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ETABS®

Three Dimensional Analysis of Building Systems

USERS MANUAL

by
Ashraf Habibullah

Version 5.4
Revised August, 1992

Developed and written in U.S.A.

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DISCLAIMER

CONSIDERABLE TIME, EFFORT AND EXPENSE HAVE GONE INTO THE DEVELOPMENT AND DOCUMENTATION OF ETABS. THE PROGRAM HAS BEEN THOROUGHLY TESTED AND USED. IN USING THE PROGRAM, HOWEVER, THE USER ACCEPTS AND UNDERSTANDS THAT NO WARRANTY IS EXPRESSED OR IMPLIED BY THE DEVELOPERS OR THE DISTRIBUTORS ON THE ACCURACY OR THE RELIABILITY OF THE PROGRAM.

THE USER MUST EXPLICITLY UNDERSTAND THE ASSUMPTIONS OF THE PROGRAM AND MUST INDEPENDENTLY VERIFY THE RESULTS.

ACKNOWLEDGMENT

Thanks are due to all of the numerous structural engineers, who over the years have given valuable feedback that has contributed toward the enhancement of this product to its current state.

Special recognition is due Professor Edward L. Wilson of the University of California at Berkeley, who originally conceived and implemented the TABS series of computer programs.

Recognition is also due Dr. Jeffery Hollings for his efforts in the development of earlier versions of the ETABS program.

The author also wishes to thank his colleagues and co-workers who have participated in the development of this program.

TABLE OF CONTENTS

III. ETABS TERMINOLOGY, CONVENTIONS AND MODELING

IV. SPECIAL MODELING ASPECTS OF ETABS

V. ETABS INPUT DATA FILE

VI. ETABS OUTPUT FILES

VII. ETABS RESTART

VIII. REFERENCES

APPENDIX A

APPENDIX B

I.

INTRODUCTION

A. TABS SERIES OF COMPUTER PROGRAMS

For nearly two decades the TABS (and ETABS) [1,2,3,4] series of computer programs, operating on main frame and personal computer systems, have demonstrated a record that unconditionally establishes them as the most practical and efficient tools for the three-dimensional static and dynamic analysis of multistory frame and shear wall buildings. This version of ETABS continues in the same tradition. Enhanced and rewritten, it brings state-of-the-art analytical capability to the profession.

B. ETABS

From an analytical standpoint multistory buildings constitute a very special class of structures. The ETABS computer program addresses itself to this particular problem.

The input, output and numerical solution techniques of ETABS are specifically designed, taking into consideration specific characteristics that are unique to building type structures, thereby giving the engineer an analytical tool that offers significant savings in the time associated with data preparation, output interpretation and execution throughput over general purpose computer programs [11,12].

The building is idealized as an assemblage of vertical frame and shear wall systems interconnected by horizontal floor diaphragm slabs which are rigid in their own plane. The basic frame geometry is defined with reference to a three-dimensional grid system and, with special modeling techniques, very complex framing situations may be considered.

A diagonal bracing element is available to model braced frames such as X-braced, K-braced or eccentrically-braced systems.

A special panel element is available to enable the modeling of general three-dimensional shear wall configurations, such as C-shaped core elevator walls, curved shear walls, discontinuous shear walls and shear walls with arbitrarily located openings. Torsional and warping effects are accurately modeled.

The panel element is based upon an isoparametric finite element membrane formulation with the in-plane rotational stiffnesses being defined. Therefore, any beams or columns that frame into the panel element, in the plane of the wall, will receive full continuity without any special modeling.

One or more panel elements at a particular level may be used to define a "wall," which may be planar or three-dimensional.

Integration of the panel finite element internal forces into a set of forces and moments for the "wall" is completely automated in a manner that produces complete equilibrium with the applied forces.

The user can apply the versatility of the finite element method to model complex shear wall systems and also expect to get results in a form that is directly usable in the wall design.

The column, beam, diagonal brace and panel element formulations include the effects of bending, axial and shear deformations. All elements are intercompatible with each other.

The effects of the finite dimensions of the beams and columns on the stiffness of a frame system are automatically included.

The buildings may be unsymmetrical and nonrectangular in plan. Torsional behavior of the floors and interstory compatibility of the floors are accurately reflected in the results. The solution enforces complete three-dimensional displacement compatibility, making it possible to capture tubular effects associated with the behavior of tall structures having relatively closely spaced columns.

Modeling of buildings with partial floor diaphragms, with stepped floor diaphragms or with no floor diaphragms is possible.

Three independent vertical and two independent lateral static load conditions are possible in any one run. These five static load conditions may be combined in any ratio to each other or to a lateral dynamic earthquake excitation which may be specified as an acceleration response spectrum or as a time-dependent ground acceleration.

The response spectrum may excite the structure from three different directions in any one run.

Time-dependent ground accelerations can excite the structure concurrently in any two orthogonal horizontal directions.

Three-dimensional mode shapes and frequencies, modal participation factors, direction factors and participating mass percentages are evaluated.

The output includes static and dynamic displacements and interstory drifts and member forces.

The unique solution procedure used by the program is based upon a consistent direct stiffness formulation and considers the frame and shear walls as substructures, reduced with an active column equation solving technique. This method results in a significant reduction in the program data preparation time, computational effort and storage requirements.

C. ADVANTAGES OF ETABS OVER OTHER PROGRAMS

There are many two- and three-dimensional computer programs for the linear analysis of complex structures [11,12]. Most of these programs can be used for the static and dynamic analysis of multistory frame and shear wall buildings. However, the following are some of the characteristics that are inherent in the basic nature of a building analysis that a general purpose analysis program may not recognize, thereby resulting in a significant loss in man-hours, computer time and possibly accuracy.

1. Most buildings are of simple geometry with horizontal beams and vertical columns. A simple grid system defined by horizontal floor lines and vertical column lines can establish such a geometry with minimal input.

2. Many of the frames and shear walls are typical. Most general programs do not recognize this fact; therefore, the input may be large and some internal calculations may be unnecessarily duplicated.

3. The in-plane stiffnesses of the floor systems of most buildings are very high. General purpose programs do not necessarily recognize this, resulting in a set of equilibrium equations which may be very large, causing an increase in computational effort by a factor of 10 to 100. Also, numerical errors may be introduced since the in-plane floor stiffnesses are several orders of magnitude greater than the story to story stiffnesses of the structure. Since these two stiffnesses are added in a direct stiffness approach, high precision may be required in the solution.

4. The loading in building systems is of a restricted form. Loads, in general, are either vertically down (dead or live) or lateral (wind or seismic). The vertical loads are usually applied on the beams and the lateral loads are generated at the floor levels.

5. In many buildings the true dimensions of the members are large and have a significant effect on the stiffness of the frame. Therefore, corrections need to be applied to the member stiffnesses. Most general purpose programs work on centerline dimensions and stiffness corrections are usually very tedious to implement.

6. In the dynamic analysis of buildings the mass of the structure can be accurately lumped at the floor levels. Recognizing this fact significantly reduces the size of the eigenvalue problem to be solved.

7. Various code loading requirements need special options that allow convenient generation and combination of the vertical and lateral static and dynamic loadings. Also, the member forces need to be printed out at the support faces of the members. Such transformations are not automatic in general purpose programs.

8. It is desirable to have a building analysis computer output printed in a special format, i.e., in terms of a particular frame, story, column and beam. Also, special output, such as lateral story displacements and interstory drifts, time periods, etc. may be desirable.

All of the abovementioned characteristics of building systems are recognized by ETABS, making it ideally suited for the specific application.

II.

SYSTEM PREPARATION AND EXECUTION PROCEDURE

This chapter deals with the installation and execution of ETABS on an MS-DOS based computer system.

User familiarity with MS-DOS is assumed.

The complete ETABS package includes:

1. This ETABS Reference Manual

2. The PLOTTER Users Manual, [21]

3. The READER Users Manual, [25]

4. The ETABS Sample Examples and Verification Manual, [20]

5. The SAP90/ETABS/SAFE Installation Guide

6. The ETABSIN Manual

7. Program diskettes, containing the following:

    a. ETABSIN Program Executables and associated files

b. ETABS Program Executables (*.EXE files)

c. SETUP Program Executables and Associated Files

d. AISC steel section database files AISC.INC and AISC.MET

e. ETABS Sample Example Files

Note: the characters <CR> appear repeatedly in the text of this chapter. These characters mean "press the carriage return key." Do not type the characters < ,C, R and >.

A. INSTALLING, CONFIGURING AND TESTING

The programs provided must first be copied to the hard disk. The programs and computer must then be configured before the programs can be used. Follow the instructions in the SAP90/ETABS/SAFE Installation Guide (included with the ETABS package) for this procedure.

