach makes use of distribution factors to define the lateral distribution of live loads (Ref. 1). The completed research have indicated that the use of the distribution factors in the definition of the forces carried by each beam is a questionable approach if "most" of the lanes are not loaded (Refs. 3, 9, 21 and 22). Even then, the accuracy of the distribution factors will not result in sufficiently reliable results. However, if the loading is substantially different than the standard design vehicle, then the results obtained by the distribution factor approach become even more questionable. Furthermore, for certain rating and overload permit operations the vehicular load may have to be placed near the support to simulate the "worst" shear case. In this case the applicability of the distribution factors becomes even more questionable in predicting the forces carried by each beam.

It has been concluded that in the absence of any other tool, the use of distribution factors may be justifiable. If some engineering analysis procedures are available, and if these procedures are not too complicated and if these procedures can produce accurate results, than the use of distribution factors for uncommon loading configurations can not be justified. The procedures referred to herein will be presented in the following sections.

1.3.2 Detailed Analysis and Equivalent Loadings

The shortcomings of the AASHTO type rating and overload permit activities have been recognized by a limited number of transportation agencies, and have led to the development of tentative guidelines and analysis schemes that could be employed within the jurisdiction of these agencies. Both the state of California and the province of Ontario, Canada have developed certain "equivalent vehicles" (Ref. 28). These vehicles are used in the rating of bridges. Furthermore, through the pre-rating of the existing bridges for various types of these vehicles, it is possible to have a good assessment of the rated capacity of any given superstructure. This type of data bank can easily be employed in the quick issuance of the overload permits. Since the vehicles that are employed in this approach are limited, it is essential that any given vehicle be "translated" to one of the equivalent vehicles.

The Ontario Code is one of the most recent and completely revised bridge codes (Ref. 28 and 29). For certain types of bridges the Code recommends the use of fairly sophisticated analysis and simulation schemes to predict the structural behavior of the bridge superstructure. Because of the complexity of the recommended methods, the use of large computer programs becomes an inevitable need. The sophistication of these computer programs far exeeds the current AASHTO Specifications that essentially employ the distribution factor approach.

1.3.3 Limited Damage Due to Infrequent Overloads

If a detailed analysis scheme could be developed, as in the case of program BOVAC, then for infrequent passages of overload vehicles it may be possible to permit limited damage to the bridge superstructure. This damage could be permitted by the bridge engineer or permit officer who has a better appreciation for the criticality of the bridge in the transportation network. The important factor that needs to be considered is the full "recoverability" of the damage, and the premise that no damage will occur to any one of the components of the superstructure that will be instrumental in the "recovery" of this local and limited damage.

The parametric investigations on the overload response of simple span multi-girder bridge superstructures with reinforced concrete deck slab and prestressed concrete I-beams have indicated that the deck slab is usually the first bridge component that will exhibit some damage when the bridge is subjected to overload vehicles of increasing gross vehicular weight (Refs. 5 and 10). The damage is in the form of the cracking of the concrete cover of the reinforcing bars of the deck slab. These cracks close when the beams return to their original position after the passage of the load. Prior to the initiation of any damage to the bridge beams, the deck slab undergoes cracks of non-negligible depth. For spans of 40 ft. or less the initiation of the damage may initiate due to the excessive interface shear between the beams and the deck slab. For increased load levels the extensive cracking of the deck slab is also observed. Thus, for short span bridges the damage between the interface of beams and slab is as likely as the cracking of the deck slab. For medium to long span bridges the damage occurs in the form of the cracking of the deck slab.

The major decision to be reached by the bridge engineer or the permit officer will be to determine the amount of damage that can be permitted for a given bridge, and to find the gross vehicular weight that can be allowed to traverse, which corresponds to the permissible amount of damage. This concept should be used only for infrequent loading of bridges.

1.2 Overload Directories

To have a better understanding of the initiation of damage to the bridge superstructure due to certain classes of overload vehicles, a parametric study was undertaken. The results of this study are reported in a tabular form referred to as overload directories (Ref. 5). For simple span beam slab bridges with reinforced concrete deck and prestressed concrete I-beams the developed overload directories can realistically predict the damage that the bridge may sustain, if any, due to traverse of overload vehicles. Conversely, if a certain amount of recoverable damage is to be allowed, the gross vehicular weight which can induce this damage can be estimated. The overload directories have been developed for bridges of certain geometries and of predefined vehicular configurations. The bridges and vehicles that are similar to these, but not the same, can also be considered via interpolations between the case studies included in the overload directories. The overload directories have been developed through the application of program BOVA (Ref. 17). Because of limitations imposed in the development of the overload directories, such as predefined bridge geometries and vehicular configurations, the problems that the bridge engineers or permit officers will have to resolve could not always be accommodated through the use of the directories. In cases as such the next practical alternative would be the use of program BOVAC.

1.3 Program BOVAC for Rating and Permit Operations

The purpose of this report is to acquaint the users with the input and output options of program BOVAC. Program BOVAC could be used for problems that are more complex than those that are included in the overload directories. To master the use of program BOVAC is more demanding than that of the use of the overload directories.

In the process of conversion of program BOVA to program BOVAC major simplifications were undertaken. These simplifications inherently introduced certain limitations on the applicability of program BOVAC. For example, if the problem to be resolved employs beam cross sections noticeably different than standard Pennsylvania Department of Transportation or AASHTO sections, than the program will not be of assistance to the user. Also, for example, if a given bridge employs different beam cross sections, again, the program can not differentiate the difference. In the development of program BOVAC a practical compromise has been reached: to make the program applicable to the majority of bridges encountered in Pennsylvania and also to make the input and output information as simple as possible.

1.4 Program BOVA for Rating and Permit Operations

There always exists the possibility that the bridge that must be rated or the permit application that must be considered may correspond to a case where, because of the nonstandard dimensioning and detailing of the bridge superstructure, it might not be handled by overload directories or program BOVAC. In situations as such the user may wish to consider the possibility of using program BOVA (Ref. 17). The output of program BOVA is extremely similar to that of BOVAC. The user who is familiar with BOVAC should be able to interpret the BOVA output. However, the preparation of input information for BOVA requires noticeable time. Under the circumstances, it is recommended that the reader not rush to master program BOVA's input information. If there is a possibility that the reader may have to use program BOVA, planned activities in developing sufficient knowledge in the use of BOVA is strongly recommended. It has been the observation of the author that the predominant majority of all rating or permit activities for bridges with the types of beams that have been described in Section 1.3 could be analyzed through the use of program BOVAC.

2. ANALYTICAL MODELING OF HIGHWAY BRIDGES

Program BOVAC employs the finite element displacement method and incremental tangent stiffness formulation. Description of these concepts and the detailed description of different phases of the overall formulation are beyond the scope of this user's manual. The reader can easily use the program without mastering the theoretical developments. If the user wishes to study the analytical formulation, the following self-study program, from fundamental to advanced levels, could be undertaken:

(a) Formulation of the elastic and inelastic behavior of reinforced and prestressed concrete beams (Refs. 11 and 12)

(b) Formulation of the elastic and inelastic behavior of reinforced concrete slabs (Ref. 16)

(c) Formulation of elastic and inelastic behavior of simple span beam-slab bridges with reinforced concrete deck and prestressed concrete I-beams (Refs. 18, 20; supplementary refs. 21 and 22).

The purpose of this chapter is to acquaint the reader with the fundamental concepts and terminology employed.

As the title of the chapter indicates, the main issue in program BOVAC, and all the developments leading to the computer program, is the simulation of the bridge superstructure via mathematical model. In structural engineering this simulation is commonly referred to as analytical or mathematical modeling. Because of the complexity of this type of formulation, the use of computer based solution is essential, as has been the case in program BOVAC. To have a better perspective of the relation of the analytical modeling to the actual structure some analogies would assist the reader. Undoubtedly the best way to determine the overload response of a given highway bridge superstructure would be the field testing of the highway bridge in question for the envisioned overload vehicle. Similarly, good results will also be obtained if a scale model of the bridge can be tested in a laboratory environment. Neither of these alternatives are practical. They require a disproportionate amount of time and great expenditures. Furthermore, if a different bridge and/or loading is to be considered, than it is essential that the new bridge be tested. The direct transportability of observations from one case to another is impractical. The only advantage of this approach would be the development of a data base, whereby after testing hundreds of bridges, the cataloged information could be employed, with or without minor adjustments, for other similar case studies that need to be resolved.

A more practical, but equally reliable approach, would be the development of a computer program. If this program can simulate the structural behavior of the bridge, then the results obtained from the computer analysis would essentially be the same as the field or laboratory testing. This is the basic philosophy that has led to the development of program BOVAC.

There are a few issues regarding the computerized approach that the user must be aware of:

1. The accuracy of computer results must be verified. Regardless of the "exactness" of the formulation that might be employed, there always exists the possibility that some systematic error in the program might have gone unnoticed. The accuracy of program BOVAC has been tested by using all of the field and laboratory test results that have been conducted and reported in the literature. All comparisons have indicated that program BOVAC yields results that are fully acceptable.
2. If the user misinterprets the information contained in the manual, then systematic errors could be introduced having magnitude as great as the errors referred to in the previous paragraph.
3. Accidental errors that can be committed by the user, either in input of the computer program or the interpretation of the output, are comparable to any other engineering computation.
4. Common sense and engineering judgment must be employed by the user. Even though a number of controls have been incorporated in the program, no controls and checks can be developed to check the accuracy of a consistently careless user.
5. The user should never consider the computer printout as indisputable fact. The results provided by the computer must always be critically examined by the user. If the results do not make sense, this should not be attributed to the complexity of the problem or to a new engineering finding. It usually corresponds to an error committed by the user.

6. If the user, after a number of checks, is convinced that no error on his part has been committed, and if the results still can not be fully justified by the user, then the prudent approach would be to contact the program developer. Even though the program has been debugged and has been tested to the fullest extent employing the available results, there is still a possibility that some error might have gone unnoticed. An interaction between the user and the program developer will provide an occasion to test the validity of the data and a possible check of the program.

2.1 Bridge Superstructures

Program BOVAC is capable of analyzing bridges having the following characteristics:

1. Bridge must be of simple span construction.
2. There must be a full composite interaction between the beams and the deck slab.
3. Bridge deck must be reinforced concrete slab.
4. Bridge beams must have the dimensions corresponding either to FHWA or Pennsylvania Department of Transportation standard prestressed beam cross sections (Refs. 25 and 27).
5. All beams in a given bridge must have the same cross sectional properties.
6. Beam spacing(s) must be constant for a given bridge.
7. It is assumed that the midspan diaphragms do not contribute to the structural stiffness of the superstructure.

8. It is assumed that the bridge beams are bending in a plane perpendicular to the deck slab, i.e. major axis bending.

9. The stresses in the slab are due to the biaxial bending of the slab and the axial forces that may develop in the deck slab in longitudinal and transversal direction.

10. Shear punching of the deck slab will not take place.

11. The other assumptions of a more technical nature have been listed in References 17, 18 and 20.

2.1.1 Skew

The analytical developments and program BOVAC are formulated for bridges with 90° skew, i.e. right bridge. The numerical comparisons have indicated that bridges having skew angle of down to 60° can also be simulated by using program BOVAC. The loss of accuracy for bridges with this skew is barely noticeable (Ref. 4). However, if the superstructure has a skew less than 60° the extent of the loss of accuracy has not been determined. It is intuitively postulated that if the skew angle is 45° or less than the accuracy of the solution should be adversely effected. In transferring the skew bridge to equivalent right bridge, the bridge width should be kept the same. The span length of the equivalent right bridge should be taken as center-to-center distance between the supports of the skew bridge.

2.1.2 Beams

Prestressed concrete I-beams that could be analyzed by program BOVAC are listed in Table 1. These beam cross sections are the standard AASHTO and Pennsylvania Department of Transportation beams. Dimensions of these beams are given in Table 2, and the key to the nomenclature used in Table 2 is shown in Figures 1 and 2. If the case studies encountered by the user employ a slightly different beam cross section, then the beam cross section that is available in the program that can closely simulate the cross section in question can be used in the analysis. It should be noted that the depth of the beam is a more critical item than the width of the flanges and the web. As the difference between the dimensions of the actual beam and the cross section available in the program increases, so does the error in the results provided by the program.

The computer program permits the input of one prestressing strand group per beam. This seems to be in contradiction with the prestressed concrete design and construction practice. The user should note that this strand group contains all the strands employed in the beam, and the group is located at the center of gravity of all strand groups placed in the beam. This is a simplification that is employed to assist the user. Past experience with program BOVAC have indicated that this simplification does not affect the results in any appreciable degree (Refs. 11, 12, 18 and 20).

2.1.3 Prestress Losses

The prestress losses in the beams are computed using the standard design provisions of Pennsylvania Department of Transportation (Refs. 24 and 25). The formulae in the prediction of these losses are quite simple and unsophisticated. However, studies carried out have indicated that other formulae developed by other researchers are more rigorous, should be able to predict the prestress losses more accurately, but at the same time require more precise information on the history and condition of the bridge. It is assumed that the bridge engineer or permit officer would not have the time to uncover additional information for the use of these formulae. Thus, a more simplistic approach has been taken. It is also noted that there exists a disagreement amongst the various researchers who have spent considerable time and effort for the development of the loss formulae as to which formula can predict the losses more accurately than the others. Under these circumstances, a particular prestress loss formula is chosen as the one that has been agreed upon. In the future, if either one of the prestress loss formula will be agreed upon, or a new formula will be developed, than this formula can easily be incorporated into the program.

2.1.4 Deck Slab

Program BOVAC assumes monolithic reinforced concrete slab placed at the top of the beams. The user only needs to define the slab thickness. The top and bottom longitudinal and transversal reinforcements are automatically computed according to the table provided in Reference 24. This table is reproduced as Table 3 in the users manual. The amount of reinforcement is related to the clear transverse distance between the beams. The formula that defines the distance between the beams for the selection of reinforcement is defined as follows:

$$B = s - B_f + 10''$$

where B is the quasi-clear span between the beams (in.)

s is the center-to-center spacing of the beams (in.) and

B_f is the top flange width of the beams (in.).

Since the user defines the type of beams, B_f is also automatically computed. The user also defines the width of the bridge, width of the overhang, and total number of beams. This information determines the center-to-center spacing of the beams.

2.2 Loading

The program accepts three types of loads on the bridge superstructure:

(a) dead loads on beams due to the weight of the superstructure,

(b) prestressing forces on individual beams, and

(c) live loads applied on the bridge deck.

Dead loads are automatically computed, and are not visible to the user. No additional input or computations are needed. Prestressing forces are defined by the user. The program accepts only the straight strands. Studies have indicated that even if the strands are laid in parabolic, trapezoidal, or three point patterns, the straight strand approach still provides a reliable approximation. The results obtained for the straight strand approach will slightly underestimate the strength of the bridge, and conversely, will slightly overestimate the damage occurred due to the vehicle. However, if the bridge is loaded in such a manner that the superstructure will be subjected to maximum flexure, then the error involved in this approximation will barely be noticeable by the user.

Live loads applied to the bridge are defined as area loads (rectangular in shape). The loads are assumed to be acting vertically on the bridge deck. The loads are defined by distance of the centroid of the area with respect to the coordinate system (See Section 2.3.1). Length and width of this area load need also be defined. Furthermore the user must define intensity of the load. The load intensity is defined as force per unit area, e.g. ksi, psi. For example, a typical 18 wheeler truck with front axle (2 wheels), drive axle (2 axles, 4 wheels per axle), and rear axle group (2 axles, 4 wheels per axle) could be defined by 6 area loads. Two of these will come from the front axle, and 2 each from the drive and rear axle groups. Due to the close proximity of the tandem wheels on the drive and rear axle group each axle group could be simulated by two area loads per axle group each, one for the right and one for the left side tandem group each. For example, if the "vehicle" under consideration is a four axle eight wheel per axle dolly, then because of the close proximity of the wheels, which is usually the current practice, the whole dolly can be simulated by one area load. This area load is a rectangle which envelopes all wheels.

The user should be cognizant of a limitation of BOVAC as far as the application of the loads is concerned. All the developments have been carried out for static or psuedo-static loadings. This implies that the traverse of the vehicle over the bridge should be carried out at low speeds in order not to cause dynamic effects. If the springs and the suspension system of the vehicle are unsatisfactory and/or if there are large "potholes" or similar obstructions on the bridge deck surface and/or if the approach road to the bridge contains many bumps or potholes and if the vehicle is approaching the bridge and traversing it at a high speed than the stresses induced in the bridge components will be amplified. This dynamic amplification, also referred to as impact factor in AASHTO Specifications, has not been determined for overload vehicles. Thus the amplification of the static stresses to obtain the dynamic stresses could not be accomplished. Under the circumstances, it is recommended that the user inspect the approach roads to the bridge and bridge surface. If any holes, bumps or undulations are noted, then the vehicular speed should be reduced to crawl speed. Within the context of this report, the crawl speed is defined as 2-3 mph vehicular speed. If the road and bridge surface is smooth enough, and if the spring and suspension system of the vehicle is fully functional, efforts to reduce the vehicular speed would still be preferable. This has been primarily due to traffic safety reasons. The traffic engineers can provide the additional information on the permissible speeds.

2.3 Analytical Modeling

The analytical modeling of the bridges, as employed in this reported research, is an extremely detailed activity. The considerations that go into the mathematical modeling of the superstructure are drawn from bridge engineering, engineering mechanics, theory of finite elements and many other ancillary fields. Rather than confuse the reader with a number of theoretical details, it is preferred to describe only the highlights in the following three subsections. If the reader wishes to study the technical details of the mathematical modeling, the first source of information would be a detailed study of Reference 18.

2.3.1 Coordinate System

The best way to visualize the coordinate system would be the consideration of a rectangle (Fig. 3). Left and right vertical sides of the rectangle are the supports, and top and bottom lines are the free edges of the bridge deck, i.e. overhang. The center of the coordinate system lies at the lower left corner of the rectangle. X-axis emanates from the origin toward the right side of the bridge. This axis coincides with the lower edge of the bridge. Y-axis extends from the origin in the direction towards the top of the rectangle. This axis coincides with the left support line. Z-axis originates at the origin, i.e. left bottom corner of the rectangle, and extends towards the top of the bridge (not in the direction of the beams).

2.3.2 Finite Element Discretization

Bridge superstructure is composed of deck slab and beams. In the finite element discretization the deck slab is divided into a series of plate bending elements. These elements are either rectangular or square. The elements are interconnected to each other at the corners of the rectangles. These corners are called nodal points. Each nodal point needs to be numbered. Program BOVAC automatically assigns nodal point numbers as indicated in Fig. 3. If there are more plate elements of smaller dimensions in the direction of the span length, then the number of nodal points will increase, but the program will still automatically assign the nodal point numbers. In Fig. 3 the bridge deck slab is divided into 4 strips in the longitudinal direction, thus the numbers at the lower line are from 1 to 5. However, if the deck would have been divided into 10 strips, the numbers on the first line would have been 1 through 11, on the second line 12 through 22, etc.

Each plate bending element also needs to be numbered. The automatic plate bending numbering scheme is depicted in Fig. 4. The numbering pattern is similar to that of the nodal point numbering.

The other major component of the bridge superstructure is the beams. Beams, just like the deck slab, also require discretization into a series of beam finite elements. The length of the beam elements coincides with those of the plate bending elements. The plate bending element and beam elements are interconnected at nodal points common to these elements. Beam numbering sequence is shown in Fig. 5. The pattern of numbering is similar to that of nodal points and plate bending elements.

2.3.3 Automatic Finite Element Discretization

Program BOVAC has a number of features to assist the user. One of them is the automatic finite element discretization of the deck slab and the beam. The program always puts one string of elements between the edge beam and the edge of the deck slab. If there is no overhang, then this string of plate bending elements will not be considered. Between each beam two strings of plate bending elements will be placed. These features could be noted in Figs. 3 and 4. This type of placement of the elements is in the transverse direction of the bridge.

In the lateral direction the division of the bridge deck into strings of elements also needs to be carried out in order to develop the rectangular grid. The user has four options for this mission:

1. Fully Automatic Discretization - Full Bridge

   The deck slab, and inevitably the beams as well, will be divided into 8 strings of rectangles as shown in Fig. 6. Once the span length-L is defined the dimensions of these elements are automatically defined as well. It should be noted that near the center of the bridge elements are smaller than those near the supports. This type of discretization is designed for accurate prediction for the placement of the vehicle for maximum flexural loading. This type of discretization is recommended for those who have not developed sufficient familiarity in "custom-tailored" discretization.

2. Semi-Automatic Discretization - Full Bridge:

The user can discretize the bridge as appropriate for the given loading condition. If the loading condition is not suitable for the use of the fully automatic discretization, then this type of approach should be used. In this approach the user defines the length of each element in the longitudinal direction. The program will then accomplish the required numbering. The user should note that the summation of the length of the members should be equal to the center-to-center span length of the bridge.

3. Fully Automatic Discretization - Half Bridge:

If the bridge superstructure is symmetric with respect to the midspan, and also if the load in longitudinal direction is symmetric and the load is to be placed symmetrically with respect to the midspan of the bridge, then the structural response of the superstructure will be symmetric with respect to the midspan of the bridge. In other words, the midspan of the bridge will be an axis of symmetry for the right and left halves of the bridge. In a situation like this the analysis of the full bridge will not reveal any additional information that could have been obtained through the analysis of one half of the bridge. The user can then define the option that only the half of the bridge will be analyzed, and that furthermore, the automatic discretization of half of the bridge will be requested. These options will result in discretization of the left half of the bridge as shown in Fig. 7. It should be noted that this discretization is similar to automatic discretization of the full bridge, however, only the left half of the bridge is considered. The right most extremity of Fig. 7 corresponds to the midspan of the bridge.

4. Semi-Automatic Discretization - Half Bridge:

In the semi-automatic discretization of half bridge superstructures the user considers only the left half of the bridge, as in Option-3. The dimensions of the elements are defined by the user in a form similar to that of Option-2.

Additional comments on the advantages and disadvantages of different types of discretization are discussed in Chapter 3. Even though the discretization options seem very simple, the use of unrealistic discretization may introduce inaccuracies. Therefore, the suggestions of the problem areas that the user must be aware of are an important issue. In order not to confuse the user with the details of bridge discretization, this aspect of the problem is deferred to Chapter 3 of the users manual. The aim of this chapter is only to provide coverage to enable the user to use the program. After mastery of this aspect, the user should refine his skills through the careful study of the later chapters.

2.3.4 Layering

In any given bridge superstructure and loading configuration, if the load level is below a certain limit, then the bridge superstructure will be in linear elastic state of stress. However, if the load level is above a certain limit, then because of nonlinearity of stress-strain curves of steel and especially concrete, parts of the structure will exhibit material nonlinearities. At this load level the structure may, and in most cases will, not exhibit any damage. However, if the load intensity is increased further some form of damage initiation takes place, usually in the form of cracking of the concrete in the outermost extremities of the deck slab. If the load level is increased even further, the cracks will get deeper, new cracks at other locations may form, and on very rare occasions, even a limited amount of crushing of concrete at the extremities of the bridge may take place. The above sequence of damage initiation and propagation has been observed in the field testing of reinforced or prestressed concrete beam slab bridges (Refs. 6, 18 and 20). There exists a clear relationship between the bridge superstructure, the type of damage, its location, and its magnitude and the placement of the vehicle and intensity of the load level. Program BOVAC is designed to predict the damage characteristics, if any, for a given bridge and vehicle. Depending upon the amount of damage that the bridge may sustain, if any, the bridge engineer or the permit officer can decide on the issuance of the overload permit for the passage of a given vehicle over the given bridge.

The critical issue in the damage initiation and propagation is the monitoring of the damage. As can be recalled, neither the working stress nor the ultimate strength approaches can predict this limited damage. In working stress approach it is tacitly assumed that no damage occurs, whereas in ultimate strength approach it is assumed that the formation of a mechanism is in the offing. In actuality, if the vehicle is heavy enough "limited recoverable damage" may take place. It is the unique feature of program BOVAC that this damage can be predicted to enable the engineer or the officer to decide on the issuance of the overload permit.

The initiation and propagation of the nonlinear material behavior and different forms of damage usually start at the extremities of the bridge surface, i.e. top and bottom surface of the deck slab, and the bottom surface of the beams and, as an exception to the rule, interface shear stresses between the beams and the deck slab near the supports as well. This damage gradually penetrates through the depth of the members for increasing load intensities. In order to simulate the penetration of the damage through the members, program BOVAC employs the "layering" technique (Fig. 8). Both the beams and the slab are divided into finite number of layers. Each layer is assumed to be in plane state of stress. In the case of beams it is assumed that each layer is subjected to axial tension or compression. In the case of deck slab layers are assumed to be in biaxial plane stress condition. The biaxial stresses in the slab are induced due to the presence of bending moments both in transverse and in longitudinal directions. Furthermore, the axial stresses that are present in the beams and the slab are also accounted for by the assumed stress fields. It should be noted that due to the assumption made regarding the types of stresses in the beams, the weak axis bending as well as torsional bending of the beams are not considered. The research have indicated that for the types of bridges and beams in question these moments do not noticeably change the stresses in the beams (Ref. 12 and 13). The prestressing strands and reinforcement are transferred to an equivalent layer of steel by the program. The depth of these layers coincides with the depth of the centroid of the given reinforcement or strand. The layering of the steel and the concrete is automatically performed by the computer program, and thus is not visible to the user. The layering becomes important to the user only in the case of the "detailed output" option of program BOVAC (Fig. 9). This option prints the stresses at each layer of each element (plate bending element of deck slab, or beam element for beams) for each load increment.

One aspect of the layering should be recognized by the user, and that is the accuracy in the monitoring of the possible damage to the superstructure. This accuracy is controlled by the number of layers that are employed for deck slab and beams. The concrete of the deck slab is divided into 6 layers. Two layers of concrete are placed at the top of the top reinforcing bars, and two layers of concrete are placed at the bottom of the bottom reinforcing bars. This implies that the concrete cover is layered into two layers each, for top and bottom of the slab. The concrete between the top reinforcement and bottom reinforcement is divided into two layers. The numbering of the layers is indicated in Fig. 9.

Beam concrete is divided into 10 layers as shown in Fig. 9. Both for the deck slab and for the beams the reinforcement and prestressing strands are also incorporated into the layering as additional layers. The details of this are described in the chapter of the report on the long output option.

The stress variation through the deck of any member changes as a continuous curve; at one extremity of the curve is the maximum compressive stress and at the other extremity the maximum tension stress, and somewhere in between the zero stress, which corresponds to the neutral axis. In layered approach this continuous variation of the stresses is simulated by discrete bars of constant stress. These bars will have negative and positive values to indicate the tension and compression. The simulation of the continuous stress variation by step-wise variation leads to some inaccuracies. These inaccuracies are reflected at each solution step. The magnitude of error does not change for overload vehicles that might or might not cause any damage, or the vehicles that can cause extensive damage.

The extent of the error can be best described by the following example: Assume a deck slab that has a 7½ inch thickness, with 2 inch concrete cover above the top reinforcing bars, and 1 inch concrete cover below the bottom reinforcing bars. This indicates that the top layer (Layer No. 1) and the layer below (Layer No. 2) are 1 inch thick each. Furthermore, concrete layers between the top and bottom reinforcing bars (Layers No. 3 and 4) are 2¼ inches thick each. The concrete layers below the bottom reinforcing bars (Layer Nos. 5 and 6) are ½ inch thick each. If in the process of bending of the deck slab a 0.6 inch crack forms at the bottom of the slab, then the program can not predict the exact depth of the crack. However, if the crack depth is closer to the thickness of one layer, it will indicate that one layer has cracked. If the depth of the crack is closer to the thickness of two layers, it will indicate it as two layers have cracked. In this example, the crack depth of 0.6 inches is closer to the thickness of one layer, i.e. 0.5 inches, than that of two layers, i.e. 1.00 inch. Thus, the program will indicate that one layer of concrete has cracked. However, if the depth of the assumed crack should have been 0.8 inches, then the program would have indicated that two layers of concrete had cracked. The accuracy in the prediction of the depth of the crack is within half the thickness of the layer. In the case of the cracking of concrete in the bottom of the slab, for the given example, it is 0.25 inches. In the case of the cracking at the top of the slab it is 0.5 inches.

Another area that is of relevance to the user of program

BOVAC is the crack width in concrete. There exists a number of detailed studies to relate the crack width to the serviceability limits of the members, and also a number of studies on the "prediction of the crack width" (Ref. 15). Most of the later studies have been conducted in a laboratory environment employing controlled conditions and most importantly, quality controlled specimens. If the findings of one researcher are applied to the test results of another, and even worse, if the laboratory results are applied to field tests, a large disagreement was observed. In view of the practical problems that will be encountered by the bridge engineer or the permit officer, the introduction of the crack width concept as far as its relation to serviceability limits would have yielded results that could have been refuted by the parties employing the findings of other studies. To prevent future complications, the crack width has not been considered as a governing parameter in the determination of the overload limits. If in the future less contestable results in the estimation of the crack width are developed, then these checks could be incorporated into program BOVAC.

2.4 Material Properties

It has been stated that program BOVAC incorporated the linear and nonlinear portions of stress-strain curves for the constitutient materials, i.e. steel and concrete. The full definition of these curves is accomplished simply through the definition of the compressive cylinder strength of concrete and the grade of prestressing strands (250 ksi or 270 ksi). The yield strength of reinforcing bars is taken as 40 ksi. The previous research have developed the necessary relations to establish fully accurate stress-strain curves for these materials through the definition of the above said strength properties. The user need not be concerned about defining these curves in any form.

2.5 Analysis Scheme

The analysis of bridge superstructures using finite element method, especially if the superstructure exhibits material nonlinearities, is beyond the scope of this manual. If interested, the reader can refer to any advanced textbook on finite element method or specific reports (Refs. 18, 20, 21 and 22). However, the basic mechanism of the analysis procedure could easily be summarized within this report. This summary could then provide a better understanding of program BOVAC.

If every single point of the bridge superstructure was to remain in linear elastic regime under the application of the dead-load of the bridge and the full live load, then the routine analysis could have been applied. An analysis as such would have computed the vertical and horizontal displacements, and two orthogonal slopes (slopes in the longitudinal direction of the bridge, and those in the transverse direction) of the nodal points. Internal mechanism of the program would then have computed the stresses in plate bending elements and the beam elements, and would have printed these values. However, it is recognized that even under the prestressing forces the stress-strain relationship of concrete is slightly nonlinear. The application of dead loads and live loads will increase the nonlinearity of the concrete even further, and will initiate the nonlinear behavior of reinforcing steel and possibly prestressing strands. In simplified terms, this phenomenon can be best described as the Modulus of Elasticity, i.e. Young's Modulus, of concrete and steel and is dependent on the applied stresses. In order to find the stresses it is necessary to find the deflections and rotations of the nodal points. This vicious circle can be broken through the incremental application of the dead weight, if need be, and of vehicular loads.

The deadweight of the structure is applied to the superstructure, and initial guesses for moduli of elasticity are made. The deflections and rotations of the nodal points are computed. From these values the stresses in the deck slab and the beams are determined. By using these values the program automatically enters the stress-strain curves of concrete, reinforcing steel and prestressing strands. New moduli of elasticity for each material at different locations are computed. If these moduli are noticeably different from those which were initially assumed, the structure is reanalyzed by using the new moduli. Again the comparisons are performed. If the difference between the assumed and computed moduli for a given set of analysis is close enough, it is assumed that the acceptable solution is obtained and the necessary information is printed (only in the case of long printout).

After the completion of the dead load analysis of the structure, the program automatically switches to the live load analysis phase. A part of the live load is applied to the structure; this is in addition to the full deadweight consideration. The analysis is performed. The comparisons between the assumed and computed elastic properties are conducted. After the attainment of acceptable accuracy, the live load is increased further and a new cycle of analysis commences.

The cycles of the live load incrementation continue until the total live load level is 110% of the vehicular load. This 10% incrementation is provided to assure the uncertainties in the correct determination of the vehicular load. Further comments on this issue are specifically addressed in the last chapter of this manual.

The increments of the live loads are automatically computed by the program, and it is not visible to the user. The execution of the program terminates if one or more of the "threshold limits" are attained before the attainment of full live load plus ten percent of the live load. In a case as such the bridge superstructure will exhibit unacceptable damage if the vehicle of a given weight traverses the bridge. This corresponds to the denial of the overload permit, or the lack of qualification of the bridge to be rated for the given vehicular configuration.

2.6 Termination Checks

For increasing live load levels the stresses and strains in the deck slab and the beams will increase. At certain load level, which depends on the bridge and the loading configuration, concrete can crack. For increased load levels the damage will penetrate through the depth of the members and will also spread throughout the superstructure. From serviceability standpoint, certain limits can be imposed on the response of the bridge superstructure, such that load levels higher than these limits will not be permitted. If the load levels are in excess of any one of these limits, the serviceability criteria will be violated. The limits have been set in terms of maximum strains, maximum stresses and number of cracked concrete layers (which controls the crack depth).

2.6.1 Termination Checks for Deck Slab

Following are the termination parameters for the deck slab:

1. The maximum allowable strain for concrete is 0.0025 inches per inch.
2. The maximum allowable tensile stress for concrete is

$$6\sqrt{f'_c}$$

   where f'_c is the compressive cylinder strength of concrete.
3. The maximum allowable concrete compressive strength is 80% of the compressive cylinder strength.
4. The maximum number of cracked concrete layers is 3.
5. The maximum number of crushed concrete layers is 1.
6. The maximum allowable strain for the reinforcing bars is 75% of the yield strain.
7. The maximum allowable tensile stress for the reinforcing bars is 75% of the yield stress of the bars.

8. The maximum allowable compressive stress for the reinforcing bars is 75% of the yield stress of the bars.

9. The maximum number of yielded steel layers is 1.

This specifies that a crack in the slab concrete is acceptable if it is less than three layers deep.

The following represents the beam termination parameters:

1. The maximum allowable strain for concrete is 0.002 inches/inch.

2. The maximum allowable tensile stress for concrete is

$$6\sqrt{f'_c}$$

3. The maximum allowable compressive stress for concrete is 80% of the compressive cylinder strength of concrete.

4. The maximum number of cracked concrete layers is 1.

5. The maximum number of crushed concrete layers is 1.

6. The maximum allowable strain for the prestressing strands is 75% of the "yield strain" of the strands.

7. The maximum allowable tensile stress for the prestressing strands is 75% of the tensile strength of the strands.

8. The maximum allowable flexural shear is

$$2 \times 0.85\sqrt{f'_c}$$

3. COLLECTION OF DATA FOR PROGRAM BOVAC

Prior to filling the input forms for program BOVAC, the collection of all necessary information, and the finalization of preliminary decisions are of great importance. Through this approach the user will have to worry only about filling the form once the activities listed in this chapter are completed. The areas of preparatory activities deal with the information regarding the bridge superstructure, vehicle, and loading configuration. The last item requires some decision making by the user.

3.1 Information on Bridge Superstructure

The user should be sure that the span of the bridge superstructure under consideration is a simple-span one. Beams are prestressed concrete I-beams, and the deck slab is reinforced concrete.

3.1.1 Beams

Bridge beams should have cross sectional dimensions coinciding with one of the standard sections of the Pennsylvania Department of Transportation or Association of American State Highway and Transportation Officials (AASHTO). If the dimensions of the beams on hand differ slightly from one of the standard sections, then the user can approximate the beam with one of the standard beams. It should be noted that this introduces slight inaccuracy into the analysis. It is preferable that the user should pick up a standard section that is slightly under dimensioned, especially in terms of the depth of the beam. This will make the approximation a conservative one.

If none of the standard beam cross sections can approximate the bridge beam on hand, then a decision has to be reached by the user.

1. The urgency of the job may require the use of the closest beam section. This could be done with the proviso that the results are approximate. The amount of error increases as the beam cross section starts differing from the assumed standard section.
2. If the user is familiar with program BOVA, and if the user has sufficient time to initiate the job by using BOVA, the job could be undertaken via BOVA (Ref. 17).
3. The user may wish to employ other means in the rating of the bridge or issuance of the overload permit.

If the user proceeds with the use of BOVAC, the following data need to be obtained:

1. Number of beams
2. Beam cross section (actual or assumed)
3. Compressive strength of beam concrete (see the note below on the assumptions regarding the compressive strength of concrete)

4. Prestressing strand diameter

5. Number of prestressing strands per beam

6. Grade of prestressing strand steel (250 or 270)

7. Initial prestressing on the strands

8. Distance from the top of the beam to the center of the prestressing strand group.

9. Age of the bridge in years (employed in the computation of prestressing losses)

3.1.2 Comments on the Concrete Compressive Strength

The compressive cylinder strength of beam and slab concrete needs to be known. This value determines not only the crushing of the concrete but more importatnly the elastic modulus of the bridge and cracking of concrete. Usually 28-day cylinder strength is used. However, if more realistic information can be determined, then this value should be preferred over the 28-day strength. Some considerations that the user should be aware of are as follows:

1. If in the construction of the bridge the quality control was observed, and if the beam and especially, the deck slab concrete have had all the desirable attributes in the aging process, and if the deck slab does not have any cracks besides the limited hairline shrinkage cracks, then the value higher then the 28-day strength could be used. The user should be able to justify the increase in concrete strength. However, if this justification

can not be met and if the above provisions are met, then 28-day strength could be used. This will give slightly conservative results.

2. If the bridge construction observed limited quality control, and if the environment has not been conducive to the increase of concrete strength, the cylinder strength should be taken as that of 28-day strength, or below. The user should justify the reduction of the concrete strength. The user should recall that the critical bridge component as far as the rating is concerned is the deck slab, assuming that the beams do not have major defects.

3. If the bridge deck exhibits major defects that may be due to incomplete aging process, effects of chemically aggressive environment, extensive use of de-icing agents, and/or poor maintenance, the user should use a concrete strength below the 28-day strength. The thickness of concrete cover at the top of the top reinforcing bars should also be reduced. This is in addition to the reduction of concrete strength, not instead of. The reduction of the thickness simulates the wear of the concrete cover.

3.1.3 Bridge Dimensions

The following information pertaining to the dimensions of the bridge superstructure needs to be determined:

1. Center-to-center span length
2. Out-to-out bridge width
3. Overhang (distance from the edge of the bridge slab to the centerline of the exterior beam)

3.2.4 Slab Information

The following information regarding the deck slab needs to be determined:

1. Compressive strength of concrete (See Section 3.1.1 for additional comments)
2. Thickness of the slab including an assumed 1/2 inch integral wearing surface (this implies that the structural capability of the slab will be analyzed for the slab thickness of 1/2 inch less than that defined by the user)
3. Cover from the top of the slab to the closest layer of reinforcement bars.
4. Cover from the bottom of the slab to the closest layer of the reinforcement bars.

Slab reinforcement is automatically computed by the program (Table 3).

3.2 Information on Vehicle

The user should consider two distinct areas: (1) the vehicular configuration, which defines the load configuration, and (2) the surface roughness of the bridge and approach spans/or highway to the bridge, which can effect the dynamic amplification of the magnitude of the axle weights.

3.2.1 Vehicle

The user should consider the plan view of the axles and the wheel spacing. In all probability the contact areas of the wheel groups could be simulated as a single area. If the contact area of a single wheel is a rectangle having dimensions a by b, a new rectangle could be constructed having dimensions (t+a+t) by (t+b+t), where t corresponds to the thickness of the deck slab. For the majority of the vehicles the wheel groups could be simulated by one area load each. In the case of special dollies where a number of axles are closely spaced and each axle contains four almost evenly spaced wheels or eight wheel groups with two wheels per group, then the plan area of the dolly could be employed as the loaded area. Any other combinations should be decided upon by the user. The sizes and the shapes of the loaded areas will have to be determined by the user, through the application of common sense and engineering judgment.

The user should be cognizant of a critical factor regarding the gross vehicular weight versus axle weights versus wheel loads. The total gross vehicular weight could be far in excess of the design vehicle weight, and still have no damage inflicted on the bridge. This no damage situation can be attained if the vehicle has multiple axles and multiple wheels per axle. The relationship of how many axles per vehicle and how many wheels per axle has not been determined as yet. In summary, reduced wheel loads, and distribution of the wheels over a larger area, will be of assistance in the reduction of possible damage to the superstructure.

Conversely, the user should be careful in the case of vehicles that might be even lighter than the design configuration, but where the loads are transmitted via limited number of closely spaced axles; and even worse, limited wheels per axle. Again, the quantification of the effects of these vehicular configurations has not been undertaken. At this stage the awareness of the effects of the axle spacings and groupings by the user is essential.

3.2.2 Approach and Traverse of the Vehicle

The smoothness of the approach road to the bridge span is an important factor in the transfer of the vehicular weight as a pseudo-static loading to the superstructure. If the approach road or the bridge surface is not smooth enough and/or if the vehicle's suspension system is not properly functioning, then the vehicular speed should be reduced to essentially crawl speed, i.e. 2-3 mph. The information regarding the road surface in the immediate vicinity of the bridge span may not be available to the user of the computer program. In that case, the overload permit could be issued, provided that the bridge can accommodate the vehicle, with the provision of the reduced vehicular speed. The factors regarding the speed of the vehicle are also governed by the traffic safety conditions. This aspect should be observed by the officers enforcing the implementation of the overload permit operations.

3.3 Placement of Vehicle

Program BOVAC performs one analysis for a given bridge, and for one particular placement of one vehicle. Therefore, it is essential that the user place the vehicle in such a manner that it will correspond to the worst possible loading of the bridge superstructure. Past experiences have indicated that through the use of engineering judgment the placement of the vehicle in a location that will cause the most adverse effect on the superstructure is possible, and also quite practical.

The user will have to decide whether the vehicle is symmetric with respect to some mid-length point of the vehicle. If that is the case, and also if the symmetric placement (with respect to the mid-span) of the vehicle on the bridge will induce the extreme loading, then the "SYMMETRY" of the problem in the input should be recognized as such (Fig. 10). The reduction of the problem from full to half symmetry (with respect to the mid-span) reduces the computer time requirement by at least a factor of four. Some of the cases where symmetry can be encountered are as follows:

1. Assume that the vehicle is composed of front axle, and front and rear axle groups, each of which could be considered as "dollies." If the distance between the centers of the front

and the rear dollies is greater than or equal to the half span length, then only one of the dollies could be symmetrically placed at the center of the bridge. This loading will induce the worst flexural response on the superstructure. If the distance between the centers of the dollies is less than the half span length of the bridge, still only one of the dollies could be placed at the center of the bridge. However, the results will not necessarily be the extreme flexural loading. As the distance between the centers of the dollies gets smaller than the half span length, the errors introduced into the loading configuration increase. The simplest tool for the user to decide on the placement of the vehicle will be the visualization of a simple beam with two concentrated loads. If one of the loads is placed at the center of the beam, than the closeness of the other loads will define the maximum bending moment that the beam will have. By "juggling" the load locations, the engineer can determine the location of the loads that will cause the highest flexure in the beams. By using the same concept the user can decide on how to place the vehicle.

2. In the case of trucks with limited spacing of the axles (front-drive, drive-rear) as compared to the half span length of the bridge, the peak flexural loading could be obtained by the placement of the drive axles over the mid-span of the bridge. In this case, the symmetricity of the loading could be violated, thus the full bridge needs to be analyzed.

3. For trucks with drive axles, and 3-4 axles under the load, especially if the distance between the drive axle and the beginning of the "rear axle group" is limited, the center of the axle groups could be placed at the midspan of the bridge. If the magnitude of the front axle loads is small enough, as compared to the individual axle loads of the "rear axle group," than it is possible to ignore the front axle, and distribute the weight of the front axle amongst the axles of the group. This will permit consideration of the symmetricity of the problem, and will also yield conservative results.

4. In the case of vehicles with limited number of axles, but where these axles have pronounced individual weights, than the heaviest axle could be placed at the center of the bridge, and full vehicle, and full bridge need to be considered.

As can be seen above, there may be a number of vehicular configurations that the user will have to face. Inclusion of all scenarios in this manual is not possible. The user should visualize the bridge as if it is a simple beam and consider the vehicle as a train of concentrated loads. Using engineering judgment and common sense, the user should place the vehicle at the worst possible location.

3.3.1 Shear Loading

For very short span bridges, 25 ft. or less, it is theoretically conceivable that the initiation of the damage to the bridge superstructure will start in shear mode, either the interface shear between the beams and the slab or the principal tension field in the "web" of the beams at the immediate vicinity of the support. If such a possibility is to be considered, the user should then place the axle at about quarter span length points. If the vehicle under consideration can be simulated as an area load due to multiple axles and wheels, than this area load could be placed on half the span length or even greater distances so long as the full area load is adjacent to the support line.

Past experience, as has been stated previously, indicated that in the majority of the bridges that have been studied the damage initiates as the cracking of the deck slab. Only in short span bridges is the damage initiated as the interface shear failure between the beams and the slab, and is then transformed into the cracking of the deck slab.

3.3.2 Load Placement in Transverse Direction

It is very rare that the vehicle under consideration will occupy the full width of the bridge cross section. The vehicular axis will traverse a certain longitudinal line on the bridge. This preference of the axis of traverse, or travel, is usually predefined by the bridge or the traffic engineer. If the transverse placement of the travel lane is predefined, then the user will have to place the vehicle, as far as the transverse placement is concerned, in a real or hypothetical traffic lane. However, if the user is given the option of defining the preferred traffic lane on the bridge, certain considerations must be given:

1. Placement of the vehicle wheels over the beams will not necessarily reduce the stressing of the deck slab. The beams under the wheels will deform because of the loading. The beams that are not under the load will try to remain in their original positions. The differential deflection of the bridge beams will be prevented by the transverse bending of the deck slab. The concept of the load distribution factor plays an important role in the transfer of the vehicular load to all the beams. The load will never be equally distributed amongst all the beams. The variation of the load distribution amongst the different beams triggers the transverse bending of the deck slab. Thus, any effort to try to place the wheels on beams corresponds to a futile effort.

2. The usual preference is to have the vehicle traverse the bridge on the outermost lane. From overloading of bridges standpoint, this practice does not correspond to the best alternative. If possible, the vehicle should traverse the bridge in one of the inner lanes. Theoretically ideal, but practically nearly impossible, this option corresponds to the placement of the vehicle axis with the centerline of the bridge. Thus, if the vehicle is located somewhere between the outermost and the innermost traffic lanes, the stresses induced on the superstructure will be slightly

less than those resulting from placement of the vehicle near the "edge" of the bridge. It should be remembered that if the bridge superstructure is composed of two side-by-side bridges, the use of the innermost traffic lane will have the same effect as the use of the outermost lane.

3. The use of the bridge solely by the overload truck during the traverse of the bridge is justifiable only in the case that other trucks, close to or heavier than the design vehicle, are attempting to traverse the bridge at the same time as the overload vehicle. The structural response of the bridge will barely change if automobiles and light vehicles are to traverse the bridge at the same time as the overload vehicle. The decisions regarding traffic control during the passage of the overload vehicle are to be decided through the consideration of traffic safety provisions. The structural response characteristics will be effected only if the bridge is to be loaded by the overload vehicle and sizeable trucks.

3.4 Discretization

After the user decides on the placement of the vehicle on the bridge that will cause the worst possible effect on the superstructure, the user will then have to decide on the type of discretization of the finite element mesh that will be employed. Symmetric loading of a symmetric bridge should be handled by using the symmetry option of program BOVAC. If slight inaccuracies can be introduced by making the problem "symmetric," an alteration as such will greatly reduce the computational effort.

After the decision by the user as to whether it is a symmetric problem or a nonsymmetric one, the second decision that has to be reached is to use the automatic mesh generation option or to discretize the structure personally. The automatic option should be considered by the beginners. Special discretization should be considered by the average or qualified users. Some of the considerations that go into the discretization of the bridges can be noted in the example problems that have been included in the manual.