Before putting the system into a production mode, the user should test the system by running the sample examples provided on the ETABS set of disks. The output files produced should be compared to the corresponding output files that are also provided on the ETABS set of disks.

The installation of ETABSIN, the interactive graphical model generator for ETABS, is also described in the SAP90/ETABS/SAFE Installation Guide. The use of ETABSIN is, however, optional as discussed in the next section.

B. PREPARING THE ETABS DATA FILE

Before executing ETABS the user needs to prepare the data for the specific structure that is to be analyzed. The user must thoroughly read the manual and understand the basic assumptions of the program. The input data for ETABS can be prepared by using the interactive graphical model generator, ETABSIN, which saves the model in a file compatible with the ETABS input data. Alternatively, the file can be directly created by use of a text editor (EDLIN or any other MS-DOS compatible editor). The data must conform to the program specifications detailed in Chapter V of the manual. Sample data files are provided on the ETABS set of disks (filenames with no extensions, e.g. EX1, EX2, etc.).

C. EXECUTING THE ETABS PROGRAM

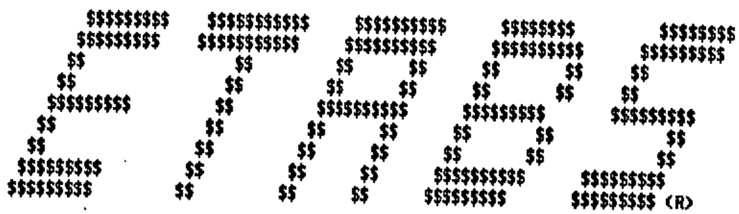
Say that the data associated with the problem the user wishes to analyze has been entered into a data file called EXAMPLE.

From the directory where the ETABS input data file is resident, enter the command:

ETABS <CR>

Note: the ETABS input data file and the ETABS executables must reside in the same directory unless a path to the ETABS executables has been activated using the MS-DOS **PATH** command.

After a few seconds the following banner will appear on the screen:



```
EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS
VERSION 5.xx
BY
ASHRAF HABIBULLAH

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COMPUTERS AND STRUCTURES, INC.
All rights reserved

hit it baby...<CR>
```

Enter **<CR>**

The program will then display a copyright notice and a prompt for the data filename as follows:

```
THIS COPY OF ETABS IS FOR THE EXCLUSIVE USE OF

THE LICENSEE

UNAUTHORIZED USE IS UNETHICAL, UNPROFESSIONAL
AND IN VIOLATION OF FEDERAL COPYRIGHT LAWS.

ADDITIONAL INFORMATION MAY BE OBTAINED FROM

COMPUTERS AND STRUCTURES, INC.
1995 UNIVERSITY AVENUE
BERKELEY, CALIFORNIA   94704

TEL:  (510) 845-2177
FAX:  (510) 845-4096

IT IS THE RESPONSIBILITY OF THE USER TO VERIFY
ALL RESULTS PRODUCED BY THIS PROGRAM.

ENTER PROBLEM NAME :
```

Enter **EXAMPLE <CR>**

The program will then ask for the disk drive for output files as follows:

```
ENTER DISK DRIVE FOR OUTPUT FILES:
```

Enter **C <CR>** or an appropriate drive letter or simply **<CR>** to default to current drive.

The program will then ask for the disk drive for temporary scratch files as follows:

```
ENTER DISK DRIVE FOR SCRATCH FILES:
```

Enter **C <CR>** or an appropriate drive letter or simply **<CR>** to default to current drive.

The program will then display the name of the input file and the names of the output files that will be produced by the program as follows:

```
INPUT DATA ---------------- EXAMPLE
ECHO OF INPUT DATA -------- EXAMPLE.EKO
EIGENVALUE OUTPUT --------- EXAMPLE.EIG
STORY LEVEL OUTPUT -------- EXAMPLE.STR
FRAME DISPLACEMENT OUTPUT -- EXAMPLE.DSP
MEMBER FORCES OUTPUT ------ EXAMPLE.FRM
POST PROCESSING FILE ------ EXAMPLE.PST



            <CR> TO CONTINUE
```

A detailed description of the output files is given in Chapter VI.

If all the filenames are appropriate,

Enter **<CR>**

The program will then enter the input phase. This phase creates a file EXAMPLE.EKO which contains a formatted and tabulated echo of the input data. When the screen indicates completion of input mode **the user should print this output file and thoroughly check the data for correctness.**

If all the data appears error-free, enter:

EGO <CR>

The program will go into execution mode and a series of progress messages will be flashed to the screen until the job is complete.

The job completion message will read

```
JOB COMPLETED . . . NO CHARGE!!!
```

At this stage the output files created by the program will be resident on disk.

To print an output file the MS-DOS **PRINT** or **TYPE** command may be used.

Appropriate line counts and page ejects are built into the program.

D. RESTARTING THE ETABS PROGRAM

In order to execute the ETABS program in a restart mode, the execution procedure is exactly the same as described in the previous section except that the user must enter

RETABS

instead of the **ETABS** command.

Before executing RETABS, the ETABS execution files ETABS.SYS, ETABS.DB1 and ETABS.DB2 from the normal execution run must be resident on disk along with the restart input data file.

See Chapter VII for specific requirements for using the program in a restart mode.

E. SAVING THE SCREEN IMAGE

If an ETABS job abnormally terminates and the error message in the .EKO file or ETABS.ERR file is insufficient to determine the problem, it is recommended that the problem be rerun with the printer switched on and put on-line to obtain a hard copy of the program messages that appear on the screen during execution.

This information is helpful in tracing possible data check and execution errors, warnings and other messages, especially if system malfunction is suspected.

The following sequence of operations will activate the creation of the hard copy:

1. Before entering the ETABS command, turn the printer on and set it on-line.

2. Holding down the **Ctrl** key, press the **PrtSc** key.

All information that appears on the screen will now be printed.

In order to deactivate the hard copy creation, repeat Step 2.

Run the problem normally from the beginning as described in Section C of this chapter.

F. USING THE INTERACTIVE GRAPHICS PROGRAM

The interactive graphics package PLOTTER may be used for plotting undeformed structural geometry, frame loading diagrams, member force/moment diagrams, deformed shapes and mode shapes.

Undeformed geometry plots and loading diagrams may be obtained after an error-free execution of the ETABS command, i.e., before or after executing the EGO command.

Deformed shapes, mode shapes and member force/moment diagrams may only be plotted after a successful execution of the EGO command.

See Reference [21] for details associated with the options and usage of the PLOTTER postprocessor.

G. USING THE INTERACTIVE OUTPUT DISPLAY PROGRAM

The interactive output display program READER may be used to selectively display on screen or print output after a successful ETABS run.

The program has options to print output on an element by element or story by story basis. Results for individual load cases as well as envelope values are provided. Loading combinations may be changed from within the READER program.

See Reference [25] for details associated with the options and usage of the READER postprocessor.

H. USING THE INTERACTIVE TIME HISTORY DISPLAY PROGRAMS

The interactive graphics package TIMER may be used for plotting base and response time functions for a combination of time-history loads and other static loads.

The program has options to display base accelerations and structural base shears and overturning moments. Displacement, velocity and relative and absolute accelerations at any joint in the structure may be obtained. Member forces or moment time functions for any element type can be obtained.

See Reference [29] for details associated with the options and usage of the TIMER postprocessor.

The interactive graphics package SPECTER may be used to obtain response spectra at any joint in the structure.

See Reference [30] for details associated with the options and usage of the SPECTER postprocessor.

III.

ETABS TERMINOLOGY, CONVENTIONS AND MODELING

This chapter constitutes the basis of the ETABS computer program. It is imperative that the user comprehend the information provided in this chapter in order to use the program correctly. The basic terminology and conventions associated with the program are detailed.

A. THE ETABS FRAMES

The program views the building system as an assemblage of vertical frames interconnected at each story level by a horizontal floor diaphragm.

A frame basically consists of columns that are vertical and beams that are horizontal. Frames can be three-dimensional with shear walls and diagonal bracing. The gridwork formed by the horizontal floor diaphragms and the vertical column lines forms the basic reference system for the description of the frame. See Figure III-1. The column lines (identified as C1, C2, C3) are located with coordinates in the X-Y plane and the bays (identified as B1, B2, B3) are located in plan as connectivities between the column lines. A bay is defined as a connection between any two column lines.

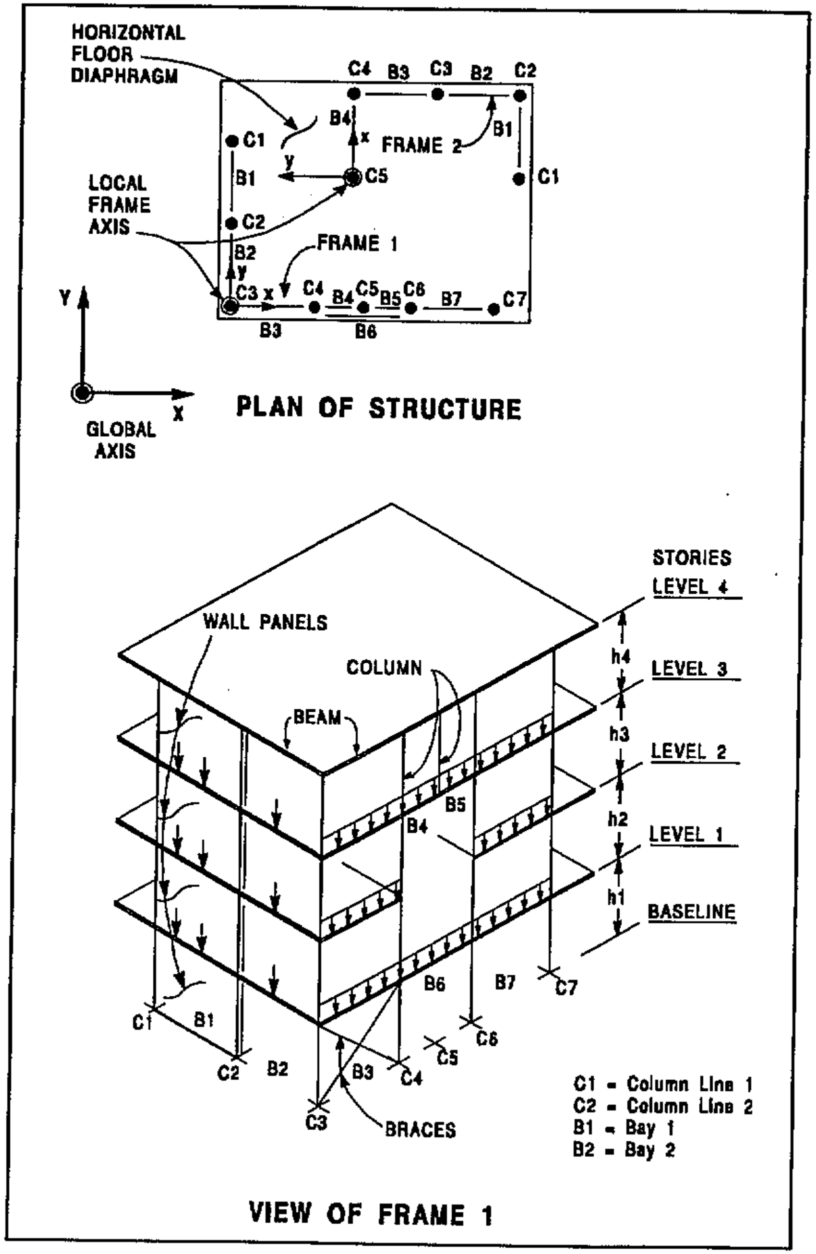
The following is an important ETABS convention: a column line is a vertical line parallel to the Z-axis defined in plan by X,Y coordinates. On each column line there **may** exist columns (or column elements) corresponding to the story levels. For example, in Figure III-1, column line C3 has 4 columns, one corresponding to each level, whereas column line C5 has only one column, corresponding to level 4.

Similarly, for each bay there **may** exist beams (or beam elements) corresponding to the story levels. For example, in Figure III-1, bay B3 has 4 beams, one corresponding to each level, whereas bay B4 has only two beams corresponding to levels 3 and 4 respectively. Note that bay 6, located between C4 and C6, has only one beam at level 1. Summarizing, therefore, **columns** are to **column lines** as **beams** are to **bays.**

The concept of a frame in the ETABS environment is an assemblage of column lines C1, C2, C3 (each of which may or may not have columns), each of which in turn may be connected to each other by bays, braces or panels. Note that a beam, a brace or a panel always exists between two column lines. The beams, braces and panels are viewed by the program as elements that connect column lines.

Now let us consider a series of column lines in a building and a corresponding set of elements that connect only to this series of column lines.

Then consider a second series of column lines in the same building and a second corresponding set of elements that connect only to the second series of column lines.



Typical Building System
Figure III-1

If such a situation exists in a building, the first series of column lines and their associated elements constitute the first frame of the building and the second series of column lines and their associated elements constitute a second frame. Thus a "frame" is defined by a series of columns and a corresponding series of elements. The elements of the frame can only connect to the column lines included in the frame. The frames satisfy what is termed **connectivity isolation.**

In Figure III-1 the plan of the structure shows two frames that are isolated from a connectivity standpoint. Modeling the structure as two frames (one with 7 column lines and one with 5 column lines) lends significantly increased efficiency and capacity to the solution process. However, there is nothing that prohibits the user from modeling the structure as a single frame with $(7 + 5) = 12$ column lines, if so desired, even if the portions of the combined frame demonstrate connectivity isolation.

As the first step of the frame data preparation, it is recommended that folded out frame elevations be drawn of all the typical frames of the structure. The story lines and the column lines that form the basic gridwork for the frame description should be shown on the elevations, including the column line numbers and the bay numbers.

The beams associated with a particular story exist at the corresponding story line, whereas the columns, panels and diagonals associated with a particular story exist **below** the corresponding story line. Beams, columns, panels and diagonals having the same properties may be generated over a series of story levels.

Although the basic gridwork for the definition of frame geometry is essentially rectangular, complex situations can be very easily modeled by creative use of the bending brace and panel elements and by defining geometries using null beam and column property assignments where needed. Modeling of X-braced, K-braced and eccentrically braced systems, A-frames, setback frames and Vierendeel trusses are all possible. Complex systems consisting of discontinuous shear walls and shear walls with arbitrarily located openings are easily modeled using the shear panel and the special modeling techniques described later in Chapter IV.

The columns, beams, panels and diagonals must be assigned property numbers. Properties associated with standard AISC sections are available in a program data base.

Vertical load data input for load conditions I through III is prepared as part of the frame data. Self weight of the frames can be included automatically. The beam span loadings associated with load conditions I through III must be assigned pattern numbers. In determining these vertical load patterns the user must take care to include those loads coming from secondary framing members which are not part of the model.

B. THE ETABS FLOOR DIAPHRAGMS

The horizontal floor at any one level is modeled by the program as a rigid horizontal plane (or diaphragm) that has infinite in-plane stiffness (in the X-Y plane) and no out-of-plane stiffness. There is only one floor diaphragm associated with each level. This horizontal plane, in effect, ties together all the column lines of all the frames in the horizontal plane associated with the level of the diaphragm. Therefore, all the column lines of all the frames at that particular level cannot displace (in the X, Y or Θz directions) independent of each other. In other words, two column lines on a diaphragm will have exactly the same spatial relationship with respect to each other (in the X-Y plane) before and after the diaphragm displaces.

There are options available whereby the user may arbitrarily disconnect particular column lines from particular diaphragms to allow unrestrained column displacements.

Therefore, a floor diaphragm, at a story level can either exist and have infinite in-plane stiffness, or not exist at all and have zero stiffness. Finite diaphragm stiffnesses are not possible.

The horizontal levels of the diaphragms establish the only levels at which beams may exist in any of the frames of the model. In other words, the floor levels of all the frames must be at the same elevation. However, all the frames need not have the same number of stories. In any case, all frames must have the same baseline.

Note that all levels of every frame get linked to the rigid story floor diaphragms at the corresponding levels. Therefore all frames are linked to each other from a lateral standpoint and the connectivity isolation described above is only of a vertical nature.

C. REFERENCE COORDINATE SYSTEMS

a. Global Reference Point and Reference Axes

The global reference point is an arbitrary point selected by the user in the plan view of the building. This point is the origin of the **global** X, Y axes and is the same for all levels of the structure. The story centers of mass, the structural lateral loads (static and dynamic) and the positions of the various frames are all located with respect to the reference point and reference axes. The lateral loading and geometry are thereby uniquely located with respect to each other, regardless of the choice of the reference point. The reference point may be chosen to be any dimensionally convenient point in the structural plan. There is only one global reference point for the whole building.

b. Frame Reference Point and Reference Axes

The frame reference point is an arbitrary reference point selected by the user in the plan view of the frame. The point is the origin of the frame **local** x, y axes and is the same for all the levels of the frame. All frame data is prepared with respect to these axes. This reference point may be chosen as any dimensionally convenient point on the structural plan. Every frame has its own frame reference point. If there are no duplicate frames in the structure, it is usually convenient to coincide the global and frame reference point locations. Note that the local frame z-axis and the global Z-axis are always parallel, vertically up.