The detailed discussions on how to discretize a given problem would be confusing to the beginning user of finite element analysis, e.g. program BOVAC. Therefore, these discussions have not been included in this chapter. However, to illustrate the dependency between the placement of the vehicular load and the "best" discretization of a given bridge for the given loading, a simple example is included herein.

If, for example, a discretization shown in the top of Fig. 11 is loaded by the equivalent vehicular loading (shaded area) two of the plate elements will be loaded. The stresses in the deck slab under the loaded area will have extreme values. However, if the same discretization is loaded by an area load as shown at the bottom of Fig. 11, the stresses in the plate bending elements that are partially covered by the area loads will not necessarily be the highest possible values. If this load is moved towards the left by half the plate element length, and either moved up or down by half the plate element height, than the stresses that will be developed due to the new load positioning will be higher. Thus, for the skilled user of the program, the best alternative is first to place the vehicle, then to perform the discretization in such a manner that the loaded area will be over one or more elements. This will give higher stress values, consequently, a more conservative estimate to the possible damage to the bridge deck. The above comments once again confirm the previous suggestions that the user of the program should use some judgment in the placement of the load and the discretization of the bridge structure.

3.5 BOVAC Data Collection Form

To assist the user, a form has been prepared that can be used in the accumulation of the data. The use of this form is not essential; however, because of its comprehensive and systematic nature, use of the form will assist the user prior to the preparation of the "data cards" for BOVAC

The first column in the list is the name of the pieces of data to be collected. The second blank column is designed to be filled during the accumulation of the data, regardless of the units, e.g. feet or inches, pounds or kips, employed. The third column is again a blank column. The user is expected to transfer the numerical values of each entry in the previous column by converting into a consistent set of units. The last column is the so-called INPUT UNIT NUMBERS, where the pieces of data are linked to various input cards used for BOVAC. The description of the INPUT UNIT NUMBERS is included in Chapter 4.

BOVAC DATA COLLECTION FORM

Description	Raw Data Values	Values w/ Consistent Dimensions	INPUT UNIT NO.
1. Job Title			1
2. Span Length		(ft)	4
3. Width		(ft)	4
4. Overhang		(ft)	4
5. Age of the Bridge (years)		(yr)	8
SLAB			
6. Concrete Strength, f'_c		(ksi)	7
7. Thickness		(in)	7
8. Top Concrete Cover		(in)	7
9. Bottom Concrete Cover		(in)	7
BEAMS			
10. Number of Beams			3
11. Beam Type			3
12. Concrete Strength, f'_c		(ksi)	8
13. Diameter of P/S Strands			8
14. Number of P/S Strands per Beam			8
15. Grade of P/S Strands (250 or 270)		(ksi)	8
16. Initial P/S Stress		(ksi)	8
17. Distance from Top of Beam to Centroid of P/S Strand Group		(in)	8

	Values w/ Consistent Dimensions	INPUT UNIT NO.
<u>PRINTOUT</u>		
18. Printout Detailed (DETAILED), Short		2
<u>DISCRETIZATION</u>		
19. Type of Symmetry (ALL or HALF)		3
20. Number of Elements in Long. Direction (Needed if Automatic Disc. is NOT Used)		5
21. Length of Elements in Long. Direction (If Predisc. is NOT Used) (in inches) (start with the top line, and continue)		6
<u>LOADING</u>		
22. Number of Independent Area Loads		9
23.1 Load #1		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	
23.2 Load #2		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	

	Values w/ Consistent Dimensions	INPUT UNIT NO.
23.3 Load #3		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	
23.4 Load #4		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	
23.5 Load #5		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	
23.6 Load #6		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	

	Values w/ Consistent Dimensions	INPUT UNIT NO.
23.7 Load #7		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	
23.8 Load #8		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	
23.9 Load #9		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	

Notes:

4. INPUT TO PROGRAM BOVAC

This chapter describes the necessary data input for the execution of the program. There is a total of ten input units or data groups; however, the number of data cards required for the execution of BOVAC can be as low as seven. The majority of program executions requires nine data cards. Each unit consists of one card with one or more different types of information per card. Under conditions of multiple patch loadings, an input unit must be repeated more than once. Various input options are selected through the use of certain variable assignments or skipping a particular unit entirely.

4.1 Format Specifications

The four format specifications, i.e. the form in which certain numerical or alphabetical information needs to be punched, required for the program are real (F-format), integer (I-format), alphanumeric (A-format), and skip (X-format). These formats can be briefly described as:

1. F-Format: This is the type used to input the numerical values with decimal fractions. For example, if the format is (F10.0), and the value to be punched is 3.1416, then the card should be punched as (in the first ten columns, remainder being blank)

   ƀƀƀƀ3.1416

   or

3.1416b̸b̸b̸b̸

or

b̸b̸3.1416b̸b̸

If the number to be punched is 31416. and if the format is still (F10.0) the card should be punched as (in the first ten columns, remainder being blank)

b̸b̸b̸b̸31416.

or

31416.b̸b̸b̸b̸

or

b̸b̸31416.b̸b̸

In the above example b̸ denotes that this particular column is to be left blank, i.e. no punching.

Two salient points that the user can observe: In F-format the decimal point must be punched, as far as the scope of this brief presentation is concerned, and the number to be punched can occupy any space within the specified number of columns. In the above examples F10.0 indicates that the number is allocated 10 columns. (The number immediately following the letter F indicates the number of columns allocated.)

2. I-Format: I-field specification is used to define integer variables (or numbers). For example, if the format calls for (2I5), it indicates that two integer values are to be punched in the particular data card. The first value will employ the first through fifth columns, and the second value will employ

sixth through tenth columns. It should be remembered that in inputting integer values no decimal points are to be punched and the number to be punched must be placed at the outermost right side of the allocated number of columns. If the number to be punched is 12 and if the format is (I5) then the number could be punched only in the following manner:

ƀƀƀ12

In the above punching only the first five columns are indicated, the rest of the card is left blank.

If the user punches the card in the following manner, for the same example as above:

12ƀƀƀ

or

ƀ12ƀƀ

the computer program assumes that in the first case the number is 12000, and in the second case the number is 1200. These mispunchings result in either the rejection of the data by the program, or the attempt to solve a problem that has no relevance to the problem on hand.

As can be noted in the above discussion, both F-format and I-format can be repeated using an appropriate integer before the letter designation. For example, FORMAT(I5,I5) is the same as FORMAT(2I5). Similarly, FORMAT(I5,I5,F10.0, F10.0,I5) serves the same purpose as FORMAT(2I5,2F10.0,I5). In the latter example the first through fifth columns are allocated for the first integer number, sixth through tenth are allocated for the second integer number, 11th through 20th are allocated for the first real number, 21st through 30th are allocated for the second real number and, the 31st through 35th columns are allocated for the third integer number.

3. A-Field Specification: A-field specification is used to transmit alphanumeric values, usually names or acronyms. The variable name can be composed of alphabetic or numeric characters. The cards must be punched, within the given field length (that is, the number of columns allocated) in such a manner that the "name" will start in the left-most column. For example, if the format is (A5) and the "value" to be punched is YES, then the value should be punched as (for the first five columns of the card, remainder being blank):

   YESƀƀ

4. X-Field Specification: X-field specification is used to skip a certain number of columns in the data card. Any value punched in these columns corresponding to this field length (number of columns representing the said field length) will be ignored. For example, if the format is (A5,I3,2X,F10.0) and if the values to be punched are YES, 2 and 3.1416 then the punching should be (for the first 20 columns of the card, remainder being blank)

   YESƀƀƀƀ2ƀƀ3.1416ƀƀƀƀ

4.2 Input Information

UNIT 1

1. Identification title for the particular problem. The title may be 80 characters long.

   FORMAT(20A4)

UNIT 2

The user has the option to select either a detailed or brief output mode. The brief output will present a summary of all cracked, crushed or yielded portions of the bridge as well as the load and displacement at the center of the bridge midspan. The detailed output will present stresses, strains, loads and deflections at every element layer or nodal point of the analytical model of the bridge superstructure. A summary of the cracked, crushed or yielded portions will also be presented. Detailed output can run into hundreds of pages of computer print-out; whereas, short printout is about a dozen pages or less.

If a detailed output is required, input DETAILED. If a short output is required, skip this input information, i.e. no input required.

FORMAT(5X,A7)

UNIT 3

1. Total number of beams.
2. Beam type chosen from Pennsylvania Department of Transportation or AASHTO shapes. See Tables 1 and 2 for the available shapes and the acronyms designating the shapes.
3. Type of symmetry desired. For nonsymmetric loading input ALL. - for symmetric loading input HALF.

   FORMAT(I5,A7,3X,A4)

UNIT 4

1. Center to center span of the entire bridge, in FEET. If half symmetry is used, the span length of the full bridge still needs to be specified.
2. Bridge overhang, in FEET, defined as the distance from the centerline of the outermost beam to the edge of the bridge deck slab in the transverse direction.
3. Out-to-out width of the bridge deck slab in FEET.

FORMAT(3F10.0)

UNIT 5

If the prediscretization option is to be used, skip this unit (i.e., no cards are needed for Unit 5). If the discretization in the longitudinal direction is to be done by the user, the card must be punched.

1. Number of elements in longitudinal direction.

FORMAT(5X,I5)

UNIT 6

If the prediscretization option is used by skipping UNIT 5, skip this unit as well. If the user will define the discretization in the longitudinal direction punch the required card(s).

Length of finite elements in the longitudinal direction. If the number of elements in the longitudinal direction is less than or equal to 8, one card will suffice. If the number of elements in the longitudinal direction is more than 8, but less than or equal to 16, two cards will be required. If this number is greater than 16, but less than or equal to 24, three cards will be required.

FORMAT(8F10.0)

UNIT 7

1. Compressive strength of slab concrete (f'_c) in KSI.
2. Thickness of the slab in INCHES, including an assumed ½ inch integral wearing surface. This implies that the structural capability of the slab will be analyzed for a slab in which the thickness will be assumed to be ½ inch less than the thickness inputted by the user.
3. Thickness of the concrete cover, in INCHES, from the top of the slab to the closest layer of reinforcing bars.
4. Thickness of the concrete cover, in INCHES, from the bottom of the slab to the closest layer of reinforcing bars.

FORMAT(4F10.0)

UNIT 8

1. Compressive strength of the beam concrete (f'_c) in KSI.
2. Prestressing strand diameter in sixteenth inches (e.g. 7/16 inch strand is inputted as 7).
3. Number of prestressing strands in each beam.
4. Grade of prestressing strands (either 250 or 270).
5. Initial prestress on the strands, in KSI.
6. Distance from the top of the beam to the centroid of the prestressing strand group in INCHES.
7. Age of the bridge in years.

FORMAT(F10.0,3I5,3F10.0)

UNIT 9 Number of independent area loads (loading patches) to be inputted.

FORMAT(I5)

UNIT 10 NOTE: THIS UNIT MUST BE REPEATED FOR EACH INDEPENDENT AREA LOAD (i.e., LOADED PATCHES). If, for example, 6 area loads are defined in UNIT 9, as is usually the case for an 18-wheeler semi-tractor trailer, 6 separate cards need to be punched.

1. Intensity of the area load in KSI.
2. Longitudinal distance to the center of the area load measured from the left side of the bridge in INCHES (i.e. y-axis).
3. Transverse distance to the center of the area load measured from the bottom of the bridge in INCHES (i.e. x-axis).
4. Length of the area load in the longitudinal direction in INCHES (i.e. the length of the side of the rectangle parallel to the x-axis).
5. Length of the area load in transverse direction in INCHES (i.e. the length of the side of the rectangle parallel to y-axis).

FORMAT(5F10.0)

THIS CONCLUDES DATA INPUT.

4.3 Units

The program and the user's manual is prepared essentially for the input of all force units in KILOPOUNDS (KIPS) and stresses in KILOPOUNDS PER SQUARE INCH (KSI). Span length, bridge width and overhang must be inputted in FEET. Other lengths should be inputted in INCHES. Any deviation from these recommended values would yield results that have no resemblance to those of the actual problem.

BOVAC INPUT FORM (SHEET - 1)

Title

1

Printout

2 (5X,A7)

No. Bm. Bm. Type Symm.

3 (I5,A7,3X,A4)

Sp. Length Overhang Width

4 (3F10.0)

No. Elems.

5 (5X,I5)

Element Lengths (8F10.0)

6

f_c' (slab) Thickness Top Cover Bottom Cover

7 (4F10.0)

f_c' (Bm.) P/S-ϕ P/S-# P/S-Grd. P/S-P_1 Dist. to-P/S C.G. Bridge Age

8 (F10.0,3I5,3F10.0)

BOVAC INPUT FORM (SHEET - 2)

No. Loads

9 ☐☐☐☐☐ (15)

	Load Intensity (pressure)	Long. Dist. from Left Side to Ctr. of Load	Trans. Dist. from Bottom to Ctr. of Load	Length of Area Load	Width of Area Load	
10						Area Load No. 1
						Area Load No. 2
						Area Load No. 3
						Area Load No. 4
						Area Load No. 5
						Area Load No. 6
						Area Load No. 7
						Area Load No. 8
						Area Load No. 9

5. EXAMPLE PROBLEMS

This chapter contains a brief presentation of three example problems worked out by BOVAC. The information contained herein is aimed at describing how the data can be collected to input BOVAC. In the subsequent chapter, the interpretation of the output of BOVAC for the three examples is given.

3.1 Example-1

3.1.1 Description of the Problem

The first case study is a four beam bridge as shown in Fig. 12. In this example the user specifies the length of the elements in the longitudinal direction (Fig. 13). It can be noted that in the vicinity of the applied loads the size of the elements is smaller than the size of the elements near the supports. This is due to the fact that the bridge will have high moments and stresses near the center of the bridge, due to the loading, and thus, more accurate information at this area is required. Near the supports the stresses will be much smaller, and consequently the size of the elements is not important. However, it is essential that the change of the element sizes from fine-mesh region, i.e. mid-span, to coarse-mesh region, i.e. near the supports, must be gradual. If there are abrupt changes of the element size, the possibility of error build-up in the

BOVAC DATA COLLECTION FORM

Description	Raw Data Values	Values w/ Consistent Dimensions	INPUT UNIT NO.
1. Job Title	EXAMPLE BRIDGE 1		1
2. Span Length	70'	70. (ft)	4
3. Width	31'	31. (ft)	4
4. Overhang	3'-6"	3.5 (ft)	4
5. Age of the Bridge (years)	0.	0 (yr)	8
SLAB			
6. Concrete Strength, f'_c	3500 psi	3.5 (ksi)	7
7. Thickness	8"	8 (in)	7
8. Top Concrete Cover	2"	2 (in)	7
9. Bottom Concrete Cover	1"	1 (in)	7
BEAMS			
10. Number of Beams	4	4	3
11. Beam Type	PDT 24/48	PD24/48	3
12. Concrete Strength, f'_c	5500 psi	5.5 (ksi)	8
13. Diameter of P/S Strands	7/16"	7	8
14. Number of P/S Strands per Beam	54	54	8
15. Grade of P/S Strands (250 or 270)	G270	270 (ksi)	8
16. Initial P/S Stress	189 ksi	189 (ksi)	8
17. Distance from Top of Beam to Centroid of P/S Strand Group	37.44"	37.44 (in)	8

	Values w/ Consistent Dimensions	INPUT UNIT NO.
PRINTOUT		
18. Printout Detailed (DETAILED), Short	DETAILED	2
DISCRETIZATION		
19. Type of Symmetry (ALL or HALF)	HALF	3
20. Number of Elements in Long. Direction (Needed if Automatic Disc. is NOT Used)	5	5
21. Length of Elements in Long. Direction (If Predisc. is NOT Used) (in inches) (start with the top line, and continue)	126 | 84 | 84 | 84 | 42	6
LOADING		
22. Number of Independent Area Loads	1	9
23.1 Load #1		10
Load Intensity	0.01 (ksi)	
Longitudinal Distance	399 (in)	
Transverse Distance	186 (in)	
Length in Long. Direction	42 (in)	
Width in Transverse Direction	96 (in)	
23.2 Load #2		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	

BOVAC INPUT FORM (SHEET - 1)

Line	Field	Entry	Format
1	Title	EXAMPLE BRIDGE 1	
2	Printout	DET	(5X,A7)
3	No. Bm.	4	(I5,A7,3X,A4)
	Bm. Type	PD24/48	
	Symm.	HALF	
4	Sp. Length	70.	(3F10.0)
	Overhang	3.5	
	Width	31.	
5	No. Elems.	5	(5X,I5)
6	Element Lengths (8F10.0)	126. 84. 84. 84. 42.	
7	f'_c (slab)	3.5	(4F10.0)
	Thickness	8.	
	Top Cover	2.	
	Bottom Cover	1.	
8	f'_c (Bm.)	5.5	(F10.0,3I5,3F10.0)
	P/S-ϕ	7	
	P/S-#	54	
	P/S-Grd.	270	
	P/S-P_1	189.	
	Dist. to-P/S C.G.	37.44	
	Bridge Age	0.	

BOVAC INPUT FORM (SHEET - 2)

No. Loads

9 [1] (15)

	Load Intensity (pressure)	Long. Dist. from Left Side to Ctr. of Load	Trans. Dist. from Botton to Ctr. of Load	Length of Area Load	Width of Area Load	
10	0.01	399.	186.	42.	96.	Area Load No. 1
						Area Load No. 2
						Area Load No. 3
						Area Load No. 4
						Area Load No. 5
						Area Load No. 6
						Area Load No. 7
						Area Load No. 8
						Area Load No. 9

numerical analysis increases. As can be seen in Fig. 13, the size of the elements increases gradually.

It can also be noted that the loads are placed on two elements, thereby making these two elements the most likely ones to exhibit damage in the case of increased load levels. The beams are Pennsylvania Department of Transportation's standard PD24/48 cross sections. The cross section of the beam is shown in Fig. 14. The prestressing strand group used in the cross section consists of 54, 7/16 inch, grade 270 strands, and its center of gravity is located 37.44 inches below the top of the beam.

The slab is 8 inches thick, including the assumed ½ inch thick integral wearing surface. This implies that the computer program will assume the slab thickness to be 7½ inches thick in the structural analysis of the bridge superstructure. The slab reinforcement is automatically defined by the program following Pennsylvania Department of Transportation standards (Fig. 18, and Table 3).

The slab concrete compressive strength is assumed to be 3500 psi, and that for the beam is assumed to be 5500 psi. These values correspond to the design specifications, in other words, an increase in concrete strength due to age, or a decrease due to environmental factors are not considered. The computer program automatically computes the uniaxial tensile strength and the modulus of elasticity of beam and slab concretes. The program assumes that the "yield strength" of the prestressing strands is 270 ksi, and that the modulus of elasticity is 27000 ksi.

The loading is assumed to be 302.4 pounds per square foot.

3.1.2 BOVAC Data Collection Form

The completed form is enclosed in the report.

3.1.3 BOVAC Input Form

The completed BOVAC Input Form is also included in the report.

3.2 Example-2

3.2.1 Description of the Problem

This example is the same bridge that was employed in the first example. The loading configuration is also the same. The difference between these two examples stems from (1) the use of the automatic mesh generation, and (2) the use of the short output. Because of the change in the definition of the discretization, the length of the elements in longitudinal direction is divided differently. The new discretization is shown in Fig. 15. The other changes in the input stream that the reader should note

BOVAC DATA COLLECTION FORM

Description	Raw Data Values	Values w/ Consistent Dimensions	INPUT UNIT NO.
1. Job Title	EXAMPLE BRIDGE 2		1
2. Span Length	70'	70. (ft)	4
3. Width	31'	31. (ft)	4
4. Overhang	3'-6"	3.5 (ft)	4
5. Age of the Bridge (years)	0	0. (yr)	8
SLAB			
6. Concrete Strength, f'_c	3500 psi	3.5 (ksi)	7
7. Thickness	8"	8 (in)	7
8. Top Concrete Cover	2"	2 (in)	7
9. Bottom Concrete Cover	1"	1 (in)	7
BEAMS			
10. Number of Beams	4	4	3
11. Beam Type	PDT 24/48	PD 24/48	3
12. Concrete Strength, f'_c	5500 psi	5.5 (ksi)	8
13. Diameter of P/S Strands	7/16"	7	8
14. Number of P/S Strands per Beam	54	54	8
15. Grade of P/S Strands (250 or 270)	G 270	270 (ksi)	8
16. Initial P/S Stress	189 ksi	189 (ksi)	8
17. Distance from Top of Beam to Centroid of P/S Strand Group	37.44"	37.44 (in)	8

	Values w/ Consistent Dimensions	INPUT UNIT NO.
PRINTOUT		
18. Printout Detailed (DETAILED), Short	short	2
DISCRETIZATION		
19. Type of Symmetry (ALL or HALF)	HALF	3
20. Number of Elements in Long. Direction (Needed if Automatic Disc. is NOT Used)		5
21. Length of Elements in Long. Direction (If Predisc. is NOT Used) (in inches) (start with the top line, and continue)		6
LOADING		
22. Number of Independent Area Loads	1	9
23.1 Load #1		10
Load Intensity	0.01 (ksi)	
Longitudinal Distance	399. (in)	
Transverse Distance	186. (in)	
Length in Long. Direction	42. (in)	
Width in Transverse Direction	96. (in)	
23.2 Load #2		10
Load Intensity	(ksi)	
Longitudinal Distance	(in)	
Transverse Distance	(in)	
Length in Long. Direction	(in)	
Width in Transverse Direction	(in)	

BOVAC INPUT FORM (SHEET - 1)

1 Title: EXAMPLE BRIDGE 2

2 Printout: (crossed out) (5X,A7)

3 No. Bm.: 4 | Bm. Type: PD24/48 | Symm.: HALF (I5,A7,3X,A4)

4 Sp. Length: 70. | Overhang: 3.5 | Width: 31. (3F10.0)

5 No. Elems.: (crossed out) (5X,I5)

6 Element Lengths (8F10.0): (crossed out)

7 f_c' (slab): 3.5 | Thickness: 8. | Top Cover: 2. | Bottom Cover: 1. (4F10.0)

8 f_c' (Bm.): 5.5 | P/S-ϕ: 7 | P/S-#: 54 | P/S-Grd.: 270 | P/S-P_1: 189. | Dist. to-P/S C.G.: 37.44 | Bridge Age: 0. (F10.0,3I5,3F10.0)

BOVAC INPUT FORM (SHEET - 2)

No. Loads

9 [1] (15)

	Load Intensity (pressure)	Long. Dist. from Left Side to Ctr. of Load	Trans. Dist. from Botton to Ctr. of Load	Length of Area Load	Width of Area Load	
10	0.01	399.	186.	42.	96.	Area Load No. 1
						Area Load No. 2
						Area Load No. 3
						Area Load No. 4
						Area Load No. 5
						Area Load No. 6
						Area Load No. 7
						Area Load No. 8
						Area Load No. 9

are that there are no cards for input Units 3 and 6; the rest of the input cards are essentially the same. The major differences between this and the previous example can be noted in the computer printout, which is presented in the next chapter.

3.2.2 BOVAC Data Collection Form

The completed form is enclosed in the report.

3.2.3 BOVAC Input Form

The completed BOVAC Input Form is also included in the report.

3.3 Example-3

3.3.1 Description of the Problem

The bridge is a three beam bridge, as shown in Fig. 16. In this example the use of automatic discretization for the entire bridge is employed. The finite element discretization resulting from the use of the automatic option, as well as the loaded areas, are shown in Fig. 17. Since the loading is not symmetrical with respect to the midspan of the bridge, and also since the loading does not have a symmetry with respect to some hypothetical point along the length of the vehicle, the use of the full discretization is essential. It should be noted that the load positioning, its

BOVAC DATA COLLECTION FORM

Description	Raw Data Values	Values w/ Consistent Dimensions	INPUT UNIT NO.
1. Job Title	EXAMPE BRIDGE 3		1
2. Span Length	50'	50. (ft)	4
3. Width	18"	18. (ft)	4
4. Overhang	3'-0"	3. (ft)	4
5. Age of the Bridge (years)	40.	40. (yr)	8
SLAB			
6. Concrete Strength, f'_c	3500 psi	3.5 (ksi)	7
7. Thickness	7 1/2"	7.5 (in)	7
8. Top Concrete Cover	2"	2 (in)	7
9. Bottom Concrete Cover	1"	1 (in)	7
BEAMS			
10. Number of Beams	3	3	3
11. Beam Type	PDT26/33	PD 26/33	3
12. Concrete Strength, f'_c	4500 psi	4.5 (ksi)	8
13. Diameter of P/S Strands	1/2"	8	8
14. Number of P/S Strands per Beam	30	30	8
15. Grade of P/S Strands (250 or 270)	G250	250 (ksi)	8
16. Initial P/S Stress	175 ksi	175 (ksi)	8
17. Distance from Top of Beam to Centroid of P/S Strand Group	25"	25. (in)	8

	Values w/ Consistent Dimensions	INPUT UNIT NO.
PRINTOUT		
18. Printout Detailed (DETAILED), Short	Short	2
DISCRETIZATION		
19. Type of Symmetry (ALL or HALF)	ALL	3
20. Number of Elements in Long. Direction (Needed if Automatic Disc. is NOT Used)		5
21. Length of Elements in Long. Direction (If Predisc. is NOT Used) (in inches) (start with the top line, and continue)		6
LOADING		
22. Number of Independent Area Loads	2	9
23.1 Load #1		10
Load Intensity	0.01 (ksi)	
Longitudinal Distance	285. (in)	
Transverse Distance	54. (in)	
Length in Long. Direction	30. (in)	
Width in Transverse Direction	36. (in)	
23.2 Load #2		10
Load Intensity	0.01 (ksi)	
Longitudinal Distance	360. (in)	
Transverse Distance	54. (in)	
Length in Long. Direction	60. (in)	
Width in Transverse Direction	36. (in)	

BOVAC INPUT FORM (SHEET - 1)

1 Title: EXAMPLE BRIDGE 3

2 Printout: (5X,A7) *(crossed out)*

3 No. Bm.: 3 | Bm. Type: PD26/33 | Symm.: ALL (I5,A7,3X,A4)

4 Sp. Length: 50. | Overhang: 3. | Width: 18. (3F10.0)

5 No. Elems.: (5X,I5) *(crossed out)*

6 Element Lengths (8F10.0) *(crossed out)*

7 f_c' (slab): 4.5 | Thickness: 7.5 | Top Cover: 2. | Bottom Cover: 1. (4F10.0)

8 f_c' (Bm.): 4.5 | P/S-ϕ: 8 | P/S-#: 30 | P/S-Grd.: 250 | $P/S-P_1$: 175. | Dist. to P/S C.G.: 25. | Bridge Age: 40. (F10.0,3I5,3F10.0)

BOVAC INPUT FORM (SHEET - 2)

No. Loads

9 [2] (15)

	Load Intensity (pressure)	Long. Dist. from Left Side to Ctr. of Load	Trans. Dist. from Botton to Ctr. of Load	Length of Area Load	Width of Area Load	
10	0.01	285.	54.	30.	36.	Area Load No. 1
	0.01	360.	54.	60.	36.	Area Load No. 2
						Area Load No. 3
						Area Load No. 4
						Area Load No. 5
						Area Load No. 6
						Area Load No. 7
						Area Load No. 8
						Area Load No. 9

size, and the correspondence of the loaded areas to the finite element discretization of the bridge is "perfect." Such an one-to-one match of the element sizes versus load is not always encountered. Slight rounding, either in the definition of the loaded elements or the definition of the loads, is usually undertaken with very little introducion of errors.

The beams used are Pennsylvania Department of Transportation's standard prestressed concrete I-beams, PD26/33. There are two prestressing groups, each containing 15, ½ inch strands of grade 250 prestressing steel, and are located 22 and 28 inches below the top of the beam. Since the program accepts only one group of strands, averaging is used, thus resulting in 30, ½ inch strands being located 25 inches below the top of the beam (Fig. 14). Initial prestress was 175 ksi, and the bridge is assumed to be 40 years old. Slab reinforcement is shown in Fig. 18.

3.3.2 BOVAC Data Collection Form

The completed form is included in the report.

3.3.3 BOVAC Input Form

The completed BOVAC Input Form is also included in the report.

6. BOVAC OUTPUT

Output of BOVAC can vary from a few pages, e.g. 10-12 pages, up to hundreds of pages, depending upon the options requested by the user in the input of the program. As can be noted, if the short printout option is requested, the printout would be rather limited. However, in solving the same bridge for the same loading condition, the printout for the detailed output would be hundreds of pages long. The difference stems from the fact that in detailed output for all load levels all stresses, strains, and deformations are printed; whereas, for the short printout, only the key control values that correspond to the last load level are printed. If the user is interested in the complete load versus stress and deformation characteristics of the bridge, the detailed output is needed. If this information is not essential, then the long printout should not be used. For all practical purposes the short printout contains all the information that is needed in the rating of the bridge or the overload permit study of the bridge.

THE USE OF THE DETAILED OUTPUT OPTION MUST BE JUSTIFIED BY THE USER.

For a given bridge and vehicle placement, even if the user selects the short printout option, but if the user employs two different discretization, length of the printouts for these two computer runs will differ. The difference between these numbers can best be illustrated by citing the number of pages of output that are generated by example problems-1, -2 and -3 that are described in Chapter 5. Examples-2 and -3 use the same bridge and same loading conditions, and both employ short printout. However, the examples use different discretizations. Example-2 gives the results in 34 pages, whereas example-3 requires 12 pages. Example-1, which is a long printout requirement, provides the results in 237 pages of computer printout. This comparison once again illustrates that the short printout should be used for all "regular" cases; and that the use of detailed, i.e. long printout, must be justified by the user.

6.1 Comments on Long Printout

No explanation is sufficient enough if all the users of program BOVAC expect all the explanations to all of the questions on hand and future questions in this user's manual. Through a careful explanation of the output provided by the program, as included in this manual, the reader/user can find answers to many questions in this manual. To initiate the self-study on the interpretation of the long printout, the rest of this section contains some general comments.

The output consists of:

1. A printout of input data
2. A printout of automatically generated data
3. A printout of displacement and stress solutions to the problem

Even though any consistent set of units may be used, the words "inches" and "kips" are printed for convenience in the output.

Solutions to the problem consist of:

1. Nodal point displacements and associated nodal point forces.
2. Internal moments and normal forces taken about the reference plane (mid-plane of the slab) for both slab and beam finite elements.
3. Slab layer stresses, principal stresses, and principal angles.
4. Beam layer stresses, flexural shear stresses, principal stresses, and principal angles.
5. A summary of cracked, crushed, and yielded layers in the slab which indicates the principal angle and the directions of layer failure.
6. Printer plots of the beams showing stress levels and areas of cracking or crushing.
7. Printer plots of the slab showing element and node point numbering, beam locations, and the number of cracked, crushed and yielded layers in each slab element.
8. A histogram at the end of the job indicating termination checks.

Displacement and force fields for only the live load are printed during the overload solution procedure. In order to obtain the total displacements and forces due to the live load plus the dead load, the prestress and dead load solutions must be added to that for the overload solution. The stress fields printed during the overload solution procedure include the contributions from the prestress and dead load solutions. Also, the internal forces computed from these stress fields will reflect not only the live load solution but also the prestress and dead load solutions.

Letters after the symbol "S" in the titles to the stress field portion of the printout indicate the direction of the stress. The numbers indicate the first (1) or second (2) principal directions. The principal angles for the slab, designated by THETA1 in the output, are measured clockwise from the X-axis of the element and indicate the direction of stress "S1." Principal angles for the beam, designated by THETA1, are also measured clockwise from the X-axis of the beam and again indicate the direction of stress "S1."

Beam and slab printer plots are generated. The stress codes used in the beam printer plots are interpreted as follows:

1. Numbers indicate compressive stresses. The number "1" indicates 10% of the yield or ultimate stress, depending on the material. "2" indicates 20%, and so on.
2. Letters indicate tensile stresses. The letter "A" indicates 10% of the yield or cracking stress. "B" indicates 20%, and so on.
3. Blanks indicate a layer has reached the cracking criteria.
4. Slashes indicate a layer has reached the crushing criteria.
5. Asterisks in a horizontal row indicate the boundary of elements.
6. Asterisks in a vertical row indicate layers.

7. The stress is measured at the centroid of a layer and is always overstated or at best correct as shown. A 7% compressive stress is indicated by a "1," whereas an 11% stress is indicated by "2."

Automatically generated data, which are not part of the solution but are used by the program, may need further explanation in addition to those already printed in the output.

1. Memory Requirements

   The program computes the memory requirements needed for each "overlay." Two numbers which are in octal are reported:

   a. The first one is the central memory requirement to load the specified overlay. This number will change only if the program is changed internally and/or a different compiler/system is used.

   b. The second number is the central memory requirement including the storage space needed for the various data arrays used in the specified overlay. This number will change according to the particular problem being solved. If the central memory required by the job is greater than the available memory, then the number of segments can be increased so as to help reduce the storage space needed.

2. Slab Element Topology Array

   The slab element topology array is automatically generated by the program and need not be punched by the user. This array contains a listing of which elements, i.e. NEQ1, NEQ2, NEQ3 and NEQ4, surround a particular node point. Absence of an element is indicated by an element number equal to NUMEL+1. This topology is represented by the numbering used in the slab plot.

3. Element Array

The element array contains a listing of the slab elements with the associated I, J, K, and L node points (corner node points). This numbering can be seen in the slab plot.

4. Beam Element Array

The beam element array lists the beam elements along with their associated I and K node points (end-points). This numbering can be seen in the slab plot.

5. Beam Element Topology

This array indicates which beam element is to the right (NXR) and which beam element is to the left (NXL) of the specified node point. Absence of a beam element is indicated by an element number equal to NBEAMX+1.

6.2 Short Printout

For the user who has mastered the long-printout, the interpretation of the short printout is rather simple. The printout contains:

1. Echo print of the critical dimensions and values.
2. Printer plots of the beams and the slab indicating incremental stress intensities for various load levels.
3. A message as to whether the bridge is adequate or not adequate enough for the vehicular load plus 10% of the vehicular load.
4. Summary of the checks as to whether the threshold values that control the serviceability limits of the bridge have been attained or not.
5. A detailed message indicating the important assumptions and limitations that have been made in the analysis scheme and BOVAC. This message is the same in the detailed or the short output.

6.3 Example-1 Printout

The inclusion of the full printout of example-1 would have required 237 pages. Since the pattern of information that is printed out at different load levels is similar, only a limited portion of this printout is included in the manual.

6.4 Example-2 Printout

The computer printout of this problem is somewhat more manageable. It requires only 34 pages, most of which are occupied by the printer plots. It is strongly recommended that the user develop sufficient familiarity with the interpretation of these plots. The first critical message that appears is the number of cracked concrete layers.

For example, in the case of 2 cracked layers, it appears as T=2. Any further discussion of the printout is somehow redundant, since the characteristics of this printout are already included in the long printout.

6.4 Example-3 Printout

The length of this printout is even shorter than that of example-2. This is due to the fact that the bridge is adequate enough for the given load plus 10% of the given load, and the solution scheme did not require any detailed internal calculations by program BOVAC. The past experience have indicated that, for a given bridge and loading, if the structure is adequate, and especially more than adequate, than the computer time is not substantial and also the number of computer printout pages is quite limited. However, if the bridge is not adequate enough, especially if the inadequacy is on the borderline for the applied load plus 10%, than the printout tends to be extensive. If the detailed printout is required, than the number of pages tends to be quite voluminous.

Because of the similarity of the printout of example-3 with that of example-2, additional comments on the printout are not included.

```
--------------------EXAMPLE BRIDGE 1                                          --------------------

NUMBER OF SLAB ELEMENTS ALONG THE X-AXIS      =        5

NUMBER OF SLAB ELEMENTS ALONG THE Y-AXIS      =        5

NUMBER OF CONCRETE LAYERS IN SLAB, NULAY      =        6

NUMBER OF STEEL LAYERS IN SLAB, NSLAYR        =        4

BEAM TYPE                                     =        PD24/48

NUMBER OF BEAMS                               =        4

TOTAL NUMBER OF BEAM ELEMENTS, NBEAMX         =       20

TYPE OF DISCRETIZATION                        =       HALF

SPAN OF ENTIRE BRIDGE (FT)                    =   70.00

BRIDGE OVERHANG (FT)                          =    3.50

BRIDGE WIDTH (FT)                             =   31.00

NUMBER OF ACTUAL LAYERS FOR BEAM              =       10

NUMBER OF PRESTRESS STRANDS                   =        1

OVERLAY  1        CM NEEDED TO LOAD OVERLAY  = 00032732
                  CM WITH DATA ARRAY STORAGE = 00035040

OVERLAY  2        CM NEEDED TO LOAD OVERLAY  = 00041234
                  CM WITH DATA ARRAY STORAGE = 00050137

OVERLAY  3        CM NEEDED TO LOAD OVERLAY  = 00026343
                  CM WITH DATA ARRAY STORAGE = 00035266

OVERLAY  4        CM NEEDED TO LOAD OVERLAY  = 00034262
                  CM WITH DATA ARRAY STORAGE = 00036721

OVERLAY  5        CM NEEDED TO LOAD OVERLAY  = 00061250
```

```
                           CM WITH DATA ARRAY STORAGE = 00071754

OVERLAY  6                 CM NEEDED TO LOAD OVERLAY  = 00024766
                           CM WITH DATA ARRAY STORAGE = 00027305

OVERLAY  7                 CM NEEDED TO LOAD OVERLAY  = 00024573
                           CM WITH DATA ARRAY STORAGE = 00025143

OVERLAY  8                 CM NEEDED TO LOAD OVERLAY  = 00033661
                           CM WITH DATA ARRAY STORAGE = 00035760

OVERLAY  9                 CM NEEDED TO LOAD OVERLAY  = 00025110
                           CM WITH DATA ARRAY STORAGE = 00025110

OVERLAY 10                 CM NEEDED TO LOAD OVERLAY  = 00030373
                           CM WITH DATA ARRAY STORAGE = 00032124


NUMBER OF SLAB ELEMENTS, NUMEL                 =       40

NUMBER OF NODAL POINTS, NUMNP                  =       54

HALF BANDWIDTH, LWIDTH                         =       40



IS THERE A DETAILED OUTPUT                     =      YES


SKEW ANGLE (DEGREES)                           =   90.000
```

ELEMENT LENGTHS IN THE X DIRECTION ARE (IN)
126.0000   84.0000   84.0000   84.0000   42.0000

ELEMENT LENGTHS IN THE Y DIRECTION ARE (IN)
42.0000   48.0000   48.0000   48.0000   48.0000   48.0000   48.0000   42.0000

SLAB THICKNESS (IN) = 8.000

NUMBER OF PATCH LOAD CARDS = 1

LOAD CARD	LOAD (KSI)	X OF CENTER(IN)	Y OF C ENTER(IN)	LENGTH(IN)	WIDTH(IN)
1	.0100	399.00	186.00	42.00	96.00

NODAL POINT FORCES WITH SPECIFIED UNIFORM AND CONCENTRATED LOADS

CONCENTRATED NODAL POINT FORCES (KIPS AND IN-KIPS)

NODAL POINT	U-LOAD	V-LOAD	W-LOAD	MX-LOAD	MY-LOAD
1	.00000	.00000	.00000	.00000	.00000
2	.00000	.00000	.00000	.00000	.00000
3	.00000	.00000	.00000	.00000	.00000
4	.00000	.00000	.00000	.00000	.00000
5	.00000	.00000	.00000	.00000	.00000
6	.00000	.00000	.00000	.00000	.00000
7	.00000	.00000	.00000	.00000	.00000
8	.00000	.00000	.00000	.00000	.00000
9	.00000	.00000	.00000	.00000	.00000
10	.00000	.00000	.00000	.00000	.00000
11	.00000	.00000	.00000	.00000	.00000
12	.00000	.00000	.00000	.00000	.00000
13	.00000	.00000	.00000	.00000	.00000
14	.00000	.00000	.00000	.00000	.00000
15	.00000	.00000	.00000	.00000	.00000
16	.00000	.00000	.00000	.00000	.00000
17	.00000	.00000	.00000	.00000	.00000
18	.00000	.00000	.00000	.00000	.00000
19	.00000	.00000	.00000	.00000	.00000
20	.00000	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000	.00000
23	.00000	.00000	5.04000	-40.32000	-35.28000

24	.00000	.00000	5.04000	-40.32000	35.28000
25	.00000	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000	.00000
29	.00000	.00000	10.08000	.00000	-70.56000
30	.00000	.00000	10.08000	.00000	70.56000
31	.00000	.00000	.00000	.00000	.00000
32	.00000	.00000	.00000	.00000	.00000
33	.00000	.00000	.00000	.00000	.00000
34	.00000	.00000	.00000	.00000	.00000
35	.00000	.00000	5.04000	40.32000	-35.28000
36	.00000	.00000	5.04000	40.32000	35.28000
37	.00000	.00000	.00000	.00000	.00000
38	.00000	.00000	.00000	.00000	.00000
39	.00000	.00000	.00000	.00000	.00000
40	.00000	.00000	.00000	.00000	.00000
41	.00000	.00000	.00000	.00000	.00000
42	.00000	.00000	.00000	.00000	.00000
43	.00000	.00000	.00000	.00000	.00000
44	.00000	.00000	.00000	.00000	.00000
45	.00000	.00000	.00000	.00000	.00000
46	.00000	.00000	.00000	.00000	.00000
47	.00000	.00000	.00000	.00000	.00000
48	.00000	.00000	.00000	.00000	.00000
49	.00000	.00000	.00000	.00000	.00000
50	.00000	.00000	.00000	.00000	.00000
51	.00000	.00000	.00000	.00000	.00000
52	.00000	.00000	.00000	.00000	.00000
53	.00000	.00000	.00000	.00000	.00000
54	.00000	.00000	.00000	.00000	.00000

SUM OF NODAL POINT W-LOADS = 40.3200

ELEMENT TOPOLOGY

NODAL POINT	NEQ1	NEQ2	NEQ3	NEQ4
1	1	41	41	41
2	2	1	41	41
3	3	2	41	41
4	4	3	41	41
5	5	4	41	41
6	41	5	41	41
7	6	41	41	1
8	7	6	1	2
9	8	7	2	3
10	9	8	3	4
11	10	9	4	5
12	41	10	5	41
13	11	41	41	6
14	12	11	6	7
15	13	12	7	8
16	14	13	8	9

17	15	14	9	10
18	41	15	10	41
19	16	41	41	11
20	17	16	11	12
21	18	17	12	13
22	19	18	13	14
23	20	19	14	15
24	41	20	15	41
25	21	41	41	16
26	22	21	16	17
27	23	22	17	18
28	24	23	18	19
29	25	24	19	20
30	41	25	20	41
31	26	41	41	21
32	27	26	21	22
33	28	27	22	23
34	29	28	23	24
35	30	29	24	25
36	41	30	25	41
37	31	41	41	26
38	32	31	26	27
39	33	32	27	28
40	34	33	28	29
41	35	34	29	30
42	41	35	30	41
43	36	41	41	31
44	37	36	31	32
45	38	37	32	33
46	39	38	33	34
47	40	39	34	35
48	41	40	35	41
49	41	41	41	36
50	41	41	36	37
51	41	41	37	38
52	41	41	38	39
53	41	41	39	40
54	41	41	40	41

ELEMENT ARRAY

ELEMENT NUMBER	I	J	K	L
1	1	7	2	8
2	2	8	3	9
3	3	9	4	10
4	4	10	5	11
5	5	11	6	12
6	7	13	8	14
7	8	14	9	15
8	9	15	10	16
9	10	16	11	17
10	11	17	12	18
11	13	19	14	20

12	14	20	15	21
13	15	21	16	22
14	16	22	17	23
15	17	23	18	24
16	19	25	20	26
17	20	26	21	27
18	21	27	22	28
19	22	28	23	29
20	23	29	24	30
21	25	31	26	32
22	26	32	27	33
23	27	33	28	34
24	28	34	29	35
25	29	35	30	36
26	31	37	32	38
27	32	38	33	39
28	33	39	34	40
29	34	40	35	41
30	35	41	36	42
31	37	43	38	44
32	38	44	39	45
33	39	45	40	46
34	40	46	41	47
35	41	47	42	48
36	43	49	44	50
37	44	50	45	51
38	45	51	46	52
39	46	52	47	53
40	47	53	48	54

SLAB- ELEMENT GEOMETRY

ELEMENT	LENGTH A	LENGTH B	DT (DIMENSIONS ARE IN INCHES)
1	63.0000	21.0000	7.5000
2	42.0000	21.0000	7.5000
3	42.0000	21.0000	7.5000
4	42.0000	21.0000	7.5000
5	21.0000	21.0000	7.5000
6	63.0000	24.0000	7.5000
7	42.0000	24.0000	7.5000
8	42.0000	24.0000	7.5000
9	42.0000	24.0000	7.5000
10	21.0000	24.0000	7.5000

11	63.0000	24.0000	7.5000
12	42.0000	24.0000	7.5000
13	42.0000	24.0000	7.5000
14	42.0000	24.0000	7.5000
15	21.0000	24.0000	7.5000
16	63.0000	24.0000	7.5000
17	42.0000	24.0000	7.5000
18	42.0000	24.0000	7.5000
19	42.0000	24.0000	7.5000
20	21.0000	24.0000	7.5000
21	63.0000	24.0000	7.5000
22	42.0000	24.0000	7.5000
23	42.0000	24.0000	7.5000
24	42.0000	24.0000	7.5000
25	21.0000	24.0000	7.5000
26	63.0000	24.0000	7.5000
27	42.0000	24.0000	7.5000
28	42.0000	24.0000	7.5000
29	42.0000	24.0000	7.5000
30	21.0000	24.0000	7.5000
31	63.0000	24.0000	7.5000
32	42.0000	24.0000	7.5000
33	42.0000	24.0000	7.5000
34	42.0000	24.0000	7.5000
35	21.0000	24.0000	7.5000
36	63.0000	21.0000	7.5000
37	42.0000	21.0000	7.5000
38	42.0000	21.0000	7.5000
39	42.0000	21.0000	7.5000

40	21.0000	21.0000	7.5000

SLAB- LAYER GEOMETRY

LAYER	THICKNESS/DT	CENTROID/DT
1	.166667	-.416667
2	.166667	-.250000
3	.166667	-.083333
4	.166667	.083333
5	.166667	.250000
6	.166667	.416667

TOP COVER OF SLAB (IN) = 2.00
BOTTOM COVER OF SLAB (IN) = 1.00

SLAB- CONCRETE MATERIAL PROPERTIES (KSI)

UNIAXIL CONCRETE COMPRESSIVE STRENGTH, FC = 3.5000

DIRECT TENSILE STRENGTH, FT = .3150

INITIAL MODULUS, EC = 3408.79

UNLOADING MODULUS IN COMPRESSION = 1000.00

UNLOADING MODULUS IN TENSION = 800.00

SLAB - STEEL LAYER MATERIAL PROPERTIES

YOUNGS MODULUS	YIELD STRENGTH	RAMBERG-M	RAMBERG-N
29500.00 KSI	40.00 KSI	.70	100.0

SLAB - STEEL LAYER GEOMETRY

LAYER	BAR NO.	SPACING (IN)	THICKNESS (IN)	CENTROID (IN)	ANGLE (DEGREES)
1	5	6.0000	.05167	-1.94	-90.000
2	4	18.0000	.01111	-1.38	.000

3	5	9.0000	.03444	1.81	.000
4	5	6.0000	.05167	2.44	-90.000

TERMINATION CHECKS FOR THE SLAB LAYERS
(STRESS IN KSI, STRAIN IN PERCENT)

MATERIAL	MAX STRAIN	MAX TENSILE STRESS	MAX COMP STRESS	NUMBER OF CRACKED OR YIELDED LAYERS	NUMBER OF CRUSHED LAYERS
CONCRETE	.250	.355	2.800	3	1
STEEL	.145	30.000	30.000	1	0

BOUNDARY CONDITIONS

U CONSTRAINED NODES ARE	6	12	18	24	30	36	42	48	54
V CONSTRAINED NODES ARE	49								
W CONSTRAINED NODES ARE	1	7	13	19	25	31	37	43	49
MX CONSTRAINED NODES ARE	1	7	13	19	25	31	37	43	49
MY CONSTRAINED NODES ARE	6	12	18	24	30	36	42	48	54

BEAM ELEMENT ARRAY // X-AXIS

ELEMENT NUMBER	I	K	LENGTH (IN)
1	7	8	126.00
2	8	9	84.00
3	9	10	84.00
4	10	11	84.00
5	11	12	42.00
6	19	20	126.00
7	20	21	84.00
8	21	22	84.00
9	22	23	84.00
10	23	24	42.00
11	31	32	126.00
12	32	33	84.00
13	33	34	84.00
14	34	35	84.00
15	35	36	42.00
16	43	44	126.00
17	44	45	84.00
18	45	46	84.00
19	46	47	84.00
20	47	48	42.00

BEAM ELEMENT TOPOLOGY //X-AXIS

NODAL POINT	NFARX	NXL	NXR
1	0	21	21
2	0	21	21
3	0	21	21
4	0	21	21
5	0	21	21
6	0	21	21
7	1	21	1
8	1	1	2
9	1	2	3
10	1	3	4
11	1	4	5
12	1	5	21
13	0	21	21

14	0	21	21
15	0	21	21
16	0	21	21
17	0	21	21
18	0	21	21
19	1	21	6
20	1	6	7
21	1	7	8
22	1	8	9
23	1	9	10
24	1	10	21
25	0	21	21
26	0	21	21
27	0	21	21
28	0	21	21
29	0	21	21
30	0	21	21
31	1	21	11
32	1	11	12
33	1	12	13
34	1	13	14
35	1	14	15
36	1	15	21
37	0	21	21
38	0	21	21
39	0	21	21
40	0	21	21
41	0	21	21
42	0	21	21
43	1	21	16
44	1	16	17
45	1	17	18
46	1	18	19
47	1	19	20
48	1	20	21
49	0	21	21
50	0	21	21
51	0	21	21
52	0	21	21
53	0	21	21
54	0	21	21

BEAM- MATERIAL PROPERTIES

MATERIAL	SIGY (KSI)	FT (KSI)	MODULUS (KSI)	ROM	RON	EDOWN (KSI)	STRAN (PERCENT)
CONCRETE	5.5000	.4400	4273.14	.6436	9.000	2853.82	.22000
STEEL	270.0000	270.0000	27000.00	.6700	25.000	.00	100.00000

BEAM- CONCRETE TENSILE PROPERTIES

MATERIAL	ROMT	RONT	EDOWNT (KSI)

CONCRETE	1.0000	9.000	800.00

TERMINATION CHECKS FOR THE BEAM LAYERS
(STRESS IN KSI, STRAIN IN PERCENT)

MATERIAL	MAX STRAIN	MAX TENSILE STRESS	MAX COMP STRESS	NUMBER OF CRACKED OR YIELDED LAYERS	NUMBER OF CRUSHED LAYERS
CONCRETE	.200	.445	4.400	1	1
STEEL	1.119	202.500	270.000	1	0

MAX ALLOWABLE FLEXURAL SHEAR FOR THE BEAM (KSI) = .126

SECTION PROPERTIES (SECTIONS ARE HORIZONTAL, LAYERS ARE VERTICAL)

ACTUAL LAYERS

SECTION- WIDTH (IN) OF LAYERS

18.0000

18.0000

13.0000

8.0000

8.0000

12.0000

20.0000

24.0000

24.0000

24.0000

BEAM SECTION - THICKNESS (IN) OF LAYERS

2.0000

6.0000

4.0000

8.5000

8.5000

5.0000

5.0000

3.5000

3.5000

2.0000

SECTION- INITIAL STRESS (KSI) OF LAYERS

.0000

.0000

.0000

.0000

.0000

.0000

.0000

.0000

.0000

.0000

SECTION- MATERIAL TYPE FOR LAYERS

1.0000

1.0000

1.0000

1.0000

1.0000

1.0000

1.0000

```
1.0000

1.0000

1.0000

AREA OF PRESTRESS STRAND GROUP      =   6.2100 SQ. IN.
             STEEL GRADE            =      270 KSI
             INITIAL STRESS         = 189.0000 KSI

PROPERTIES FOR BEAM CROSS-SECTION
     AREA                           =   708.00 SQ. IN
     INERTIA                        = 172712.0 IN4
     STRAND ECCENTRICITY FROM C.G. =  10.7200 IN
     DEAD LOAD MOMENT ON SECTION    =  5420.62 IN-KIPS
     MODULAR RATIO OF STEEL/CONC.   =   6.0053


AGE OF BRIDGE IN YEARS              =      .00


LOSS DUE TO RELAXATION OF STEEL     =     .000 KSI


PRESTRESS AFTER LOSSES (EXCEPT ELASTIC LOSS) =  144.755 KSI
ESTIMATED ELASTIC LOSS                       =   10.511 KSI


BEAM ELEMENT/LAYER PROPERTIES (LAYERS VERTICAL, ELEMENTS HORIZONTAL)

ELEMENTS- INITIAL STRESS (KSI) IN LAYERS
```

.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000

.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
.0000	.0000	.0000	.0000	.0000
144.7553	144.7553	144.7553	144.7553	144.7553

ELEMENTS- MATERIAL TYPE FOR LAYERS

1 = CONCRETE , 2 = STEEL

1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
2	2	2	2	2

ELEMENTS- AREAS (SQ.IN) OF LAYERS

36.0000	36.0000	36.0000	36.0000	36.0000
108.0000	108.0000	108.0000	108.0000	108.0000
52.0000	52.0000	52.0000	52.0000	52.0000
68.0000	68.0000	68.0000	68.0000	68.0000
68.0000	68.0000	68.0000	68.0000	68.0000
60.0000	60.0000	60.0000	60.0000	60.0000
100.0000	100.0000	100.0000	100.0000	100.0000
84.0000	84.0000	84.0000	84.0000	84.0000
84.0000	84.0000	84.0000	84.0000	84.0000

48.0000	48.0000	48.0000	48.0000	48.0000
6.2100	6.2100	6.2100	6.2100	6.2100

ELEMENTS- MOMENT OF INERTIA OF LAYERS

12.0000	12.0000	12.0000	12.0000	12.0000
324.0000	324.0000	324.0000	324.0000	324.0000
69.3333	69.3333	69.3333	69.3333	69.3333
409.4167	409.4167	409.4167	409.4167	409.4167
409.4167	409.4167	409.4167	409.4167	409.4167
125.0000	125.0000	125.0000	125.0000	125.0000
208.3333	208.3333	208.3333	208.3333	208.3333
85.7500	85.7500	85.7500	85.7500	85.7500
85.7500	85.7500	85.7500	85.7500	85.7500
16.0000	16.0000	16.0000	16.0000	16.0000
.0000	.0000	.0000	.0000	.0000

ELEMENTS- CENTROIDAL DISTANCE (IN) OF LAYERS FROM REFERENCE PLANE

4.7500	4.7500	4.7500	4.7500	4.7500
8.7500	8.7500	8.7500	8.7500	8.7500
13.7500	13.7500	13.7500	13.7500	13.7500
20.0000	20.0000	20.0000	20.0000	20.0000
28.5000	28.5000	28.5000	28.5000	28.5000
35.2500	35.2500	35.2500	35.2500	35.2500
40.2500	40.2500	40.2500	40.2500	40.2500
44.5000	44.5000	44.5000	44.5000	44.5000
48.0000	48.0000	48.0000	48.0000	48.0000
50.7500	50.7500	50.7500	50.7500	50.7500
41.0800	41.0800	41.0800	41.0800	41.0800

ELEMENTS- SHEAR THICKNESS (IN) OF LAYERS

18.0000	18.0000	18.0000	18.0000	18.0000
18.0000	18.0000	18.0000	18.0000	18.0000
13.0000	13.0000	13.0000	13.0000	13.0000
8.0000	8.0000	8.0000	8.0000	8.0000
8.0000	8.0000	8.0000	8.0000	8.0000
12.0000	12.0000	12.0000	12.0000	12.0000
20.0000	20.0000	20.0000	20.0000	20.0000
24.0000	24.0000	24.0000	24.0000	24.0000
24.0000	24.0000	24.0000	24.0000	24.0000
24.0000	24.0000	24.0000	24.0000	24.0000
1.0000	1.0000	1.0000	1.0000	1.0000

DEAD LOAD AND/OR PRESTRESS SOLUTION FOR INDIVIDUAL BEAMS

SOLUTION NUMBER = 1
NUMBER OF DUPLICATE SOLUTIONS IN THIS GROUP = 1
STARTING BEAM = 1 END BEAM = 1

BOUNDARY CONDITIONS

NODAL POINT	U-DISP	W-DISP	MY-DISP
1	0	1	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	1	0	1

UNIFORM LOAD ON BEAM = .1240 KIPS/IN

END FORCES ON BEAM DUE TO PRESTRESS

NODE	AXIAL LOAD(KIPS)	VERTICAL LOAD (KIPS)	MOMENT (IN-KIPS)
1	898.93	.0000	36928.053
6	-898.93	.0000	-36928.053

NODAL POINT FORCES INCLUDING SPECIFIED UNIFORM AND CONCENTRATED LOADS (KIPS AND IN-KIPS)

NODAL POINT	U-LOAD	W-LOAD	MY-LOAD
1	898.9302	7.8094	36764.0562
2	.0000	13.0156	91.1094
3	.0000	10.4125	.0000
4	.0000	10.4125	.0000
5	.0000	7.8094	54.6656
6	-898.9302	2.6031	-36909.8312

ITERATION FOR BEAM SOLUTION = 1

ITERATION FOR BEAM SOLUTION = 2

NODAL POINT DISPLACEMENTS FOR THE BEAM

U-DISP (IN)	W-DISP (IN)	MY-DISP (RADIANS)
.08605	.00000	.00104
.08269	-.06389	.00000
.06661	-.05343	-.00024
.04298	-.03277	-.00024
.01483	-.01834	-.00010
.00000	-.01630	.00000

STRESSES (KSI) - ELEMENTS HORIZONTAL, LAYERS VERTICAL

-.2916	-.8772	-1.2020	-1.3968	-1.4617
-.4227	-.9271	-1.2021	-1.3671	-1.4221
-.5989	-.9894	-1.2023	-1.3301	-1.3727
-.8193	-1.0673	-1.2026	-1.2838	-1.3108
-1.1189	-1.1732	-1.2029	-1.2208	-1.2267
-1.3568	-1.2573	-1.2032	-1.1707	-1.1599
-1.5329	-1.3196	-1.2034	-1.1337	-1.1105
-1.6823	-1.3725	-1.2035	-1.1022	-1.0684
-1.8051	-1.4161	-1.2037	-1.0762	-1.0337
-1.9014	-1.4503	-1.2038	-1.0558	-1.0065
134.8832	136.3518	137.1513	137.6308	137.7907

SOLUTION NUMBER = 2
NUMBER OF DUPLICATE SOLUTIONS IN THIS GROUP = 2
STARTING BEAM = 2 END BEAM = 3

BOUNDARY CONDITIONS

NODAL POINT	U-DISP	W-DISP	MY-DISP
1	0	1	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0

6	1	0	1

UNIFORM LOAD ON BEAM = .1281 KIPS/IN

END FORCES ON BEAM DUE TO PRESTRESS

NODE	AXIAL LOAD(KIPS)	VERTICAL LOAD (KIPS)	MOMENT (IN-KIPS)
1	898.93	.0000	36928.053
6	-898.93	.0000	-36928.053

NODAL POINT FORCES INCLUDING SPECIFIED UNIFORM AND CONCENTRATED LOADS (KIPS AND IN-KIPS)

NODAL POINT	U-LOAD	W-LOAD	MY-LOAD
1	898.9302	8.0719	36758.5437
2	.0000	13.4531	94.1719
3	.0000	10.7625	.0000
4	.0000	10.7625	.0000
5	.0000	8.0719	56.5031
6	-898.9302	2.6906	-36909.2187

ITERATION FOR BEAM SOLUTION = 1

ITERATION FOR BEAM SOLUTION = 2

ITERATION FOR BEAM SOLUTION = 3

NODAL POINT DISPLACEMENTS FOR THE BEAM

U-DISP (IN)	W-DISP (IN)	MY-DISP (RADIANS)
.09028	.00000	.00091
.08640	-.04763	-.00012
.06951	-.02815	-.00034
.04483	-.00103	-.00030
.01546	.01677	-.00012
.00000	.01925	.00000

STRESSES (KSI) - ELEMENTS HORIZONTAL, LAYERS VERTICAL

-.2964	-.9120	-1.2476	-1.4490	-1.5161
-.4351	-.9565	-1.2408	-1.4113	-1.4682
-.6086	-1.0122	-1.2323	-1.3643	-1.4084
-.8254	-1.0817	-1.2216	-1.3055	-1.3335
-1.1202	-1.1764	-1.2071	-1.2256	-1.2317
-1.3543	-1.2515	-1.1956	-1.1621	-1.1509
-1.5276	-1.3071	-1.1870	-1.1150	-1.0910
-1.6746	-1.3544	-1.1798	-1.0750	-1.0401
-1.7955	-1.3933	-1.1738	-1.0421	-.9982
-1.8902	-1.4239	-1.1691	-1.0162	-.9652
134.9197	136.4374	137.2637	137.7593	137.9245

SOLUTION NUMBER = 3
NUMBER OF DUPLICATE SOLUTIONS IN THIS GROUP = 1
STARTING BEAM = 4 END BEAM = 4

BOUNDARY CONDITIONS

NODAL POINT	U-DISP	W-DISP	MY-DISP
1	0	1	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	1	0	1

UNIFORM LOAD ON BEAM = .1240 KIPS/IN

END FORCES ON BEAM DUE TO PRESTRESS

NODE	AXIAL LOAD(KIPS)	VERTICAL LOAD (KIPS)	MOMENT (IN-KIPS)
1	898.93	.0000	36928.053
6	-898.93	.0000	-36928.053

NODAL POINT FORCES INCLUDING SPECIFIED UNIFORM AND CONCENTRATED LOADS (KIPS AND IN-KIPS)

NODAL POINT	U-LOAD	W-LOAD	MY-LOAD
1	898.9302	7.8094	36764.0562
2	.0000	13.0156	31.1094

3	.0000	10.4125	.0000
4	.0000	10.4125	.0000
5	.0000	7.8094	54.6656
6	-838.9302	2.6031	-36909.8312

ITERATION FOR BEAM SOLUTION = 1

ITERATION FOR BEAM SOLUTION = 2

NODAL POINT DISPLACEMENTS FOR THE BEAM

U-DISP (IN)	W-DISP (IN)	MY-DISP (RADIANS)
.08605	.00000	.00104
.08269	-.06389	.00000
.06661	-.05343	-.00024
.04298	-.03277	-.00024
.01483	-.01834	-.00010
.00000	-.01630	.00000

STRESSES (KSI) - ELEMENTS HORIZONTAL, LAYERS VERTICAL

-.2816	-.8772	-1.2020	-1.3968	-1.4617
-.4227	-.9271	-1.2021	-1.3671	-1.4221
-.5989	-.9894	-1.2023	-1.3301	-1.3727
-.8193	-1.0673	-1.2026	-1.2838	-1.3108
-1.1189	-1.1732	-1.2029	-1.2208	-1.2267
-1.3568	-1.2573	-1.2032	-1.1707	-1.1599
-1.5329	-1.3196	-1.2034	-1.1337	-1.1105
-1.6823	-1.3725	-1.2035	-1.1022	-1.0684
-1.8051	-1.4161	-1.2037	-1.0762	-1.0337
-1.9014	-1.4503	-1.2039	-1.0558	-1.0065
134.8832	136.3518	137.1513	137.6308	137.7907

INTERNAL MOMENTS (IN-KIPS) AND NORMAL FORCES (KIPS) IN BEAM ELEMENTS

EL	MB	NB
1	3013.4552	.0000
2	6982.5019	.0000
3	9147.4510	.0000
4	10446.4199	.0000
5	10879.4089	.0000
6	3111.6949	.0000
7	7214.1573	.0000
8	9451.8780	-.0000
9	10794.5091	-.0000
10	11242.0520	-.0000

11	3111.6949	.0000
12	7214.1573	.0000
13	9451.8780	-.0000
14	10794.5091	-.0000
15	11242.0520	-.0000
16	3013.4552	.0000
17	6982.5019	.0000
18	9147.4510	.0000
19	10446.4199	.0000
20	10879.4089	.0000

SLAB ELEMENT	NODE POINT AT WHICH ELEMENT STRESSES ARE COMPUTED (0 = CENTER OF ELEMENT)
1	7
2	8
3	10
4	10
5	12
6	8
7	15
8	15
9	16
10	18
11	20
12	21
13	22
14	22
15	24
16	20
17	21
18	22
19	29
20	30
21	32
22	33
23	34
24	29
25	30
26	32
27	33
28	34
29	34
30	36
31	44
32	39
33	39
34	40
35	42
36	43
37	44
38	46
39	46
40	48

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 1

ALLOWABLE STRESS CHANGE OF .279751125E+00 HAS BEEN EXCEEDED IN ELEMENT 19 LAYER 5

DECREASE FORCE VECTOR BY 50 PER CENT AND SCALE TO THE ELASTIC LIMITS.

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 2

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 3

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 4

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 5

ALLOWABLE STRESS CHANGE OF .283500000E+00 HAS BEEN EXCEEDED IN ELEMENT 20 LAYER 6

DECREASE FORCE VECTOR BY 50 PER CENT AND SCALE TO THE ELASTIC LIMITS.

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 1

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 2

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 3

SCALING PROCEDURE

NUMBER OF TRIALS = 0

NUMBER OF ITERATIONS = 4

INITIAL SCALING RATIO = .4029E+00

SCALING PROCEDURE

NUMBER OF TRIALS = 1

NUMBER OF ITERATIONS = 1

SCALING PROCEDURE

NUMBER OF TRIALS = 1

NUMBER OF ITERATIONS = 2

FIND THE FORCE INCREMENT

REFERENCE DISPLACEMENT = .88322E-01 NODE= 30 WDISP
REFERENCE FORCE = .40527E+01 NODE= 30 WFORCE

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
20	6	5.1953
25	6	-5.1953

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

APPLIED NODAL POINT FORCES IN KIPS AND IN-KIPS

NODAL POINTS	U-LOAD	V-LOAD	W-LOAD	MX-LOAD	MY-LOAD
1	.00000	.00000	.00000	.00000	.00000
2	.00000	.00000	.00000	.00000	.00000
3	.00000	.00000	.00000	.00000	.00000
4	.00000	.00000	.00000	.00000	.00000
5	.00000	.00000	.00000	.00000	.00000
6	.00000	.00000	.00000	.00000	.00000
7	.00000	.00000	.00000	.00000	.00000
8	.00000	.00000	.00000	.00000	.00000
9	.00000	.00000	.00000	.00000	.00000
10	.00000	.00000	.00000	.00000	.00000
11	.00000	.00000	.00000	.00000	.00000
12	.00000	.00000	.00000	.00000	.00000
13	.00000	.00000	.00000	.00000	.00000
14	.00000	.00000	.00000	.00000	.00000
15	.00000	.00000	.00000	.00000	.00000
16	.00000	.00000	.00000	.00000	.00000
17	.00000	.00000	.00000	.00000	.00000
18	.00000	.00000	.00000	.00000	.00000
19	.00000	.00000	.00000	.00000	.00000
20	.00000	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000	.00000
23	.00000	.00000	2.03051	-16.24410	-14.21359
24	.00000	.00000	2.03051	-16.24410	14.21359
25	.00000	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000	.00000
29	.00000	.00000	4.06102	.00000	-28.42717
30	.00000	.00000	4.06102	.00000	28.42717
31	.00000	.00000	.00000	.00000	.00000
32	.00000	.00000	.00000	.00000	.00000
33	.00000	.00000	.00000	.00000	.00000
34	.00000	.00000	.00000	.00000	.00000
35	.00000	.00000	2.03051	16.24410	-14.21359
36	.00000	.00000	2.03051	16.24410	14.21359
37	.00000	.00000	.00000	.00000	.00000

38	.00000	.00000	.00000	.00000	.00000
39	.00000	.00000	.00000	.00000	.00000
40	.00000	.00000	.00000	.00000	.00000
41	.00000	.00000	.00000	.00000	.00000
42	.00000	.00000	.00000	.00000	.00000
43	.00000	.00000	.00000	.00000	.00000
44	.00000	.00000	.00000	.00000	.00000
45	.00000	.00000	.00000	.00000	.00000
46	.00000	.00000	.00000	.00000	.00000
47	.00000	.00000	.00000	.00000	.00000
48	.00000	.00000	.00000	.00000	.00000
49	.00000	.00000	.00000	.00000	.00000
50	.00000	.00000	.00000	.00000	.00000
51	.00000	.00000	.00000	.00000	.00000
52	.00000	.00000	.00000	.00000	.00000
53	.00000	.00000	.00000	.00000	.00000
54	.00000	.00000	.00000	.00000	.00000

NODAL POINT DISPLACEMENTS IN INCHES AND RADIANS

NODAL POINTS	U-DISP	V-DISP	W-DISP	MX-DISP	MY-DISP
1	.00257	-.00080	-.00000	-.00000	-.00003
2	.00229	-.00032	.00308	-.00022	-.00003
3	.00184	-.00012	.00506	-.00034	-.00003
4	.00116	.00003	.00695	-.00041	-.00002
5	.00038	.00016	.00881	-.00043	-.00001
6	.00000	.00018	.00907	-.00044	-.00000
7	.00290	-.00079	.00000	-.00000	-.00010
8	.00251	-.00033	.01241	-.00022	-.00009
9	.00202	-.00018	.01940	-.00035	-.00007
10	.00129	-.00004	.02446	-.00043	-.00005
11	.00043	.00008	.02707	-.00044	-.00002
12	.00000	.00011	.02740	-.00043	-.00000
13	.00313	-.00073	.00000	.00000	-.00019
14	.00283	-.00035	.02271	-.00019	-.00016
15	.00231	-.00025	.03568	-.00031	-.00014
16	.00154	-.00014	.04504	-.00041	-.00007
17	.00054	-.00003	.04808	-.00044	-.00002
18	.00000	-.00001	.04819	-.00043	.00000
19	.00360	-.00059	.00000	.00000	-.00025
20	.00331	-.00038	.03029	-.00011	-.00023
21	.00279	-.00032	.04795	-.00018	-.00019
22	.00198	-.00027	.06163	-.00024	-.00013
23	.00079	-.00020	.06945	-.00045	-.00005
24	-.00000	-.00021	.07053	-.00055	-.00000
25	.00350	-.00040	.00000	.00000	-.00027
26	.00324	-.00040	.03300	.00000	-.00025
27	.00269	-.00040	.05224	.00000	-.00020
28	.00184	-.00040	.06722	.00000	-.00018
29	.00064	-.00040	.08325	.00000	-.00022
30	.00000	-.00040	.08850	-.00000	-.00000
31	.00369	-.00022	.00000	-.00000	-.00025

32	.00331	-.00043	.03029	.00011	-.00023
33	.00278	-.00048	.04795	.00018	-.00019
34	.00198	-.00054	.06163	.00024	-.00013
35	.00079	-.00060	.06945	.00045	-.00005
36	-.00000	-.00059	.07053	.00055	-.00000
37	.00313	-.00007	.00000	-.00000	-.00019
38	.00283	-.00045	.02271	.00019	-.00016
39	.00231	-.00055	.03568	.00031	-.00014
40	.00154	-.00067	.04504	.00041	-.00007
41	.00054	-.00077	.04809	.00044	-.00002
42	.00000	-.00080	.04819	.00043	.00000
43	.00280	-.00001	.00000	.00000	-.00010
44	.00251	-.00047	.01241	.00022	-.00009
45	.00202	-.00063	.01940	.00035	-.00007
46	.00129	-.00077	.02446	.00043	-.00005
47	.00043	-.00089	.02707	.00044	-.00002
48	.00000	-.00091	.02740	.00043	-.00000
49	.00257	.00000	-.00000	.00000	-.00003
50	.00229	-.00049	.00308	.00022	-.00003
51	.00184	-.00068	.00506	.00034	-.00003
52	.00116	-.00084	.00695	.00041	-.00002
53	.00038	-.00096	.00881	.00043	-.00001
54	.00000	-.00098	.00907	.00044	-.00000

DISPLACEMENT/REFERENCE DISPLACEMENT = 1.00206

FORCE/REFERENCE FORCE = 1.00206

SUM OF NODAL POINT W-LOADS = 16.2441

INTERNAL MOMENTS (IN-KIPS/IN) AND NORMAL FORCES (KIPS/IN) IN THE SLAB

EL	MY	MX	MXY	NX	NY	NXY
1	-.001	-.004	.140	-.050	-.012	-.018
2	-.026	-.020	.130	-.145	-.013	-.026
3	-.044	-.092	.052	-.214	.004	-.010
4	-.027	-.091	.039	-.262	-.003	-.014
5	.035	.029	-.006	-.275	-.003	.006
6	-.007	-.021	.126	-.047	.005	-.026
7	.137	.254	.120	-.149	.012	-.051
8	.112	.245	.131	-.219	-.002	-.051
9	.229	.234	.076	-.302	-.001	-.044
10	-.079	-.009	-.007	-.348	.001	.006
11	.089	.322	.092	-.052	.009	-.081
12	.169	.530	.081	-.152	.014	-.093
13	.253	.611	.092	-.230	.033	-.087
14	.292	.813	.244	-.345	.007	-.089
15	-.142	-.781	.176	-.433	.022	.005
16	.094	.316	.074	-.055	.007	.031
17	.171	.540	.060	-.151	.021	.025
18	.252	.784	.124	-.228	.039	.034
19	.293	2.294	.146	-.344	.061	.031
20	1.440	3.377	-.200	-.374	.066	.000
21	.094	.316	-.074	-.055	.007	-.031

22	.171	.540	-.060	-.151	.021	-.025
23	.252	.784	-.124	-.228	.039	-.034
24	.293	2.294	-.146	-.344	.061	-.031
25	1.440	3.377	.200	-.374	.066	-.000
26	.089	.322	-.092	-.052	.009	.081
27	.169	.530	-.081	-.152	.014	.093
28	.253	.811	-.092	-.230	.033	.087
29	.292	.813	-.244	-.345	.007	.089
30	-.142	-.781	-.176	-.433	.022	-.005
31	-.007	-.021	-.126	-.047	.005	.026
32	.137	.254	-.120	-.149	.012	.051
33	.112	.245	-.131	-.219	-.002	.051
34	.229	.234	-.076	-.302	-.001	.044
35	-.079	-.009	.007	-.348	.001	-.006
36	-.001	-.004	-.140	-.050	-.012	.018
37	-.026	-.020	-.130	-.145	-.013	.026
38	-.044	-.092	-.052	-.214	.004	.010
39	-.027	-.091	-.039	-.262	-.003	.014
40	.035	.029	.006	-.275	-.003	-.006

INTERNAL MOMENTS (IN-KIPS) AND NORMAL FORCES (KIPS) IN BEAM ELEMENTS

EL	MB	NB
1	3120.5437	1.3582
2	7252.1263	3.3429
3	9506.1079	3.8285
4	10840.2760	3.8526
5	11275.9874	3.9105
6	3509.2482	8.9149
7	8288.2572	24.0189
8	11109.8901	37.1562
9	13094.0312	50.8878
10	13986.6359	59.6020
11	3509.2482	8.9149
12	8288.2572	24.0189
13	11109.8901	37.1562
14	13094.0312	50.8878
15	13986.6359	59.6020
16	3120.5437	1.3582
17	7252.1263	3.3429
18	9506.1079	3.8285
19	10840.2760	3.8526
20	11275.9874	3.9105

TOTAL ACCUMULATED STRESSES IN SLAB LAYERS
(STRESS IS IN KSI, ANGLES ARE IN DEGREES
+ = TENSION, - = COMPRESSION)

EL	LAYER	SXX	SYY	SXY	S1	S2	THETA1
1	1	-.00508	-.00013	-.01499	-.01760	.01259	40.31385

1	2	-.00563	-.00097	-.00960	-.01318	.00657	38.18194
1	3	-.00844	-.00275	-.00581	-.01207	.00088	31.95695
1	4	-.00817	-.00269	.00054	-.00822	-.00264	-5.56787
1	5	-.00556	-.00160	.00518	-.00913	.00197	-34.53574
1	6	-.00465	-.00060	.01060	-.01342	.00816	-39.59173
1	7	-.00000	-.00918	.00000	-.00918	-.00000	-90.00000
1	8	-.06955	.00000	.00000	-.06955	.00000	.00000
1	9	-.06398	.00000	.00000	-.06398	.00000	.00000
1	10	-.00000	-.00918	.00000	-.00918	-.00000	-90.00000
2	1	-.01569	.00030	-.01465	-.02439	.00900	30.69729
2	2	-.01547	-.00078	-.00997	-.02051	.00426	26.81301
2	3	-.02084	-.00242	-.00760	-.02358	.00032	19.76072
2	4	-.02002	-.00268	-.00195	-.02024	-.00247	6.33993
2	5	-.01918	-.00294	.00370	-.01999	-.00214	-12.25436
2	6	-.01841	-.00321	.00939	-.02290	.00127	-25.50449
2	7	.00000	.01906	-.00000	.01906	.00000	-90.00000
2	8	-.18110	.00000	.00000	-.18110	.00000	.00000
2	9	-.16151	.00000	.00000	-.16151	.00000	.00000
2	10	.00000	.00608	-.00000	.00608	-.00000	-90.00000
3	1	-.02297	.00750	-.00576	-.02402	.00855	10.35961
3	2	-.02244	.00436	-.00392	-.02300	.00492	8.15727
3	3	-.03041	.00149	-.00297	-.03069	.00176	5.28142
3	4	-.02943	-.00156	-.00071	-.02945	-.00154	1.46283
3	5	-.02866	-.00459	.00153	-.02876	-.00449	-3.62847
3	6	-.02787	-.00762	.00378	-.02855	-.00693	-10.23584
3	7	.00000	.09414	-.00000	.09414	.00000	-90.00000
3	8	-.27217	.00000	.00000	-.27217	.00000	.00000
3	9	-.24103	.00000	.00000	-.24103	.00000	.00000
3	10	-.00000	-.00252	.00000	-.00252	.00000	-90.00000
4	1	-.02695	.00626	-.00470	-.02760	.00691	7.90681
4	2	-.03615	.00347	-.00455	-.03667	.00399	6.47022
4	3	-.03538	.00045	-.00295	-.03562	.00069	4.67077
4	4	-.03438	-.00256	-.00132	-.03444	-.00250	2.37249
4	5	-.03346	-.00555	.00030	-.03346	-.00555	-.61930
4	6	-.03250	-.00854	.00193	-.03265	-.00839	-4.56902
4	7	.00000	.09414	-.00000	.09414	-.00000	-90.00000
4	8	-.31562	.00000	.00000	-.31562	.00000	.00000
4	9	-.28101	.00000	.00000	-.28101	.00000	.00000
4	10	-.00000	-.00252	.00000	-.00252	.00000	-90.00000
5	1	-.03935	-.00350	.00137	-.03940	-.00345	-2.18952
5	2	-.03758	-.00255	.00115	-.03762	-.00252	-1.87648
5	3	-.03582	-.00161	.00093	-.03584	-.00158	-1.54804
5	4	-.03405	-.00066	.00070	-.03406	-.00064	-1.20313
5	5	-.03231	.00029	.00048	-.03232	.00030	-.84059
5	6	-.03060	.00127	.00026	-.03060	.00128	-.45915
5	7	.00000	.04285	-.00000	.04285	-.00000	-90.00000

5 8	-.31631	.00000	.00000	-.31631	.00000	.00000
5 9	-.28151	.00000	.00000	-.28151	.00000	.00000
5 10	.00000	.06089	-.00000	.06089	.00000	-90.00000
6 1	-.00494	.00289	-.01511	-.01663	.01458	37.73547
6 2	-.00520	.00175	-.01033	-.01268	.00915	35.60162
6 3	-.00555	.00059	-.00559	-.00886	.00390	30.62519
6 4	-.00763	-.00063	-.00156	-.00796	-.00030	11.97179
6 5	-.00722	-.00104	.00403	-.00921	.00094	-26.26371
6 6	-.00438	-.00012	.00766	-.01020	.00570	-37.22641
6 7	.00000	.01668	-.00000	.01668	.00000	-90.00000
6 8	-.07184	.00000	.00000	-.07184	.00000	.00000
6 9	-.06096	.00000	.00000	-.06096	.00000	.00000
6 10	.00000	.00150	-.00000	.00150	.00000	-90.00000
7 1	-.03174	-.01991	-.01796	-.04474	-.00691	35.88953
7 2	-.02739	-.01160	-.01355	-.03517	-.00382	29.88604
7 3	-.02305	-.00329	-.00914	-.02663	.00029	21.38168
7 4	-.01347	.00504	-.00368	-.01418	.00575	10.84719
7 5	-.01038	.01322	-.00026	-.01038	.01322	.62195
7 6	-.00714	.02163	.00374	-.00762	.02210	-7.28947
7 7	-.00000	-.05632	.00000	-.05632	.00000	-90.00000
7 8	-.20809	.00000	.00000	-.20809	.00000	.00000
7 9	-.14871	.00000	.00000	-.14871	.00000	.00000
7 10	.00000	.16946	-.00000	.16946	-.00000	-90.00000
8 1	-.03809	-.02118	-.01905	-.05048	-.00880	33.03421
8 2	-.03544	-.01321	-.01414	-.04231	-.00634	25.91905
8 3	-.03276	-.00524	-.00923	-.03557	-.00243	16.91980
8 4	-.02147	.00453	-.00342	-.02191	.00497	7.37310
8 5	-.01987	.01046	.00046	-.01988	.01047	-.87585
8 6	-.01788	.01857	.00460	-.018454	.01915	-7.08577
8 7	-.00000	-.05632	.00000	-.05632	.00000	-90.00000
8 8	-.28071	.00000	.00000	-.28071	.00000	.00000
8 9	-.25732	.00000	.00000	-.25732	.00000	.00000
8 10	.00000	.16946	-.00000	.16946	-.00000	-90.00000
9 1	-.05875	-.02047	-.01275	-.06261	-.01651	16.83212
9 2	-.05159	-.01274	-.00998	-.05400	-.01032	13.59936
9 3	-.04432	-.00497	-.00720	-.04560	-.00369	10.05563
9 4	-.03719	.00283	-.00445	-.03768	.00332	6.27565
9 5	-.02169	.01030	-.00133	-.02174	.01035	2.37607
9 6	-.01649	.01813	.00091	-.01651	.01815	-1.59424
9 7	-.00000	-.02370	.00000	-.02370	.00000	-90.00000
9 8	-.40554	.00000	.00000	-.40554	.00000	.00000
9 9	-.28082	.00000	.00000	-.28082	.00000	.00000
9 10	.00000	.16815	-.00000	.16815	.00000	-90.00000

10	1	-.03865	.00016	.00150	-.03871	.00022	-2.20430
10	2	-.04078	-.00024	.00124	-.04082	-.00021	-1.74596
10	3	-.04294	-.00064	.00098	-.04296	-.00062	-1.32496
10	4	-.04509	-.00104	.00072	-.04511	-.00103	-.93706
10	5	-.04725	-.00144	.00046	-.04725	-.00144	-.57864
10	6	-.04940	-.00184	.00020	-.04940	-.00184	-.24657
10	7	.00000	.06875	-.00000	.06875	-.00000	-90.00000
10	8	-.36121	.00000	.00000	-.36121	.00000	.00000
10	9	-.40727	.00000	.00000	-.40727	.00000	.00000
10	10	.00000	.06974	-.00000	.06974	-.00000	-90.00000
11	1	-.01579	-.02609	-.01999	-.00030	-.04158	-37.77806
11	2	-.01259	-.01564	-.01670	.00266	-.03088	-42.39331
11	3	-.00610	-.00279	-.01037	-.01495	.00606	40.47364
11	4	-.00365	.00618	-.00847	-.00853	.01106	29.94489
11	5	-.00160	.01608	-.00617	-.00354	.01802	17.46096
11	6	.00043	.02655	-.00320	.00004	.02693	6.88258
11	7	-.00000	-.11790	.00000	-.11790	.00000	-90.00000
11	8	-.07801	.00000	.00000	-.07801	.00000	.00000
11	9	-.05269	.00000	.00000	-.05269	.00000	.00000
11	10	.00000	.18189	-.00000	.18189	-.00000	-90.00000
12	1	-.03522	-.04233	-.01995	-.01851	-.05904	-39.94802
12	2	-.02961	-.02511	-.01715	-.04466	-.01006	41.26694
12	3	-.02393	-.00783	-.01433	-.03232	.00056	30.33988
12	4	-.01280	.00996	-.00947	-.01622	.01339	19.87453
12	5	-.00878	.02677	-.00788	-.01045	.02844	11.94885
12	6	-.00486	.04399	-.00566	-.00551	.04463	6.52142
12	7	-.00000	-.17331	.00000	-.17331	.00000	-90.00000
12	8	-.20539	.00000	.00000	-.20539	.00000	.00000
12	9	-.15655	.00000	.00000	-.15655	.00000	.00000
12	10	.00000	.31620	-.00000	.31620	-.00000	-90.00000
13	1	-.05304	-.06335	-.02015	-.03740	-.07900	-37.82484
13	2	-.04462	-.03702	-.01694	-.05818	-.02346	38.67347
13	3	-.03611	-.01060	-.01369	-.04207	-.00464	23.51767
13	4	-.01971	.01602	-.00861	-.02167	.01799	12.86824
13	5	-.01360	.04229	-.00659	-.01437	.04306	6.63836
13	6	-.00753	.06884	-.00386	-.00772	.06903	2.88670
13	7	-.00000	-.25473	.00000	-.25473	.00000	-90.00000
13	8	-.31181	.00000	.00000	-.31181	.00000	.00000
13	9	-.23983	.00000	.00000	-.23983	.00000	.00000
13	10	.00000	.49669	-.00000	.49669	.00000	-90.00000
14	1	-.07104	-.06693	-.03447	-.10352	-.03446	43.29595
14	2	-.06219	-.04050	-.02549	-.07897	-.02362	33.52047
14	3	-.05303	-.01399	-.01646	-.05904	-.00798	20.06491
14	4	-.03177	.01236	-.02582	-.03252	.01312	7.38397
14	5	-.02525	.03888	.00135	-.02528	.03891	-1.20702
14	6	-.01845	.06569	.00972	-.01956	.06680	-6.50673

14 7	-.00000	-.25473	.00000	-.25473	.00000	-90.00000
14 8	-.45569	.00000	.00000	-.45569	.00000	.00000
14 9	-.37233	.00000	.00000	-.37233	.00000	.00000
14 10	.00000	.49669	-.00000	.49669	.00000	-90.00000
15 1	-.04589	.06559	-.01524	-.04793	.06763	7.64668
15 2	-.04600	.03985	-.00997	-.04691	.04076	5.83915
15 3	-.04600	.01411	-.00289	-.04614	.01425	2.74321
15 4	-.06344	-.01086	.00322	-.06364	-.01067	-3.49393
15 5	-.06321	-.03629	.01021	-.06665	-.03286	-18.58792
15 6	-.06295	-.06172	.01718	-.07953	-.04514	-43.97175
15 7	.00000	.47057	-.00000	.47057	.00000	-90.00000
15 8	-.60445	.00000	.00000	-.60445	.00000	.00000
15 9	-.48836	.00000	.00000	-.48836	.00000	.00000
15 10	-.00000	-.30572	.00000	-.30572	.00000	-90.00000
16 1	-.01565	-.02528	-.00256	-.01501	-.02592	-14.00063
16 2	-.01246	-.01503	.00027	-.01244	-.01505	5.85845
16 3	-.00928	-.00477	.00309	-.01085	-.00319	-26.95879
16 4	-.00406	.00579	.00504	-.00618	.00791	-22.81960
16 5	-.00136	.01597	.00813	-.00457	.01918	-21.58436
16 6	.00132	.02617	.01118	-.00297	.03046	-20.39339
16 7	-.00000	-.11278	.00000	-.11278	.00000	-90.00000
16 8	-.07801	.00000	.00000	-.07801	.00000	.00000
16 9	-.05269	.00000	.00000	-.05269	.00000	.00000
16 10	.00000	.17907	-.00000	.17907	-.00000	-90.00000
17 1	-.03518	-.04232	-.00224	-.03454	-.04297	-16.03181
17 2	-.02951	-.02476	.00010	-.02951	-.02476	-1.25419
17 3	-.02382	-.00717	.00245	-.02417	-.00682	-8.19432
17 4	-.01299	.01042	.00393	-.01363	.01106	-9.27845
17 5	-.00859	.02810	.00649	-.00980	.02921	-9.71685
17 6	-.00438	.04576	.00908	-.00597	.04736	-9.95402
17 7	-.00000	-.17082	.00000	-.17082	.00000	-90.00000
17 8	-.20539	.00000	.00000	-.20539	.00000	.00000
17 9	-.15655	.00000	.00000	-.15655	.00000	.00000
17 10	.00000	.32903	-.00000	.32903	.00000	-90.00000
18 1	-.05243	-.06040	-.00685	-.04849	-.06434	-29.90801
18 2	-.04419	-.03495	-.00209	-.04464	-.03450	12.14279
18 3	-.03592	-.00945	.00269	-.03619	-.00918	-5.73442
18 4	-.01978	.01609	.00612	-.02080	.01711	-9.42258
18 5	-.01342	.04180	.01108	-.01556	.04394	-10.93667
18 6	-.00698	.06745	.01619	-.01035	.07082	-11.75669
18 7	-.00000	-.23734	.00000	-.23734	.00000	-90.00000
18 8	-.31181	.00000	.00000	-.31181	.00000	.00000
18 9	-.23983	.00000	.00000	-.23983	.00000	.00000
18 10	.00000	.48818	-.00000	.48818	.00000	-90.00000

19	1	-.07127	-.18107	-.00927	-.07049	-.18185	-4.79089
19	2	-.06202	-.10712	-.00376	-.06171	-.10743	-4.73663
19	3	-.05278	-.03285	.00177	-.05294	-.03270	-5.03649
19	4	-.03119	.04153	.00625	-.03172	.04206	-4.87730
19	5	-.02407	.11649	.01203	-.02509	.11751	-4.85615
19	6	-.01695	.19145	.01790	-.01846	.19296	-4.94773
19	7	-.00000	-.85696	.00000	-.85696	.00000	-90.00000
19	8	-.37369	.00000	.00000	-.37369	.00000	.00000
19	9	-.49119	.00000	.00000	-.49119	.00000	.00000
19	10	.00000	1.35294	-.00000	1.35294	.00000	-90.00000
20	1	-.17877	-.26985	.01818	-.17528	-.27334	10.88233
20	2	-.12845	-.16181	.01096	-.12517	-.16509	16.65584
20	3	-.07702	-.05212	.00367	-.07755	-.05159	-8.21026
20	4	-.01756	.05890	-.00337	-.01771	.05905	2.51718
20	5	.02872	.17077	-.01103	.02787	.17163	4.41549
20	6	.08181	.28241	-.01839	.08014	.28408	5.19531
20	7	-.00000	-1.23824	.00000	-1.23824	-.00000	-90.00000
20	8	-.73927	.00000	.00000	-.73927	.00000	.00000
20	9	-.06035	.00000	.00000	-.06035	.00000	.00000
20	10	.00000	1.82159	-.00000	1.82159	-.00000	-90.00000
21	1	-.01565	-.02528	.00256	-.01501	-.02592	14.00063
21	2	-.01246	-.01503	-.00027	-.01244	-.01505	-5.85845
21	3	-.00928	-.00477	-.00309	-.01085	-.00319	26.95879
21	4	-.00406	.00579	-.00504	-.00618	.00791	22.81960
21	5	-.00136	.01597	-.00813	-.00457	.01918	21.58436
21	6	.00132	.02617	-.01118	-.00297	.03046	20.99339
21	7	-.00000	-.11278	.00000	-.11278	.00000	-90.00000
21	8	-.07801	.00000	.00000	-.07801	.00000	.00000
21	9	-.05269	.00000	.00000	-.05269	.00000	.00000
21	10	.00000	.17907	-.00000	.17907	.00000	-90.00000
22	1	-.03518	-.04232	.00224	-.03454	-.04297	16.03181
22	2	-.02951	-.02476	-.00010	-.02951	-.02476	1.26419
22	3	-.02382	-.00717	-.00245	-.02417	-.00682	8.19432
22	4	-.01299	.01042	-.00393	-.01363	.01106	9.27845
22	5	-.00869	.02810	-.00649	-.00980	.02921	9.71685
22	6	-.00438	.04576	-.00908	-.00597	.04736	9.95402
22	7	-.00000	-.17082	.00000	-.17082	.00000	-90.00000
22	8	-.20539	.00000	.00000	-.20539	.00000	.00000
22	9	-.15655	.00000	.00000	-.15655	.00000	.00000
22	10	.00000	.32903	-.00000	.32903	-.00000	-90.00000
23	1	-.05243	-.06040	.00685	-.04849	-.06434	29.90801
23	2	-.04419	-.03495	.00209	-.04464	-.03450	-12.14279
23	3	-.03532	-.00945	-.00269	-.03619	-.00918	5.73442
23	4	-.01378	.01609	-.00612	-.02080	.01711	9.42258
23	5	-.01342	.04180	-.01108	-.01555	.04394	10.93667

23	6	-.00698	.06745	-.01619	-.01035	.07082	11.75669
23	7	-.00000	-.23734	.00000	-.23734	.00000	-90.00000
23	8	-.31181	.00000	.00000	-.31181	.00000	.00000
23	9	-.23983	.00000	.00000	-.23983	.00000	.00000
23	10	.00000	.48818	-.00000	.48818	.00000	-90.00000
24	1	-.07127	-.18107	.00927	-.07049	-.18185	4.79089
24	2	-.06202	-.10712	.00376	-.06171	-.10743	4.73663
24	3	-.05278	-.03285	-.00177	-.05294	-.03270	5.03649
24	4	-.03119	.04153	-.00625	-.03172	.04206	4.87730
24	5	-.02407	.11649	-.01203	-.02509	.11751	4.85615
24	6	-.01695	.19145	-.01780	-.01846	.19296	4.94773
24	7	-.00000	-.85696	.00000	-.85696	.00000	-90.00000
24	8	-.37369	.00000	.00000	-.37369	.00000	.00000
24	9	-.49119	.00000	.00000	-.49119	.00000	.00000
24	10	.00000	1.35294	-.00000	1.35294	-.00000	-90.00000
25	1	-.17877	-.26985	-.01818	-.17528	-.27334	-10.88233
25	2	-.12845	-.16181	-.01096	-.12517	-.16509	-16.65584
25	3	-.07702	-.05212	-.00367	-.07755	-.05159	8.21026
25	4	-.01756	.05890	.00337	-.01771	.05905	-2.51718
25	5	.02872	.17077	.01103	.02787	.17163	-4.41549
25	6	.08181	.28241	.01839	.08014	.28408	-5.19531
25	7	-.00000	-1.23824	.00000	-1.23824	.00000	-90.00000
25	8	-.73927	.00000	.00000	-.73927	.00000	.00000
25	9	-.06035	.00000	.00000	-.06035	.00000	.00000
25	10	.00000	1.82159	-.00000	1.82159	.00000	-90.00000
26	1	-.01579	-.02609	.01999	-.00030	-.04158	37.77806
26	2	-.01259	-.01564	.01670	.00266	-.03088	42.39331
26	3	-.00610	-.00279	.01037	-.01495	.00606	-40.47364
26	4	-.00365	.00618	.00847	-.00853	.01106	-29.94489
26	5	-.00160	.01608	.00617	-.00354	.01802	-17.46096
26	6	.00043	.02655	.00320	.00004	.02693	-6.88258
26	7	-.00000	-.11790	.00000	-.11790	.00000	-90.00000
26	8	-.07801	.00000	.00000	-.07801	.00000	.00000
26	9	-.05269	.00000	.00000	-.05269	.00000	.00000
26	10	.00000	.18189	-.00000	.18189	-.00000	-90.00000
27	1	-.03522	-.04233	.01995	-.01851	-.05904	39.94802
27	2	-.02961	-.02511	.01715	-.04466	-.01006	-41.26694
27	3	-.02393	-.00783	.01433	-.03232	.00056	-30.33988
27	4	-.01280	.00996	.00947	-.01622	.01339	-19.37453
27	5	-.00878	.02677	.00788	-.01045	.02844	-11.94885
27	6	-.00486	.04399	.00566	-.00551	.04463	-6.52142
27	7	-.00000	-.17331	.00000	-.17331	.00000	-90.00000
27	8	-.20539	.00000	.00000	-.20539	.00000	.00000
27	9	-.15655	.00000	.00000	-.15655	.00000	.00000
27	10	.00000	.31620	-.00000	.31620	-.00000	-90.00000