D. FRAME LOCATION DATA

It is possible for the structure to have some frames (with identical geometry and vertical loading) that are repeated at different locations in the structural plan. The data for such typical frames need only be prepared once.

In other words, one set of frame data is set up for each different frame in the structure. Every one of the different frames may then be placed at one or more locations in the structural plan, via the frame location data. This data locates the local axes of the frames with respect to the global reference axes. Most buildings usually end up being modeled as a single frame.

Static and dynamic story displacements and interstory drift ratios are reported by the program at the point at each story level that corresponds to the origin of the frame (in plan). By creating a dummy frame (single column line and all zero properties) and locating it at selected points on the structural plan, the user can conveniently obtain critical static and dynamic displacement and drift information which otherwise may be very tedious or impossible to extrapolate.

E. LOAD CONDITIONS AND LOAD CASES

It is important to recognize the subtle distinction between a load condition and a load case as defined in the terminology of ETABS.

The load conditions are the independent loadings for which the structure is analyzed internally. These loadings are: three vertical static load conditions (I through III), two lateral static load conditions (A and B) and three dynamic load conditions (1, 2 and 3).

The load cases are assembled as combinations of the load conditions. Although the number of independent load conditions is fixed at eight (five for static runs), there is no limit on the number of load cases that may be formulated as combinations of the load conditions.

The vertical static load data input for load conditions I through III is prepared as part of the frame data. The self dead load of the members can be accounted for automatically by assigning unit weights to the frame materials. The unit weight specification causes the frame self weight to be added into the user-specified load condition.

Lateral static load data (for load conditions A and B) includes magnitudes and points of application for each story level. Each force acts on the complete floor level and gets distributed to each individual frame in accordance with the stiffness and location of the frame.

Lateral static loads may be due to wind or earthquake. A general static load pattern input option is also available.

The wind loads can be calculated by the program based upon wind exposure data provided by the user, based upon the UBC [14], BOCA [26], ASCE 7-88 [27] or NBCC [28] Specifications.

The equivalent lateral seismic load data can also be generated by the program based upon the UBC [14], ATC [19], BOCA [26] or NBCC [28] requirements.

Individual lateral loads may also be applied to the column lines of a frame that are disconnected from the story level diaphragms. Disconnected column lateral loads should not be applied with automatically generated diaphragm loads.

Lateral dynamic seismic ground excitation loading may either be in the form of an acceleration response spectrum or in the form of an acceleration time history input. This data is, in general, provided by the engineer responsible for the geotechnical evaluation of the building site. Time history data and corresponding response spectrum curves of well-known historical earthquakes are available in published reports [16].

Vertical dynamic analysis options are not available.

Time history data in digitized form for well-known earthquakes is available from the National Information Service/Earthquake Engineering, University of California, Berkeley, California. Response spectra can be generated from time history data [17].

F. RIGID ZONE

All structural members have finite dimensions. In many structures the dimensions of the members are large and have a significant effect on the stiffness of the structure. An analysis based upon a centerline to centerline geometry, in general, overestimates the deflections. Also, engineers prefer to have member forces output at the support faces. The rigid offsets are the distances from the joints to the face of the supports. See Figures III-2 and III-3. The beam and column stiffness formulation assumes no member flexural or shear deformations within the rigid offset lengths and all member forces are output at the outer ends of the rigid offsets. The flexible length of the member is given by

$$L^* = L - (Ri + Rj)$$

where L is the actual element length.

It has been found that an analysis based upon rigid offset lengths to the outer face of the supports can underestimate the deflections of the structure. A rigid zone reduction factor is used to reduce the lengths of the rigid offsets, thereby compensating for some of the deformations that do exist in the zone bounded by the finite dimensions of the joint. The flexible element length is then given by

$$L^* = L - (1-z)(Ri + Rj)$$

Irrespective of the value of z, **the member forces will always be output at the outer faces of the rigid offsets.**

The column element has four rigid zone offsets, **RTMAJ, RTMIN, RBMAJ** and **RBMIN,** corresponding to the major and minor directions of the top and bottom ends of the column respectively. These offsets are set by the depth dimension of the beams that frame into the columns. See Figure III-2.

A column will have a top rigid end offset in the major direction, **RTMAJ,** only if beams framing into the top of the column are in a direction that has a component parallel to the column line major direction.

For each such beam, the program calculates the quantity

$$R = DB * \cos^2\Theta$$

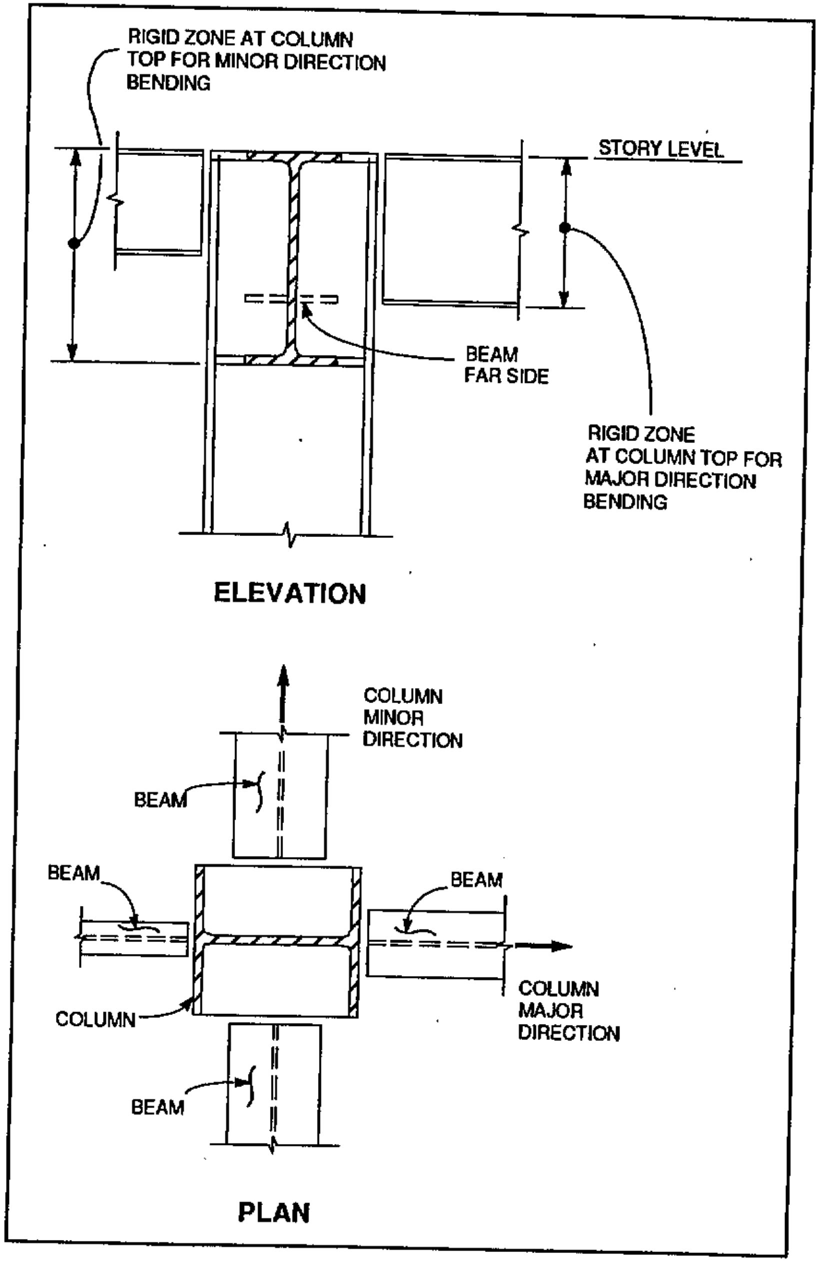
where **DB** is the depth of the beam below the diaphragm, and Θ is the angle between the direction of the beam and the column major direction.

The value of **RTMAJ** is then the largest of the R values thus obtained.

Similarly, **RTMIN,** the column top rigid end offset for the column minor direction, is obtained by calculating the quantity

$$R = DB * \sin^2\Theta$$

for each beam that frames into the top of the column. The value of **RTMIN** is then the largest of the R values thus obtained.



Column Rigid End Offsets
Figure III-2

The rigid zone offsets for the column bottom end **RBMAJ** and the **RBMIN** are defined in a similar fashion except that the beams framing into the bottom end of the column and the corresponding beam depths above the diaphragm are examined.

It is obvious that if a column has beams framing only in a direction parallel to the column major direction, it will have no minor direction rigid end offsets and vice versa.

Also, beams with zero depth values do not make any contributions to the column rigid end offsets.

The beam element has two rigid end offsets, **RI** and **RJ**, corresponding to the I and J ends of the beam. These offsets are set by the major or minor dimensions, respectively, of the columns that exist at the ends of the beams.

In calculating **RI**, the two column elements above and below the End I of the beam are examined. The quantities

$$R = \frac{\text{DMAJ}\cos^2\theta}{2} + \frac{\text{DMIN}\sin^2\theta}{2}$$

are then established for each of the column elements, where **DMAJ** and **DMIN** are the major and minor dimensions of the column element, and   is the angle between the direction of the beam and the column major direction.

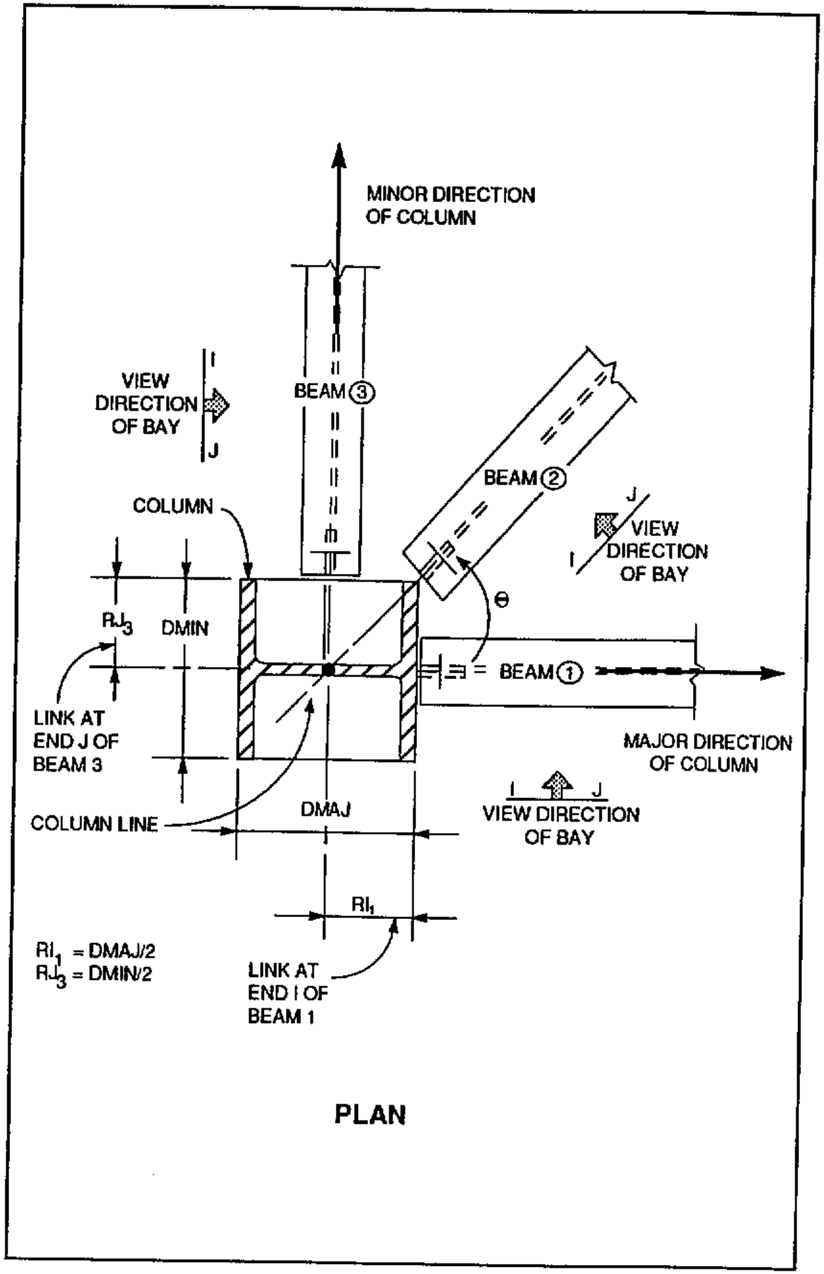
The value of **RI** is then established as the largest of the two R values thus obtained.

Similarly, **RJ** is established by examining the column above and below the beam at End J.

The rigid end offsets for the beam are active only in the major direction bending of the beams.

It is obvious that if the column dimensions are defined as zero, no rigid end offsets will be generated for the corresponding beams.

There are no rigid zone offsets generated for the brace or panel elements, and these elements are not included in determining the rigid end offsets for the column and beam elements.



Beam Rigid Joint Offsets
Figure III-3

G. SPECIAL CHARACTERISTICS OF THE STRUCTURAL ELEMENTS OF ETABS

The following are some important characteristics of the elements that must be recognized by the user in order to correctly use, understand and apply the ETABS computer program.

a. Column Element

1. The column always exists vertically at any level on a column line. The length of the column element is the story height.

2. The top or bottom of columns may be either continuous (fixed) or pinned.

3. Columns must be prismatic from floor level to floor level.

4. The column element may have rigid end offsets for stiffness corrections. The member forces are output at the outer faces of the rigid end offsets in the column local coordinate system. For coordinate system see Figure VI-3.

5. The column element formulation includes the effects of axial, shear, bending and torsional deformations.

6. The column is by default always connected (laterally) to a floor diaphragm at each end. The column may be disconnected from the floor diaphragm to model laterally unconstrained conditions.

7. The self weight of the column element is based upon the story-to-story length of the column and is lumped at the top end of the column.

b. Beam Element

1. A beam always exists horizontally at any level in a predefined bay, i.e., between two column lines.

2. Beam connections at either end may be either fixed or pinned.

3. Beams must be prismatic from column line to column line.

4. The beam element may have rigid end offsets for stiffness corrections. The member forces are output at the outer faces of the rigid end offsets in the beam local coordinate system. For beam local coordinate system see Figure VI-4.

5. The beam element formulation includes the effects of shear, bending and torsional deformations. Axial deformation effects and minor direction shear and bending deformation effects are only activated if any one or both of the column lines defining the beam at the particular level are disconnected from the diaphragm.

6. If the column line defining the beam element is disconnected from the diaphragm at the level of the beam, the corresponding end of the beam is disconnected from the diaphragm.

7. The self weight of the beam is based upon the clear beam length and is applied as a uniform load across this length.

8. Any participation of the structural floors in the bending of the beams must be reflected in the properties of the beams (T-beam or L-beam action) provided by the user, if it is to be included in the analysis.

9. Vertical loading can only be applied on beam spans and ends, not on any other elements.

c. Brace Element

1. The brace element may exist in any vertical plane between any two column lines (consecutive or nonconsecutive) between any two consecutive floors.

2. The ends of the brace may be continuous or pinned.

3. The brace element must be prismatic from floor level to floor level.

4. The brace has no options for rigid end offsets for stiffness corrections. The member forces are output at the floor levels in the brace local coordinate system. For brace local coordinate system see Figure VI-5.

5. The brace element formulation includes the effects of axial, shear, bending and torsional deformations. Zero moments of inertia and shear areas will generate axial braces that have no bending stiffness.

6. If a column line defining the brace is disconnected from the diaphragm at the level where the column line intersects the brace, the brace is disconnected from the diaphragm at that level.

7. The self weight of the brace is based upon the story to story length of the brace, and is lumped at the top end of the brace.

d. Panel Element

1. The panel element can exist between any two column lines (consecutive or nonconsecutive), between any two consecutive levels.

2. Panels in the lowermost story are assumed fixed at the bottom.

3. The panel element must be prismatic from floor level to floor level.

4. The panel stiffness is based upon a length equal to the story height with no rigid zone offsets due to the depths of the beams that may be framing into the panel. Panels may share column lines and assemblages of panel elements (at a particular level) may be defined to form T-, L- or C-shaped "walls," and other complex "wall" configurations. The program will produce integrated moments, shears and axial forces for the "wall" defined by the panel assemblage at the center of gravity of the "wall", or forces for planar segments of such assemblages may be produced.

   The section forces are output at the floor levels in the local coordinate system of the panel assemblage. See Figure VI-6.

5. The panel element is based upon an isoparametric finite element membrane formulation with incompatible modes.

   The formulation includes in-plane rotational stiffness components. This allows the panel to connect to the column, beam and brace elements and achieve moment continuity, without any artificial elements such as rigid beams.