28	1	-.05304	-.06335	.02015	-.03740	-.07900	37.82484
28	2	-.04462	-.03702	.01694	-.05818	-.02346	-38.67347
28	3	-.03611	-.01060	.01369	-.04207	-.00464	-23.51767
28	4	-.01971	.01602	.00861	-.02167	.01799	-12.86824
28	5	-.01360	.04229	.00659	-.01437	.04306	-6.63836
28	6	-.00753	.06884	.00386	-.00772	.06903	-2.88670
28	7	-.00000	-.25473	.00000	-.25473	.00000	-90.00000
28	8	-.31181	.00000	.00000	-.31181	.00000	.00000
28	9	-.23983	.00000	.00000	-.23983	.00000	.00000
28	10	.00000	.49669	-.00000	.49669	.00000	-90.00000
29	1	-.07104	-.06693	.03447	-.10352	-.03446	-43.29595
29	2	-.06209	-.04050	.02549	-.07897	-.02362	-33.52047
29	3	-.05303	-.01399	.01646	-.05904	-.00798	-20.06491
29	4	-.03177	.01236	.00582	-.03252	.01312	-7.38397
29	5	-.02525	.03888	-.00135	-.02528	.03891	1.20702
29	6	-.01845	.06569	-.00972	-.01956	.06680	6.50673
29	7	-.00000	-.25473	.00000	-.25473	.00000	-90.00000
29	8	-.45569	.00000	.00000	-.45569	.00000	.00000
29	9	-.37233	.00000	.00000	-.37233	.00000	.00000
29	10	.00000	.49669	-.00000	.49669	.00000	-90.00000
30	1	-.04589	.06559	.01524	-.04793	.06763	-7.64668
30	2	-.04600	.03985	.00887	-.04691	.04076	-5.83815
30	3	-.04600	.01411	.00289	-.04614	.01425	-2.74321
30	4	-.06344	-.01086	-.00322	-.06364	-.01067	3.49393
30	5	-.06321	-.03829	-.01021	-.06665	-.03286	18.58792
30	6	-.06295	-.06172	-.01718	-.07953	-.04514	43.97175
30	7	.00000	.47057	-.00000	.47057	-.00000	-90.00000
30	8	-.60445	.00000	.00000	-.60445	.00000	.00000
30	9	-.48836	.00000	.00000	-.48836	.00000	.00000
30	10	-.00000	-.30572	.00000	-.30572	.00000	-90.00000
31	1	-.00494	.00289	.01511	-.01663	.01458	-37.73547
31	2	-.00528	.00175	.01033	-.01268	.00915	-35.60162
31	3	-.00555	.00059	.00559	-.00886	.00390	-30.62519
31	4	-.00763	-.00063	.00156	-.00796	-.00030	-11.97179
31	5	-.00722	-.00104	-.00403	-.00921	.00094	26.26371
31	6	-.00438	-.00012	-.00766	-.01020	.00570	37.22641
31	7	.00000	.01668	-.00000	.01668	-.00000	-90.00000
31	8	-.07184	.00000	.00000	-.07184	.00000	.00000
31	9	-.06096	.00000	.00000	-.06096	.00000	.00000
31	10	.00000	.00150	-.00000	.00150	-.00000	-90.00000
32	1	-.03174	-.01991	.01796	-.04474	-.00691	-35.88953
32	2	-.02739	-.01160	.01355	-.03517	-.00382	-29.88604
32	3	-.02305	-.00329	.00914	-.02663	.00029	-21.38168
32	4	-.01347	.00504	.00368	-.01418	.00575	-10.84719

32	5	-.01038	.01322	.00026	-.01038	.01322	-.62195
32	6	-.00714	.02163	-.00374	-.00762	.02210	7.28947
32	7	-.00000	-.05632	.00000	-.05632	.00000	-90.00000
32	8	-.20809	.00000	.00000	-.20809	.00000	.00000
32	9	-.14871	.00000	.00000	-.14871	.00000	.00000
32	10	.00000	.16946	-.00000	.16946	.00000	-90.00000
33	1	-.03809	-.02118	.01905	-.05048	-.00880	-33.03421
33	2	-.03544	-.01321	.01414	-.04231	-.00634	-25.91905
33	3	-.03276	-.00524	.00923	-.03557	-.00243	-16.91980
33	4	-.02147	.00453	.00342	-.02191	.00497	-7.37310
33	5	-.01987	.01046	-.00046	-.01988	.01047	.37585
33	6	-.01798	.01857	-.00469	-.01845	.01915	7.08577
33	7	-.00000	-.05632	.00000	-.05632	.00000	-90.00000
33	8	-.28071	.00000	.00000	-.28071	.00000	.00000
33	9	-.25732	.00000	.00000	-.25732	.00000	.00000
33	10	.00000	.16946	-.00000	.16946	-.00000	-90.00000
34	1	-.05875	-.02047	.01275	-.06261	-.01561	-16.83212
34	2	-.05159	-.01274	.00998	-.05400	-.01032	-13.59936
34	3	-.04432	-.00497	.00720	-.04560	-.00369	-10.05563
34	4	-.03719	.00283	.00445	-.03768	.00332	-6.27565
34	5	-.02169	.01030	.00133	-.02174	.01035	-2.37607
34	6	-.01649	.01813	-.00091	-.01651	.01815	1.50424
34	7	-.00000	-.02370	.00000	-.02370	.00000	-90.00000
34	8	-.40554	.00000	.00000	-.40554	.00000	.00000
34	9	-.28082	.00000	.00000	-.28082	.00000	.00000
34	10	.00000	.16815	-.00000	.16815	.00000	-90.00000
35	1	-.03865	.00016	-.00151	-.03871	.00022	2.20430
35	2	-.04078	-.00024	-.00124	-.04082	-.00021	1.74596
35	3	-.04294	-.00064	-.00098	-.04296	-.00062	1.32496
35	4	-.04509	-.00104	-.00072	-.04511	-.00103	.93706
35	5	-.04725	-.00144	-.00046	-.04725	-.00144	.57864
35	6	-.04940	-.00184	-.00020	-.04940	-.00184	.24657
35	7	.00000	.06875	-.00000	.06875	-.00000	-90.00000
35	8	-.36121	.00000	.00000	-.36121	.00000	.00000
35	9	-.40727	.00000	.00000	-.40727	.00000	.00000
35	10	.00000	.06974	-.00000	.06974	-.00000	-90.00000
36	1	-.00598	-.00013	.01499	-.01780	.01259	-40.31385
36	2	-.00563	-.00097	.00960	-.01318	.00657	-38.18194
36	3	-.00844	-.00275	.00581	-.01207	.00088	-31.95695
36	4	-.00817	-.00269	-.00054	-.00822	-.00264	5.56787
36	5	-.00556	-.00160	-.00518	-.00913	.00197	34.53574
36	6	-.00465	-.00060	-.01060	-.01342	.00816	39.59173
36	7	-.00000	-.00918	.00000	-.00918	.00000	-90.00000
36	8	-.06955	.00000	.00000	-.06955	.00000	.00000
36	9	-.06398	.00000	.00000	-.06398	.00000	.00000
36	10	-.00000	-.00918	.00000	-.00918	.00000	-90.00000

37	1	-.01569	.00030	.01465	-.02439	.00900	-30.69729
37	2	-.01547	-.00078	.00997	-.02051	.00426	-26.81301
37	3	-.02084	-.00242	.00760	-.02358	.00032	-19.76072
37	4	-.02002	-.00268	.00195	-.02024	-.00247	-6.33993
37	5	-.01918	-.00294	-.00370	-.01999	-.00214	12.25436
37	6	-.01841	-.00321	-.00939	-.02290	.00127	25.50449
37	7	.00000	.01906	-.00000	.01906	.00000	-90.00000
37	8	-.18110	.00000	.00000	-.18110	.00000	.00000
37	9	-.16151	.00000	.00000	-.16151	.00000	.00000
37	10	.00000	.00608	-.00000	.00608	-.00000	-90.00000
38	1	-.02297	.00750	.00576	-.02402	.00855	-10.35961
38	2	-.02244	.00436	.00392	-.02300	.00492	-8.15727
38	3	-.03041	.00149	.00297	-.03069	.00176	-5.28142
38	4	-.02943	-.00156	.00071	-.02945	-.00154	-1.46283
38	5	-.02866	-.00459	-.00153	-.02876	-.00449	3.62847
38	6	-.02787	-.00762	-.00378	-.02855	-.00693	10.23584
38	7	.00000	.09414	-.00000	.09414	-.00000	-90.00000
38	8	-.27217	.00000	.00000	-.27217	.00000	.00000
38	9	-.24103	.00000	.00000	-.24103	.00000	.00000
38	10	-.00000	-.00252	.00000	-.00252	.00000	-90.00000
39	1	-.02695	.00626	.00470	-.02760	.00691	-7.90681
39	2	-.03615	.00347	.00455	-.03667	.00399	-6.47022
39	3	-.03538	.00045	.00295	-.03562	.00069	-4.67077
39	4	-.03438	-.00256	.00132	-.03444	-.00250	-2.37249
39	5	-.03346	-.00555	-.00030	-.03346	-.00555	.61930
39	6	-.03250	-.00854	-.00193	-.03265	-.00839	4.56902
39	7	.00000	.09414	-.00000	.09414	.00000	-90.00000
39	8	-.31562	.00000	.00000	-.31562	.00000	.00000
39	9	-.28101	.00000	.00000	-.28101	.00000	.00000
39	10	-.00000	-.00252	.00000	-.00252	.00000	-90.00000
40	1	-.03935	-.00350	-.00137	-.03940	-.00345	2.18952
40	2	-.03758	-.00255	-.00115	-.03762	-.00252	1.87648
40	3	-.03582	-.00161	-.00093	-.03584	-.00158	1.54804
40	4	-.03405	-.00066	-.00070	-.03406	-.00064	1.20313
40	5	-.03231	.00029	-.00048	-.03232	.00030	.84059
40	6	-.03060	.00127	-.00026	-.03060	.00128	.45915
40	7	.00000	.04285	-.00000	.04285	-.00000	-90.00000
40	8	-.31631	.00000	.00000	-.31631	.00000	.00000
40	9	-.28151	.00000	.00000	-.28151	.00000	.00000
40	10	.00000	.06089	-.00000	.06089	-.00000	-90.00000

TOTAL ACCUMULATED STRESSES IN BEAM LAYERS
(STRESS IS IN KSI, + = TENSION, - = COMPRESSION)

BEAM

ELEMENT/ LAYER =	1	2	3	4	5	6	7	8	9	10	11
1	-.290	-.429	-.604	-.822	-1.118	-1.353	-1.528	-1.675	-1.797	-1.892	134.919
2	-.898	-.944	-1.001	-1.073	-1.171	-1.249	-1.306	-1.355	-1.395	-1.427	136.441
3	-1.233	-1.228	-1.221	-1.212	-1.201	-1.192	-1.185	-1.180	-1.175	-1.171	137.272
4	-1.433	-1.397	-1.352	-1.296	-1.219	-1.159	-1.114	-1.076	-1.044	-1.019	137.765
5	-1.498	-1.452	-1.395	-1.323	-1.225	-1.148	-1.090	-1.042	-1.001	-.970	137.926
6	-.303	-.439	-.609	-.821	-1.110	-1.339	-1.509	-1.653	-1.772	-1.864	135.040
7	-.930	-.967	-1.013	-1.070	-1.149	-1.211	-1.257	-1.296	-1.329	-1.354	136.763
8	-1.274	-1.256	-1.233	-1.204	-1.164	-1.133	-1.110	-1.090	-1.074	-1.061	137.766
9	-1.490	-1.436	-1.368	-1.283	-1.167	-1.076	-1.008	-.950	-.903	-.865	138.458
10	-1.572	-1.503	-1.417	-1.310	-1.164	-1.049	-.963	-.890	-.830	-.783	138.762
11	-.303	-.439	-.609	-.821	-1.110	-1.339	-1.509	-1.653	-1.772	-1.864	135.040
12	-.930	-.967	-1.013	-1.070	-1.143	-1.211	-1.257	-1.296	-1.329	-1.354	136.763
13	-1.274	-1.256	-1.233	-1.204	-1.164	-1.133	-1.110	-1.090	-1.074	-1.031	137.766

14	-1.490 138.458	-1.436	-1.368	-1.283	-1.167	-1.076	-1.008	-.950	-.903	-.865
15	-1.572 138.762	-1.503	-1.417	-1.310	-1.164	-1.049	-.963	-.890	-.830	-.783
16	-.290 134.319	-.429	-.604	-.822	-1.118	-1.353	-1.528	-1.675	-1.797	-1.832
17	-.898 136.441	-.944	-1.001	-1.073	-1.171	-1.249	-1.306	-1.355	-1.395	-1.427
18	-1.233 137.272	-1.228	-1.221	-1.212	-1.201	-1.192	-1.185	-1.180	-1.175	-1.171
19	-1.433 137.765	-1.397	-1.352	-1.296	-1.219	-1.159	-1.114	-1.076	-1.044	-1.019
20	-1.498 137.926	-1.452	-1.395	-1.323	-1.225	-1.148	-1.090	-1.042	-1.001	-.970

TOTAL NORMAL, SHEAR, AND PRINCIPAL STRESSES IN BEAM
(STRESS IS IN KSI, ANGLES ARE IN DEGREES
+ = TENSION, - = COMPRESSION)

BEAM ELEMENT	SHEAR STRESS (KSI) AT TOP
1	-.0017
2	-.0012
3	-.0005
4	-.0002
5	-.0002
6	-.0087
7	-.0089
8	-.0093
9	-.0086
10	-.0079
11	-.0087
12	-.0089
13	-.0093
14	-.0086
15	-.0079
16	-.0017
17	-.0012
18	-.0005
19	-.0002
20	-.0002

N	ML	SXX	SZZ	SXZ	S1	S2	THETA1
1	1	-.28959	.00000	-.00684	-.28975	.00016	1.35261
1	2	-.42911	.00000	-.02734	-.43084	.00173	3.63049
1	3	-.60351	.00000	-.06579	-.61059	.00709	6.14933
1	4	-.82150	.00000	-.12940	-.84140	.01990	8.74304
1	5	-1.11797	.00000	-.14173	-1.13565	.01769	7.11389
1	6	-1.35333	.00000	-.09343	-1.35975	.00642	3.93055
1	7	-1.52754	.00000	-.04929	-1.52913	.00159	1.84621
1	8	-1.67542	.00000	-.02759	-1.67587	.00045	.94317
1	9	-1.79693	.00000	-.01556	-1.79706	.00013	.49595
1	10	-1.89212	.00000	-.00443	-1.89213	.00001	.13417
1	11	134.91878	.00000	.00000	134.91878	.00000	.00000
2	1	-.89770	.00000	-.00558	-.89773	.00003	.35591
2	2	-.94373	.00000	-.02289	-.94428	.00055	1.38844
2	3	-1.00126	.00000	-.05529	-1.00431	.00304	3.15102
2	4	-1.07318	.00000	-.10886	-1.08411	.01093	5.73428
2	5	-1.17098	.00000	-.11932	-1.18302	.01203	5.75921
2	6	-1.24864	.00000	-.07868	-1.25358	.00494	3.59135
2	7	-1.30615	.00000	-.04152	-1.30747	.00132	1.81891
2	8	-1.35503	.00000	-.02325	-1.35543	.00040	.98288
2	9	-1.39528	.00000	-.01312	-1.39540	.00012	.53851
2	10	-1.42689	.00000	-.00374	-1.42690	.00001	.15005
2	11	136.44149	.00000	.00000	136.44149	.00000	.00000
3	1	-1.23289	.00000	-.00335	-1.23290	.00001	.15586
3	2	-1.22753	.00000	-.01463	-1.22770	.00017	.68280
3	3	-1.22084	.00000	-.03564	-1.22188	.00104	1.67067
3	4	-1.21247	.00000	-.07033	-1.21653	.00407	3.30860
3	5	-1.20109	.00000	-.07718	-1.20603	.00494	3.66188
3	6	-1.19205	.00000	-.05093	-1.19422	.00217	2.44224
3	7	-1.18535	.00000	-.02690	-1.18596	.00061	1.29913
3	8	-1.17966	.00000	-.01508	-1.17986	.00019	.73217
3	9	-1.17498	.00000	-.00851	-1.17504	.00006	.41490
3	10	-1.17130	.00000	-.00243	-1.17130	.00001	.11865
3	11	137.27239	.00000	.00000	137.27239	.00000	.00000
4	1	-1.43283	.00000	-.00174	-1.43283	.00000	.06955
4	2	-1.39689	.00000	-.00778	-1.39693	.00004	.31910
4	3	-1.35196	.00000	-.01901	-1.35223	.00027	.80550
4	4	-1.29579	.00000	-.03755	-1.29688	.00109	1.65849
4	5	-1.21940	.00000	-.04123	-1.22079	.00139	1.93447
4	6	-1.15873	.00000	-.02722	-1.15936	.00064	1.34486
4	7	-1.11378	.00000	-.01437	-1.11397	.00019	.73931
4	8	-1.07558	.00000	-.00806	-1.07564	.00006	.42938
4	9	-1.04411	.00000	-.00455	-1.04413	.00002	.24967
4	10	-1.01939	.00000	-.00130	-1.01939	.00000	.07290
4	11	137.76485	.00000	.00000	137.76485	.00000	.00000

5	1	-1.49781	.00000	-.00108	-1.49781	.00000	.04141
5	2	-1.45193	.00000	-.00474	-1.45195	.00002	.18685
5	3	-1.39457	.00000	-.01154	-1.39466	.00010	.47400
5	4	-1.32285	.00000	-.02277	-1.32324	.00039	.98595
5	5	-1.22530	.00000	-.02500	-1.22581	.00051	1.16817
5	6	-1.14782	.00000	-.01650	-1.14806	.00024	.82322
5	7	-1.09042	.00000	-.00871	-1.09049	.00007	.45769
5	8	-1.04163	.00000	-.00488	-1.04166	.00002	.26865
5	9	-1.00146	.00000	-.00276	-1.00146	.00001	.15771
5	10	-.96989	.00000	-.00079	-.96989	.00000	.04642
5	11	137.92551	.00000	.00000	137.92551	.00000	.00000
6	1	-.30278	.00000	-.01396	-.30342	.00064	2.63454
6	2	-.43873	.00000	-.03501	-.44150	.00278	4.53411
6	3	-.60867	.00000	-.07705	-.61827	.00960	7.10400
6	4	-.82109	.00000	-.14781	-.84689	.02580	9.90003
6	5	-1.10997	.00000	-.15947	-1.13242	.02246	8.01553
6	6	-1.33931	.00000	-.10430	-1.34739	.00807	4.42651
6	7	-1.50907	.00000	-.05475	-1.51106	.00198	2.07514
6	8	-1.65318	.00000	-.03044	-1.65374	.00056	1.05434
6	9	-1.77161	.00000	-.01711	-1.77177	.00017	.55313
6	10	-1.86440	.00000	-.00486	-1.86441	.00001	.14939
6	11	135.04020	.00000	.00000	135.04020	.00000	.00000
7	1	-.92962	.00000	-.01333	-.92982	.00019	.82426
7	2	-.96654	.00000	-.03112	-.96754	.00100	1.84230
7	3	-1.01267	.00000	-.06715	-1.01711	.00443	3.77730
7	4	-1.07034	.00000	-.12805	-1.08545	.01511	6.72803
7	5	-1.14877	.00000	-.13765	-1.16503	.01626	6.73826
7	6	-1.21104	.00000	-.08987	-1.21767	.00663	4.22085
7	7	-1.25716	.00000	-.04712	-1.25892	.00176	2.14342
7	8	-1.29636	.00000	-.02615	-1.29688	.00053	1.15524
7	9	-1.32863	.00000	-.01469	-1.32879	.00016	.63333
7	10	-1.35398	.00000	-.00417	-1.35399	.00001	.17657
7	11	136.76305	.00000	.00000	136.76305	.00000	.00000
8	1	-1.27439	.00000	-.01222	-1.27450	.00012	.54936
8	2	-1.25586	.00000	-.02393	-1.25632	.00046	1.09134
8	3	-1.23270	.00000	-.04896	-1.23464	.00194	2.27103
8	4	-1.20375	.00000	-.09181	-1.21071	.00696	4.33658
8	5	-1.16438	.00000	-.09766	-1.17251	.00813	4.76132
8	6	-1.13311	.00000	-.06341	-1.13665	.00354	3.19305
8	7	-1.10995	.00000	-.03313	-1.11094	.00099	1.70810
8	8	-1.09026	.00000	-.01830	-1.09057	.00031	.96132
8	9	-1.07405	.00000	-.01026	-1.07415	.00010	.54703
8	10	-1.06131	.00000	-.00291	-1.06132	.00001	.15704
8	11	137.76613	.00000	.00000	137.76613	.00000	.00000

9	1	-1.48993	.00000	-.01032	-1.49001	.00007	.39665
9	2	-1.43564	.00000	-.01707	-1.43584	.00020	.68095
9	3	-1.36776	.00000	-.03270	-1.36854	.00078	1.36862
9	4	-1.28290	.00000	-.05995	-1.28569	.00280	2.66966
9	5	-1.16747	.00000	-.06285	-1.17084	.00337	3.07253
9	6	-1.07579	.00000	-.04049	-1.07731	.00152	2.15231
9	7	-1.00788	.00000	-.02104	-1.00832	.00044	1.19557
9	8	-.95016	.00000	-.01154	-.95030	.00014	.69561
9	9	-.90262	.00000	-.00644	-.90266	.00005	.40898
9	10	-.86527	.00000	-.00182	-.86527	.00000	.12072
9	11	138.45807	.00000	,00000	138.45807	.00000	.00000
10	1	-1.57174	.00000	-.00898	-1.57179	.00005	.32745
10	2	-1.50316	.00000	-.01350	-1.50328	.00012	.51439
10	3	-1.41742	.00000	-.02472	-1.41785	.00043	.99869
10	4	-1.31022	.00000	-.04457	-1.31173	.00151	1.94600
10	5	-1.16439	.00000	-.04620	-1.16622	.00183	2.26881
10	6	-1.04857	.00000	-.02958	-1.04941	.00083	1.61484
10	7	-.96279	.00000	-.01531	-.96302	.00024	.91097
10	8	-.88985	.00000	-.00835	-.88993	.00008	.53732
10	9	-.82979	.00000	-.00465	-.82981	.00003	.32090
10	10	-.78260	.00000	-.00131	-.78260	.00000	.09607
10	11	138.76186	.00000	.00000	138.76186	.00000	.00000
11	1	-.30278	.00000	-.01396	-.30342	.00064	2.63454
11	2	-.43873	.00000	-.03501	-.44150	.00278	4.53411
11	3	-.60867	.00000	-.07705	-.61827	.00960	7.10400
11	4	-.82109	.00000	-.14781	-.84689	.02580	9.90003
11	5	-1.10997	.00000	-.15947	-1.13242	.02246	8.01553
11	6	-1.33931	.00000	-.10430	-1.34739	.00907	4.42651
11	7	-1.50907	.00000	-.05475	-1.51106	.00198	2.07514
11	8	-1.65319	.00000	-.03044	-1.65374	.00056	1.03434
11	9	-1.77161	.00000	-.01711	-1.77177	.00017	.55313
11	10	-1.86440	.00000	-.00486	-1.86441	.00001	.14939
11	11	135.04020	.00000	.00000	135.04020	.00000	.00000
12	1	-.92962	.00000	-.01338	-.92992	.00019	.82426
12	2	-.96654	.00000	-.03112	-.96754	.00100	1.84230
12	3	-1.01267	.00000	-.06715	-1.01711	.00443	3.77730
12	4	-1.07034	.00000	-.12805	-1.08545	.01511	6.72803
12	5	-1.14877	.00000	-.13765	-1.16503	.01626	6.73826
12	6	-1.21104	.00000	-.08987	-1.21767	.00663	4.22085
12	7	-1.25716	.00000	-.04712	-1.25892	.00176	2.14342
12	8	-1.29636	.00000	-.02615	-1.29688	.00053	1.15524
12	9	-1.32863	.00000	-.01469	-1.32879	.00016	.63333
12	10	-1.35398	.00000	-.00417	-1.35399	.00001	.17657
12	11	136.76305	.00000	.00000	136.76305	.00000	.00000
13	1	-1.27439	.00000	-.01222	-1.27450	.00012	.54936

13	2	-1.25586	.00000	-.02393	-1.25632	.00046	1.09134
13	3	-1.23270	.00000	-.04896	-1.23464	.00194	2.27103
13	4	-1.20375	.00000	-.09181	-1.21071	.00696	4.33658
13	5	-1.16438	.00000	-.09766	-1.17251	.00813	4.76132
13	6	-1.13311	.00000	-.06341	-1.13665	.00354	3.19305
13	7	-1.10995	.00000	-.03313	-1.11094	.00099	1.70810
13	8	-1.09026	.00000	-.01830	-1.09057	.00031	.96132
13	9	-1.07405	.00000	-.01026	-1.07415	.00010	.54703
13	10	-1.06131	.00000	-.00291	-1.06132	.00001	.15704
13	11	137.76613	.00000	.00000	137.76613	.00000	.00000
14	1	-1.48993	.00000	-.01032	-1.49001	.00007	.39665
14	2	-1.43564	.00000	-.01707	-1.43584	.00020	.68095
14	3	-1.36776	.00000	-.03270	-1.36854	.00078	1.36862
14	4	-1.28290	.00000	-.05995	-1.28569	.00280	2.66966
14	5	-1.16747	.00000	-.06285	-1.17084	.00337	3.07253
14	6	-1.07579	.00000	-.04349	-1.07731	.00152	2.15231
14	7	-1.00788	.00000	-.02104	-1.00832	.00044	1.19557
14	8	-.95016	.00000	-.01154	-.95030	.00014	.69561
14	9	-.90262	.00000	-.00644	-.90266	.00005	.40898
14	10	-.86527	.00000	-.00182	-.86527	.00000	.12072
14	11	138.45807	.00000	.00000	138.45807	.00000	.00000
15	1	-1.57174	.00000	-.00898	-1.57179	.00005	.32745
15	2	-1.50316	.00000	-.01350	-1.50328	.00012	.51439
15	3	-1.41742	.00000	-.02472	-1.41785	.00043	.99869
15	4	-1.31022	.00000	-.04457	-1.31173	.00151	1.94600
15	5	-1.16439	.00000	-.04620	-1.16622	.00183	2.26881
15	6	-1.04857	.00000	-.02958	-1.04941	.00083	1.61484
15	7	-.96278	.00000	-.01531	-.96302	.00024	.91097
15	8	-.88985	.00000	-.00835	-.88993	.00008	.53732
15	9	-.82979	.00000	-.00465	-.82981	.00003	.32090
15	10	-.78260	.00000	-.00131	-.78260	.00000	.09607
15	11	138.76186	.00000	.00000	138.76186	.00000	.00000
16	1	-.28959	.00000	-.00684	-.28975	.00016	1.35261
16	2	-.42911	.00000	-.02734	-.43084	.00173	3.63049
16	3	-.60351	.00000	-.06579	-.61059	.00709	6.14933
16	4	-.82150	.00000	-.12940	-.84140	.01990	8.74304
16	5	-1.11797	.00000	-.14173	-1.13565	.01769	7.11389
16	6	-1.35333	.00000	-.09343	-1.35975	.00642	3.93055
16	7	-1.52754	.00000	-.04929	-1.52913	.00159	1.84621
16	8	-1.67542	.00000	-.02759	-1.67587	.00045	.94317
16	9	-1.79593	.00000	-.01556	-1.79706	.00013	.49595
16	10	-1.89212	.00000	-.00443	-1.89213	.00001	.13417
16	11	134.91878	.00000	.00000	134.91878	.00000	.00000
17	1	-.89770	.00000	-.00558	-.89773	.00003	.35591
17	2	-.94373	.00000	-.02209	-.94428	.00055	1.38844
17	3	-1.00126	.00000	-.05529	-1.00431	.00304	3.15102

17	4	-1.07318	.00000	-.10886	-1.08411	.01093	5.73428
17	5	-1.17098	.00000	-.11932	-1.18302	.01203	5.75921
17	6	-1.24864	.00000	-.07868	-1.25358	.00494	3.59135
17	7	-1.30615	.00000	-.04152	-1.30747	.00132	1.81891
17	8	-1.35503	.00000	-.02325	-1.35543	.00040	.95288
17	9	-1.39528	.00000	-.01312	-1.39540	.00012	.53851
17	10	-1.42689	.00000	-.00374	-1.42690	.00001	.15005
17	11	136.44149	.00000	.00000	136.44149	.00000	.00000
18	1	-1.23289	.00000	-.00335	-1.23290	.00001	.15586
18	2	-1.22753	.00000	-.01463	-1.22770	.00017	.68280
18	3	-1.22084	.00000	-.03564	-1.22188	.00104	1.67067
18	4	-1.21247	.00000	-.07033	-1.21653	.00407	3.30860
18	5	-1.20109	.00000	-.07718	-1.20603	.00494	3.66188
18	6	-1.19205	.00000	-.05093	-1.19422	.00217	2.44224
18	7	-1.18535	.00000	-.02690	-1.18596	.00061	1.29913
18	8	-1.17966	.00000	-.01508	-1.17986	.00019	.73217
18	9	-1.17498	.00000	-.00851	-1.17504	.00006	.41490
18	10	-1.17130	.00000	-.00243	-1.17130	.00001	.11865
18	11	137.27239	.00000	.00000	137.27239	.00000	.00000
19	1	-1.43283	.00000	-.00174	-1.43283	.00000	.06955
19	2	-1.39689	.00000	-.00778	-1.39693	.00004	.31910
19	3	-1.35196	.00000	-.01901	-1.35223	.00027	.80550
19	4	-1.29579	.00000	-.03755	-1.29688	.00109	1.65849
19	5	-1.21940	.00000	-.04123	-1.22079	.00139	1.93447
19	6	-1.15873	.00000	-.02722	-1.15936	.00064	1.34486
19	7	-1.11378	.00000	-.01437	-1.11397	.00019	.73931
19	8	-1.07558	.00000	-.00806	-1.07564	.00006	.42938
19	9	-1.04411	.00000	-.00455	-1.04413	.00002	.24957
19	10	-1.01939	.00000	-.00130	-1.01939	.00000	.07290
19	11	137.76485	.00000	.00000	137.76485	.00000	.00000
20	1	-1.49781	.00000	-.00108	-1.49781	.00000	.04141
20	2	-1.45193	.00000	-.00474	-1.45195	.00002	.18685
20	3	-1.39457	.00000	-.01154	-1.39466	.00010	.47400
20	4	-1.32285	.00000	-.02277	-1.32324	.00039	.98595
20	5	-1.22530	.00000	-.02500	-1.22581	.00051	1.16817
20	6	-1.14782	.00000	-.01650	-1.14806	.00024	.82322
20	7	-1.09042	.00000	-.00871	-1.09049	.00007	.45769
20	8	-1.04163	.00000	-.00498	-1.04166	.00002	.26865
20	9	-1.00146	.00000	-.00276	-1.00146	.00001	.15771
20	10	-.96989	.00000	-.00079	-.96989	.00000	.04642
20	11	137.92551	.00000	.00000	137.92551	.00000	.00000

ANGLES SHOWING DIRECTION OF PRINCIPAL AXIS, FIRST CRACK,
AND SECOND CRACK (ANGLE = 999.0 IF NO CRACK)
ANGLES ARE IN DEGREES

EL LAYER PRINCIPAL FIRST SECOND

29	6	5.195307	5.195307-CRACK	999.000000-
25	6	-5.195307	-5.195307-CRACK	999.000000-

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

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* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
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* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
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* 4444444444444444444444444444443333333333333333333333333333333333333333333332222222222222222222222222 *
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BEAM NUMBER 2

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BEAM NUMBER 3

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BEAM NUMBER 4

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* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333333322222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333333333322222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333333333333332222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **         *
```

```
     SLAB PLOT

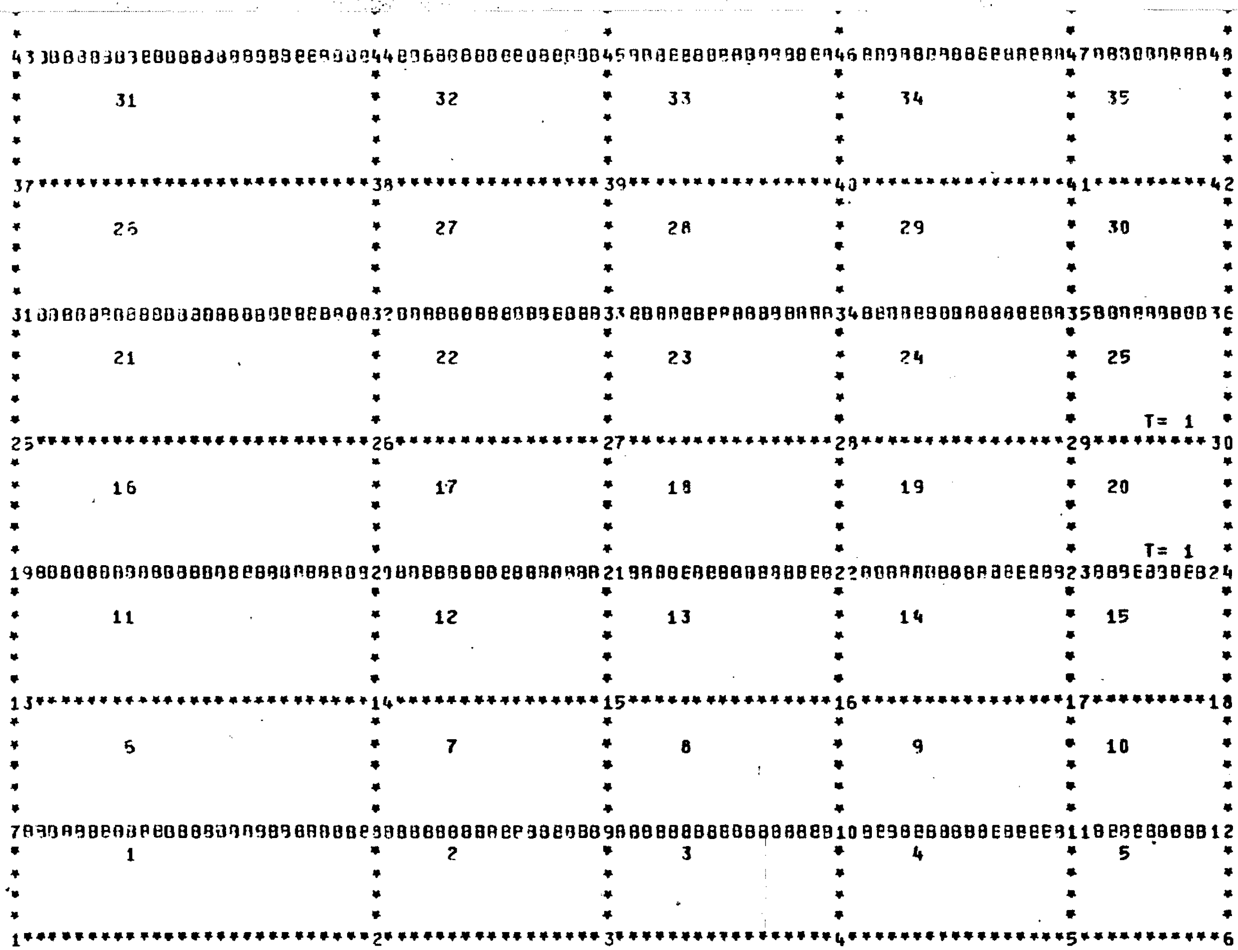
          NODE J                                                               NODE L

                 ELEMENT NUMBER                  Y = NUMBER OF YIELDED LAYERS

                 C = NUMBER OF CRUSHED LAYERS    T = NUMBER OF CRACKED LAYERS

          NODE I                                                               NODE K


49***************************50*****************51*****************52*****************53**********54
*        36                  *     37           *     38           *     39           *  40       *
*                            *                  *                  *                  *           *
```



LOAD CYCLE = 1

----LOAD RATIO AT START OF CYCLE = .200000000E+00
----PRESCAN FACTOR AT START OF CYCLE = .100000000E+01

NUMBER OF TRIALS = 1

NUMBER OF ITERATIONS = 1

NUMBER OF TRIALS = 1

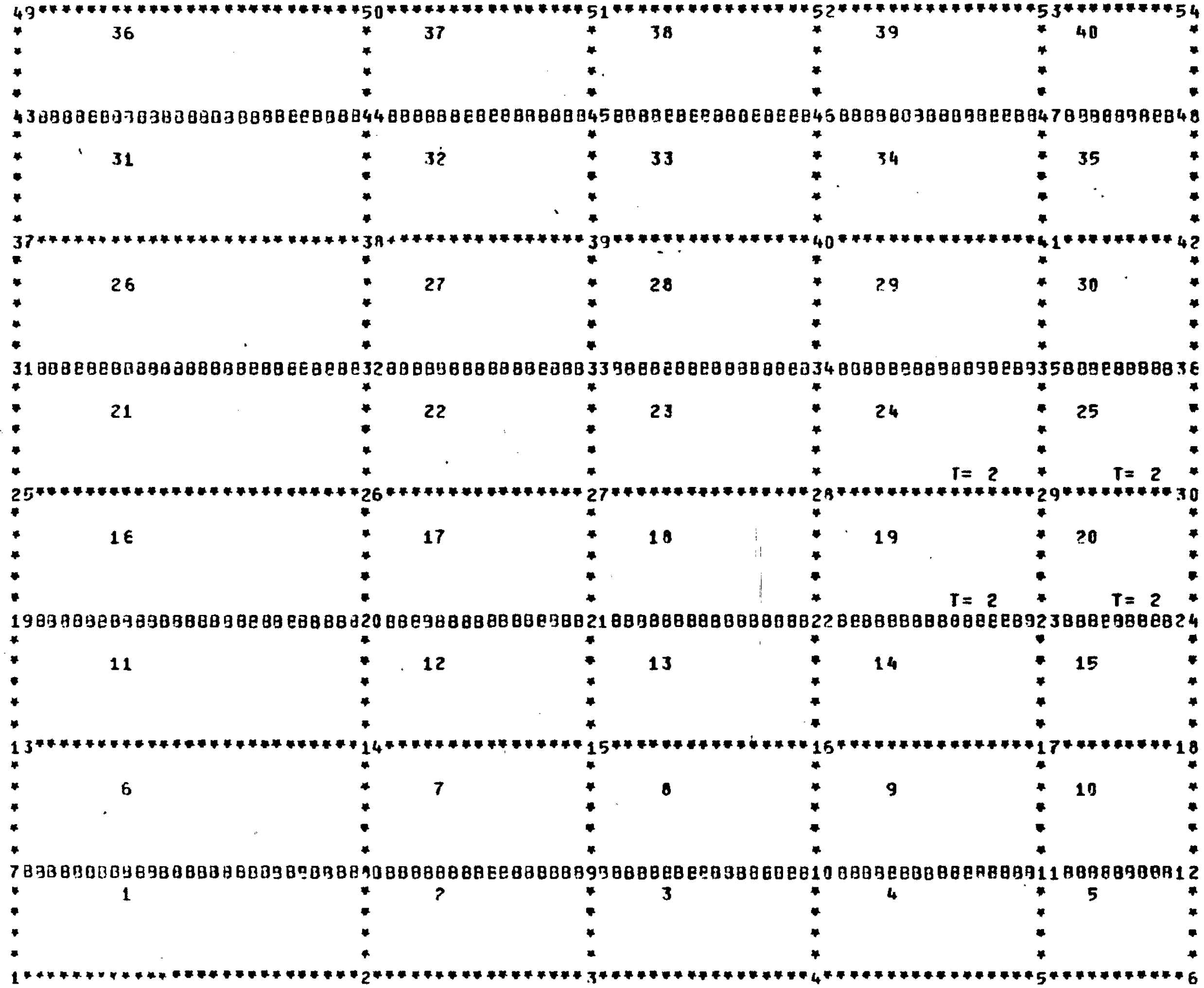
NUMBER OF ITERATIONS = 2

FOR THE SAKE OF BREVITY

166 PRINTOUT PAGES

ARE NOT INCLUDED

IN THE REPORT



LOAD CYCLE = 8

----LOAD RATIO AT START OF CYCLE = .200000000E+00
----PRESCAN FACTOR AT START OF CYCLE = .100000000E+01

NUMBER OF TRIALS = 1

NUMBER OF ITERATIONS = 1

```
----LOAD STEP WILL BE REDUCED---------
    PRESCAN REDUCTION FACTOR    =   .545803940E+00
    NEW LOAD RATIO              =   .109160788E+00