If a column line defining the panel is disconnected from the diaphragm at a particular level, the panel will be disconnected from the diaphragm at the corresponding end.

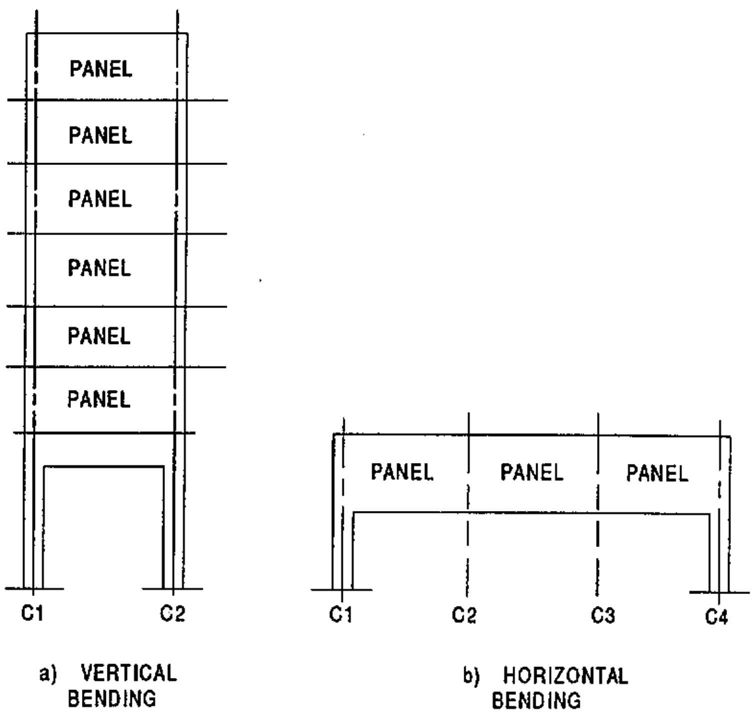
6. The panel element will be completely disconnected from the diaphragm at a particular level if both column lines bounding the panel are disconnected from the diaphragm at that level.

7. The self weight of the panel is based upon the story to story height of the panel and the weight is lumped at the two top joints of the panel.

8. The panel element has been designed to be used in the modeling of shear wall systems where the primary mode of bending is vertical, i.e. associated with horizontal shears, such as shown in Figure III-4a.

   The panel element may be used to model situations where the bending deformations are associated with vertical shears, such as shown in Figure III-4b, recognizing that the rigid diaphragm constraint will make the element stiff in bending, although shear deformations will still be accurately captured. However, the section shear forces and moments output will still correspond to horizontal sections.

   Caution is advised when very slender column-like elements are modeled using the panel element. Any column or beam elements framing into these slender panels will not receive correct fixity at their ends. Also, the slender panel element is too stiff for flexural deformation. These slender elements are better modeled as columns.



Panel Behavior
Figure III-4

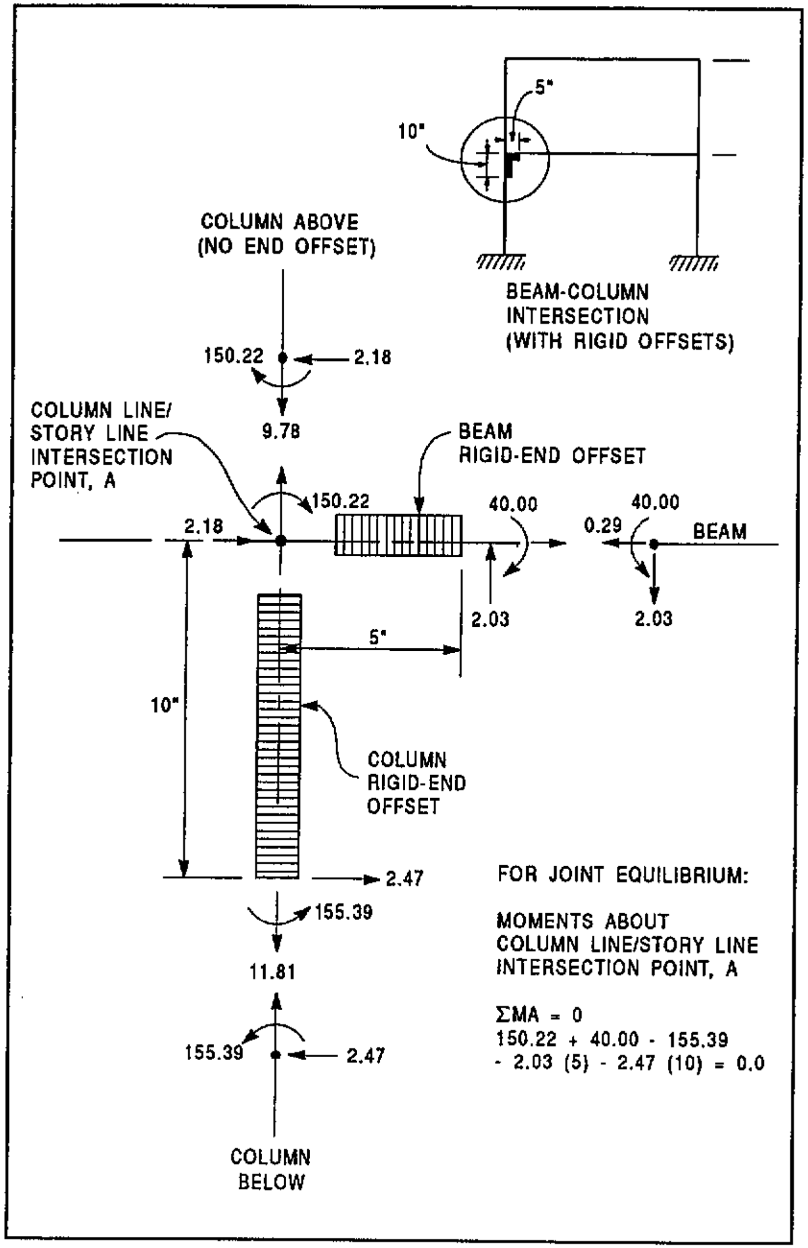
H. STATICS CHECK

Results from all static load conditions must satisfy statics. However, as the column and beam moments are evaluated at the outer faces of the rigid end offsets of the corresponding members, joint moment equilibrium is not readily obvious. Checking joint statics involves transformations of the column and beam moments to the point of intersection of the corresponding column line and story level. Statics will be satisfied once all moments are transformed to this common point. It is clear that the beam and column shears and the dimensions of the rigid joint offsets will need to be a part of the moment equilibrium equations. An illustration of joint static equilibrium is presented in Figure III-5.

Results from all dynamic load conditions, in general, will not satisfy statics. In the response spectrum analysis, the analysis technique involves the summation of the modal components by methods which cause the signs of the resultant parameters to be lost. In the time history analysis absolute maxima of the displacements and member forces are printed, thereby causing the sign to be lost. Besides, these maxima may not exist at the same instant in the analysis time span.

I. P-DELTA EFFECTS

In the analysis of building systems subjected to lateral displacements, the movement of the structural mass to a deformed position generates second-order overturning moments. This second-order behavior has been termed the P-Delta effect since the additional overturning moments on the building are equal to the sum of story weights "P" times the lateral displacements "Delta."



Joint Static Equilibrium/Beam-column Intersection (2-d Analysis)
Figure III-5

The P-Delta phenomenon has always been an area of analytical concern for structural engineers. Traditional methods for including P-Delta effects in the analysis of multistory buildings have been tedious and time-consuming. Such methods have been based upon iterative techniques, which offer limited accuracy, and in general have been used only in two-dimensional static analysis environments.

In the solution algorithm of ETABS, the P-Delta effects are incorporated into the basic formulation of the structural stiffness matrix as a geometric stiffness correction. In this manner, the effects are exactly represented in all aspects of the structural analysis without any additional computational effort or iterative algorithms.

The additional displacements and overturning moments due to the softening effects of the P-Delta corrections automatically manifest themselves in analysis, so that three-dimensional overturning equilibrium in the final deformed configuration is immediately satisfied for the complete building.

The algorithm also accounts for the lengthening of the structural time periods due to P-Delta effects and changes in the corresponding mode shapes that finally affect the dynamic displacements and member forces of the structure.

The comparison of a set of analyses with and without P-Delta effects will illustrate the magnitude of the P-Delta effects on the analysis.

A well-designed building usually has well-conditioned level by level stiffness/weight ratios. For such structures, P-Delta effects are usually not very significant. The changes in the displacements and member forces are less than 10%.