NUMBER OF TRIALS     =     1

NUMBER OF ITERATIONS =     2

NUMBER OF TRIALS     =     1

NUMBER OF ITERATIONS =     3
```

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
20	4	2.1688
25	4	-2.1688

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

APPLIED NODAL POINT FORCES IN KIPS AND IN-KIPS

NODAL POINTS	U-LOAD	V-LOAD	W-LOAD	MX-LOAD	MY-LOAD
1	.00000	.00000	.00000	.00000	.00000
2	.00000	.00000	.00000	.00000	.00000
3	.00000	.00000	.00000	.00000	.00000
4	.00000	.00000	.00000	.00000	.00000
5	.00000	.00000	.00000	.00000	.00000
6	.00000	.00000	.00000	.00000	.00000
7	.00000	.00000	.00000	.00000	.00000
8	.00000	.00000	.00000	.00000	.00000
9	.00000	.00000	.00000	.00000	.00000
10	.00000	.00000	.00000	.00000	.00000
11	.00000	.00000	.00000	.00000	.00000
12	.00000	.00000	.00000	.00000	.00000
13	.00000	.00000	.00000	.00000	.00000
14	.00000	.00000	.00000	.00000	.00000
15	.00000	.00000	.00000	.00000	.00000
16	.00000	.00000	.00000	.00000	.00000
17	.00000	.00000	.00000	.00000	.00000
18	.00000	.00000	.00000	.00000	.00000
19	.00000	.00000	.00000	.00000	.00000
20	.00000	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000	.00000
23	.00000	.00000	4.89299	-39.14387	-34.25089

24	.00000	.00000	4.89298	-39.14387	34.25089
25	.00000	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000	.00000
29	.00000	.00000	9.78597	.00000	-68.50178
30	.00000	.00000	9.78597	.00000	68.50178
31	.00000	.00000	.00000	.00000	.00000
32	.00000	.00000	.00000	.00000	.00000
33	.00000	.00000	.00000	.00000	.00000
34	.00000	.00000	.00000	.00000	.00000
35	.00000	.00000	4.89298	39.14387	-34.25089
36	.00000	.00000	4.89298	39.14387	34.25089
37	.00000	.00000	.00000	.00000	.00000
38	.00000	.00000	.00000	.00000	.00000
39	.00000	.00000	.00000	.00000	.00000
40	.00000	.00000	.00000	.00000	.00000
41	.00000	.00000	.00000	.00000	.00000
42	.00000	.00000	.00000	.00000	.00000
43	.00000	.00000	.00000	.00000	.00000
44	.00000	.00000	.00000	.00000	.00000
45	.00000	.00000	.00000	.00000	.00000
46	.00000	.00000	.00000	.00000	.00000
47	.00000	.00000	.00000	.00000	.00000
48	.00000	.00000	.00000	.00000	.00000
49	.00000	.00000	.00000	.00000	.00000
50	.00000	.00000	.00000	.00000	.00000
51	.00000	.00000	.00000	.00000	.00000
52	.00000	.00000	.00000	.00000	.00000
53	.00000	.00000	.00000	.00000	.00000
54	.00000	.00000	.00000	.00000	.00000

NODAL POINT DISPLACEMENTS IN INCHES AND RADIANS

NODAL POINTS	U-DISP	V-DISP	W-DISP	MX-DISP	MY-DISP
1	.00602	-.00234	-.00000	-.00000	-.00003
2	.00531	-.00100	.00195	-.00060	-.00003
3	.00413	-.00037	.00395	-.00091	-.00004
4	.00241	.00044	.00749	-.00108	-.00005
5	.00069	.00128	.01268	-.00110	-.00003
6	.00000	.00143	.01348	-.00110	-.00000
7	.00663	-.00231	.00000	-.00000	-.00023
8	.00592	-.00104	.02732	-.00061	-.00020
9	.00469	-.00051	.04256	-.00093	-.00016
10	.00290	.00025	.05336	-.00112	-.00010
11	.00094	.00113	.05877	-.00109	-.00003
12	.00000	.00131	.05944	-.00108	-.00000
13	.00759	-.00214	.00000	.00000	-.00046
14	.00689	-.00107	.05532	-.00053	-.00040
15	.00564	-.00072	.08674	-.00086	-.00032
16	.00376	-.00005	.10810	-.00112	-.00015
17	.00129	.00091	.11237	-.00117	-.00002

18	.00000	.00115	.11200	-.00114	.00000
19	.00886	-.00172	.00000	.00000	-.00062
20	.00820	-.00112	.07590	-.00030	-.00057
21	.00697	-.00094	.12027	-.00049	-.00048
22	.00507	-.00049	.15485	-.00073	-.00034
23	.00211	.00056	.17483	-.00148	-.00013
24	-.00000	.00085	.17762	-.00179	-.00000
25	.00865	-.00117	.00000	.00000	-.00068
26	.00806	-.00117	.08325	.00000	-.00062
27	.00682	-.00117	.13202	.00000	-.00051
28	.00463	-.00117	.17144	.00000	-.00051
29	.00149	-.00117	.22005	.00000	-.00068
30	.00000	-.00117	.23633	-.00000	-.00000
31	.00886	-.00063	.00000	-.00000	-.00062
32	.00820	-.00123	.07590	.00030	-.00057
33	.00697	-.00140	.12027	.00049	-.00048
34	.00507	-.00187	.15485	.00073	-.00034
35	.00211	-.00299	.17483	.00148	-.00013
36	-.00000	-.00319	.17762	.00179	-.00000
37	.00759	-.00021	.00000	-.00000	-.00046
38	.00689	-.00127	.05532	.00053	-.00040
39	.00564	-.00163	.08674	.00086	-.00032
40	.00376	-.00229	.10810	.00112	-.00015
41	.00129	-.00326	.11237	.00117	-.00002
42	.00000	-.00349	.11200	.00114	.00000
43	.00663	-.00004	.00000	.00000	-.00023
44	.00592	-.00130	.02732	.00061	-.00020
45	.00469	-.00183	.04256	.00093	-.00016
46	.00290	-.00259	.05336	.00112	-.00010
47	.00094	-.00348	.05877	.00109	-.00003
48	.00000	-.00365	.05944	.00108	-.00000
49	.00602	.00000	-.00000	.00000	-.00003
50	.00531	-.00135	.00195	.00060	-.00003
51	.00413	-.00198	.00395	.00091	-.00004
52	.00241	-.00278	.00749	.00108	-.00005
53	.00069	-.00362	.01268	.00110	-.00003
54	.00000	-.00378	.01348	.00110	-.00000

DISPLACEMENT/REFERENCE DISPLACEMENT = 2.67577

FORCE/REFERENCE FORCE = 2.41469

SUM OF NODAL POINT W-LOADS = 39.1439

INTERNAL MOMENTS (IN-KIPS/IN) AND NORMAL FORCES (KIPS/IN) IN THE SLAB

EL	MY	MX	MXY	NX	NY	NXY
1	-.002	-.009	.381	-.123	-.030	-.043
2	-.070	-.059	.356	-.359	-.035	-.063
3	-.121	-.277	.101	-.570	.014	-.072
4	-.086	-.275	.057	-.595	.003	-.012
5	.085	.150	-.019	-.607	-.030	.045
6	-.025	-.061	.344	-.115	.009	-.089
7	.367	.664	.324	-.355	.050	-.161

8	.293	.638	.364	-.532	.011	-.127
9	.605	.453	.183	-.739	.031	-.071
10	-.410	-.516	-.005	-.834	-.071	.058
11	.230	.859	.248	-.118	.018	-.224
12	.442	1.495	.229	-.353	.069	-.262
13	.615	1.995	.342	-.535	.153	-.226
14	.726	2.008	.835	-.839	.087	-.169
15	-.597	-3.412	.542	-1.195	-.109	.084
16	.245	.863	.205	-.127	.013	.077
17	.429	1.415	.170	-.352	.073	.052
18	.694	2.440	.487	-.506	.323	.143
19	.641	5.033	.259	-.919	.007	.082
20	3.843	6.502	-.339	-.981	-.527	.107
21	.245	.863	-.205	-.127	.013	-.077
22	.429	1.415	-.170	-.352	.073	-.052
23	.694	2.440	-.487	-.506	.323	-.143
24	.641	5.033	-.259	-.919	.007	-.082
25	3.843	6.502	.339	-.981	-.527	-.107
26	.230	.859	-.248	-.118	.018	.224
27	.442	1.495	-.229	-.353	.069	.262
28	.615	1.995	-.342	-.535	.153	.226
29	.726	2.008	-.835	-.839	.087	.169
30	-.597	-3.412	-.542	-1.195	-.109	-.084
31	-.025	-.061	-.344	-.115	.009	.089
32	.367	.664	-.324	-.355	.050	.161
33	.293	.638	-.364	-.532	.011	.127
34	.605	.453	-.183	-.739	.031	.071
35	-.410	-.516	.005	-.834	-.071	-.058
36	-.012	-.009	-.381	-.123	-.030	.043
37	-.070	-.059	-.356	-.359	-.035	.063
38	-.121	-.277	-.101	-.520	.014	.022
39	-.086	-.275	-.057	-.595	.003	.012
40	.085	.150	.019	-.607	-.030	-.045

INTERNAL MOMENTS (IN-KIPS) AND NORMAL FORCES (KIPS) IN BEAM ELEMENTS

EL	MB	NB
1	3229.5961	2.0748
2	7515.9131	4.7634
3	9822.2596	4.1686
4	11126.3535	3.0291
5	11521.4699	2.6838
6	4111.2003	22.7152
7	9917.4027	61.1117
8	13636.1312	94.6589
9	16616.5911	129.3566
10	18179.0059	148.8557
11	4111.2003	22.7152
12	9317.4027	61.1117
13	13636.1312	94.6589
14	16616.5911	129.3566
15	18179.0059	148.8557
16	3229.5961	2.0748
17	7515.9131	4.7634
18	9822.2596	4.1686
19	11126.3535	3.0291

20 11521.4699 2.6838

TOTAL ACCUMULATED STRESSES IN SLAB LAYERS
(STRESS IS IN KSI, ANGLES ARE IN DEGREES
+ = TENSION, - = COMPRESSION)

EL	LAYER	SXX	SYY	SXY	S1	S2	THETA1
1	1	-.01225	-.00009	-.04022	-.04685	.03451	40.70244
1	2	-.01382	-.00239	-.02554	-.03428	.01806	38.69185
1	3	-.02103	-.00707	-.01501	-.03061	.00250	32.53293
1	4	-.02035	-.00693	.00227	-.02072	-.00656	-9.35454
1	5	-.01369	-.00396	.01481	-.02442	.00676	-35.90268
1	6	-.01117	-.00124	.02960	-.03622	.02381	-40.23813
1	7	-.00000	-.02482	.00000	-.02482	.00000	-90.00000
1	8	-.17285	.00000	.00000	-.17285	.00000	.00000
1	9	-.15902	.00000	.00000	-.15902	.00000	.00000
1	10	-.00000	-.02482	.00000	-.02482	.00000	-90.00000
2	1	-.03844	.00136	-.03889	-.06222	.02515	31.45216
2	2	-.03818	-.00169	-.02615	-.05182	.01195	27.54781
2	3	-.05167	-.00609	-.01931	-.05875	.00098	20.13440
2	4	-.04980	-.00701	-.00399	-.05017	-.00665	5.27763
2	5	-.04788	-.00791	.01133	-.05087	-.00492	-14.77887
2	6	-.04618	-.00881	.02680	-.06017	.00518	-27.56047
2	7	.00000	.04828	-.00000	.04828	.00000	-90.00000
2	8	-.44849	.00000	.00000	-.44849	.00000	.00000
2	9	-.40234	.00000	.00000	-.40234	.00000	.00000
2	10	.00000	.00951	-.00000	.00951	.00000	-90.00000
3	1	-.05471	.02288	-.01154	-.05639	.02456	8.29405
3	2	-.05383	.01354	-.00789	-.05474	.01446	6.59343
3	3	-.07362	.00521	-.00611	-.07409	.00568	4.40904
3	4	-.07173	-.00410	-.00167	-.07177	-.00406	1.41109
3	5	-.07056	-.01333	.00274	-.07069	-.01320	-2.73304
3	6	-.06925	-.02255	.00715	-.07032	-.02148	-8.51023
3	7	.00000	.25774	-.00000	.25774	.00000	-90.00000
3	8	-.65971	.00000	.00000	-.65971	.00000	.00000
3	9	-.58987	.00000	.00000	-.58987	.00000	.00000
3	10	-.00000	-.03029	.00000	-.03029	.00000	-90.00000
4	1	-.06043	.02061	-.00582	-.06085	.02103	4.08635
4	2	-.07852	.01297	-.00552	-.07885	.01330	3.43964
4	3	-.08050	.00377	-.00306	-.08061	.00389	2.07482
4	4	-.07879	-.00552	-.00071	-.07880	-.00551	.55269
4	5	-.07740	-.01470	.00166	-.07744	-.01466	-1.51245
4	6	-.07586	-.02386	.00402	-.07617	-.02355	-4.39855

4	7	.00000	.25774	-.00000	.25774	-.00000	-90.00000
4	8	-.72174	.00000	.00000	-.72174	.00000	.00000
4	9	-.64697	.00000	.00000	-.64697	.00000	.00000
4	10	-.00000	-.03029	.00000	-.03029	.00000	-90.00000
5	1	-.08741	-.01747	.00771	-.08825	-.01663	-6.21548
5	2	-.08322	-.01261	.00700	-.08391	-.01192	-5.60857
5	3	-.07903	-.00775	.00630	-.07958	-.00720	-5.00852
5	4	-.07485	-.00290	.00559	-.07528	-.00247	-4.41574
5	5	-.07085	.00200	.00492	-.07118	.00233	-3.84481
5	6	-.06681	.00694	.00421	-.06705	.00718	-3.25673
5	7	.00000	.03324	-.00000	.03324	.00000	-90.00000
5	8	-.68977	.00000	.00000	-.68977	.00000	.00000
5	9	-.61937	.00000	.00000	-.61937	.00000	.00000
5	10	.00000	.15568	-.00000	.15568	.00000	-90.00000
6	1	-.01129	.00761	-.04369	-.04654	.04285	38.89763
6	2	-.01247	.00448	-.03058	-.03573	.02774	37.25615
6	3	-.01349	.00126	-.01752	-.02512	.01289	33.58486
6	4	-.01920	-.00245	-.00687	-.02166	.00001	19.69301
6	5	-.01833	-.00360	.00843	-.02216	.00023	-24.43679
6	6	-.01130	-.00124	.01883	-.02576	.01322	-37.52666
6	7	.00000	.03562	-.00000	.03562	-.00000	-90.00000
6	8	-.17748	.00000	.00000	-.17748	.00000	.00000
6	9	-.15292	.00000	.00000	-.15292	.00000	.00000
6	10	-.00000	-.00470	.00000	-.00470	.00000	-90.00000
7	1	-.07957	-.04983	-.05146	-.11826	-.01113	36.94250
7	2	-.06750	-.02804	-.03969	-.09209	-.00345	31.79046
7	3	-.05561	-.00620	-.02806	-.06829	.00648	24.31829
7	4	-.03114	.01550	-.01287	-.03445	.01881	14.44667
7	5	-.02269	.03686	-.00376	-.02293	.03710	3.59575
7	6	-.01384	.05880	.00598	-.01450	.05946	-5.43680
7	7	-.00000	-.13457	.00000	-.13457	.00000	-90.00000
7	8	-.51102	.00000	.00000	-.51102	.00000	.00000
7	9	-.34071	.00000	.00000	-.34071	.00000	.00000
7	10	.00000	.45445	-.00000	.45445	.00000	-90.00000
8	1	-.09446	-.05282	-.05097	-.12870	-.01858	33.89140
8	2	-.08717	-.03198	-.03728	-.10596	-.01319	26.74788
8	3	-.07979	-.01112	-.02357	-.08710	-.00381	17.23496
8	4	-.05221	.01118	-.00762	-.05312	.01208	6.75641
8	5	-.04726	.02963	.00309	-.04738	.02975	-2.29529
8	6	-.04166	.05101	.01481	-.04397	.05332	-8.86439
8	7	-.00000	-.13457	.00000	-.13457	.00000	-90.00000
8	8	-.69042	.00000	.00000	-.69042	.00000	.00000
8	9	-.62125	.00000	.00000	-.62125	.00000	.00000
8	10	.00000	.45445	-.00000	.45445	-.00000	-90.00000

9	1	-.14803	-.03620	-.02646	-.15398	-.03026	12.66093
9	2	-.12866	-.02123	-.01954	-.13211	-.01779	9.99736
9	3	-.10906	-.00616	-.01261	-.11059	-.00463	6.88292
9	4	-.08972	.00905	-.00572	-.09005	.00938	3.30197
9	5	-.05109	.02346	.00103	-.05111	.02348	-.78954
9	6	-.03699	.03885	.00680	-.03759	.03946	-5.08047
9	7	.00000	.03484	-.00000	.03484	.00000	-90.00000
9	8	-1.02354	.00000	.00000	-1.02354	.00000	.00000
9	9	-.66133	.00000	.00000	-.66133	.00000	.00000
9	10	.00000	.37394	-.00000	.37394	-.00000	-90.00000
10	1	-.07140	.03051	.00787	-.07200	.03111	-4.38976
10	2	-.08528	.01618	.00803	-.08592	.01681	-4.49729
10	3	-.10017	-.00109	.00801	-.10081	-.00044	-4.59492
10	4	-.11255	-.01863	.00771	-.11318	-.01801	-4.65943
10	5	-.12490	-.03622	.00740	-.12551	-.03561	-4.73580
10	6	-.13714	-.05371	.00707	-.13773	-.05312	-4.81344
10	7	.00000	.30321	-.00000	.30321	-.00000	-90.00000
10	8	-.82457	.00000	.00000	-.82457	.00000	.00000
10	9	-1.01880	.00000	.00000	-1.01880	.00000	.00000
10	10	-.00000	-.15729	.00000	-.15729	.00000	-90.00000
11	1	-.03384	-.07037	-.05460	.00223	-.11144	-36.94839
11	2	-.03037	-.04227	-.04559	.00966	-.08230	-41.28181
11	3	-.01396	-.00794	-.02866	-.03977	.01787	42.00555
11	4	-.00761	.01595	-.02352	-.02213	.03047	31.69674
11	5	-.00240	.04229	-.01727	-.00829	.04819	18.84393
11	6	.00329	.07028	-.00925	.00203	.07154	7.71586
11	7	-.00000	-.32692	.00000	-.32692	.00000	-90.00000
11	8	-.18141	.00000	.00000	-.18141	.00000	.00000
11	9	-.11893	.00000	.00000	-.11893	.00000	.00000
11	10	.00000	.47632	-.00000	.47632	.00000	-90.00000
12	1	-.08651	-.11568	-.05617	-.04306	-.15913	-37.72348
12	2	-.07150	-.06712	-.04820	-.11756	-.02106	43.69779
12	3	-.05636	-.01831	-.04033	-.08193	.00726	32.37328
12	4	-.02833	.03143	-.02690	-.03865	.04175	20.99732
12	5	-.01770	.07905	-.02221	-.02255	.08390	12.33305
12	6	-.00727	.12779	-.01573	-.00907	.12960	6.55627
12	7	-.00000	-.47796	.00000	-.47796	.00000	-90.00000
12	8	-.48468	.00000	.00000	-.48468	.00000	.00000
12	9	-.36430	.00000	.00000	-.36430	.00000	.00000
12	10	.00000	.91052	-.00000	.91052	.00000	-90.00000
13	1	-.12587	-.14682	-.06187	-.07359	-.19909	-40.19415
13	2	-.10522	-.08215	-.04950	-.14451	-.04285	38.44306
13	3	-.08414	-.01718	-.03595	-.10052	-.00080	23.91060
13	4	-.04517	.04765	-.02049	-.04949	.05137	11.91035
13	5	-.03024	.11261	-.01139	-.03114	.11351	4.53090

13	6	-.01518	.17819	-.00044	-.01518	.17819	.13087
13	7	-.00000	-.55767	.00000	-.55767	.00000	-90.00000
13	8	-.74366	.00000	.00000	-.74366	.00000	.00000
13	9	-.56526	.00000	.00000	-.56526	.00000	.00000
13	10	.00000	1.29226	-.00000	1.29226	.00000	-90.00000
14	1	-.17391	-.15637	-.10023	-.26575	-.06453	42.59070
14	2	-.15185	-.09143	-.06874	-.19673	-.04655	33.13826
14	3	-.12934	-.02625	-.03702	-.14125	-.01433	17.84380
14	4	-.07753	.03769	-.00399	-.07767	.03782	1.97567
14	5	-.06072	.10431	.02261	-.06376	.10735	-7.66154
14	6	-.04269	.17153	.05211	-.05469	.18353	-12.97107
14	7	-.00000	-.55767	.00000	-.55767	.00000	-90.00000
14	8	-1.12860	.00000	.00000	-1.12860	.00000	.00000
14	9	-.91962	.00000	.00000	-.91962	.00000	.00000
14	10	.00000	1.29226	-.00000	1.29226	-.00000	-90.00000
15	1	-.10902	.26350	-.03757	-.11277	.26725	5.70259
15	2	-.11603	.15136	-.01797	-.11723	.15256	3.82663
15	3	-.12265	.04029	-.00022	-.12265	.04029	.07747
15	4	-.17805	-.06962	.02030	-.18172	-.06594	-10.26258
15	5	-.18604	-.18066	.04103	-.22447	-.14223	-43.12297
15	6	-.19402	-.29149	.06170	-.16413	-.32139	25.84882
15	7	.00000	1.66967	-.00000	1.66967	.00000	-90.00000
15	8	-1.61487	.00000	.00000	-1.61487	.00000	.00000
15	9	-1.31463	.00000	.00000	-1.31463	.00000	.00000
15	10	-.00000	-1.68863	.00000	-1.68863	-.00000	-90.00000
16	1	-.03877	-.06971	-.00851	-.03658	-.07190	-14.40918
16	2	-.03038	-.04167	-.00072	-.03033	-.04172	-3.63287
16	3	-.02197	-.01361	.00708	-.02601	-.00957	-29.71173
16	4	-.00890	.01514	.01275	-.01440	.02064	-23.34753
16	5	-.00172	.04297	.02123	-.01020	.05145	-21.76640
16	6	.00539	.07091	.02963	-.00603	.08233	-21.06302
16	7	-.00000	-.32014	.00000	-.32014	-.00000	-90.00000
16	8	-.18141	.00000	.00000	-.18141	.00000	.00000
16	9	-.11893	.00000	.00000	-.11893	.00000	.00000
16	10	.00000	.48090	-.00000	.48090	.00000	-90.00000
17	1	-.08491	-.10839	-.00870	-.08204	-.11126	-18.26424
17	2	-.07045	-.06242	-.00222	-.07102	-.06185	14.44665
17	3	-.05594	-.01635	.00427	-.05640	-.01590	-6.09310
17	4	-.02963	.02941	.00893	-.03096	.03074	-8.41701
17	5	-.01861	.07585	.01592	-.02122	.07846	-9.31407
17	6	-.00755	.12224	.02301	-.01151	.12620	-9.76260
17	7	-.00000	-.43891	.00000	-.43891	.00000	-90.00000
17	8	-.48468	.00000	.00000	-.48468	.00000	.00000
17	9	-.36430	.00000	.00000	-.36430	.00000	.00000
17	10	.00000	.87461	-.00000	.87461	.00000	-90.00000

18	1	-.12883	-.16245	-.02578	-.11486	-.17642	-28.44961
18	2	-.10540	-.08359	-.00721	-.10757	-.08142	16.73123
18	3	-.08178	-.00445	.01142	-.08343	-.00280	-8.22613
18	4	-.04091	.07361	.02593	-.04650	.07921	-12.18233
18	5	-.02214	.15433	.04516	-.03303	.16521	-13.55103
18	6	-.00321	.23456	.06467	-.01966	.25101	-14.27232
18	7	-.00000	-.57691	.00000	-.57691	-.00000	-90.00000
18	8	-.74366	.00000	.00000	-.74366	.00000	.00000
18	9	-.56526	.00000	.00000	-.56526	.00000	.00000
18	10	.00000	1.69241	-.00000	1.69241	-.00000	-90.00000
19	1	-.19408	-.50665	-.01983	-.19295	-.50778	-3.43548
19	2	-.15986	-.26574	-.00398	-.15971	-.26588	-2.14776
19	3	-.12519	-.02210	.01100	-.12636	-.02094	-6.02359
19	4	-.06390	.21978	.02362	-.06585	.22174	-4.72621
19	5	-.06676	.25998	.02856	-.06924	.26246	-4.95866
19	6	-.08184	.19844	.02533	-.08411	.20071	-5.12370
19	7	-.00000	-2.14815	.00000	-2.14815	.00000	-90.00000
19	8	-.98406	.00000	.00000	-.98406	.00000	.00000
19	9	-1.26378	.00000	.00000	-1.26378	.00000	.00000
19	10	.00000	5.09957	-.00000	5.09957	-.00000	-90.00000
20	1	-.50233	-.76419	.05791	-.49010	-.77643	11.93038
20	2	-.34533	-.41778	.03515	-.33108	-.43203	22.06670
20	3	-.18086	-.05925	.01181	-.18199	-.05811	-5.49659
20	4	-.00681	.30536	-.01184	-.00725	.30581	2.16883
20	5	.08577	.22857	-.01157	.08484	.22950	4.60176
20	6	.17709	.13512	.00385	.17744	.13477	5.19531
20	7	-.00000	-3.23258	.00000	-3.23258	-.00000	-90.00000
20	8	-1.98653	.00000	.00000	-1.98653	.00000	.00000
20	9	.19603	.00000	.00000	.19603	.00000	.00000
20	10	.00000	6.87269	-.00000	6.87269	.00000	-90.00000
21	1	-.03877	-.06971	.00851	-.03658	-.07190	14.40918
21	2	-.03038	-.04167	.00072	-.03033	-.04172	3.63287
21	3	-.02197	-.01361	-.00708	-.02601	-.00957	29.71173
21	4	-.00890	.01514	-.01275	-.01440	.02064	23.34753
21	5	-.00172	.04297	-.02123	-.01020	.05145	21.75640
21	6	.00538	.07091	-.02963	-.00603	.08233	21.06302
21	7	-.00000	-.32014	.00000	-.32014	.00000	-90.00000
21	8	-.18141	.00000	.00000	-.18141	.00000	.00000
21	9	-.11893	.00000	.00000	-.11893	.00000	.00000
21	10	.00000	.48090	-.00000	.48090	-.00000	-90.00000
22	1	-.08491	-.10839	.00870	-.08204	-.11126	18.26424
22	2	-.07045	-.06242	.00222	-.07102	-.06185	-14.44665
22	3	-.05594	-.01635	-.00427	-.05640	-.01590	6.09310
22	4	-.02963	.02941	-.00393	-.03096	.03074	8.41701

22	5	-.01861	.07585	-.01592	-.02122	.07846	9.31407
22	6	-.00755	.12224	-.02301	-.01151	.12620	9.76260
22	7	-.00000	-.43891	.00000	-.43891	.00000	-90.00000
22	8	-.48468	.00000	.00000	-.48468	.00000	.00000
22	9	-.36430	.00000	.00000	-.36430	.00000	.00000
22	10	.00000	.87461	-.00000	.87461	-.00000	-90.00000
23	1	-.12883	-.16245	.02578	-.11486	-.17642	28.44961
23	2	-.10540	-.08359	.00721	-.10757	-.08142	-16.73123
23	3	-.08178	-.00445	-.01142	-.08343	-.00280	8.22613
23	4	-.04091	.07361	-.02593	-.04650	.07921	12.18233
23	5	-.02214	.15433	-.04516	-.03303	.16521	13.55103
23	6	-.00321	.23456	-.06467	-.01966	.25101	14.27232
23	7	-.00000	-.57691	.00000	-.57691	.00000	-90.00000
23	8	-.74366	.00000	.00000	-.74366	.00000	.00000
23	9	-.56526	.00000	.00000	-.56526	.00000	.00000
23	10	.00000	1.69241	-.00000	1.69241	.00000	-90.00000
24	1	-.19408	-.50665	.01883	-.19295	-.50778	3.43548
24	2	-.15986	-.26574	.00399	-.15971	-.26588	2.14776
24	3	-.12519	-.02210	-.01100	-.12636	-.02094	6.02359
24	4	-.06390	.21978	-.02362	-.06585	.22174	4.72621
24	5	-.06676	.25998	-.02856	-.06924	.26246	4.95866
24	6	-.08184	.19844	-.02533	-.08411	.20071	5.12370
24	7	-.00000	-2.14815	.00000	-2.14815	.00000	-90.00000
24	8	-.98406	.00000	.00000	-.98406	.00000	.00000
24	9	-1.26378	.00000	.00000	-1.26378	.00000	.00000
24	10	.00000	5.09957	-.00000	5.09957	-.00000	-90.00000
25	1	-.50233	-.76419	-.05791	-.49010	-.77643	-11.93038
25	2	-.34533	-.41778	-.03515	-.33108	-.43203	-22.06670
25	3	-.18086	-.05925	-.01181	-.18199	-.05811	5.49659
25	4	-.00681	.30536	.01184	-.00725	.30581	-2.16883
25	5	.08577	.22857	.01157	.08484	.22950	-4.60176
25	6	.17709	.13512	-.00385	.17744	.13477	-5.19531
25	7	-.00000	-3.23258	.00000	-3.23258	.00000	-90.00000
25	8	-1.98653	.00000	.00000	-1.98653	.00000	.00000
25	9	.19603	.00000	.00000	.19603	.00000	.00000
25	10	.00000	6.87269	-.00000	6.87269	-.00000	-90.00000
26	1	-.03884	-.07037	.05460	.00223	-.11144	36.94839
26	2	-.03037	-.04227	.04559	.00966	-.08230	41.28181
26	3	-.01396	-.00794	.02866	-.03977	.01787	-42.00555
26	4	-.00761	.01595	.02352	-.02213	.03047	-31.69674
26	5	-.00240	.04229	.01727	-.00829	.04819	-18.84393
26	6	.00329	.07028	.00925	.00203	.07154	-7.71586
26	7	-.00000	-.32692	.00000	-.32692	.00000	-90.00000
26	8	-.18141	.00000	.00000	-.18141	.00000	.00000
26	9	-.11893	.00000	.00000	-.11893	.00000	.00000
26	10	.00000	.47632	-.00000	.47632	.00000	-90.00000

27	1	-.08651	-.11568	.05617	-.04306	-.15913	37.72348
27	2	-.07150	-.06712	.04820	-.11756	-.02106	-43.69779
27	3	-.05636	-.01831	.04033	-.08193	.00726	-32.37328
27	4	-.02833	.03143	.02690	-.03865	.04175	-20.99732
27	5	-.01770	.07905	.02221	-.02255	.08390	-12.33305
27	6	-.00727	.12779	.01573	-.00907	.12960	-6.55627
27	7	-.00000	-.47796	.00000	-.47796	.00000	-90.00000
27	8	-.48468	.00000	.00000	-.48468	.00000	.00000
27	9	-.36430	.00000	.00000	-.36430	.00000	.00000
27	10	.00000	.91052	-.00000	.91052	-.00000	-90.00000
28	1	-.12587	-.14682	.06187	-.07359	-.19909	40.19415
28	2	-.10522	-.08215	.04950	-.14451	-.04285	-38.44306
28	3	-.08414	-.01718	.03695	-.10052	-.00030	-23.91060
28	4	-.04517	.04765	.02049	-.04949	.05197	-11.91035
28	5	-.03024	.11261	.01139	-.03114	.11351	-4.53090
28	6	-.01518	.17819	.00044	-.01518	.17819	-.13087
28	7	-.00000	-.55767	.00000	-.55767	-.00000	-90.00000
28	8	-.74366	.00000	.00000	-.74366	.00000	.00000
28	9	-.56526	.00000	.00000	-.56526	.00000	.00000
28	10	.00000	1.29226	-.00000	1.29226	.00000	-90.00000
29	1	-.17391	-.15637	.10023	-.26575	-.06453	-42.50070
29	2	-.15105	-.09143	.06874	-.19673	-.04655	-33.13826
29	3	-.12934	-.02625	.03702	-.14125	-.01433	-17.84380
29	4	-.07753	.03769	.00398	-.07767	.03782	-1.97567
29	5	-.06072	.10431	-.02261	-.06376	.10735	7.56154
29	6	-.04269	.17153	-.05211	-.05469	.18353	12.97107
29	7	-.00000	-.55767	.00000	-.55767	.00000	-90.00000
29	8	-1.12860	.00000	.00000	-1.12860	.00000	.00000
29	9	-.91962	.00000	.00000	-.91962	.00000	.00000
29	10	.00000	1.29226	-.00000	1.29226	.00000	-90.00000
30	1	-.10902	.26350	.03757	-.11277	.26725	-5.70259
30	2	-.11603	.15136	.01797	-.11723	.15256	-3.82663
30	3	-.12265	.04029	.00022	-.12265	.04029	-.07747
30	4	-.17805	-.06962	-.02030	-.18172	-.06594	10.26258
30	5	-.18604	-.18066	-.04103	-.22447	-.14223	43.12297
30	6	-.19402	-.29149	-.06170	-.16413	-.32139	-25.84882
30	7	.00000	1.66967	-.00000	1.66967	.00000	-90.00000
30	8	-1.61487	.00000	.00000	-1.61487	.00000	.00000
30	9	-1.31463	.00000	.00000	-1.31463	.00000	.00000
30	10	-.00000	-1.68863	.00000	-1.68863	.00000	-90.00000
31	1	-.01129	.00761	.04369	-.04654	.04285	-38.89763
31	2	-.01247	.00448	.03058	-.03573	.02774	-37.25615
31	3	-.01349	.00126	.01752	-.02512	.01289	-33.58486

31	5	-.01833	-.00360	-.00843	-.02216	.00023	24.43679
31	6	-.01130	-.00124	-.01883	-.02576	.01322	37.52666
31	7	.00000	.03562	-.00000	.03562	.00000	-90.00000
31	8	-.17748	.00000	.00000	-.17748	.00000	.00000
31	9	-.15292	.00000	.00000	-.15292	.00000	.00000
31	10	-.00000	-.00470	.00000	-.00470	-.00000	-90.00000
32	1	-.07957	-.04983	.05146	-.11826	-.01113	-36.94250
32	2	-.06750	-.02804	.03959	-.09209	-.00345	-31.78046
32	3	-.05561	-.00620	.02806	-.06829	.00648	-24.31829
32	4	-.03114	.01550	.01287	-.03445	.01881	-14.44667
32	5	-.02269	.03686	.00376	-.02293	.03710	-3.59575
32	6	-.01384	.05880	-.00698	-.01450	.05946	5.43680
32	7	-.00000	-.13457	.00000	-.13457	.00000	-90.00000
32	8	-.51102	.00000	.00000	-.51102	.00000	.00000
32	9	-.34071	.00000	.00000	-.34071	.00000	.00000
32	10	.00000	.45445	-.00000	.45445	.00000	-90.00000
33	1	-.09446	-.05282	.05097	-.12870	-.01858	-33.89140
33	2	-.08717	-.03198	.03728	-.10596	-.01319	-26.74788
33	3	-.07979	-.01112	.02357	-.08710	-.00381	-17.23496
33	4	-.05221	.01118	.00762	-.05312	.01208	-6.75641
33	5	-.04726	.02963	-.00309	-.04738	.02975	2.29529
33	6	-.04165	.05101	-.01481	-.04397	.05332	8.86439
33	7	-.00000	-.13457	.00000	-.13457	.00000	-90.00000
33	8	-.69042	.00000	.00000	-.69042	.00000	.00000
33	9	-.62125	.00000	.00000	-.62125	.00000	.00000
33	10	.00000	.45445	-.00000	.45445	.00000	-90.00000
34	1	-.14803	-.03620	.02646	-.15398	-.03026	-12.66093
34	2	-.12866	-.02123	.01954	-.13211	-.01779	-9.99736
34	3	-.10906	-.00616	.01261	-.11059	-.00463	-6.88292
34	4	-.08972	.00905	.00572	-.09005	.00938	-3.30197
34	5	-.05109	.02346	-.00103	-.05111	.02348	.78954
34	6	-.03699	.03685	-.00680	-.03759	.03946	5.08047
34	7	.00000	.03484	-.00000	.03484	.00000	-90.00000
34	8	-1.02354	.00000	.00000	-1.02354	.00000	.00000
34	9	-.66133	.00000	.00000	-.66133	.00000	.00000
34	10	.00000	.37394	-.00000	.37394	.00000	-90.00000
35	1	-.07140	.03051	-.00787	-.07200	.03111	4.38976
35	2	-.08529	.01618	-.00803	-.08592	.01681	4.49729
35	3	-.10017	-.00109	-.00801	-.10081	-.00044	4.59492
35	4	-.11255	-.01863	-.00771	-.11318	-.01801	4.65943
35	5	-.12490	-.03622	-.00740	-.12551	-.03561	4.73580
35	6	-.13714	-.05371	-.00707	-.13773	-.05312	4.81343
35	7	.00000	.30321	-.00000	.30321	-.00000	-90.00000
35	8	-.82457	.00000	.00000	-.82457	.00000	.00000
35	9	-1.01880	.00000	.00000	-1.01880	.00000	.00000

35	10	-.00000	-.15729	.00000	-.15729	-.00000	-90.00000
36	1	-.01225	-.00009	.04022	-.04685	.03451	-40.70244
36	2	-.01382	-.00239	.02554	-.03428	.01806	-38.69185
36	3	-.02103	-.00707	.01501	-.03061	.00250	-32.53293
36	4	-.02035	-.00693	-.00227	-.02072	-.00656	9.35454
36	5	-.01369	-.00396	-.01481	-.02442	.00676	35.90268
36	6	-.01117	-.00124	-.02960	-.03622	.02381	40.23813
36	7	-.00000	-.02482	.00000	-.02482	.00000	-90.00000
36	8	-.17285	.00000	.00000	-.17285	.00000	.00000
36	9	-.15902	.00000	.00000	-.15902	.00000	.00000
36	10	-.00000	-.02482	.00000	-.02482	.00000	-90.00000
37	1	-.03844	.00136	.03889	-.06222	.02515	-31.45216
37	2	-.03818	-.00169	.02615	-.05182	.01195	-27.54781
37	3	-.05167	-.00609	.01931	-.05875	.00098	-20.13440
37	4	-.04980	-.00761	.00399	-.05017	-.00665	-5.27763
37	5	-.04788	-.00791	-.01133	-.05087	-.00492	14.77887
37	6	-.04618	-.00881	-.02680	-.06017	.00518	27.56047
37	7	.00000	.04828	-.00000	.04828	-.00000	-90.00000
37	8	-.44849	.00000	.00000	-.44849	.00000	.00000
37	9	-.40234	.00000	.00000	-.40234	.00000	.00000
37	10	.00000	.00951	-.00000	.00951	.00000	-90.00000
38	1	-.05471	.02288	.01154	-.05639	.02456	-8.28405
38	2	-.05383	.01354	.00789	-.05474	.01446	-6.59343
38	3	-.07362	.00521	.00611	-.07409	.00568	-4.40904
38	4	-.07173	-.00410	.00167	-.07177	-.00406	-1.41109
38	5	-.07056	-.01333	-.00274	-.07069	-.01320	2.73304
38	6	-.06925	-.02255	-.00715	-.07032	-.02148	8.51023
38	7	.00000	.25774	-.00000	.25774	-.00000	-90.00000
38	8	-.65971	.00000	.00000	-.65971	.00000	.00000
38	9	-.58387	.00000	.00000	-.58987	.00000	.00000
38	10	-.00000	-.03029	.00000	-.03029	.00000	-90.00000
39	1	-.06043	.02061	.00582	-.06085	.02103	-4.08635
39	2	-.07852	.01297	.00552	-.07885	.01330	-3.43964
39	3	-.08050	.00377	.00306	-.08061	.00389	-2.07482
39	4	-.07879	-.00552	.00071	-.07880	-.00551	-.55269
39	5	-.07740	-.01470	-.00166	-.07744	-.01466	1.51245
39	6	-.07586	-.02386	-.00402	-.07617	-.02355	4.39855
39	7	.00000	.25774	-.00000	.25774	.00000	-90.00000
39	8	-.72174	.00000	.00000	-.72174	.00000	.00000
39	9	-.64697	.00000	.00000	-.64697	.00000	.00000
39	10	-.00000	-.03029	.00000	-.03029	.00000	-90.00000
40	1	-.08741	-.01747	-.00771	-.08825	-.01663	6.21548
40	2	-.08322	-.01261	-.00700	-.08391	-.01192	5.60857

40	3	-.07903	-.00775	-.00630	-.07958	-.00720	5.09852
40	4	-.07485	-.00290	-.00559	-.07528	-.00247	4.41574
40	5	-.07085	.00200	-.00492	-.07118	.00233	3.84481
40	6	-.06681	.00694	-.00421	-.06705	.00718	3.25673
40	7	.00000	.03324	-.00000	.03324	-.00000	-90.00000
40	8	-.68977	.00000	.00000	-.68977	.00000	.00000
40	9	-.61937	.00000	.00000	-.61937	.00000	.00000
40	10	.00000	.15568	-.00000	.15568	.00000	-90.00000

TOTAL ACCUMULATED STRESSES IN BEAM LAYERS
(STRESS IS IN KSI, + = TENSION, - = COMPRESSION)

BEAM ELEMENT/ LAYER =	1	2	3	4	5	6	7	8	9	10	11
1	-.302	-.439	-.611	-.826	-1.118	-1.350	-1.522	-1.668	-1.787	-1.881	134.957
2	-.929	-.970	-1.021	-1.085	-1.172	-1.241	-1.292	-1.336	-1.372	-1.400	136.535
3	-1.278	-1.266	-1.250	-1.231	-1.205	-1.184	-1.169	-1.155	-1.145	-1.136	137.388
4	-1.481	-1.438	-1.384	-1.316	-1.225	-1.152	-1.098	-1.052	-1.015	-.985	137.873
5	-1.542	-1.490	-1.424	-1.342	-1.231	-1.142	-1.077	-1.021	-.975	-.939	138.020
6	-.311	-.443	-.607	-.814	-1.094	-1.316	-1.481	-1.621	-1.736	-1.826	135.222
7	-.952	-.978	-1.011	-1.051	-1.106	-1.149	-1.182	-1.209	-1.232	-1.249	137.255
8	-1.310	-1.274	-1.229	-1.174	-1.098	-1.037	-.993	-.955	-.924	-.899	138.529
9	-1.550	-1.470	-1.371	-1.247	-1.078	-.943	-.844	-.759	-.690	-.635	139.527
10	-1.667	-1.566	-1.439	-1.280	-1.065	-.893	-.766	-.658	-.570	-.590	140.046

11	-.311 135.222	-.443	-.607	-.814	-1.094	-1.316	-1.481	-1.621	-1.736	-1.826
12	-.952 137.255	-.978	-1.011	-1.051	-1.106	-1.149	-1.182	-1.209	-1.232	-1.249
13	-1.310 138.523	-1.274	-1.229	-1.174	-1.098	-1.037	-.993	-.955	-.924	-.899
14	-1.550 139.527	-1.470	-1.371	-1.247	-1.078	-.943	-.844	-.759	-.690	-.635
15	-1.667 140.046	-1.566	-1.439	-1.280	-1.065	-.893	-.766	-.658	-.570	-.500
16	-.302 134.957	-.439	-.611	-.826	-1.118	-1.350	-1.522	-1.668	-1.787	-1.881
17	-.929 136.535	-.970	-1.021	-1.085	-1.172	-1.241	-1.292	-1.336	-1.372	-1.400
18	-1.278 137.388	-1.266	-1.250	-1.231	-1.205	-1.194	-1.169	-1.155	-1.145	-1.136
19	-1.481 137.873	-1.438	-1.384	-1.316	-1.225	-1.152	-1.098	-1.052	-1.015	-.985
20	-1.542 138.020	-1.490	-1.424	-1.342	-1.231	-1.142	-1.077	-1.021	-.975	-.939

TOTAL NORMAL, SHEAR, AND PRINCIPAL STRESSES IN BEAM
(STRESS IS IN KSI, ANGLES ARE IN DEGREES
+ = TENSION, - = COMPRESSION)

BEAM ELEMENT	SHEAR STRESS (KSI) AT TOP
1	-.0021
2	-.0011
3	.0002
4	.0003
5	.0002
6	-.0211
7	-.0219

8	-.0230
9	-.0204
10	-.0175
11	-.0211
12	-.0219
13	-.0230
14	-.0204
15	-.0175
16	-.0021
17	-.0011
18	.0002
19	.0003
20	.0002

N	ML	SXX	SZZ	SXZ	S1	S2	THETA1
1	1	-.30167	.00000	-.00740	-.30185	.00018	1.40341
1	2	-.43919	.00000	-.02853	-.44104	.00185	3.70079
1	3	-.61110	.00000	-.06830	-.61864	.00754	6.29978
1	4	-.82598	.00000	-.13415	-.84722	.02124	8.99780
1	5	-1.11820	.00000	-.14682	-1.13716	.01896	7.35686
1	6	-1.35020	.00000	-.09674	-1.35709	.00690	4.07745
1	7	-1.52192	.00000	-.05102	-1.52363	.00171	1.91806
1	8	-1.66767	.00000	-.02855	-1.66816	.00049	.98054
1	9	-1.78744	.00000	-.01610	-1.78759	.00014	.51588
1	10	-1.88127	.00000	-.00458	-1.88128	.00001	.13961
1	11	134.95694	.00000	.00000	134.95694	.00000	.00000
2	1	-.92878	.00000	-.00558	-.92881	.00003	.34428
2	2	-.96976	.00000	-.02352	-.97033	.00057	1.38826
2	3	-1.02099	.00000	-.05701	-1.02416	.00317	3.19620
2	4	-1.08503	.00000	-.11237	-1.09654	.01151	5.85085
2	5	-1.17210	.00000	-.12322	-1.18492	.01281	5.93701
2	6	-1.24125	.00000	-.08128	-1.24655	.00530	3.73058
2	7	-1.29245	.00000	-.04290	-1.29388	.00142	1.89907
2	8	-1.33597	.00000	-.02403	-1.33640	.00043	1.03028
2	9	-1.37180	.00000	-.01356	-1.37193	.00013	.55616
2	10	-1.39995	.00000	-.00386	-1.39996	.00001	.15810
2	11	136.53468	.00000	.00000	136.53468	.00000	.00000
3	1	-1.27827	.00000	-.00271	-1.27828	.00001	.12153
3	2	-1.26590	.00000	-.01435	-1.26607	.00016	.64938
3	3	-1.25044	.00000	-.03575	-1.25147	.00102	1.63647
3	4	-1.23112	.00000	-.07097	-1.23519	.00408	3.29837
3	5	-1.20483	.00000	-.07815	-1.20988	.00505	3.69598
3	6	-1.18396	.00000	-.05166	-1.18621	.00225	2.49387
3	7	-1.16850	.00000	-.02731	-1.16914	.00064	1.33817
3	8	-1.15536	.00000	-.01533	-1.15556	.00020	.76028
3	9	-1.14454	.00000	-.00866	-1.14460	.00007	.43349
3	10	-1.13603	.00000	-.00247	-1.13604	.00001	.12457
3	11	137.38809	.00000	.00000	137.38809	.00000	.00000

4	1	-1.48065	.00000	-.00116	-1.48065	.00000	.04497
4	2	-1.43757	.00000	-.00716	-1.43760	.00004	.28524
4	3	-1.38370	.00000	-.01810	-1.38394	.00024	.74913
4	4	-1.31637	.00000	-.03605	-1.31736	.00099	1.56768
4	5	-1.22478	.00000	-.03979	-1.22607	.00129	1.85880
4	6	-1.15205	.00000	-.02633	-1.15265	.00060	1.31872
4	7	-1.09817	.00000	-.01393	-1.09834	.00018	.72665
4	8	-1.05237	.00000	-.00783	-1.05243	.00006	.42625
4	9	-1.01465	.00000	-.00442	-1.01467	.00002	.24980
4	10	-.98501	.00000	-.00126	-.98502	.00000	.07341
4	11	137.87287	.00000	.00000	137.87287	.00000	.00000
5	1	-1.54195	.00000	-.00067	-1.54195	.00000	.02484
5	2	-1.48957	.00000	-.00412	-1.48958	.00001	.15840
5	3	-1.42408	.00000	-.01041	-1.42416	.00008	.41892
5	4	-1.34221	.00000	-.02075	-1.34253	.00032	.88537
5	5	-1.23084	.00000	-.02290	-1.23126	.00043	1.06544
5	6	-1.14238	.00000	-.01515	-1.14258	.00020	.75988
5	7	-1.07686	.00000	-.00802	-1.07692	.00006	.42652
5	8	-1.02116	.00000	-.00451	-1.02118	.00002	.25282
5	9	-.97529	.00000	-.00255	-.97530	.00001	.14957
5	10	-.93925	.00000	-.00073	-.93925	.00000	.04431
5	11	138.01974	.00000	.00000	138.01974	.00000	.00000
6	1	-.31065	.00000	-.02643	-.31288	.00223	4.82814
6	2	-.44257	.00000	-.04785	-.44768	.00511	6.10036
6	3	-.60747	.00000	-.09512	-.62201	.01455	8.69437
6	4	-.81359	.00000	-.17665	-.85029	.03670	11.73636
6	5	-1.09391	.00000	-.18674	-1.12491	.03100	9.42519
6	6	-1.31645	.00000	-.12083	-1.32745	.01100	5.20102
6	7	-1.48118	.00000	-.06298	-1.48385	.00267	2.43032
6	8	-1.62101	.00000	-.03465	-1.62175	.00074	1.22437
6	9	-1.73592	.00000	-.01939	-1.73613	.00022	.63984
6	10	-1.82595	.00000	-.00549	-1.82597	.00002	.17232
6	11	135.22176	.00000	.00000	135.22176	.00000	.00000
7	1	-.95245	.00000	-.02644	-.95318	.00073	1.58861
7	2	-.97827	.00000	-.04456	-.98030	.00203	2.60234
7	3	-1.01055	.00000	-.08605	-1.01783	.00727	4.83237
7	4	-1.05090	.00000	-.15821	-1.07420	.02330	8.37837
7	5	-1.10577	.00000	-.16615	-1.13020	.02443	8.36337
7	6	-1.14934	.00000	-.10714	-1.15924	.00990	5.28042
7	7	-1.18160	.00000	-.05571	-1.18422	.00262	2.69364
7	8	-1.20902	.00000	-.03057	-1.20979	.00077	1.44733
7	9	-1.23159	.00000	-.01707	-1.23183	.00024	.79410
7	10	-1.24932	.00000	-.00483	-1.24934	.00002	.22156
7	11	137.25505	.00000	.00000	137.25505	.00000	.00000

8	1	-1.30986	.00000	-.02612	-1.31039	.00052	1.14203
8	2	-1.27414	.00000	-.03846	-1.27530	.00116	1.72740
8	3	-1.22948	.00000	-.06970	-1.23342	.00394	3.23444
8	4	-1.17365	.00000	-.12518	-1.18686	.01320	6.02102
8	5	-1.09773	.00000	-.12942	-1.11278	.01505	6.63383
8	6	-1.03744	.00000	-.08274	-1.04399	.00656	4.53132
8	7	-.99278	.00000	-.04278	-.99462	.00184	2.46282
8	8	-.95481	.00000	-.02328	-.95538	.00057	1.39587
8	9	-.92355	.00000	-.01295	-.92373	.00018	.80345
8	10	-.89899	.00000	-.00366	-.89900	.00001	.23298
8	11	138.52907	.00000	.00000	138.52907	.00000	.00000
9	1	-1.54962	.00000	-.02243	-1.54995	.00032	.82924
9	2	-1.47014	.00000	-.03058	-1.47077	.00064	1.19105
9	3	-1.37076	.00000	-.05311	-1.37282	.00205	2.21558
9	4	-1.24653	.00000	-.09379	-1.25355	.00702	4.27894
9	5	-1.07755	.00000	-.09583	-1.08601	.00846	5.04299
9	6	-.94336	.00000	-.06087	-.94727	.00391	3.67648
9	7	-.84395	.00000	-.03133	-.84511	.00116	2.12308
9	8	-.75945	.00000	-.01694	-.75983	.00038	1.27704
9	9	-.68986	.00000	-.00940	-.68999	.00013	.79012
9	10	-.63518	.00000	-.00265	-.63520	.00001	.23860
9	11	139.52694	.00000	.00000	139.52694	.00000	.00000
10	1	-1.66747	.00000	-.01907	-1.66768	.00022	.65499
10	2	-1.56599	.00000	-.02550	-1.56640	.00042	.93266
10	3	-1.43910	.00000	-.04380	-1.44043	.00133	1.74157
10	4	-1.28046	.00000	-.07698	-1.28507	.00461	3.42832
10	5	-1.06467	.00000	-.07841	-1.07042	.00574	4.18928
10	6	-.89330	.00000	-.04970	-.89606	.00276	3.17496
10	7	-.76635	.00000	-.02555	-.76720	.00085	1.90752
10	8	-.65844	.00000	-.01379	-.65873	.00029	1.19913
10	9	-.56957	.00000	-.00764	-.56967	.00010	.76847
10	10	-.49975	.00000	-.00215	-.49975	.00001	.24647
10	11	140.04616	.00000	.00000	140.04616	.00000	.00000
11	1	-.31065	.00000	-.02643	-.31288	.00223	4.82814
11	2	-.44257	.00000	-.04785	-.44768	.00511	6.10036
11	3	-.60747	.00000	-.09512	-.62201	.01455	8.69437
11	4	-.81359	.00000	-.17665	-.85029	.03670	11.73636
11	5	-1.09391	.00000	-.18674	-1.12491	.03100	9.42519
11	6	-1.31645	.00000	-.12083	-1.32745	.01100	5.20102
11	7	-1.48118	.00000	-.06298	-1.48385	.00267	2.43032
11	8	-1.62101	.00000	-.03466	-1.62175	.00074	1.22437
11	9	-1.73592	.00000	-.01939	-1.73613	.00022	.63984
11	10	-1.82595	.00000	-.00549	-1.82597	.00002	.17232
11	11	135.22176	.00000	.00000	135.22176	.00000	.00000
12	1	-.95245	.00000	-.02644	-.95318	.00073	1.58861

12	2	-.97827	.00000	-.04456	-.98030	.00203	2.60234
12	3	-1.01055	.00000	-.08605	-1.01783	.00727	4.83237
12	4	-1.05090	.00000	-.15821	-1.07420	.02330	8.37837
12	5	-1.10577	.00000	-.16615	-1.13020	.02443	6.36337
12	6	-1.14934	.00000	-.10714	-1.15924	.00990	5.28042
12	7	-1.18160	.00000	-.05571	-1.18422	.00262	2.69364
12	8	-1.20902	.00000	-.03057	-1.20979	.00077	1.44733
12	9	-1.23159	.00000	-.01707	-1.23183	.00024	.79410
12	10	-1.24932	.00000	-.00483	-1.24934	.00002	.22156
12	11	137.25505	.00000	.00000	137.25505	.00000	.00000
13	1	-1.30986	.00000	-.02612	-1.31039	.00052	1.14203
13	2	-1.27414	.00000	-.03846	-1.27530	.00116	1.72740
13	3	-1.22948	.00000	-.06970	-1.23342	.00394	3.23444
13	4	-1.17365	.00000	-.12518	-1.18686	.01320	6.02102
13	5	-1.09773	.00000	-.12942	-1.11278	.01505	6.63383
13	6	-1.03744	.00000	-.08274	-1.04399	.00656	4.53132
13	7	-.99278	.00000	-.04278	-.99462	.00184	2.46282
13	8	-.95481	.00000	-.02328	-.95538	.00057	1.39587
13	9	-.92355	.00000	-.01295	-.92373	.00018	.80345
13	10	-.89899	.00000	-.00366	-.89900	.00001	.23298
13	11	138.52907	.00000	.00000	138.52907	.00000	.00000
14	1	-1.54962	.00000	-.02243	-1.54995	.00032	.82924
14	2	-1.47014	.00000	-.03058	-1.47077	.00064	1.19105
14	3	-1.37076	.00000	-.05311	-1.37282	.00205	2.21558
14	4	-1.24653	.00000	-.09379	-1.25355	.00702	4.27894
14	5	-1.07755	.00000	-.09583	-1.08601	.00846	5.04299
14	6	-.94336	.00000	-.06087	-.94727	.00391	3.67648
14	7	-.84395	.00000	-.03133	-.84511	.00116	2.12308
14	8	-.75945	.00000	-.01694	-.75983	.00038	1.27704
14	9	-.68986	.00000	-.00949	-.68999	.00013	.79012
14	10	-.63518	.00000	-.00265	-.63520	.00001	.23860
14	11	139.52694	.00000	.00000	139.52694	.00000	.00000
15	1	-1.66747	.00000	-.01907	-1.66768	.00022	.65499
15	2	-1.56599	.00000	-.02550	-1.56640	.00042	.93266
15	3	-1.43910	.00000	-.04380	-1.44043	.00133	1.74157
15	4	-1.28046	.00000	-.07698	-1.28507	.00461	3.42832
15	5	-1.06467	.00000	-.07841	-1.07042	.00574	4.18928
15	6	-.89339	.00000	-.04970	-.89606	.00276	3.17496
15	7	-.76635	.00000	-.02555	-.76720	.00085	1.90752
15	8	-.65844	.00000	-.01379	-.65873	.00029	1.19913
15	9	-.56957	.00000	-.00764	-.56967	.00010	.76847
15	10	-.49975	.00000	-.00215	-.49975	.00001	.24647
15	11	140.04616	-.00000	.00000	140.04616	.00000	.00000
16	1	-.30167	.00000	-.00740	-.30185	.00018	1.40341
16	2	-.43919	.00000	-.02853	-.44104	.00185	3.70079
16	3	-.61110	.00000	-.06830	-.61864	.00754	6.29978

16	4	-.82598	.00000	-.13415	-.84722	.02124	8.99780
16	5	-1.11820	.00000	-.14682	-1.13716	.01896	7.35686
16	6	-1.35020	.00000	-.09674	-1.35709	.00690	4.07745
16	7	-1.52192	.00000	-.05102	-1.52363	.00171	1.91806
16	8	-1.66767	.00000	-.02855	-1.66816	.00049	.99054
16	9	-1.78744	.00000	-.01610	-1.78759	.00014	.51588
16	10	-1.88127	.00000	-.00458	-1.88128	.00001	.13961
16	11	134.95694	.00000	.00000	134.95694	.00000	.00000
17	1	-.92878	.00000	-.00558	-.92881	.00003	.34428
17	2	-.96976	.00000	-.02352	-.97033	.00057	1.38826
17	3	-1.02099	.00000	-.05701	-1.02416	.00317	3.18620
17	4	-1.08503	.00000	-.11237	-1.09654	.01151	5.85085
17	5	-1.17210	.00000	-.12322	-1.18492	.01281	5.93701
17	6	-1.24125	.00000	-.08128	-1.24655	.00530	3.73058
17	7	-1.29245	.00000	-.04290	-1.29388	.00142	1.89907
17	8	-1.33597	.00000	-.02403	-1.33640	.00043	1.03028
17	9	-1.37180	.00000	-.01356	-1.37193	.00013	.56616
17	10	-1.39995	.00000	-.00386	-1.39996	.00001	.15810
17	11	136.53468	.00000	.00000	136.53468	.00000	.00000
18	1	-1.27827	.00000	-.00271	-1.27828	.00001	.12153
18	2	-1.26590	.00000	-.01435	-1.26607	.00016	.64938
18	3	-1.25044	.00000	-.03575	-1.25147	.00102	1.63647
18	4	-1.23112	.00000	-.07097	-1.23519	.00408	3.28837
18	5	-1.20483	.00000	-.07815	-1.20988	.00505	3.69598
18	6	-1.18396	.00000	-.05166	-1.18621	.00225	2.49387
18	7	-1.16850	.00000	-.02731	-1.16914	.00064	1.33817
18	8	-1.15536	.00000	-.01533	-1.15556	.00020	.76028
18	9	-1.14454	.00000	-.00866	-1.14460	.00007	.43349
18	10	-1.13603	.00000	-.00247	-1.13604	.00001	.12457
18	11	137.38809	.00000	.00000	137.38809	.00000	.00000
19	1	-1.48065	.00000	-.00116	-1.48065	.00000	.04497
19	2	-1.43757	.00000	-.00716	-1.43760	.00004	.28524
19	3	-1.38370	.00000	-.01810	-1.38394	.00024	.74913
19	4	-1.31637	.00000	-.03605	-1.31736	.00099	1.56768
19	5	-1.22478	.00000	-.03979	-1.22607	.00129	1.85880
19	6	-1.15205	.00000	-.02633	-1.15265	.00060	1.30872
19	7	-1.09817	.00000	-.01393	-1.09834	.00018	.72665
19	8	-1.05237	.00000	-.00783	-1.05243	.00006	.42625
19	9	-1.01465	.00000	-.00442	-1.01467	.00002	.24980
19	10	-.98501	.00000	-.00126	-.98502	.00000	.07341
19	11	137.87287	.00000	.00000	137.87287	.00000	.00000
20	1	-1.54195	.00000	-.00067	-1.54195	.00000	.02484
20	2	-1.48957	.00000	-.00412	-1.48958	.00001	.15840
20	3	-1.42408	.00000	-.01041	-1.42416	.00008	.41892
20	4	-1.34221	.00000	-.02075	-1.34253	.00032	.88537
20	5	-1.23084	.00000	-.02290	-1.23126	.00043	1.06544

20 6	-1.14238	.00000	-.01515	-1.14258	.00020	.75988
20 7	-1.07686	.00000	-.00802	-1.07692	.00006	.42652
20 8	-1.02116	.00000	-.00451	-1.02118	.00002	.25282
20 9	-.97529	.00000	-.00255	-.97530	.00001	.14957
20 10	-.93925	.00000	-.00073	-.93925	.00000	.04431
20 11	138.01974	.00000	.00000	138.01974	.00000	.00000

ANGLES SHOWING DIRECTION OF PRINCIPAL AXIS, FIRST CRACK,
AND SECOND CRACK (ANGLE = 999.0 IF NO CRACK)
ANGLES ARE IN DEGREES

EL	LAYER	PRINCIPAL	FIRST	SECOND
19	5	-4.958658	-4.958658-CRACK	999.000000-
19	6	-5.123703	-5.123703-CRACK	999.000000-
20	4	2.168832	2.168832-CRACK	999.000000-
20	5	4.601763	4.601763-CRACK	999.000000-
20	6	5.195307	5.195307-CRACK	999.000000-
24	5	4.958658	4.958658-CRACK	999.000000-
24	6	5.123703	5.123703-CRACK	999.000000-
25	4	-2.168832	-2.168832-CRACK	999.000000-
25	5	-4.601763	-4.601763-CRACK	999.000000-
25	6	-5.195307	-5.195307-CRACK	999.000000-

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

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* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

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BEAM NUMBER 2

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* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333334444444444 *
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* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

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BEAM NUMBER 3

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BEAM NUMBER 4

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* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *
```

SLAB PLOT

NODE J   NODE L

ELEMENT NUMBER   Y = NUMBER OF YIELDED LAYERS

C = NUMBER OF CRUSHED LAYERS   T = NUMBER OF CRACKED LAYERS

NODE I   NODE K

```
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
78888BB6B3BB6BB88B0BCBB3E8d3Bd9BBBBBEBB9EBBBE8B39BBBBB20EBBBBBBBBE1BBEBB3BB3BBEEBBBB11BBB2B3BBB12
*            1               *       2          *        3         *       4          *    5     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
1****************************2******************3******************4******************5**********6
```

LOAD CYCLE = 9

----LOAD RATIO AT START OF CYCLE = .200000000E+00
----PRESCAN FACTOR AT START OF CYCLE = .100000000E+01

BRIDGE IS NOT ADEQUATE FOR THE APPLIED LOAD WITH A 10 PER CENT SAFTEY FACTOR

SLAB -FIRST CRACK LOAD = 16.2441 KIPS

SLAB -FIRST CRUSH LOAD = -999.0000 KIPS

SLAB -FIRST YIELD LOAD = -999.0000 KIPS

BEAM -FIRST CRACK LOAD = -999.0000 KIPS

BEAM -FIRST CRUSH LOAD = -999.0000 KIPS

BEAM -FIRST YIELD LOAD = -999.0000 KIPS

TOTAL APPLIED LOAD = 39.144

MAX SHEAR HAS BEEN EXCEEDED(BEAM ELEMENT,LAYER)= NO(0, 0)

BEAM TERMINATION CHECKS / FOR EXCEEDING LIMITS ON	MATERIAL TYPE = 1	2
STRAIN =	NO	NO

ELEMENT LAYER		0 0	0 0
TENSILE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
COMPRESSIVE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
CRACKED OR YIELDED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0
CRUSHED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0

SLAB TERMINATION CHECKS / MATERIAL TYPE = CONCRETE/STEEL-1
FOR EXCEEDING LIMITS ON

STRAIN	=	NO	NO
ELEMENT LAYER		0 0	0 0
TENSILE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
COMPRESSIVE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
CRACKED OR YIELDED LAYERS	=	YES	NO
ELEMENT LAYER		25 0	0 0
CRUSHED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0

THIS ANALYTIC MODEL CONSIDERS THE FLEXURAL AND INPLANE BEHAVIOR OF THE DECK SLAB AND THE FLEXURAL AND AXIAL DEFORMATIONS OF THE BEAMS. TRANSVERSE SHEAR DEFORMATION NORMAL TO THE PLANE OF THE DECK SLAB IS NOT CONSIDERED.

THE PREDICTED OVERLOADING OF 6 BRIDGE SUPERSTRUCTURES TO FAILURE HAVE INDICATED THAT (1) AT THE EARLY PHASES OF THE OVERLOADING, I.E. CRACKING OF THE SLAB AND/OR BEAMS, THE RESULTS MAY BE OFF BY 20 PERCENT, (2) AT FIRST YIELDING OR A DECREASE IN STIFFNESS THE RESULTS MAY BE OFF BY 20 PERCENT, AND (3) AT THE LATER STAGES OF OVERLOADING ,I.E. CRUSHING OF THE CONCRETE AND/OR FRACTURING OF THE STEEL THE RESULTS MAY BE OFF BY 10 PERCENT. THESE CONCLUSIONS DEPEND ON THE PARTICULAR DISCRETIZATION, METHOD OF STRESS COMPUTATION, AND ITERATION SCHEME CHOSEN. THUS THE CONCLUSIONS ARE ONLY APPLICABLE TO THE AFOREMENTIONED EXAMPLES. ALSO IT SHOULD BE NOTED THAT THE ABOVE PERCENTAGES ARE THE MAXIMUM OBSERVED DEVIATIONS.

THE ACCURACY OF THE RESULTS DEPENDS UPON THE ACCURACY OF THE

INPUT OF THE MATERIAL PROPERTIES, DEFINITION OF THE BRIDGE DESIGN PARAMETERS, AND THE CORRECT SIMULATION OF THE OVERLOAD CONFIGURATION. SUBSTANTIAL DEVIATIONS FROM ANY ONE OF THESE VALUES WILL RESULT IN A SOLUTION THAT MAY NOT BE PEPRESENTATIVE OF THE ACTUAL BRIDGE BEHAVIOR.

THE AGE OF THE CONCRETE AND THE DETERIORATION OF THE BRIDGE SUPERSTRUCTURE MUST BE CONSIDERED BY THE USER. THE USER MUST EXERT JUDGEMENT IN THE CORRECT ASSESMENT OF THESE PARAMETERS. ANY SUBSTANTIAL DEVIATION IN THE INPUT FROM THE ACTUAL STATE OF THE SUPERSTRUCTURE MAY RESULT IN AN INCORRECT SIMULATION OF THE OVERLOAD RESPONSE OF THE BRIDGE.

CRACK WIDTHS ARE COMPUTED FROM FORMULAE THAT ARE BASED ON EMPIRICALLY DERIVED RELATIONSHIPS AND ARE THEREFORE CONSIDERED TO BE APPROXIMATE.

THE PROGRAM DOES NOT INCLUDE FATIGUE PROVISIONS FOR THE SUPERSTRUCTURE OR ITS CONSTITUTIVE MATERIALS. IF THE FATIGUE IS BELIEVED TO BE IMPORTANT, THEN IT MAY BE ADVISABLE TO PERFORM A NEW ANALYSIS WITH REDUCED CONCRETE AND/OR STEEL STRENGTHS.

THE ANALYSIS IS CARRIED OUT FOR THE LANE LOCATION OF THE OVERLOAD VEHICLE THAT IS DEFINED BY THE USER OF THE PROGRAM. ANY DEVIATION FROM THIS LANE LOADING IN THE ACTUAL OVERLOADING OF THE BRIDGE MAY RESULT IN A RESPONSE DIFFERENT FROM THAT PREDICTED BY THE PROGRAM.

THE ANALYSIS IS CARRIED OUT FOR THE GIVEN LOADING SPECIFIED BY THE USER. IF DURING THE ACTUAL LOADING OF THE BRIDGE OTHER VEHICLES OF QUESTIONABLE WEIGHT ARE PRESENT IN ADDITION TO THE GIVEN LOADING, THEN THE ACTUAL BRIDGE RESPONSE MAY BE DIFFERENT AS COMPARED TO THAT PREDICTED BY THE PROGRAM.

THE COMPUTER PROGRAM ASSUMES THAT DYNAMIC EFFECTS ARE NOT PRESENT. THUS THE VEHICULAR SPEED SHOULD BE REDUCED TO CRAWL SPEED, I.E. A MAXIMUM OF 5 MPH, DURING THE TRAVEL ACROSS THE BRIDGE. IF THE VEHICLE IS TO TRAVEL THE BRIDGE AT NORMAL TRAFFIC SPEED, THEN THE ACTUAL VEHICULAR LOAD SHOULD BE INCREASED BY SOME IMPACT FACTOR FOR ANALYSIS PURPOSES.

IF THE OVERLOAD ANALYSIS IS CARRIED OUT FOR THE MAXIMUM FLEXURAL RESPONSE, THEN THE USER SHOULD ALSO CONSIDER THE NECESSITY OF AN ANALYSIS FOR A LOAD CONFIGURATION/POSITION WHICH WILL PRODUCE A MAXIMUM HORIZONTAL SHEAR CONDITION IN THE BEAMS NEAR THE SUPPORTS.

IT IS ADVISABLE THAT THE USER CONSIDERS THE MAXIMUM DEFLECTION OF THE BRIDGE SUPERSTRUCTURE AS COMPARED TO THE DESIGN DEFLECTION. THE DESIGN DEFLECTION IS TO BE OBTAINED BY THE USER.

NO SPECIAL STRESS CHECKS HAVE BEEN UNDERTAKEN FOR THE BEAMS WITH DRAPED STRANDS AT THE DRAPE POINTS. THE USER SHOULD INVESTIGATE THIS MANUALLY IF IT IS PERTINENT.

---------------------EXAMPLE BRIDGE 2 --------------------

NUMBER OF SLAB ELEMENTS ALONG THE X-AXIS	=	5
NUMBER OF SLAB ELEMENTS ALONG THE Y-AXIS	=	8
NUMBER OF CONCRETE LAYERS IN SLAB, NULAY	=	6
NUMBER OF STEEL LAYERS IN SLAB, NSLAYR	=	4
BEAM TYPE	=	PD24/48
NUMBER OF BEAMS	=	4
TOTAL NUMBER OF BEAM ELEMENTS, NBEAMX	=	20
TYPE OF DISCRETIZATION	=	HALF
SPAN OF ENTIRE BRIDGE (FT)	=	70.00
BRIDGE OVERHANG (FT)	=	3.50
BRIDGE WIDTH (FT)	=	31.00
NUMBER OF ACTUAL LAYERS FOR BEAM	=	10
NUMBER OF PRESTRESS STRANDS	=	1
NUMBER OF SLAB ELEMENTS, NUMEL	=	40
NUMBER OF NODAL POINTS, NUMNP	=	54
IS THERE A DETAILED OUTPUT	=	NO

```
ELEMENT LENGTHS IN THE X DIRECTION ARE (IN)
    126.0000      84.0000      84.0000      84.0000      42.0000

ELEMENT LENGTHS IN THE Y DIRECTION ARE (IN)
     42.0000      48.0000      48.0000      48.0000      48.0000      48.0000      48.0000      42.0000

SLAB THICKNESS (IN)   =   8.000

NUMBER OF PATCH LOAD CARDS        =    1

LOAD CARD    LOAD (KSI)   X OF CENTER(IN)  Y OF C ENTER(IN)  LENGTH(IN)   WIDTH(IN)
     1          .0100        399.00            186.00          42.00        96.00

TOTAL VERTICAL LOAD      =     40.3200 KIPS

               SLAB-LAYER THICKNESS (IN)

   1        1.250000

   2        1.250000

   3        1.250000

   4        1.250000

   5        1.250000

   6        1.250000

TOP COVER OF SLAB (IN)       =       2.00
BOTTOM COVER OF SLAB (IN)    =       1.00

UNIAXIAL SLAB CONCRETE COMPRESSIVE STRENGTH     =      3.500 KSI
```

UNIAXIAL BEAM CONCRETE COMPRESSIVE STRENGTH = 5.500 KSI

BEAM SECTION - THICKNESS (IN) OF LAYERS

2.0000

6.0000

4.0000

8.5000

8.5000

5.0000

5.0000

3.5000

3.5000

2.0000

AREA OF PRESTRESS STRAND GROUP	=	6.2100 SQ. IN.
STEEL GRADE	=	270 KSI
INITIAL STRESS	=	189.0000 KSI

PROPERTIES FOR BEAM CROSS-SECTION

AREA	=	708.00 SQ. IN
INERTIA	=	172712.0 IN4
STRAND ECCENTRICITY FROM C.G.	=	10.7200 IN
DEAD LOAD MOMENT ON SECTION	=	5420.62 IN-KIPS
MODULAR RATIO OF STEEL/CONC.	=	6.0053

AGE OF BRIDGE IN YEARS = .00

LOSS DUE TO RELAXATION OF STEEL = .000 KSI

```
PRESTRESS AFTER LOSSES (EXCEPT ELASTIC LOSS) =  144.755 KSI
ESTIMATED ELASTIC LOSS                       =   10.511 KSI
```

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
20	6	5.1953
25	6	-5.1953

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS = 16.2441

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

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BEAM NUMBER 2

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BEAM NUMBER 3

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BEAM NUMBER 4

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* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

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```

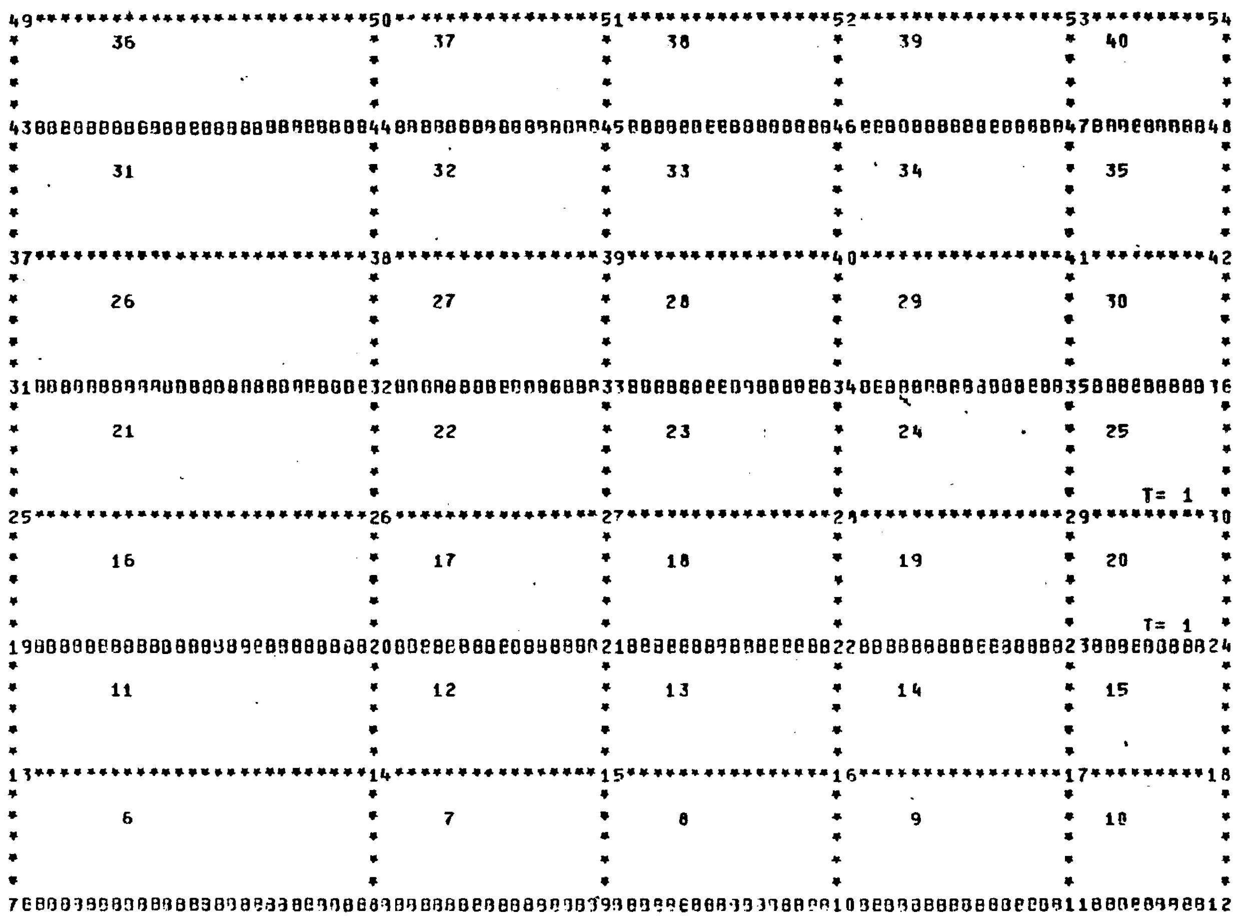
SLAB PLOT

NODE J   NODE L

ELEMENT NUMBER   Y = NUMBER OF YIELDED LAYERS

C = NUMBER OF CRUSHED LAYERS   T = NUMBER OF CRACKED LAYERS

NODE I   NODE K



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*                             *                    *                    *                    *             *
*                             *                    *                    *                    *             *
*                             *                    *                    *                    *             *
1*****************************2********************3********************4********************5*************6
```

LOAD CYCLE =   1

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER   ANGLE

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS   =   19.4862

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

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  *                                 **                     **                     **                     **           *


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BEAM NUMBER 2

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BEAM NUMBER  3

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BEAM NUMBER  4

  *                            **                  **                  **                  **        *

* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333322222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

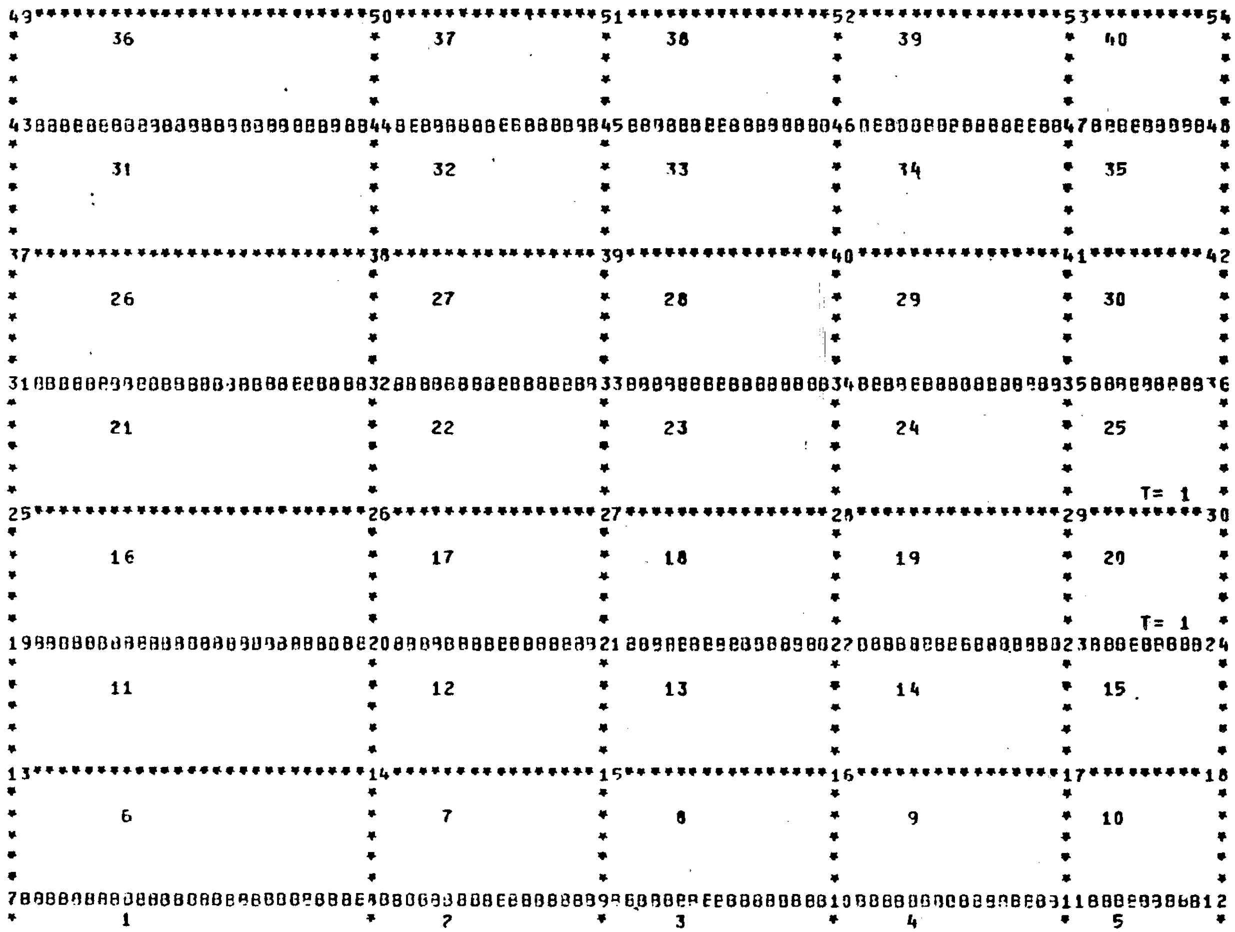
  *                            **                  **                  **                  **        *
```

NODE J NODE L

ELEMENT NUMBER Y = NUMBER OF YIELDED LAYERS

C = NUMBER OF CRUSHED LAYERS T = NUMBER OF CRACKED LAYERS

NODE I NODE K



```
*                            *                  *                  *                  *            *
*                            *                  *                  *                  *            *
*                            *                  *                  *                  *            *
1****************************2******************3******************4******************5************6
```

LOAD CYCLE =   2

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
19	6	-5.1237
24	6	5.1237

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS = 22.7284

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                             **                  **                  **                  **          *

* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333322222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                             **                  **                  **                  **          *
```

BEAM NUMBER 2

```
  *                             **                  **                  **                  **          *
```

-181-

```
* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 3

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 4

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333332222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

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SLAB PLOT

```
     NODE J                                                               NODE L

            ELEMENT NUMBER                    Y = NUMBER OF YIELDED LAYERS

            C = NUMBER OF CRUSHED LAYERS      T = NUMBER OF CRACKED LAYERS

     NODE I                                                               NODE K
```

```
49***************************50*****************51*****************52*****************53*********54
*        36                  *    37           *    38           *    39           *   40     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
43888888888888888888888888888448888888888888888458888888888888888468888888888888888478888888888848
*                            *                 *                 *                 *          *
*        31                  *    32           *    33           *    34           *   35     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
37***************************38*****************39*****************40*****************41*********42
*                            *                 *                 *                 *          *
*        26                  *    27           *    28           *    29           *   30     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
31888888888888888888888888888328888888888888888338888888888888888348888888888888888358888888888836
*                            *                 *                 *                 *          *
*        21                  *    22           *    23           *    24           *   25     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
*                            *                 *                 *           T= 1  *    T= 1  *
25***************************26*****************27*****************28*****************29*********30
*                            *                 *                 *                 *          *
*        16                  *    17           *    18           *    19           *   20     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
*                            *                 *                 *           T= 1  *    T= 1  *
19888888888888888888888888888208888888888888888218888888888888888228888888888888888238888888888824
*                            *                 *                 *                 *          *
*        11                  *    12           *    13           *    14           *   15     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
13***************************14*****************15*****************16*****************17*********18
*                            *                 *                 *                 *          *
*         6                  *     7           *     8           *     9           *   10     *
*                            *                 *                 *                 *          *
*                            *                 *                 *                 *          *
```

```
*                            *                  *                  *                  *            *
78388888838888898388009888808888E88J2889E898888998888888E8898888981088898888888888E8811878E8888812
*        1                   *        2         *        3         *        4         *     5      *
*                            *                  *                  *                  *            *
*                            *                  *                  *                  *            *
*                            *                  *                  *                  *            *
1****************************2******************3******************4******************5************6

     LOAD CYCLE =         3

          SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

     ELEMENT  LAYER    ANGLE

          20       5     4.6018

          25       5    -4.6018

          BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

     ELEMENT  LAYER

                   SUM OF NODAL POINT W-LOADS          =    24.4057


PLOT SHOWING  CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)


BEAM NUMBER  1

  *                            **                  **                  **                  **          *


* 11111111111111111111111111111222222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333332222222222 *
* 44444444444444444444444444444333333333333333333333333333333333333333333333332222222222222222222222222 *
* 44444444444444444444444444444333333333333333333333333333333333333333333333332222222222222222222222222 *
* 44444444444444444444444444444333333333333333333333333333333333333333333333332222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *


  *                            **                  **                  **                  **          *


BEAM NUMBER  2
```

```
  *                            **                  **                  **                  **         *

* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333332222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **         *
```

BEAM NUMBER 3

```
  *                            **                  **                  **                  **         *

* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333332222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **         *
```

BEAM NUMBER 4

```
  *                            **                  **                  **                  **         *

* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333322222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *
```

SLAB PLOT

NODE J   NODE L

ELEMENT NUMBER   Y = NUMBER OF YIELDED LAYERS

C = NUMBER OF CRUSHED LAYERS   T = NUMBER OF CRACKED LAYERS

NODE I   NODE K

```
49**************************50****************51****************52****************53**********54
*       36                  *    37           *    38           *    39           *  40       *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
43BBBBBBBBBBBBBBBBBBBBBBBBBB44BBBBBBBBBBBBBBBB45BBBBBBBBBBBBBBBB46BBBBBBBBBBBBBBBB47BBBBBBBBBB48
*                           *                 *                 *                 *           *
*       31                  *    32           *    33           *    34           *  35       *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
37**************************38****************39****************40****************41**********42
*                           *                 *                 *                 *           *
*       26                  *    27           *    28           *    29           *  30       *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
31BBBBBBBBBBBBBBBBBBBBBBBBBB32BBBBBBBBBBBBBBBB33BBBBBBBBBBBBBBBB34BBBBBBBBBBBBBBBB35BBBBBBBBBB36
*                           *                 *                 *                 *           *
*       21                  *    22           *    23           *    24           *  25       *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
*                           *                 *                 *          T= 1   *     T= 2  *
25**************************26****************27****************28****************29**********30
*                           *                 *                 *                 *           *
*       16                  *    17           *    18           *    19           *  20       *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
*                           *                 *                 *          T= 1   *     T= 2  *
19BBBBBBBBBBBBBBBBBBBBBBBBBB20BBBBBBBBBBBBBBBB21BBBBBBBBBBBBBBBB22BBBBBBBBBBBBBBBB23BBBBBBBBBB24
*                           *                 *                 *                 *           *
*       11                  *    12           *    13           *    14           *  15       *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
*                           *                 *                 *                 *           *
13**************************14****************15****************16****************17**********18
*                           *                 *                 *                 *           *
```

```
*        6                 *     7           *     8           *     9           *   10      *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
76000888888388838883888888888888888888888888889888888E8EE898988881088888888888888888118888888888812
*        1                 *     2           *     3           *     4           *    5      *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
1***************************2*****************3*****************4*****************5***********6
```

LOAD CYCLE =   4

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER   ANGLE

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS   =   27.6479

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                            **                  **                  **                  **        *

* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333322222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 2

```
  *                            **                  **                  **                  **        *
```

```
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **         *
```

BEAM NUMBER 3

```
  *                            **                  **                  **                  **         *

* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 33333333333333333333333333333333333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333222222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **         *
```

BEAM NUMBER 4

```
  *                            **                  **                  **                  **         *

* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *
```

SLAB PLOT

```
     NODE J                                                      NODE L

            ELEMENT NUMBER                  Y = NUMBER OF YIELDED LAYERS

            C = NUMBER OF CRUSHED LAYERS    T = NUMBER OF CRACKED LAYERS

     NODE I                                                      NODE K


49*************************50***************51***************52***************53*********54
*       36                 *     37         *     38         *     39         *  40     *
*                          *                *                *                *         *
*                          *                *                *                *         *
43BBBBBBBBBBBBBBBBBBBBBBBBB44BBBBBBBBBBBBBBB45BBBBBBBBBBBBBBB46BBBBBBBBBBBBBBB47BBBBBBBBB48
*                          *                *                *                *         *
*       31                 *     32         *     33         *     34         *  35     *
*                          *                *                *                *         *
*                          *                *                *                *         *
37*************************38***************39***************40***************41*********42
*                          *                *                *                *         *
*       26                 *     27         *     28         *     29         *  30     *
*                          *                *                *                *         *
*                          *                *                *                *         *
31BBBBBBBBBBBBBBBBBBBBBBBBB32BBBBBBBBBBBBBBB33BBBBBBBBBBBBBBB34BBBBBBBBBBBBBBB35BBBBBBBBB36
*                          *                *                *                *         *
*       21                 *     22         *     23         *     24         *  25     *
*                          *                *                *                *         *
*                          *                *                *           T= 1 *    T= 2 *
25*************************26***************27***************28***************29*********30
*                          *                *                *                *         *
*       16                 *     17         *     18         *     19         *  20     *
*                          *                *                *                *         *
*                          *                *                *           T= 1 *    T= 2 *
19BBBBBBBBBBBBBBBBBBBBBBBBB20BBBBBBBBBBBBBBB21BBBBBBBBBBBBBBB22BBBBBBBBBBBBBBB23BBBBBBBBB24
*                          *                *                *                *         *
*       11                 *     12         *     13         *     14         *  15     *
*                          *                *                *                *         *
*                          *                *                *                *         *
13*************************14***************15***************16***************17*********18
*                          *                *                *                *         *
*       6                  *     7          *     8          *     9          *  10     *
```

```
*                                    *                       *                       *                       *               *
*                                    *                       *                       *                       *               *
7898808983888838888888888838839888888888888888888993888888888888888810888888888888888311898829888812
*           1                        *   .    2              *         3             *         4             *    5          *
*                                    *                       *                       *                       *               *
*                                    *                       *                       *                       *               *
*                                    *                       *                       *                       *               *
1************************************2***********************3***********************4***********************5***************6
```

LOAD CYCLE = 5

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
19	5	-4.9587
24	5	4.9587

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS = 30.8900

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                            **                   **                   **                   **          *


* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111222222222222222222223333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333332222222222? *
* 444444444444444444444444444444333333333333333333333333333333333333333333333332222222222222222222222222 *
* 444444444444444444444444444444333333333333333333333333333333333333333333333332222222222222222222222222 *
* 444444444444444444444444444444333333333333333333333333333333333333333333333332222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *


  *                            **                   **                   **                   **          *
```

BEAM NUMBER 2

```
  *                            **                  **                  **                  **        *

* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 3

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333322222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 4

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 1111111111111111111111111111112222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333322222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333332222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333332222222222222222222222222222222 *
```

```
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

 *                   **              **              **              **         *


     SLAB PLOT

          NODE J                                                              NODE L

                 ELEMENT NUMBER                 Y = NUMBER OF YIELDED LAYERS

                 C = NUMBER OF CRUSHED LAYERS   T = NUMBER OF CRACKED LAYERS

          NODE I                                                              NODE K



49***************************50***************51***************52***************53*********54
*        36                  *     37         *     38         *     39         *   40     *
*                            *                *                *                *          *
*                            *                *                *                *          *
*                            *                *                *                *          *
43888888888888888888888888888844888888888888888458888888888888888468888888888888888847888888888848
*                            *                *                *                *          *
*        31                  *     32         *     33         *     34         *   35     *
*                            *                *                *                *          *
*                            *                *                *                *          *
*                            *                *                *                *          *
37***************************38***************39***************40***************41*********42
*                            *                *                *                *          *
*        26                  *     27         *     28         *     29         *   30     *
*                            *                *                *                *          *
*                            *                *                *                *          *
*                            *                *                *                *          *
31888888888888888888888888888832888888888888888338888888888888888348888888888888888835888888888836
*                            *                *                *                *          *
*        21                  *     22         *     23         *     24         *   25     *
*                            *                *                *                *          *
*                            *                *                *                *          *
*                            *                *                *           T= 2 *    T= 2  *
25***************************26***************27***************28***************29*********30
*                            *                *                *                *          *
*        16                  *     17         *     18         *     19         *   20     *
*                            *                *                *                *          *
*                            *                *                *                *          *
*                            *                *                *           T= 2 *    T= 2  *
19888888888888888888888888888820888888888888888218888888888888888228888888888888888823888888888824
*                            *                *                *                *          *
*        11                  *     12         *     13         *     14         *   15     *
*                            *                *                *                *          *
*                            *                *                *                *          *
*                            *                *                *                *          *
```

```
13****************************14******************15******************16******************17***********18
*                              *                   *                   *                   *            *
*         6                    *     7             *     8             *     9             *  10        *
*                              *                   *                   *                   *            *
*                              *                   *                   *                   *            *
*                              *                   *                   *                   *            *
7BBBBBBBBBBBBBBBBBBBBBBBBBBBBBB8BBBBBBBBBBBBBBBBBBB9BBBBBBBBBBBBBBBBBB10BBBBBBBBBBBBBBBBBB11BBBBBBBBBBB12
*         1                    *     2             *     3             *     4             *   5        *
*                              *                   *                   *                   *            *
*                              *                   *                   *                   *            *
*                              *                   *                   *                   *            *
1******************************2*******************3*******************4*******************5************6
```

LOAD CYCLE =   6

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER   ANGLE

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS   =   34.1322

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                               **                    **                    **                    **          *


* 11111111111111111111111111111111222222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111111222222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444443333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444433333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444433333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *


  *                               **                    **                    **                    **          *
```

BEAM NUMBER 2

*   **   **   **   **   *

* 111111111111111111111111111111111222222222222222222222333333333333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111111222222222222222222222333333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222223333333333333333333333333333333333333333333332222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

*   **   **   **   **   *

BEAM NUMBER 3

*   **   **   **   **   *

* 111111111111111111111111111111111222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111111222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222333333333333333333333333333333333333333333333222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333332222222222222222222222222222222222222222222222222222222 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

*   **   **   **   **   *

BEAM NUMBER 4

*   **   **   **   **   *

* 111111111111111111111111111111111222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111111222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333333333333333333333333332222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333333333333333333333333332222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333333333333333333333333332222222222222222222222222222222222 *

```
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

 *                         **                  **                  **                  **          *


    SLAB PLOT
         NODE J                                                                  NODE L
                ELEMENT NUMBER                  Y = NUMBER OF YIELDED LAYERS
                C = NUMBER OF CRUSHED LAYERS    T = NUMBER OF CRACKED LAYERS
         NODE I                                                                  NODE K


49***************************50*****************51*****************52*****************53**********54
*       36                   *     37           *     38           *     39           *   40     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
43BBBBBBBBBBBBBBBBBBBBBBBBBBB44BBBBBBBBBBBBBBBBB45BBBBBBBBBBBBBBBBB46BBBBBBBBBBBBBBBBB47BBBBBBBBBB48
*                            *                  *                  *                  *          *
*       31                   *     32           *     33           *     34           *   35     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
37***************************38*****************39*****************40*****************41**********42
*                            *                  *                  *                  *          *
*       26                   *     27           *     28           *     29           *   30     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
31BBBBBBBBBBBBBBBBBBBBBBBBBBB32BBBBBBBBBBBBBBBBB33BBBBBBBBBBBBBBBBB34BBBBBBBBBBBBBBBBB35BBBBBBBBBB36
*                            *                  *                  *                  *          *
*       21                   *     22           *     23           *     24           *   25     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *          T= 2    *   T= 2   *
25***************************26*****************27*****************28*****************29**********30
*                            *                  *                  *                  *          *
*       16                   *     17           *     18           *     19           *   20     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *          T= 2    *   T= 2   *
19BBBBBBBBBBBBBBBBBBBBBBBBBBB20BBBBBBBBBBBBBBBBB21BBBBBBBBBBBBBBBBB22BBBBBBBBBBBBBBBBB23BBBBBBBBBB24
*                            *                  *                  *                  *          *
*       11                   *     12           *     13           *     14           *   15     *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
*                            *                  *                  *                  *          *
13***************************14*****************15*****************16*****************17**********18
```

```
*        6                 *     7           *     8           *     9           *   10      *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
7888888888888888888888888888888888888888888889888888888888888888881088888888888888881188888888888812
*        1                 *     2           *     3           *     4           *    5      *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
*                          *                 *                 *                 *           *
1**************************2*****************3*****************4*****************5***********6
```

LOAD CYCLE =   7

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER   ANGLE

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS   =   37.3743

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                            **                  **                  **                  **         *


* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 11111111111111111111111111111122222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 22222222222222222222222222222222222222222222222222333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 33333333333333333333333333333333333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* 44444444444444444444444444444433333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *


  *                            **                  **                  **                  **         *
```

BEAM NUMBER 2

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222223333333333333333333333333333333333333333334444444444 *
* 1111111111111111111111111111112222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222223333333333333333333333333332222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333332222222222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333332222222222222222222222222222222222222222222221111111111 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 3

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222223333333333333333333333333333333333333333334444444444 *
* 1111111111111111111111111111112222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222223333333333333333333333333332222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333332222222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222 *
* 3333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333332222222222222222222222222222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333332222222222222222222222222222222222222222222221111111111 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                            **                  **                  **                  **        *
```

BEAM NUMBER 4

```
  *                            **                  **                  **                  **        *

* 1111111111111111111111111111112222222222222222223333333333333333333333333333333333333333333333333333 *
* 1111111111111111111111111111112222222222222222223333333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333 *
* 2222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 3333333333333333333333333333333333333333333333333333333333333333333333333333333222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333222222222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333333333333222222222222222222222222 *
* 4444444444444444444444444444443333333333333333333333333333333333333332222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *
```

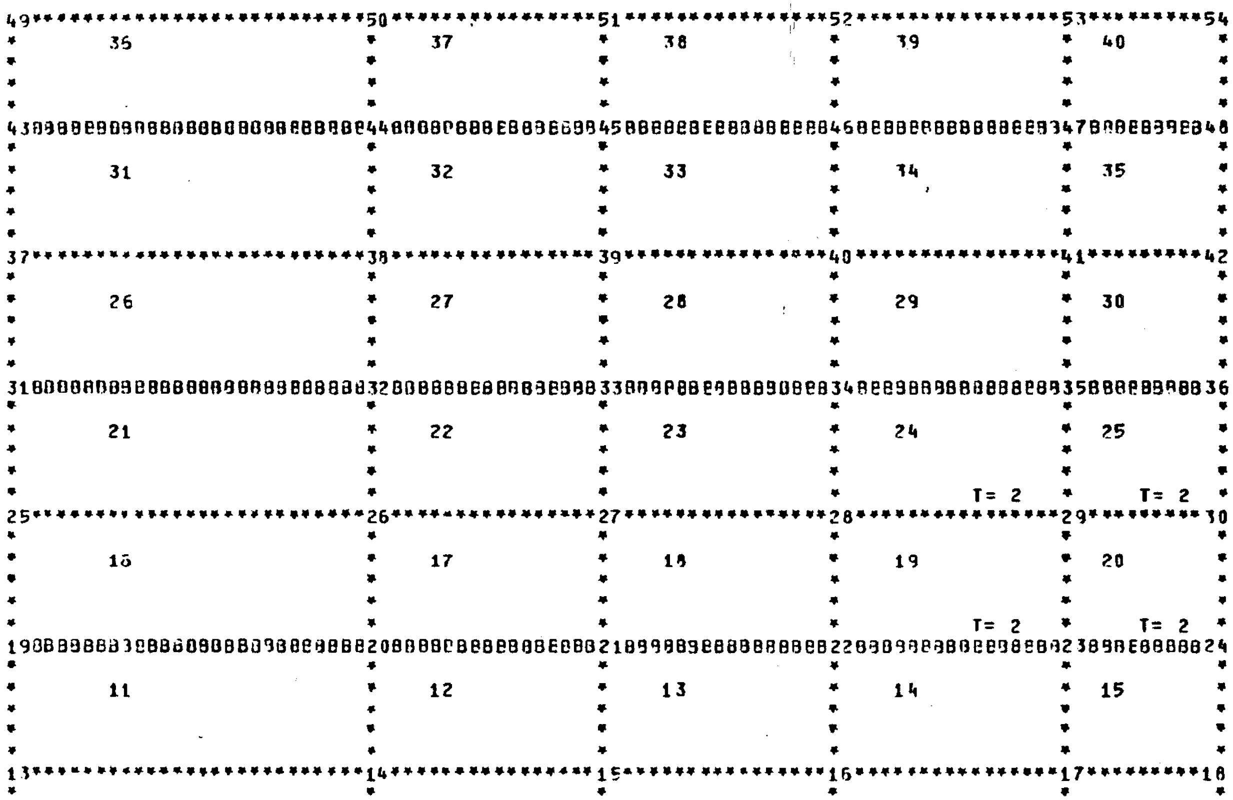
SLAB PLOT

NODE J NODE L

ELEMENT NUMBER Y = NUMBER OF YIELDED LAYERS

C = NUMBER OF CRUSHED LAYERS T = NUMBER OF CRACKED LAYERS

NODE I NODE K



```
*        6                    *     7           *       8         *       9         *  10       *
*                             *                 *                 *                 *           *
*                             *                 *                 *                 *           *
*                             *                 *                 *                 *           *
7B0388B2O38BBBBBBBBB378EEBBBBE8BBBBBBBBBBBBEBBEBBE9B9BEBBBEEBBBBEBBE10BEB3BBBBBBBEBBBBB11B99EB9BBB12
*        1                    *     2           *       3         *       4         *   5       *
*                             *                 *                 *                 *           *
*                             *                 *                 *                 *           *
*                             *                 *                 *                 *           *
1****************************2*****************3*****************4*****************5***********6
```