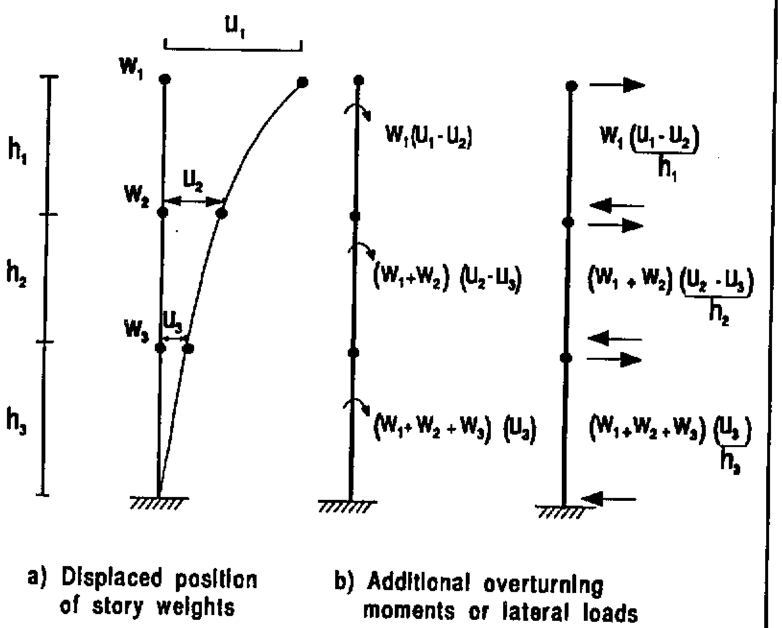
However, if the weight of the structure is high in proportion to the lateral stiffness of the structure, the contributions from the P-Delta effects are highly amplified and under certain circumstances, can change the displacements and member forces by 25 or 30%. Excessive P-Delta effects will eventually introduce singularities into the solution, indicating physical structure instability. Such behavior is clearly indicative of a poorly designed structure that is in need of additional stiffness.

Reference [18] provides detailed information associated with the P-Delta formulation of ETABS.

The net effect of the geometric stiffness correction is to replace the overturning moment with an equivalent lateral force couple, as shown in Figure III-6.

Therefore, the overturning moment of the applied loads will equal the base overturning only when $\Sigma P\Delta$ is added to the overturning moment, where P is the weight of a story and Δ is the corresponding story lateral displacement, and, the structural base shear will add up to the applied loads only if the force given by $P_n \Delta_n / h_n$ is subtracted from the sum of the lateral column shears, where P_n, Δ_n and h_n are the cummulative weight, displacement and story height of the bottom level of the frame.

ETABS obtains the story weights, P, from the specified story masses and the story displacements, Δ, are the elastic calculated displacements. It allows for a multiplier for the P-Delta effect to account for factored story weights and/or inelastic displacements.



P-Delta Effects
Figure III-6

IV.

SPECIAL MODELING ASPECTS OF ETABS

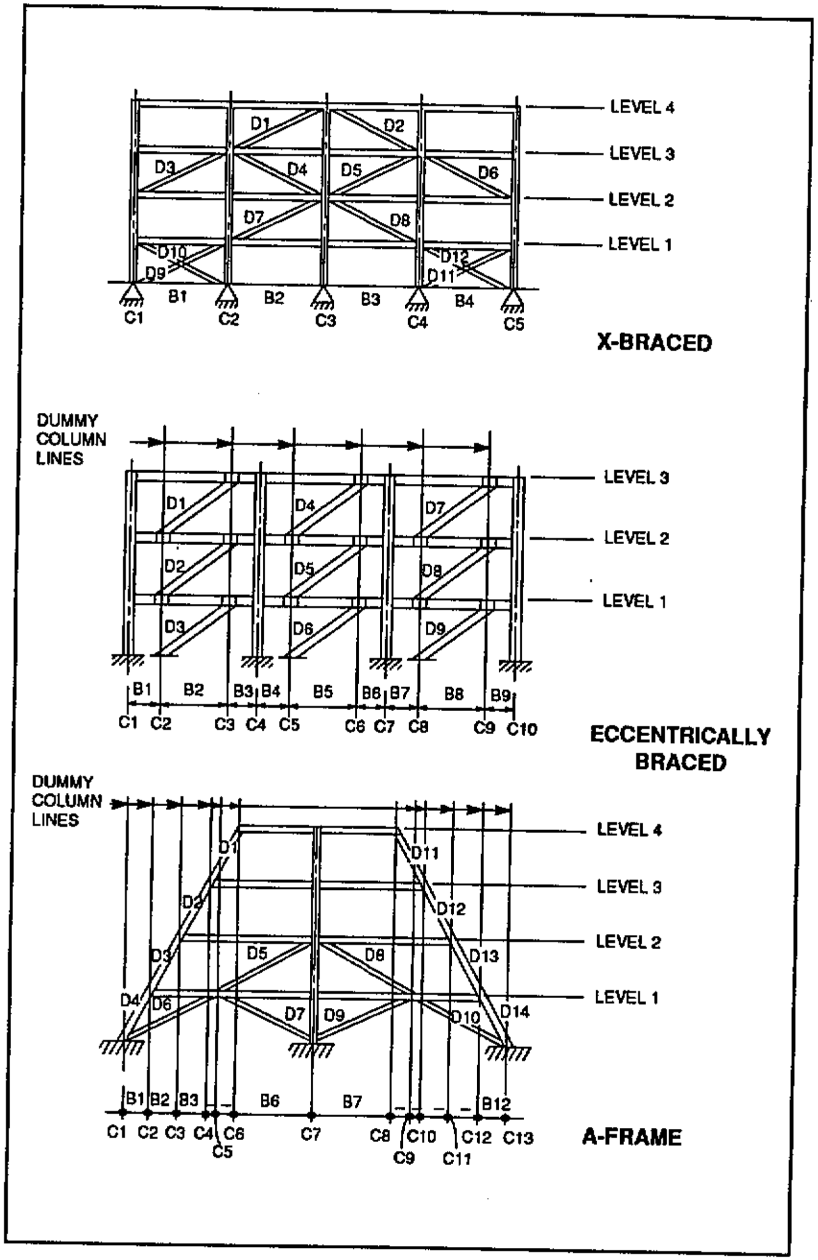
The following sections will focus on some important aspects pertaining to the use of the program. Modeling of complex systems using the various elements, general points of caution associated with the use of each element and the limitations of the program are specifically discussed.

The figures used to illustrate these modeling approaches show the column line numbers, bay numbers, brace (diagonal) identification numbers and wall identification numbers prefixed with the letters C, B, D and W respectively.

A. ECCENTRICALLY-BRACED SYSTEMS, K- AND X-BRACED AND A-FRAMES

By effectively using column lines for the definition of the frames as shown in Figure IV-1, complex bracing systems can be conveniently modeled. The "dummy" column lines are for geometric definition only and do not need any property assignments since the program default values are zero.

Null (zero) property assignments can be effectively used for dummy beams and columns in modeling structures with setbacks and other situations involving missing elements on the grid system used for the frame definition.



Modeling Braced Frame
Figure IV-1

B. COLUMN LINE DISCONNECTION

As mentioned earlier every floor (or level) of the structure has an associated horizontal rigid floor diaphragm. All the vertical column lines of every frame by default connect to the rigid diaphragms associated with the corresponding floor levels.

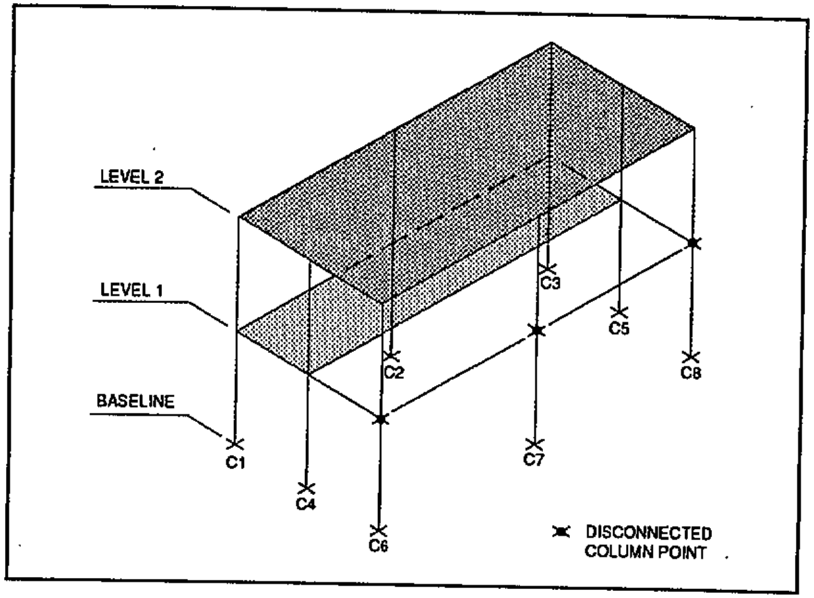
Often there are situations where a column line of a frame may not attach to all the diaphragms associated with all the story levels of the frame. For example, in Figure IV-2 column lines C6, C7 and C8 do not connect to the partial (mezzanine) floor diaphragm at level 1.