LOAD CYCLE = 8

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
20	4	2.1688
25	4	-2.1688

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS = 39.1439

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                            **                    **                   **                   **          *


* 111111111111111111111111111111222222222222222222222223333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111222222222222222222222223333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222223333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444333333333333333333333333333333333333333333222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *


  *                            **                    **                   **                   **          *
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BEAM NUMBER 2

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  *                                ** (column markers)
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  *                               **                    **                    **                    **          *

* 111111111111111111111111111111111222222222222222222222233333333333333333333333333333333333333333333444444444444 *
* 111111111111111111111111111111111222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333322222222222222222222222222222222222222222222111111111111 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                               **                    **                    **                    **          *
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BEAM NUMBER 3

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  *                               **                    **                    **                    **          *

* 111111111111111111111111111111111222222222222222222222233333333333333333333333333333333333333333333444444444444 *
* 111111111111111111111111111111111222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333333333333333333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333322222222222222222222222222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333322222222222222222222222222222222222222222222111111111111 *
* FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                               **                    **                    **                    **          *
```

BEAM NUMBER 4

```
  *                               **                    **                    **                    **          *

* 111111111111111111111111111111111222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 111111111111111111111111111111111222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 222222222222222222222222222222222222222222222222222222233333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333333 *
* 333333333333333333333333333333333333333333333333333333333333333333333333333332222222222222222222222222222222222 *
* 444444444444444444444444444444444333333333333333333333333333333333333333333222222222222222222222222222222222222 *
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* 444444444444444444444444444444333333333333333333333333333333333333333333222222222222222222222222222222 *
* 444444444444444444444444444444333333333333333333333333333333333333333333222222222222222222222222222222 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF *

  *                             **                  **                  **                  **         *


     SLAB PLOT

          NODE J                                                                  NODE L

                 ELEMENT NUMBER                    Y = NUMBER OF YIELDED LAYERS

                 C = NUMBER OF CRUSHED LAYERS      T = NUMBER OF CRACKED LAYERS

          NODE I                                                                  NODE K



49***************************50****************51*****************52*****************53*********54
*       36                   *    37           *    38            *    39           *  40       *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
4398888888898888388888888898E44E8888888E888888E45E888888888888888884688888888E888898478988E8888E848
*                            *                 *                  *                 *          *
*       31                   *    32           *    33            *    34           *  35       *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
37***************************38****************39*****************40*****************41*********42
*                            *                 *                  *                 *          *
*       26                   *    27           *    28            *    29           *  30       *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
31838888898898888888988888832E8868888E888839833888E88888889888834888E8888988888358988E898836
*                            *                 *                  *                 *          *
*       21                   *    22           *    23            *    24           *  25       *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
*                            *                 *                  *           T= 2  *     T= 3 *
25***************************26****************27*****************28*****************29*********30
*                            *                 *                  *                 *          *
*       16                   *    17           *    18            *    19           *  20       *
*                            *                 *                  *                 *          *
*                            *                 *                  *           T= 2  *     T= 3 *
199888889889888898898888988E2988888888888888821888E88EE89888888022E898888888888882398E888824
*                            *                 *                  *                 *          *
*       11                   *    12           *    13            *    14           *  15       *
*                            *                 *                  *                 *          *
*                            *                 *                  *                 *          *
```

```
13***************************14*****************15*****************16*****************17**********18
*                            *                  *                  *                  *           *
*         6                  *       7          *        8         *        9         *  10       *
*                            *                  *                  *                  *           *
*                            *                  *                  *                  *           *
*                            *                  *                  *                  *           *
7BBBBBBBBBBBBBBBBBBBBBBBBBBBB8BBBBBBBBBBBBBBBBBB9BBBBBBBBBBBBBBBBBB10BBBBBBBBBBBBBBBBB11BBBBBBBBBB12
*         1                  *       2          *        3         *        4         *   5       *
*                            *                  *                  *                  *           *
*                            *                  *                  *                  *           *
*                            *                  *                  *                  *           *
1****************************2******************3******************4******************5***********6
```

LOAD CYCLE = 9

BRIDGE IS NOT ADEQUATE FOR THE APPLIED LOAD WITH A 10 PER CENT SAFTEY FACTOR

SLAB -FIRST CRACK LOAD = 16.2441 KIPS

SLAB -FIRST CRUSH LOAD = -999.0000 KIPS

SLAB -FIRST YIELD LOAD = -999.0000 KIPS

BEAM -FIRST CRACK LOAD = -999.0000 KIPS

BEAM -FIRST CRUSH LOAD = -999.0000 KIPS

BEAM -FIRST YIELD LOAD = -999.0000 KIPS

TOTAL APPLIED LOAD = 39.144

MAX SHEAR HAS BEEN EXCEEDED(BEAM ELEMENT,LAYER) = NO(0, 0)

BEAM TERMINATION CHECKS / MATERIAL TYPE = 1 2
FOR EXCEEDING LIMITS ON

STRAIN	=	NO		NO	
ELEMENT LAYER		0	0	0	0
TENSILE STRESS	=	NO		NO	
ELEMENT LAYER		0	0	0	0
COMPRESSIVE STRESS	=	NO		NO	
ELEMENT LAYER		0	0	0	0
CRACKED OR YIELDED LAYERS	=	NO		NO	
ELEMENT LAYER		0	0	0	0
CRUSHED LAYERS	=	NO		NO	
ELEMENT LAYER		0	0	0	0

SLAB TERMINATION CHECKS / MATERIAL TYPE = CONCRETE/STEEL-1
FOR EXCEEDING LIMITS ON

STRAIN	=	NO		NO	
ELEMENT LAYER		0	0	0	0
TENSILE STRESS	=	NO		NO	
ELEMENT LAYER		0	0	0	0
COMPRESSIVE STRESS	=	NO		NO	
ELEMENT LAYER		0	0	0	0
CRACKED OR YIELDED LAYERS	=	YES		NO	
ELEMENT LAYER		25	0	0	0
CRUSHED LAYERS	=	NO		NO	
ELEMENT LAYER		0	0	0	0

THIS ANALYTIC MODEL CONSIDERS THE FLEXURAL AND INPLANE BEHAVIOR OF THE DECK SLAB AND THE FLEXURAL AND AXIAL DEFORMATIONS OF THE BEAMS. TRANSVERSE SHEAR DEFORMATION NORMAL TO THE PLANE OF THE DECK SLAB IS NOT CONSIDERED.

THE PREDICTED OVERLOADING OF 6 BRIDGE SUPERSTRUCTURES TO FAILURE HAVE INDICATED THAT (1) AT THE EARLY PHASES OF THE OVERLOADING, I.E. CRACKING OF THE SLAB AND/OR BEAMS, THE RESULTS MAY BE OFF BY 20 PERCENT, (2) AT FIRST YIELDING OR A DECREASE IN STIFFNESS THE RESULTS MAY BE OFF BY 20 PERCENT, AND (3) AT THE LATER STAGES OF OVERLOADING ,I.E. CRUSHING OF THE CONCRETE AND/OR FRACTURING OF THE STEEL THE RESULTS MAY BE OFF BY 10 PERCENT. THESE CONCLUSIONS DEPEND ON THE PARTICULAR DISCRETIZATION, METHOD OF STRESS COMPUTATION, AND ITERATION SCHEME CHOSEN. THUS THE CONCLUSIONS ARE ONLY APPLICABLE TO THE AFOREMENTIONED EXAMPLES. ALSO IT SHOULD BE NOTED THAT THE ABOVE PERCENTAGES ARE THE MAXIMUM OBSERVED DEVIATIONS.

THE ACCURACY OF THE RESULTS DEPENDS UPON THE ACCURACY OF THE INPUT OF THE MATERIAL PROPERTIES, DEFINITION OF THE BRIDGE DESIGN PARAMETERS, AND THE CORRECT SIMULATION OF THE OVERLOAD CONFIGURATION. SUBSTANTIAL DEVIATIONS FROM ANY ONE OF THESE VALUES WILL RESULT IN A SOLUTION THAT MAY NOT BE REPRESENTATIVE OF THE ACTUAL BRIDGE BEHAVIOR.

THE AGE OF THE CONCRETE AND THE DETERIORATION OF THE BRIDGE SUPERSTRUCTURE MUST BE CONSIDERED BY THE USER. THE USER MUST EXERT JUDGEMENT IN THE CORRECT ASSESMENT OF THESE PARAMETERS. ANY SUBSTANTIAL DEVIATION IN THE INPUT FROM THE ACTUAL STATE OF THE SUPERSTRUCTURE MAY RESULT IN AN INCORRECT SIMULATION OF THE OVERLOAD RESPONSE OF THE BRIDGE.

CRACK WIDTHS ARE COMPUTED FROM FORMULAE THAT ARE BASED ON EMPIRICALLY DERIVED RELATIONSHIPS AND ARE THEREFORE CONSIDERED TO BE APPROXIMATE.

THE PROGRAM DOES NOT INCLUDE FATIGUE PROVISIONS FOR THE SUPERSTRUCTURE OR ITS CONSTITUTIVE MATERIALS. IF THE FATIGUE IS BELIEVED TO BE IMPORTANT, THEN IT MAY BE ADVISABLE TO PERFORM A NEW ANALYSIS WITH REDUCED CONCRETE AND/OR STEEL STRENGTHS.

THE ANALYSIS IS CARRIED OUT FOR THE LANE LOCATION OF THE OVERLOAD VEHICLE THAT IS DEFINED BY THE USER OF THE PROGRAM. ANY DEVIATION FROM THIS LANE LOADING IN THE ACTUAL OVERLOADING OF THE BRIDGE MAY RESULT IN A RESPONSE DIFFERENT FROM THAT PREDICTED BY THE PROGRAM.

THE ANALYSIS IS CARRIED OUT FOR THE GIVEN LOADING SPECIFIED BY THE USER. IF DURING THE ACTUAL LOADING OF THE BRIDGE OTHER VEHICLES OF QUESTIONABLE WEIGHT ARE PRESENT IN ADDITION TO THE GIVEN LOADING, THEN THE ACTUAL BRIDGE RESPONSE MAY BE DIFFERENT AS COMPARED TO THAT PREDICTED BY THE PROGRAM.

THE COMPUTER PROGRAM ASSUMES THAT DYNAMIC EFFECTS ARE NOT PRESENT. THUS THE VEHICULAR SPEED SHOULD BE REDUCED TO CRAWL SPEED, I.E. A MAXIMUM OF 5 MPH, DURING THE TRAVEL ACROSS THE BRIDGE. IF THE VEHICLE IS TO TRAVEL THE BRIDGE AT NORMAL TRAFFIC SPEED, THEN THE ACTUAL VEHICULAR LOAD SHOULD BE INCREASED BY SOME IMPACT FACTOR FOR ANALYSIS PURPOSES.

IF THE OVERLOAD ANALYSIS IS CARRIED OUT FOR THE MAXIMUM FLEXURAL RESPONSE, THEN THE USER SHOULD ALSO CONSIDER THE NECESSITY OF AN ANALYSIS FOR A LOAD CONFIGURATION/POSITION WHICH WILL PRODUCE A MAXIMUM HORIZONTAL SHEAR CONDITION IN THE BEAMS NEAR THE SUPPORTS.

IT IS ADVISABLE THAT THE USER CONSIDERS THE MAXIMUM DEFLECTION OF THE BRIDGE SUPERSTRUCTURE AS COMPARED TO THE DESIGN DEFLECTION. THE DESIGN DEFLECTION IS TO BE OBTAINED BY THE USER.

NO SPECIAL STRESS CHECKS HAVE BEEN UNDERTAKEN FOR THE BEAMS WITH DRAPED STRANDS AT THE DRAPE POINTS. THE USER SHOULD INVESTIGATE THIS MANUALLY IF IT IS PERTINENT.

--------------------EXAMPLE BRIDGE 3 --------------------

NUMBER OF SLAB ELEMENTS ALONG THE X-AXIS	= 8
NUMBER OF SLAB ELEMENTS ALONG THE Y-AXIS	= 6
NUMBER OF CONCRETE LAYERS IN SLAB, NULAY	= 6
NUMBER OF STEEL LAYERS IN SLAB, NSLAYR	= 4
BEAM TYPE	= PD26/33
NUMBER OF BEAMS	= 3
TOTAL NUMBER OF BEAM ELEMENTS, NBEAMX	= 24
TYPE OF DISCRETIZATION	= ALL
SPAN OF ENTIRE BRIDGE (FT)	= 50.00
BRIDGE OVERHANG (FT)	= 3.00
BRIDGE WIDTH (FT)	= 18.00
NUMBER OF ACTUAL LAYERS FOR BEAM	= 10
NUMBER OF PRESTRESS STRANDS	= 1
NUMBER OF SLAB ELEMENTS, NUMEL	= 48
NUMBER OF NODAL POINTS, NUMNP	= 63
IS THERE A DETAILED OUTPUT	= NO

ELEMENT LENGTHS IN THE X DIRECTION ARE (IN)

120.0000	90.0000	60.0000	30.0000	30.0000	60.0000	90.0000	120.0000

ELEMENT LENGTHS IN THE Y DIRECTION ARE (IN)

36.0000	36.0000	36.0000	36.0000	36.0000	36.0000

SLAB THICKNESS (IN) = 7.500

NUMBER OF PATCH LOAD CARDS = 2

LOAD CARD	LOAD (KSI)	X OF CENTER(IN)	Y OF C ENTER(IN)	LENGTH(IN)	WIDTH(IN)
1	.0100	285.00	54.00	30.00	36.00
2	.0100	360.00	54.00	60.00	36.00

TOTAL VERTICAL LOAD = 32.4000 KIPS

SLAB-LAYER THICKNESS (IN)

1	1.1666E7
2	1.1666E7
3	1.1666E7
4	1.1666E7
5	1.1666E7
6	1.1666E7

TOP COVER OF SLAB (IN) = 2.00
BOTTOM COVER OF SLAB (IN) = 1.00

UNIAXIAL SLAB CONCRETE COMPRESSIVE STRENGTH = 3.500 KSI

UNIAXIAL BEAM CONCRETE COMPRESSIVE STRENGTH = 4.500 KSI

BEAM SECTION - THICKNESS (IN) OF LAYERS

2.0000

2.0000

3.0000

6.0000

6.0000

4.0000

4.0000

2.0000

2.0000

2.0000

AREA OF PRESTRESS STRAND GROUP	=	4.3200 SQ. IN.
STEEL GRADE	=	250 KSI
INITIAL STRESS	=	175.0000 KSI

PROPERTIES FOR BEAM CROSS-SECTION

AREA	=	615.00 SQ. IN
INERTIA	=	63346.0 IN4
STRAND ECCENTRICITY FROM C.G.	=	7.0400 IN
DEAD LOAD MOMENT ON SECTION	=	2402.34 IN-KIPS
MODULAR RATIO OF STEEL/CONC.	=	6.6391

AGE OF BRIDGE IN YEARS = 40.00

LOSS DUE TO RELAXATION OF STEEL = 7.569 KSI

```
PRESTRESS AFTER LOSSES (EXCEPT ELASTIC LOSS) =  130.340 KSI
ESTIMATED ELASTIC LOSS                       =    7.769 KSI
```

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER ANGLE

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS = 32.4000

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                  **             **        **   **   **        **             **                  *

* 1111111111111111111122222222222222233333333333333333333333333333322222222222222211111111111111111111 *
* 1111111111111111111122222222222222233333333333333333333333333333322222222222222211111111111111111111 *
* 1111111111111111111122222222222222233333333333333333333333333333322222222222222211111111111111111111 *
* 2222222222222222222222222222222222233333333333333333333333333333322222222222222222222222222222222222 *
* 2222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222222222211111222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222221111111111111111111122222222222222233333333333333333333 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE *

  *                  **             **        **   **   **        **             **                  *
```

BEAM NUMBER 2

```
  *                  **             **        **   **   **        **             **                  *

* 1111111111111111111122222222222222233333333333333333333333333333322222222222222211111111111111111111 *
* 1111111111111111111122222222222222233333333333333333333333333333322222222222222211111111111111111111 *
* 1111111111111111111122222222222222233333333333333333333333333333322222222222222211111111111111111111 *
* 2222222222222222222222222222222222233333333333333333333333333333322222222222222222222222222222222222 *
* 2222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
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* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE *

  *                  **             **         **   **   **         **             **                  *


BEAM NUMBER  3

  *                  **             **         **   **   **         **             **                  *


* 1111111111111111111112222222222222223333333333333333333333333333333322222222222222221111111111111111 *
* 1111111111111111111112222222222222223333333333333333333333333333333322222222222222221111111111111111 *
* 1111111111111111111112222222222222223333333333333333333333333333333322222222222222221111111111111111 *
* 2222222222222222222222222222222222223333333333333333333333333333222222222222222222222222222222222222 *
* 2222222222222222222222222222222222222222222222222222223333322222222222222222222222222222222222222222 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333322222222222222222222222222222222222222222222222222222222222233333333333333333333 *
* 3333333333333333333333333333333333222222222222222222222222222222223333333333333333333333333333333333 *
* 3333333333333333333333333333333333222222222222222222222222222222223333333333333333333333333333333333 *
* 3333333333333333333333333333333333222222222222222222222222222222223333333333333333333333333333333333 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE *

  *                  **             **         **   **   **         **             **                  *


     SLAB PLOT

          NODE J                                                                NODE L

                 ELEMENT NUMBER                    Y = NUMBER OF YIELDED LAYERS

                 C = NUMBER OF CRUSHED LAYERS      T = NUMBER OF CRACKED LAYERS

          NODE I                                                                NODE K



55*****************56************57***********58***********59***********60***********61************62*****************63
*   41             *  42         *  43        *  44        *  45        *  46        *  47         *      48         *
*                  *             *            *            *            *            *             *                 *
*                  *             *            *            *            *            *             *                 *
*                  *             *            *            *            *            *             *                 *
463B8888B8C9B88888847888888889808488888E8E800049BB88E8B8E8B850B8888BE888851BE83988B89052BB988BE98BB53B8888888888B88854
*   33             *  34         *  35        *  36        *  37        *  38        *  39         *      40         *
*                  *             *            *            *            *            *             *                 *
*                  *             *            *            *            *            *             *                 *
*                  *             *            *            *            *            *             *                 *
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37****************38***********39***********40**********41**********42**********43***********44****************45
*     25          *  26        *  27        *  28       *  29       *  30       *  31        *      32         *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
28888888888888888829888888888883088888888883188888888883288888888883388888888883488888888888358888888888888888836
*     17          *  18        *  19        *  20       *  21       *  22       *  23        *      24         *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
19****************20***********21***********22**********23**********24**********25***********26****************27
*      9          *  10        *  11        *  12       *  13       *  14       *  15        *      16         *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
10888888888888888811888888888881288888888881388888888881488888888881588888888881688888888888178888888888888888818
*      1          *   2        *   3        *   4       *   5       *   6       *   7        *       8         *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
*                 *            *            *           *           *           *            *                *
1*****************2************3************4***********5***********6***********7************8*****************9
```

LOAD CYCLE = 1

SLAB - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT	LAYER	ANGLE
14	6	-15.9363

BEAM - NEWLY CRACKED, CRUSHED OR YIELDED LAYERS

ELEMENT LAYER

SUM OF NODAL POINT W-LOADS = 35.6400

PLOT SHOWING CRACK-CRUSH AREAS, STRESSES, NODE AND LAYER MARKERS FOR REFERENCE
(SEE USERS MANUAL FOR DETAILS)

BEAM NUMBER 1

```
  *                **            **        **   **   **       **             **                   *

* 11111111111111111222222222222223333333333333333333333333333333333331111111111111111111 *
* 11111111111111111222222222222223333333333333333333333222222222222222111111111111111111 *
* 11111111111111111222222222222222333333333333333333333222222222222222111111111111111111 *
* 22222222222222222222222222222222333333333333333333333222222222222222222222222222222222 *
* 22222222222222222222222222222222222222222222222222222222222222222222222222222222222222 *
* 33333333333333333222222222222222222222222222222222222222222222222222233333333333333333 *
* 33333333333333333222222222222222222222222222222222222222222222222222233333333333333333 *
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-211-

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* 3333333333333333333333222222222222222222222222222111111111111111111112222222222222222233333333333333333333333 *
* 3333333333333333333333222222222222222222222222222111111111111111111112222222222222222233333333333333333333333 *
* EEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEEEEEEEEEEEEEEEF *

  *                   **              **        **    **    **        **              **                     *


BEAM NUMBER  2

  *                   **              **        **    **    **        **              **                     *

* 111111111111111111111122222222222222222333333333333333333333333333333222222222222222221111111111111111111111 *
* 111111111111111111111122222222222222222333333333333333333333333333333222222222222222221111111111111111111111 *
* 111111111111111111111122222222222222222333333333333333333333333333333222222222222222221111111111111111111111 *
* 222222222222222222222222222222222222223333333333333333333333333333333322222222222222222222222222222222222222 *
* 222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222 *
* 333333333333333333333322222222222222222222222222222222222222222222222222222222222222223333333333333333333333 *
* 333333333333333333333322222222222222222222222222222222222222222222222222222222222222223333333333333333333333 *
* 333333333333333333333322222222222222222222222222222222222222222222222222222222222222223333333333333333333333 *
* 333333333333333333333322222222222222222222222222222222222222222222222222222222222222223333333333333333333333 *
* 333333333333333333333322222222222222222222222222222222222222222222222222222222222222223333333333333333333333 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEFFFFFFFFFFFFFFFFFFFFFFFFFFFFEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE *

  *                   **              **        **    **    **        **              **                     *


BEAM NUMBER  3

  *                   **              **        **    **    **        **              **                     *

* 111111111111111111111122222222222222222333333333333333333333333333333222222222222222221111111111111111111111 *
* 111111111111111111111122222222222222222333333333333333333333333333333222222222222222221111111111111111111111 *
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* 222222222222222222222222222222222222223333333333333333333333333333333322222222222222222222222222222222222222 *
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* 333333333333333333333333333333333333332222222222222222222222222222222233333333333333333333333333333333333333 *
* EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE *

  *                   **              **        **    **    **        **              **                     *

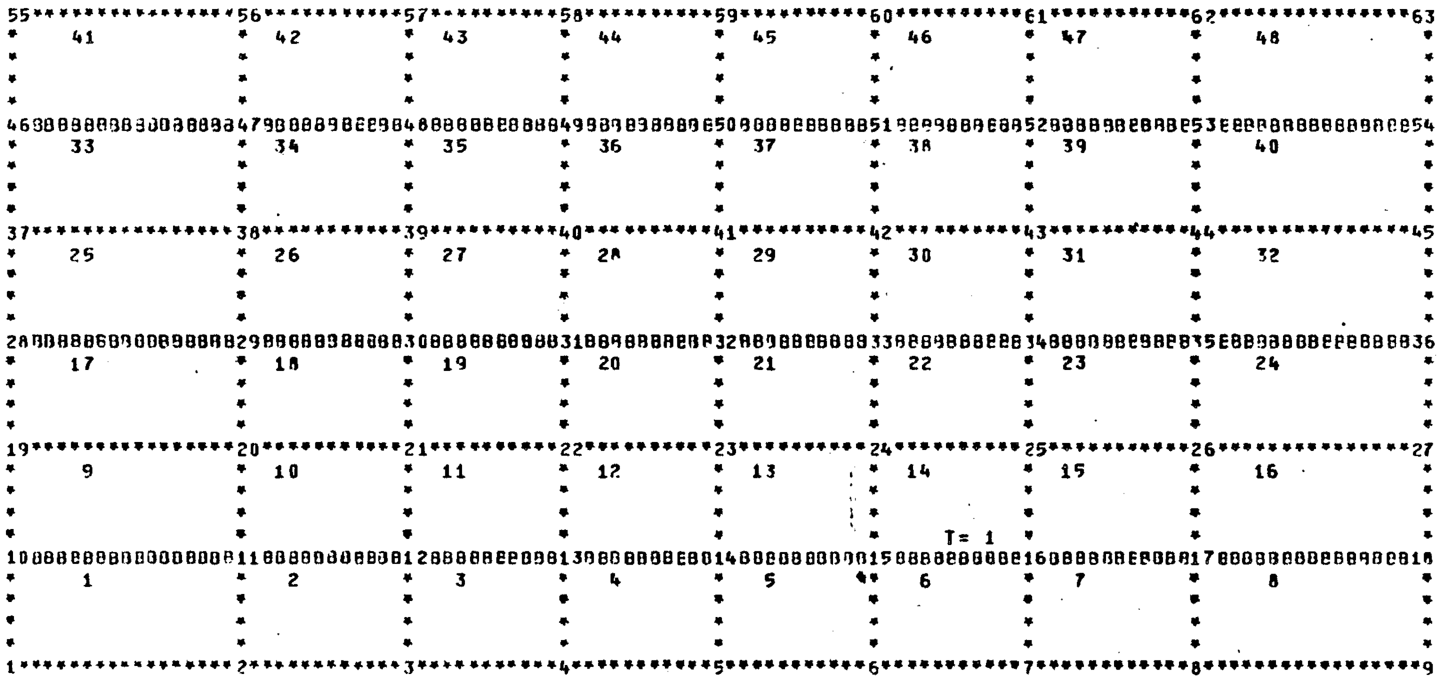

     SLAB PLOT

          NODE J                                                                       NODE L
```

ELEMENT NUMBER   Y = NUMBER OF YIELDED LAYERS

C = NUMBER OF CRUSHED LAYERS   T = NUMBER OF CRACKED LAYERS

NODE I   NODE K



LOAD CYCLE =   2

BRIDGE IS ADEQUATE FOR THE APPLIED LOAD WITH A 10 PER CENT SAFTEY FACTOR

SLAB -FIRST CRACK LOAD =   35.6400 KIPS

SLAB -FIRST CRUSH LOAD =   -999.0000 KIPS

BEAM -FIRST CRACK LOAD = -999.0000 KIPS

BEAM -FIRST CRUSH LOAD = -999.0000 KIPS

BEAM -FIRST YIELD LOAD = -999.0000 KIPS

TOTAL APPLIED LOAD = 35.640

MAX SHEAR HAS BEEN EXCEEDED(BEAM ELEMENT,LAYER)= NO(0, 0)

BEAM TERMINATION CHECKS / MATERIAL TYPE = 1 2
FOR EXCEEDING LIMITS ON

		1	2
STRAIN	=	NO	NO
ELEMENT LAYER		0 0	0 0
TENSILE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
COMPRESSIVE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
CRACKED OR YIELDED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0
CRUSHED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0

SLAB TERMINATION CHECKS / MATERIAL TYPE = CONCRETE/STEEL-1
FOR EXCEEDING LIMITS ON

STRAIN	=	NO	NO
ELEMENT LAYER		0 0	0 0
TENSILE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0
COMPRESSIVE STRESS	=	NO	NO
ELEMENT LAYER		0 0	0 0

CRACKED OR YIELDED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0
CRUSHED LAYERS	=	NO	NO
ELEMENT LAYER		0 0	0 0

THIS ANALYTIC MODEL CONSIDERS THE FLEXURAL AND INPLANE BEHAVIOR OF THE DECK SLAB AND THE FLEXURAL AND AXIAL DEFORMATIONS OF THE BEAMS. TRANSVERSE SHEAR DEFORMATION NORMAL TO THE PLANE OF THE DECK SLAB IS NOT CONSIDERED.

THE PREDICTED OVERLOADING OF 6 BRIDGE SUPERSTRUCTURES TO FAILURE HAVE INDICATED THAT (1) AT THE EARLY PHASES OF THE OVERLOADING, I.E. CRACKING OF THE SLAB AND/OR BEAMS, THE RESULTS MAY BE OFF BY 20 PERCENT, (2) AT FIRST YIELDING OR A DECREASE IN STIFFNESS THE RESULTS MAY BE OFF BY 20 PERCENT, AND (3) AT THE LATER STAGES OF OVERLOADING ,I.E. CRUSHING OF THE CONCRETE AND/OR FRACTURING OF THE STEEL THE RESULTS MAY BE OFF BY 10 PERCENT. THESE CONCLUSIONS DEPEND ON THE PARTICULAR DISCRETIZATION, METHOD OF STRESS COMPUTATION, AND ITERATION SCHEME CHOSEN. THUS THE CONCLUSIONS ARE ONLY APPLICABLE TO THE AFOREMENTIONED EXAMPLES. ALSO IT SHOULD BE NOTED THAT THE ABOVE PERCENTAGES ARE THE MAXIMUM OBSERVED DEVIATIONS.

THE ACCURACY OF THE RESULTS DEPENDS UPON THE ACCURACY OF THE INPUT OF THE MATERIAL PROPERTIES, DEFINITION OF THE BRIDGE DESIGN PARAMETERS, AND THE CORRECT SIMULATION OF THE OVERLOAD CONFIGURATION. SUBSTANTIAL DEVIATIONS FROM ANY ONE OF THESE VALUES WILL RESULT IN A SOLUTION THAT MAY NOT BE REPRESENTATIVE OF THE ACTUAL BRIDGE BEHAVIOR.

THE AGE OF THE CONCRETE AND THE DETERIORATION OF THE BRIDGE SUPERSTRUCTURE MUST BE CONSIDERED BY THE USER. THE USER MUST EXERT JUDGEMENT IN THE CORRECT ASSESMENT OF THESE PARAMETERS. ANY SUBSTANTIAL DEVIATION IN THE INPUT FROM THE ACTUAL STATE OF THE SUPERSTRUCTURE MAY RESULT IN AN INCORRECT SIMULATION OF THE OVERLOAD RESPONSE OF THE BRIDGE.

CRACK WIDTHS ARE COMPUTED FROM FORMULAE THAT ARE BASED ON EMPIRICALLY DERIVED RELATIONSHIPS AND ARE THEREFORE CONSIDERED TO BE APPROXIMATE.

THE PROGRAM DOES NOT INCLUDE FATIGUE PROVISIONS FOR THE SUPERSTRUCTURE OR ITS CONSTITUTIVE MATERIALS. IF THE FATIGUE IS BELIEVED TO BE IMPORTANT, THEN IT MAY BE ADVISABLE TO PERFORM A NEW ANALYSIS WITH REDUCED CONCRETE AND/OR STEEL STRENGTHS.

THE ANALYSIS IS CARRIED OUT FOR THE LANE LOCATION OF THE OVERLOAD VEHICLE THAT IS DEFINED BY THE USER OF THE PROGRAM. ANY DEVIATION FROM THIS LANE LOADING IN THE ACTUAL OVERLOADING OF THE BRIDGE MAY RESULT IN A RESPONSE DIFFERENT FROM THAT

THE ANALYSIS IS CARRIED OUT FOR THE GIVEN LOADING SPECIFIED BY THE USER. IF DURING THE ACTUAL LOADING OF THE BRIDGE OTHER VEHICLES OF QUESTIONABLE HEIGHT ARE PRESENT IN ADDITION TO THE GIVEN LOADING, THEN THE ACTUAL BRIDGE RESPONSE MAY BE DIFFERENT AS COMPARED TO THAT PREDICTED BY THE PROGRAM.

THE COMPUTER PROGRAM ASSUMES THAT DYNAMIC EFFECTS ARE NOT PRESENT. THUS THE VEHICULAR SPEED SHOULD BE REDUCED TO CRAWL SPEED, I.E. A MAXIMUM OF 5 MPH, DURING THE TRAVEL ACROSS THE BRIDGE. IF THE VEHICLE IS TO TRAVEL THE BRIDGE AT NORMAL TRAFFIC SPEED, THEN THE ACTUAL VEHICULAR LOAD SHOULD BE INCREASED BY SOME IMPACT FACTOR FOR ANALYSIS PURPOSES.

IF THE OVERLOAD ANALYSIS IS CARRIED OUT FOR THE MAXIMUM FLEXURAL RESPONSE, THEN THE USER SHOULD ALSO CONSIDER THE NECESSITY OF AN ANALYSIS FOR A LOAD CONFIGURATION/POSITION WHICH WILL PRODUCE A MAXIMUM HORIZONTAL SHEAR CONDITION IN THE BEAMS NEAR THE SUPPORTS.

IT IS ADVISABLE THAT THE USER CONSIDERS THE MAXIMUM DEFLECTION OF THE BRIDGE SUPERSTRUCTURE AS COMPARED TO THE DESIGN DEFLECTION. THE DESIGN DEFLECTION IS TO BE OBTAINED BY THE USER.

NO SPECIAL STRESS CHECKS HAVE BEEN UNDERTAKEN FOR THE BEAMS WITH DRAPED STRANDS AT THE DRAPE POINTS. THE USER SHOULD INVESTIGATE THIS MANUALLY IF IT IS PERTINENT.

7. TABLES

TABLE 1: DIMENSIONS OF I-BEAMS (INCHES)

Name	D1	D2	D3	D4	D5	B1	B2	B3
Type I	4	3	11	5	5	12	16	6
Type II	6	3	15	6	6	12	18	6
Type III	7	4½	19	7½	7	16	22	7
Type IV	8	6	23	9	8	20	26	8
Type V*	5	3	37	10	8	42	28	8
Type VI*	5	3	46	10	8	42	28	8
18/30	3	3	12	8	4	12	18	6
20/30	3	3	12	8	4	14	20	8
18/33	4	3	12	8	6	12	18	6
20/33	4	3	12	8	6	14	20	8
24/33	4	3	12	8	6	18	24	12
26/33	4	3	12	8	6	20	26	14
18/36	5	3	12	8	8	12	18	6
20/36	5	3	12	8	8	14	20	8
24/36	5	3	12	8	8	18	24	12
26/36	5	3	12	8	8	20	26	14
20/39	8	3	12	8	8	14	20	8
24/42	4	4	17	10	7	18	24	8
24/45	7	4	17	10	7	18	24	8
24/48	8	4	17	10	9	18	24	8
24/51	11	4	17	10	9	18	24	8
24/54	14	4	17	10	9	18	24	8
24/60	6	6	29	10	9	24	24	8
26/60	6	6	29	10	9	26	26	10
26/63	9	6	29	10	9	26	26	10

* Idealized Dimensions Used in This Study

TABLE 2: BEAM INPUT CODES FOR AUTOMATIC ASSIGNMENT OF LAYER PROPERTIES

AASHTO-PCI Beams	Input Code
Type I	AASHO-1
Type II	AASHO-2
Type III	AASHO-3
Type IV	AASHO-4
Type V	AASHO-5
Type VI	AASHO-6

Pennsylvania Department of Transportation Beams	Input Code
18/30	PD18/30
20/30	PD20/30
18/33	PD18/33
20/33	PD20/33
24/33	PD24/33
26/33	PD26/33
18/36	PD18/36
20/36	PD20/36
24/36	PD24/36
26/36	PD26/36
20/39	PD20/39
24/42	PD24/42
24/45	PD24/45
24/48	PD24/48
24/51	PD24/51
24/54	PD24/54
24/60	PD24/60
26/60	PD26/60
26/63	PD26/63

TABLE 3: SLAB REINFORCEMENT[4]

(Taken from Ref. 24)

Clear Spans[1]	Slab Thickness[2]	Transverse Reinforcement	Longitudinal Reinforcement Bottom	N[3]
2'-9"	7½"	#4 @ 7½"	#4 @ 11"	3
3'-0"	7½"	#4 @ 7"	#4 @ 10"	3
3'-5"	7½"	#4 @ 6½"	#4 @ 9"	4
3'-9"	7½"	#4 @ 6"	#4 @ 9"	4
4'-3"	7½"	#5 @ 8½"	#5 @ 12"	4
4'-7"	7½"	#5 @ 8"	#5 @ 11"	4
4'-11"	7½"	#5 @ 7½"	#5 @ 11"	5
5'-3"	7½"	#5 @ 7"	#5 @ 10"	5
5'-5"	7½"	#5 @ 6½"	#5 @ 9"	6
5'-7"	7½"	#5 @ 6"	#5 @ 9"	6
5'-10"	8"	#5 @ 7"	#5 @ 10"	6
6'-4"	8"	#5 @ 6½"	#5 @ 9"	7
6'-7"	8"	#5 @ 6"	#5 @ 9"	8
6'-10"	8"	#5 @ 5½"	#5 @ 8"	9
7'-0"	8½"	#5 @ 6½"	#5 @ 9"	8
7'-7"	8½"	#5 @ 6"	#5 @ 9"	9
7'-9"	8½"	#5 @ 5½"	#5 @ 8"	10

1 Not exceeding ½"

2 Includes ½" integral wearing surface

3 Number of longitudinal bars in bottom of slab between beams, place symmetric about center line of clear span

4 The slab reinforcement provisions do not exactly correspond to the current prevailing design specifications. However, the given values were used extensively in the 1960s and 1970s.

8. <u>F I G U R E S</u>

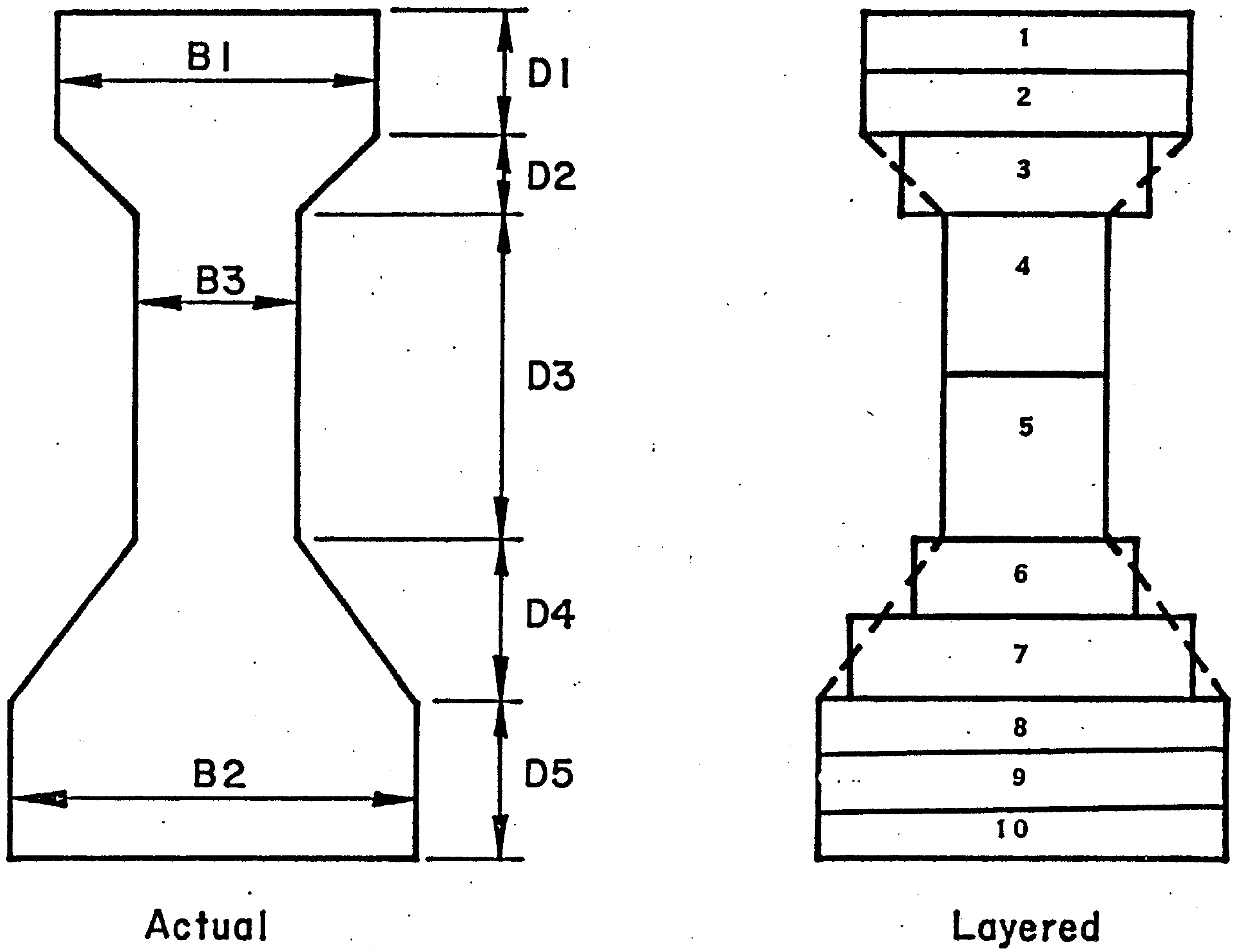


Fig. 1 Beam Layering (AASHTO-PCI Beams Types I, II, III, IV and PennDOT Sections)

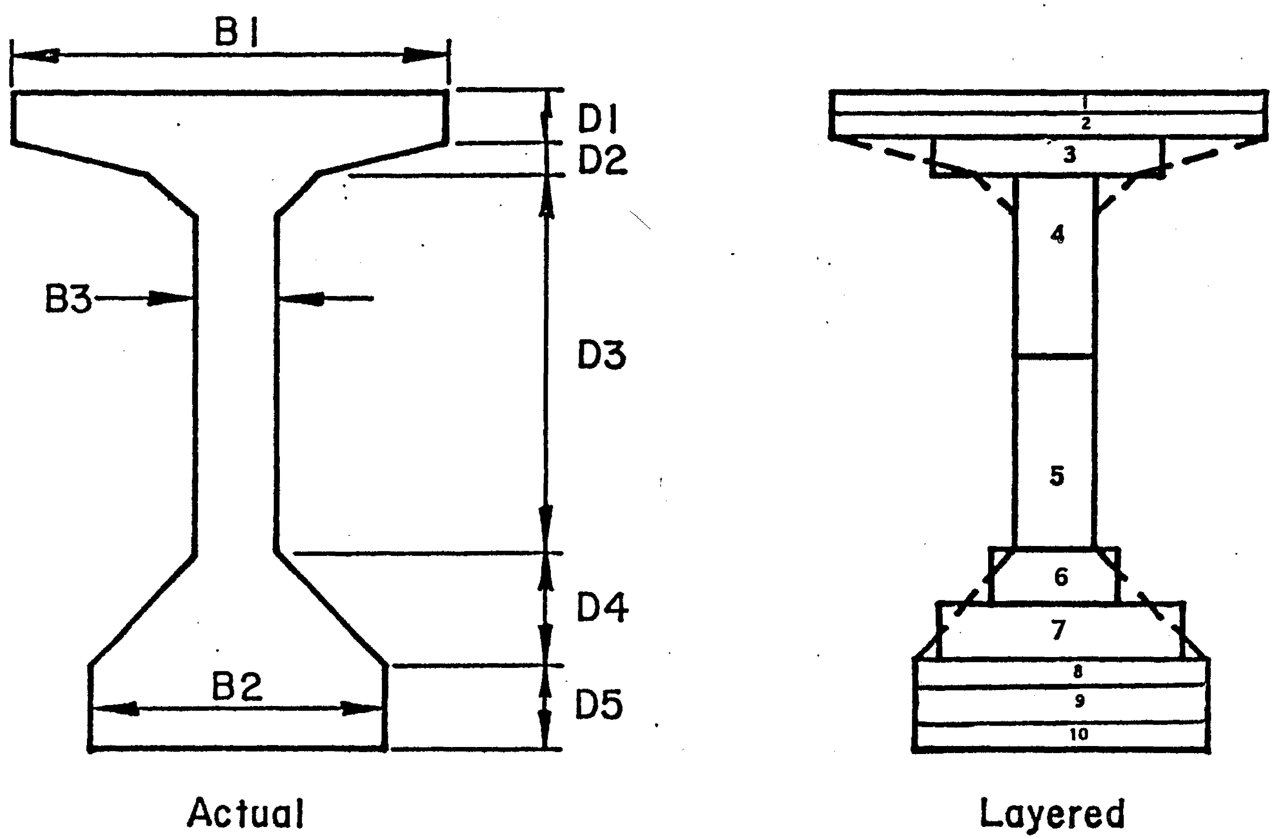


Fig. 2 Beam Layering (AASHTO-PCI Beams Types V and VI)

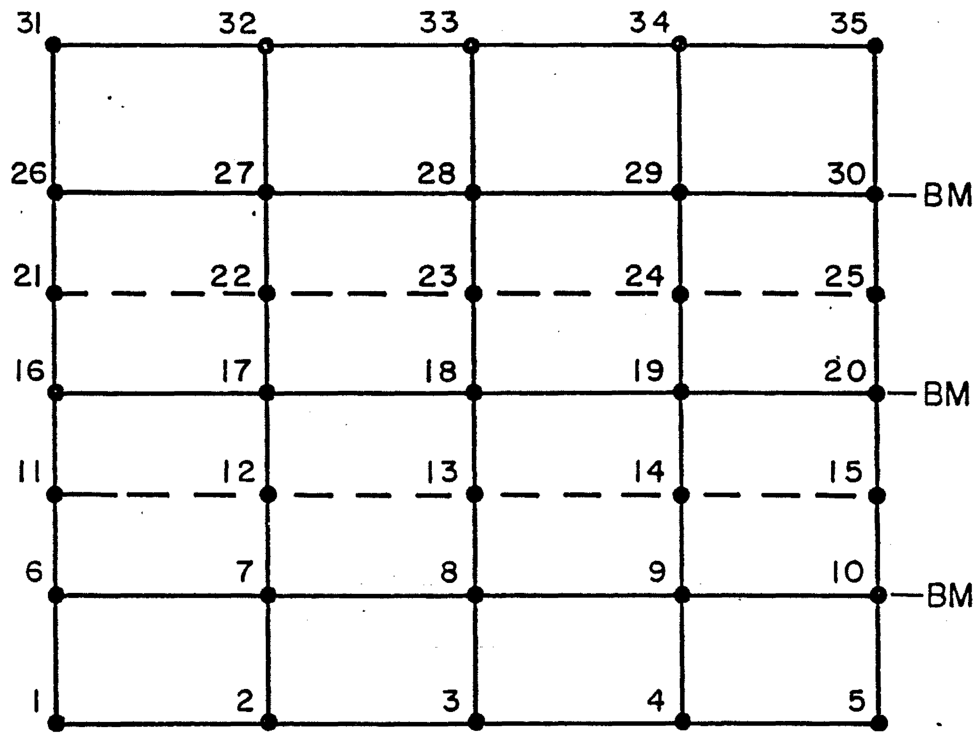


Fig. 3 Nodal Point Numbering Scheme

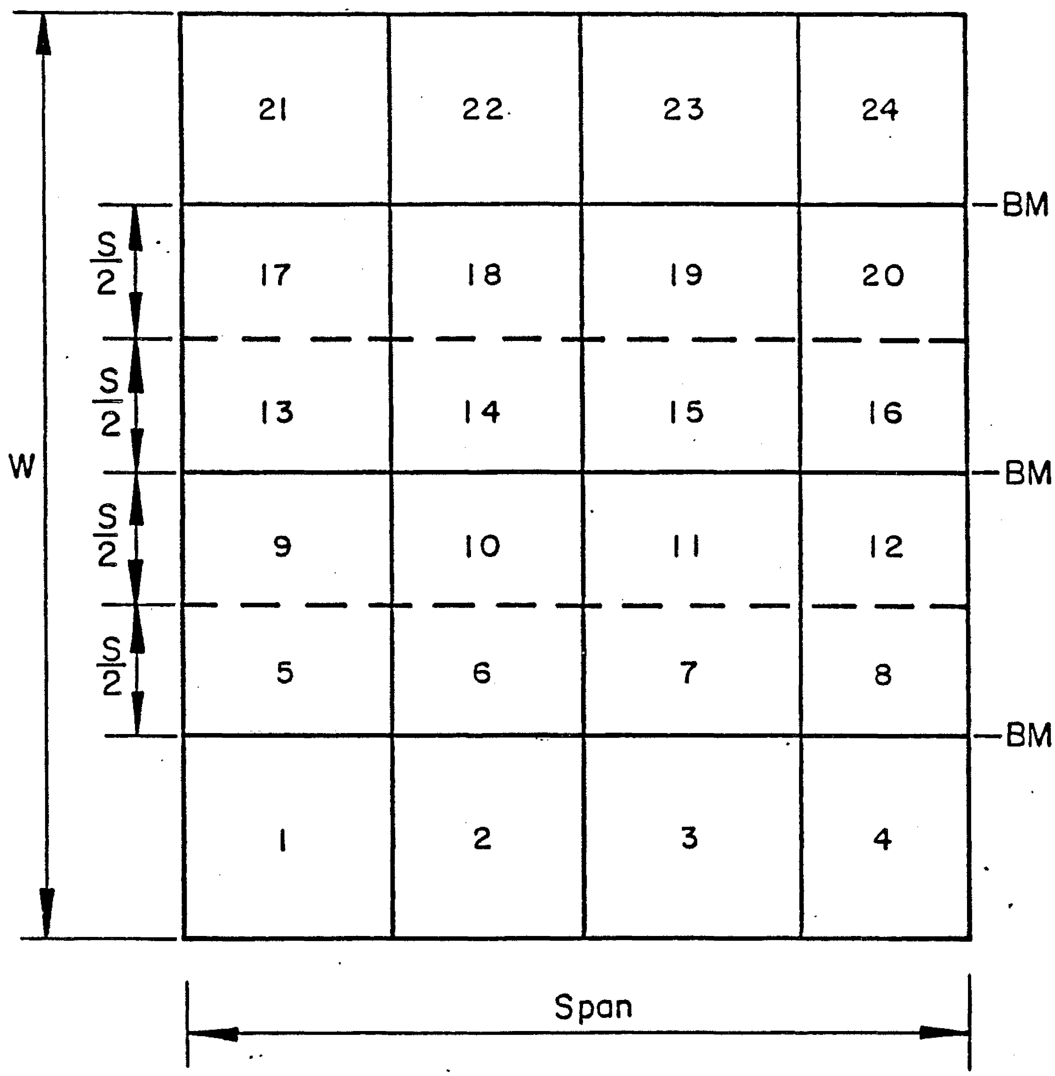


Fig. 4 Plate Element Numbering Scheme

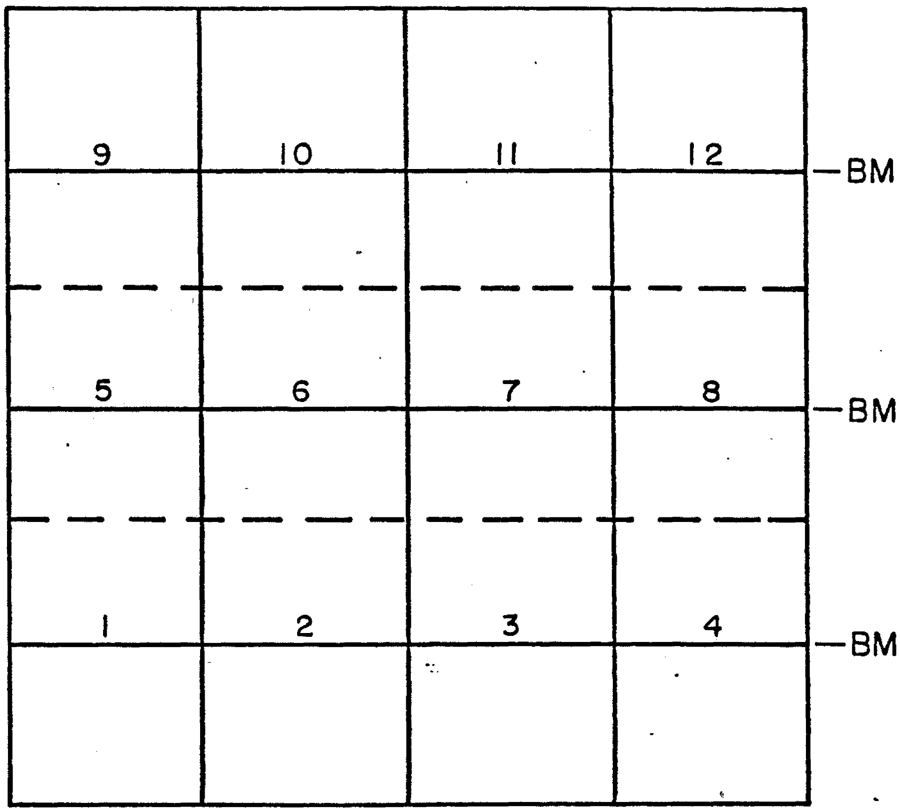


Fig. 5 Beam Element Numbering Scheme

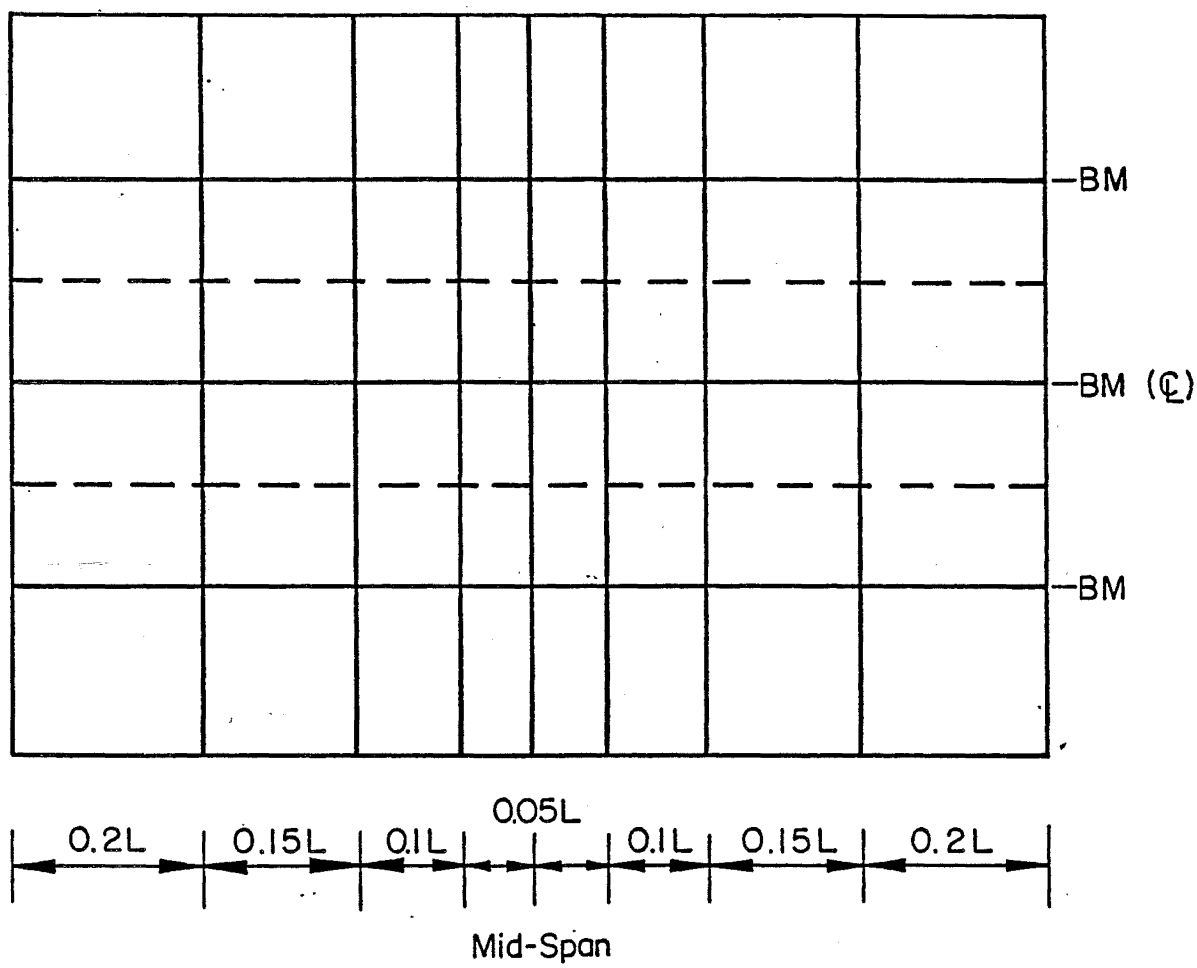


Fig. 6 Automatic Discretization-Full Bridge

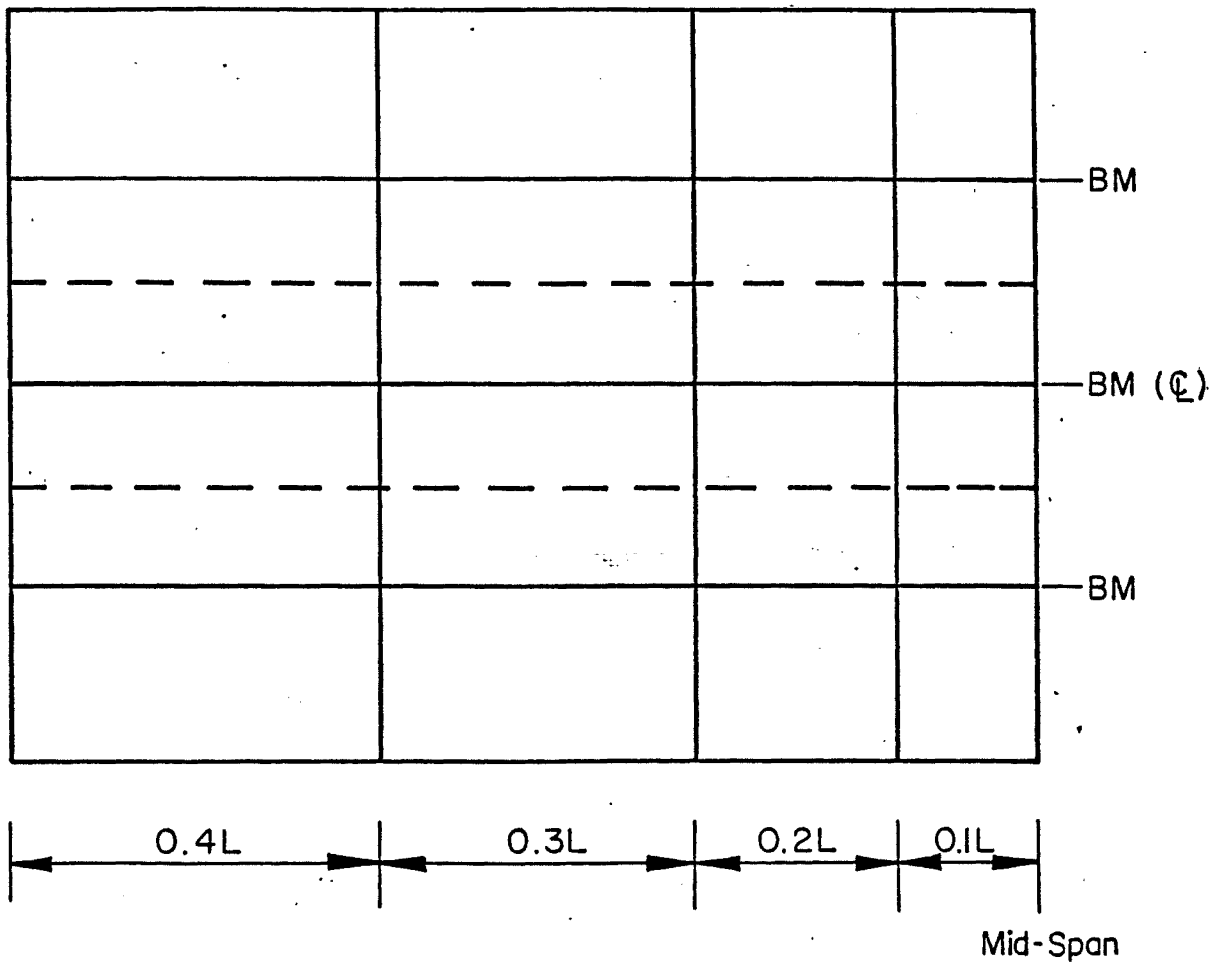


Fig. 7 Automatic Discretization-Half Bridge

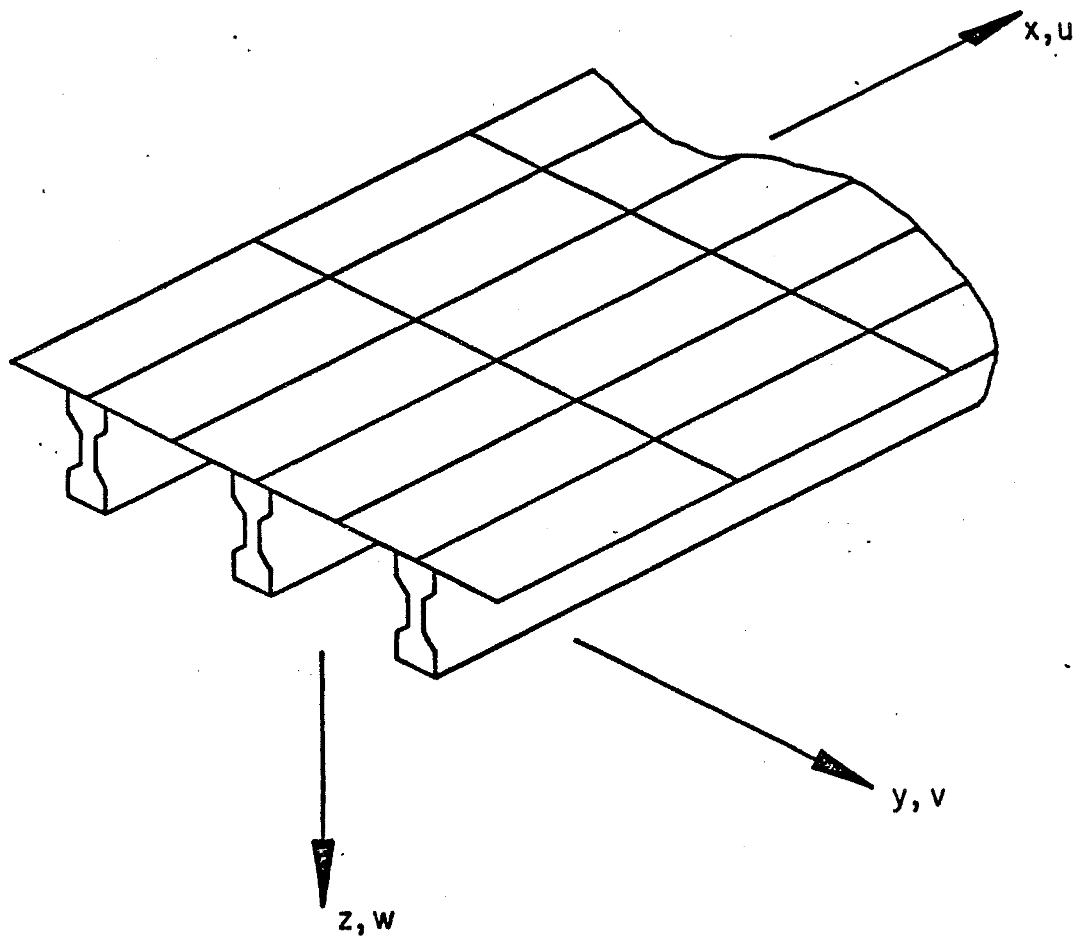


Fig. 8 Beam-Slab Discretization of Bridge Superstructure

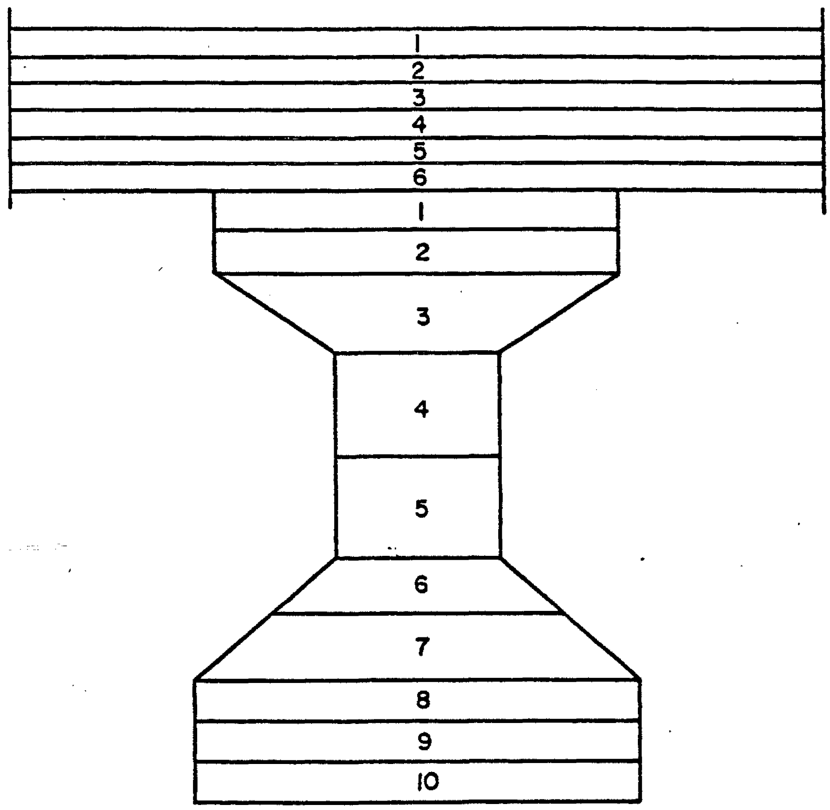


Fig. 9 Beam and Slab Layer Numbering Scheme

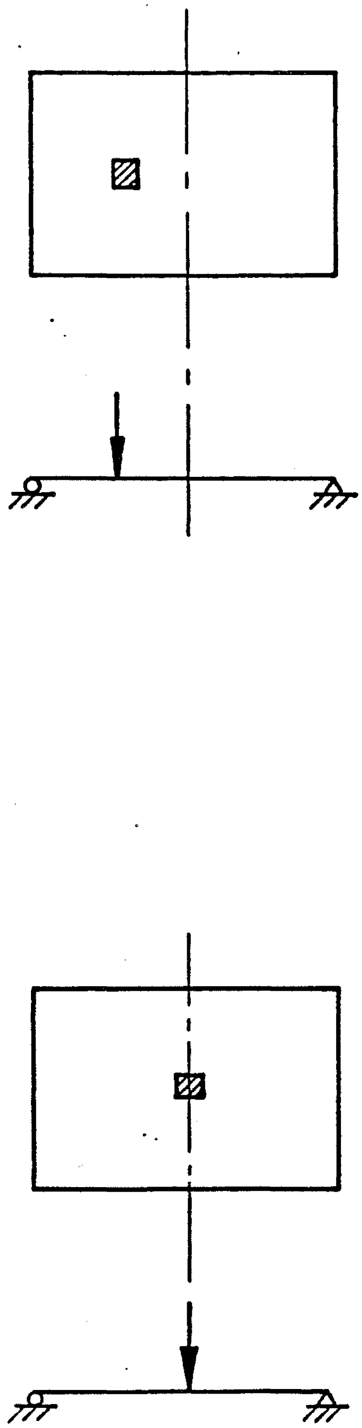
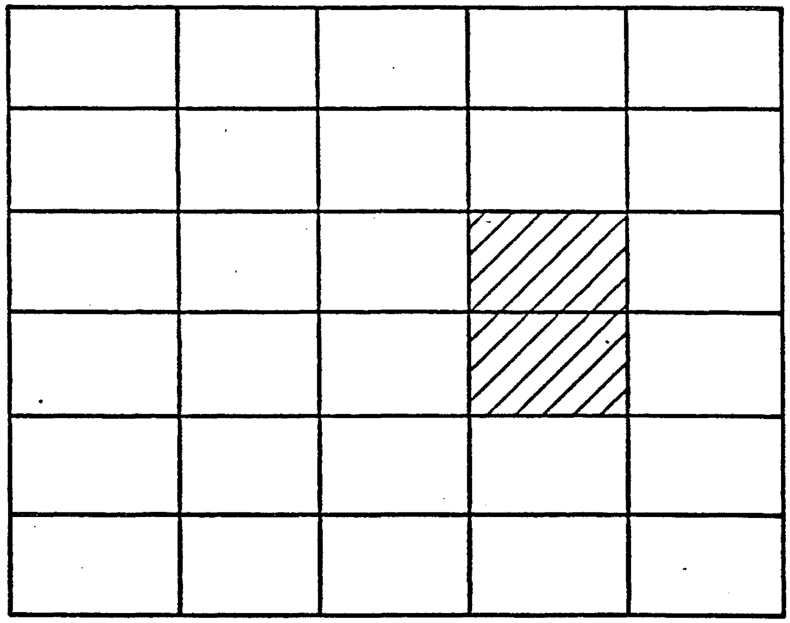


Fig. 10 Nonsymmetric (Top) and Symmetric (Bottom) Loading Arrangements



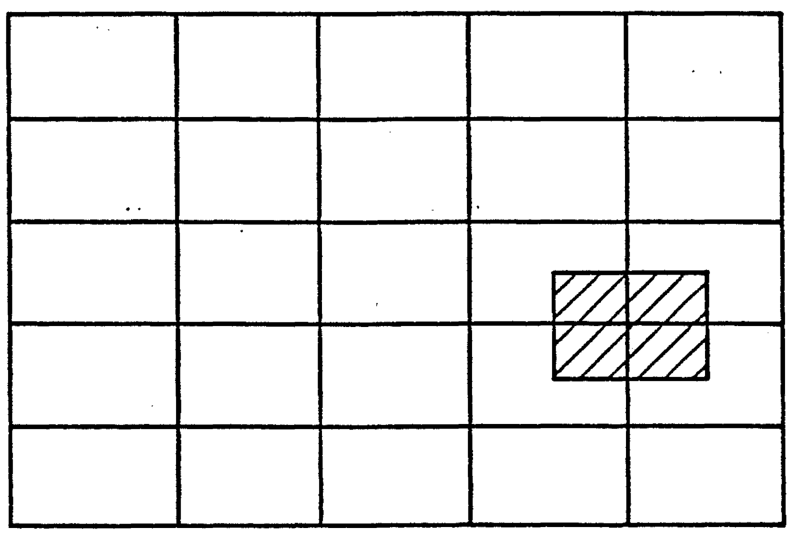


Fig. 11 Acceptable and Desirable (Top) and Acceptable But Undesirable (Bottom) Loading vs. Discretization

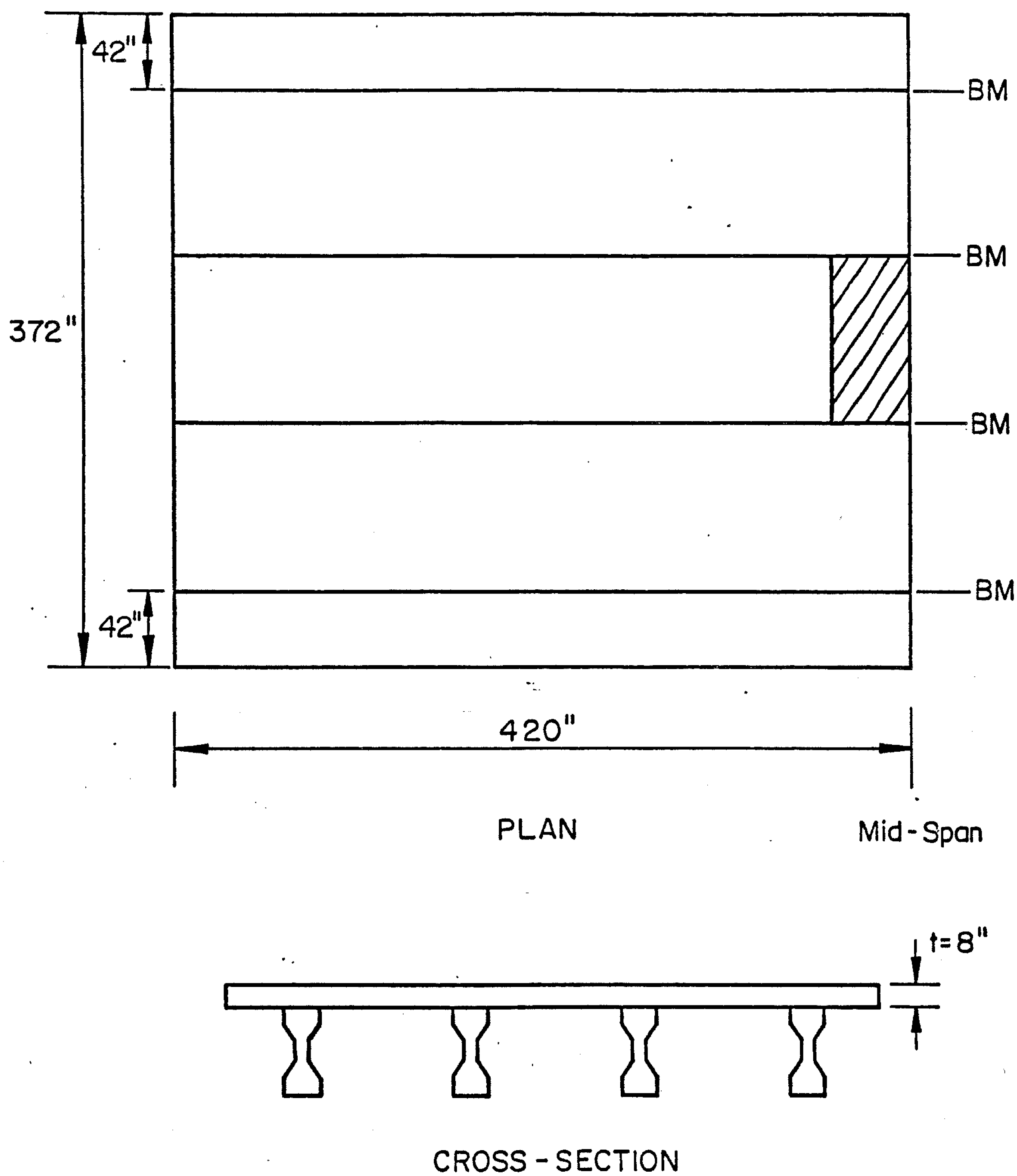


Fig. 12 Plan and Cross Section of Example-1

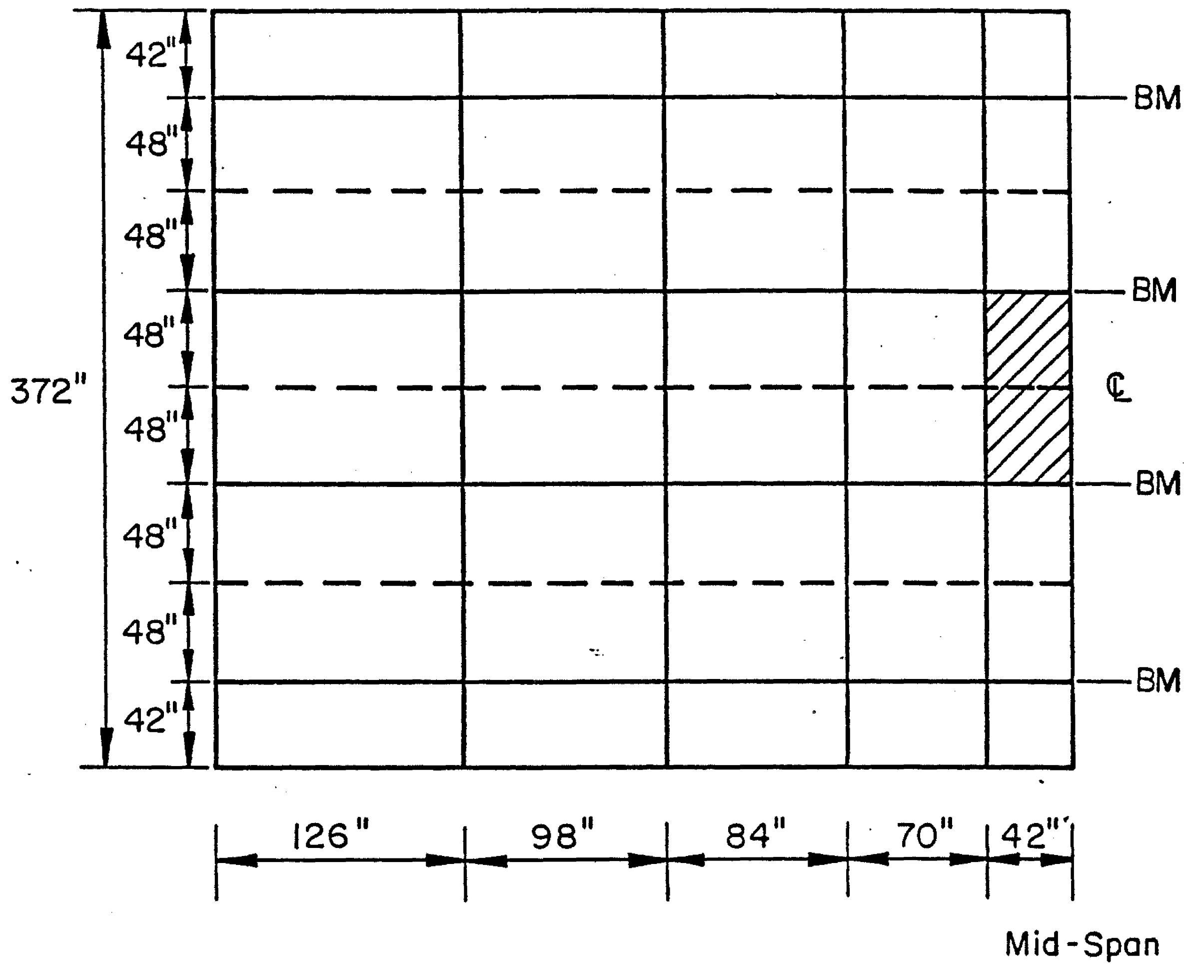


Fig. 13 Discretization of Example-1

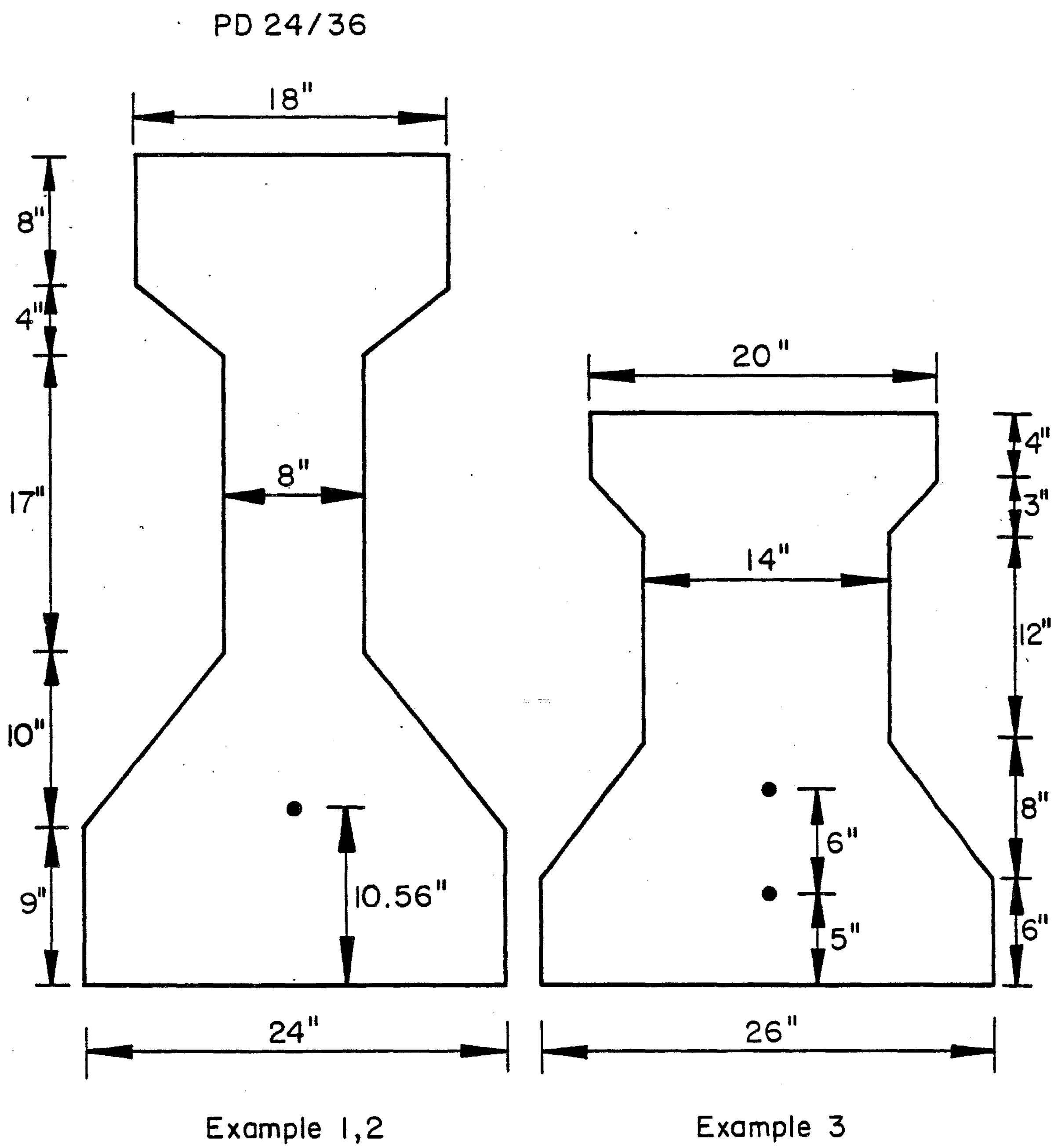


Fig. 14 Beam Details for Examples

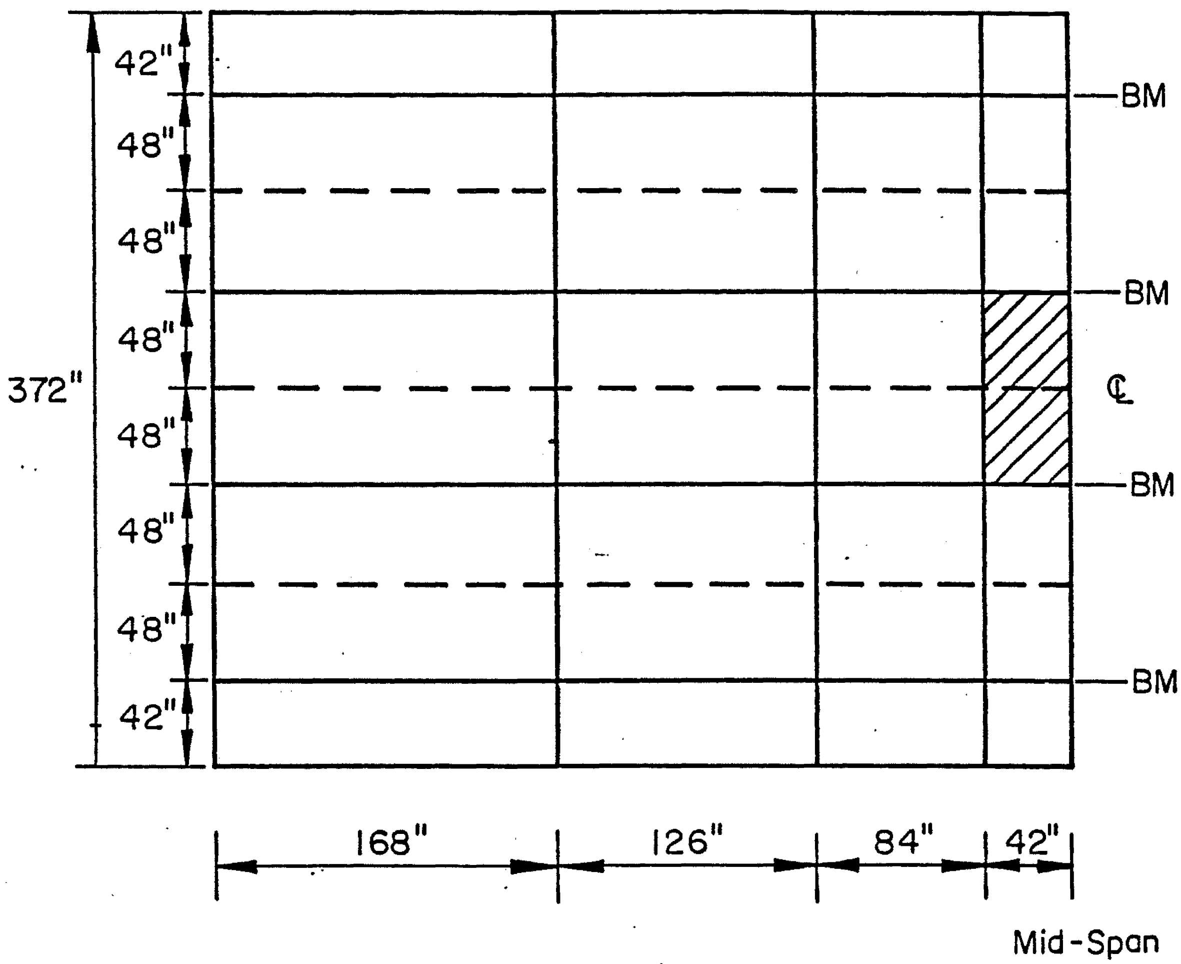


Fig. 15 Discretization of Example-2

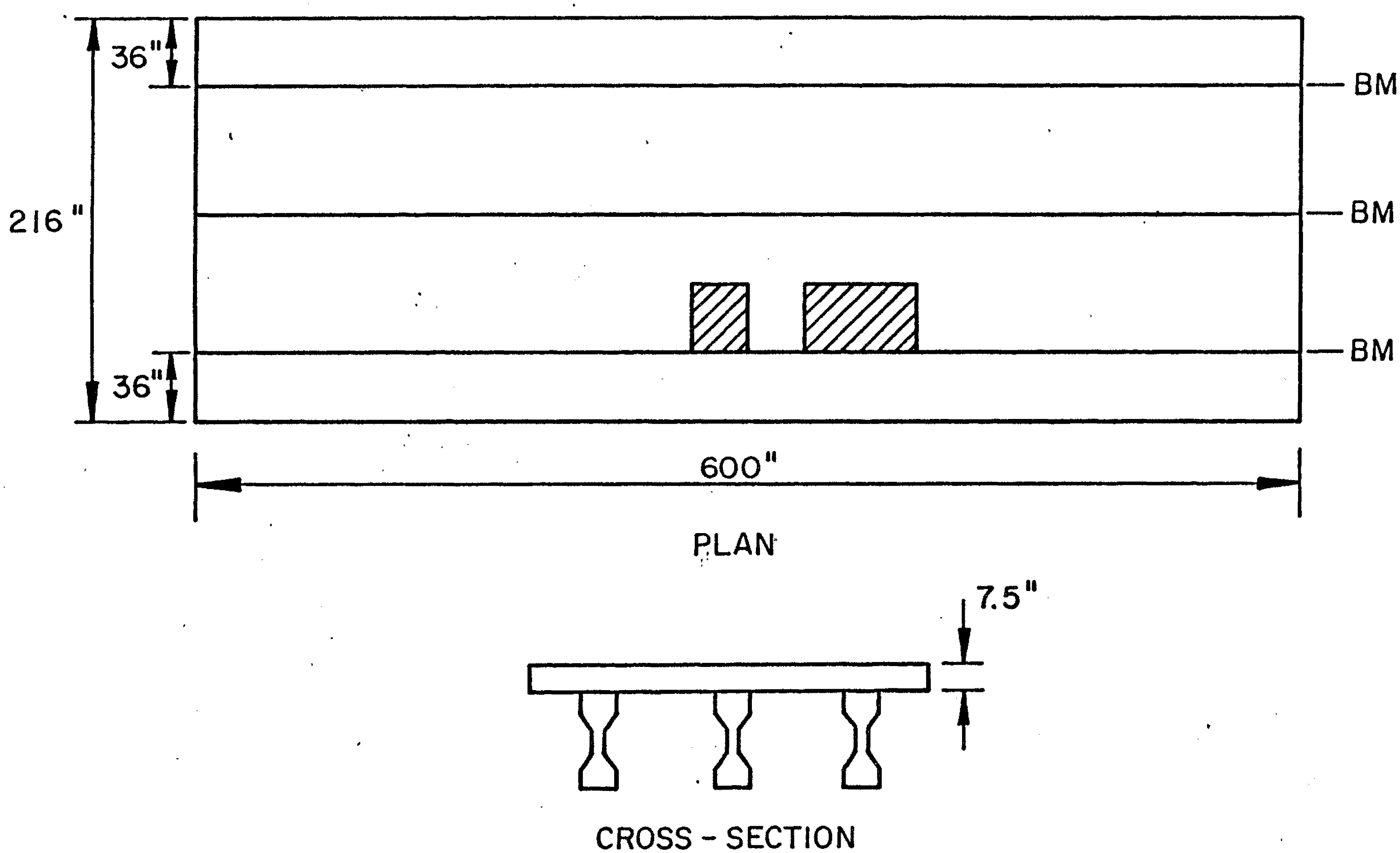


Fig. 16 Plan and Cross Section of Example-3

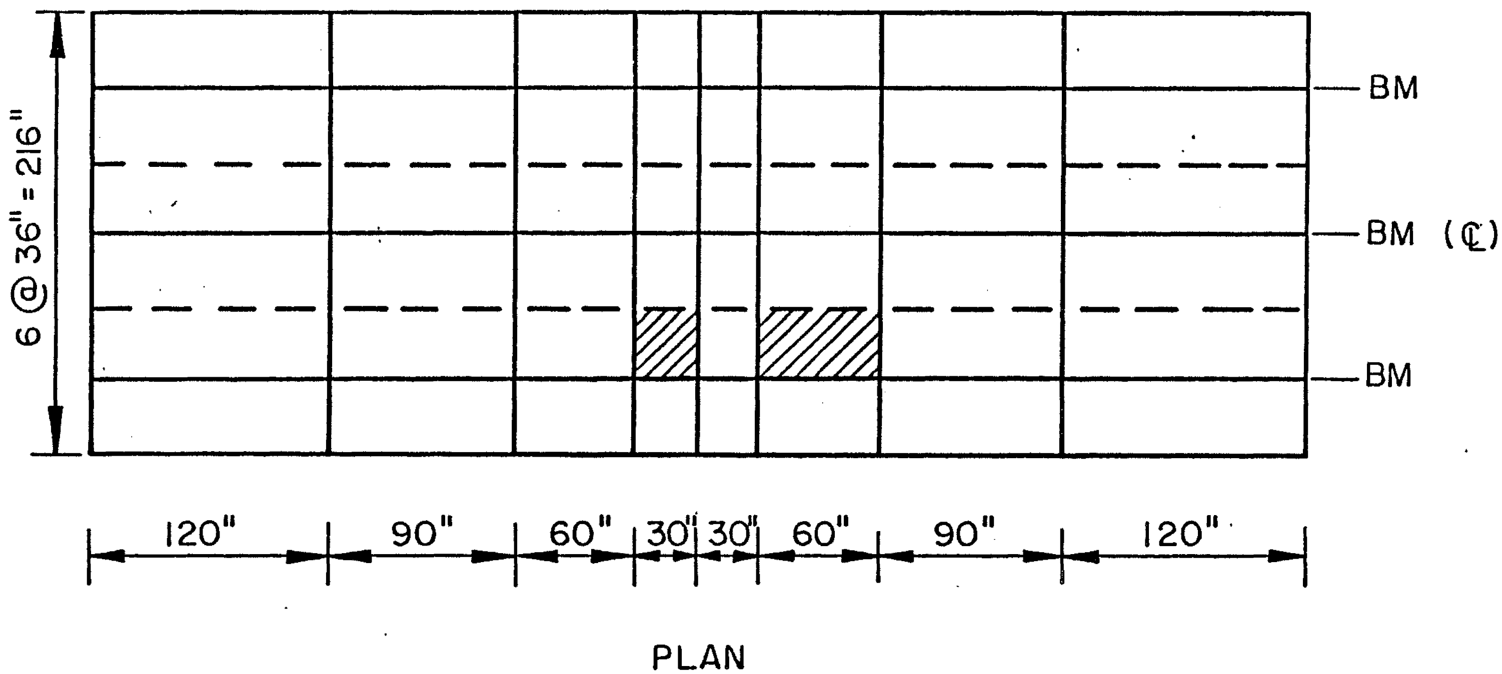
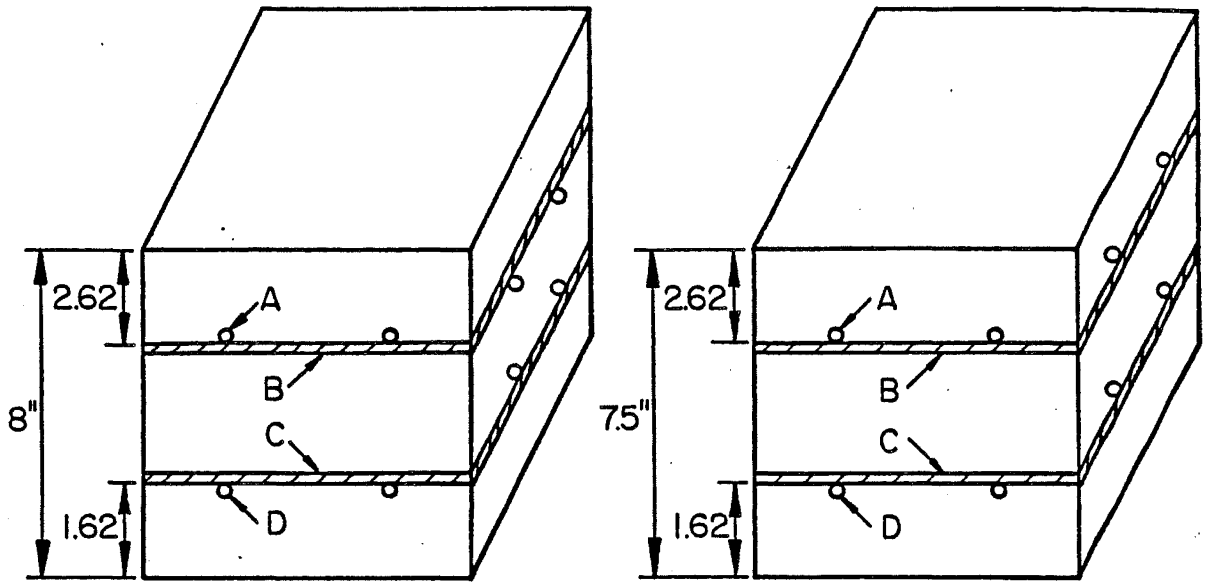


Fig. 17 Discretization of Example-3



EXAMPLE 1, 2	EXAMPLE 3
A) #5 @ 6"	A) #5 @ 7"
B) #4 @ 18"	B) #4 @ 18"
C) #5 @ 9"	C) #5 @ 10"
D) #5 @ 6"	D) #5 @ 7"

Fig. 18 Slab Reinforcement Details of Examples-1, -2 and -3

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10. ACKNOWLEDGMENTS

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