The column line disconnection option is used for modeling such situations. Activation of this option causes the column line to be free from the diaphragm.

Beams, braces and panels can attach to disconnected column points.

A disconnected column point of the type shown in Figure IV-2, that is, with no other elements connecting to the disconnected point, will have constant shear forces between level 2 and the baseline, if there are no lateral loads applied to the disconnected point. It is possible to apply lateral point loads to such disconnected points.

Another common use of the disconnection option is the modeling of structures with wood floor diaphragms. In such situations all the column lines are disconnected at the level of the wood floor diaphragm and the lateral loads are assigned on a tributary basis to the various disconnected column points.

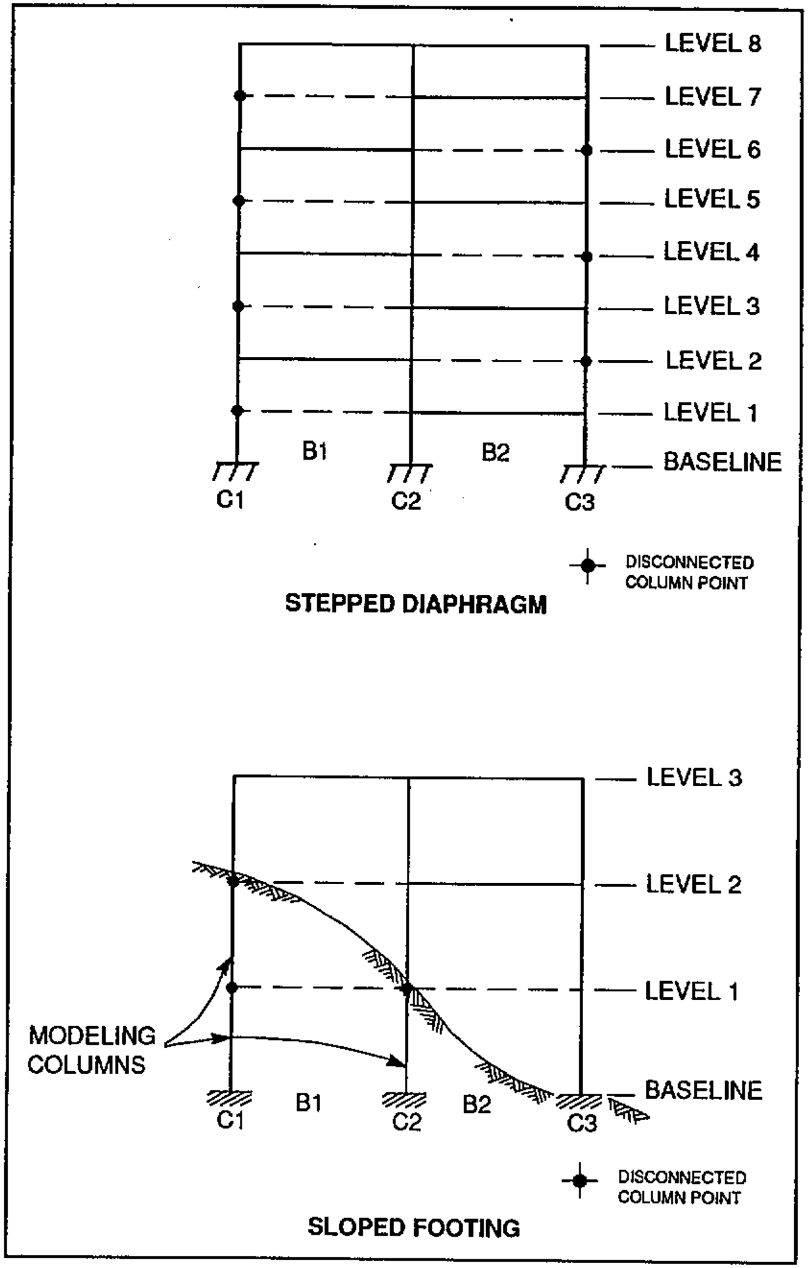


Mezzanine Modeling Column Line Disconnection
Figure IV-2

Disconnection of all the column lines from the diaphragm essentially removes the rigid floor diaphragm. In such cases the automatic lateral static load generation options are meaningless.

Creative use of this option with a series of dummy diaphragms will allow the user to model structures founded on sloped levels and buildings with stepped floor diaphragms, such as parking structures, as shown in Figure IV-3.

The user is reminded that using a rigid diaphragm model will result in zero axial forces in the beams. These forces may be important in braced frames. The user must disconnect some of the column lines from the diaphragm to allow beams to carry axial loads. It is recommended that only one column line per braced frame be connected to the rigid diaphragm.



Partial Diaphragm Modeling
Figure IV-3

C. MODELING SHEAR WALL SYSTEMS

One of the most powerful aspects of the ETABS computer program is associated with the modeling of shear walls. The program has a special panel element that combines the versatility of the finite element method with the design requirement that the wall output be in terms of total moments and forces, instead of the usual finite element output of direct stress, shear stress and principal stress values.

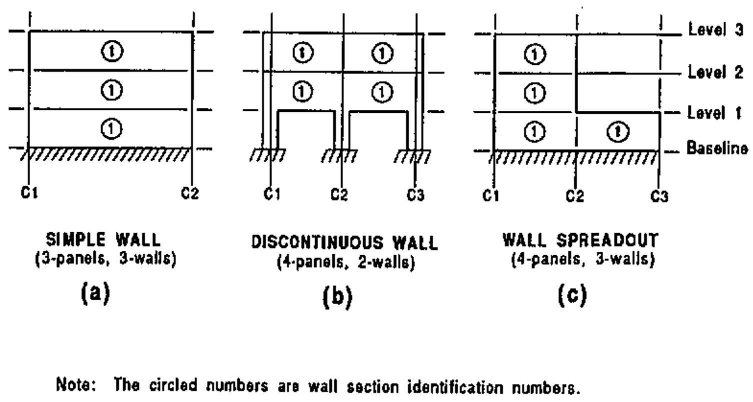
When the input is defined, each panel element is assigned a wall ID number.

All the panel elements **at a particular level with the same wall ID number** form an assemblage that defines the "wall" with the associated ID at the particular level.

The moments and forces produced by the program for the "wall" will be at the center of gravity of the "wall," in the "wall" local coordinate system.

The "wall" forces are obtained by consistently integrating the panel element internal forces of all the elements that form the "wall" at a particular level. The integration is implemented at the stress transformation level in order to be consistently carried through the static and dynamic analysis options.

All **connected** panel element systems are treated identically by the program internally, but output for a system may be requested in different forms. For the three-dimensional shear wall systems shown in Figure IV-6, the output may be as shown or in the form of three planar "walls" for (a) and four for (b). The latter output form is more useful for wall design in general and is required if the WALLER postprocessor is to be used.



Planar Shear Wall Systems
Figure IV-4

a. Simple Wall

A simple cantilever shear wall is shown in Figure IV-4(a). This wall is modeled as a two column line system with 3-panel elements. No bays need to be defined (unless there is vertical loading). The column lines are used as basic reference lines to define the extent of the panels.

Each panel has been assigned a wall ID of 1, producing three "walls," namely, "wall" with ID 1 at level 3, "wall" with ID 1 at level 2, and "wall" with ID 1 at level 1.

It is important to remember that a "wall" with a particular ID at a particular level is created by an assemblage of only those elements that exist at the particular level and have a particular wall ID.

Simple walls of this form may also be modeled with a single column line placed at the center of the wall. Column properties representing the wall axial area, shear area and moment of inertia are then assigned to the column line.

b. Discontinuous Wall

In this example, shown in Figure IV-4(b), shear walls from above terminate on a series of three columns below.

The model for this situation will require three column lines and four panel elements. No bays need be defined. Each panel has been assigned a wall ID of 1, producing two "walls," namely the 2-panel "wall" with ID 1 at level 3, and the 2-panel "wall" with ID 1 at level 2.

The column elements defined at level 1 will receive continuity with the panel elements at the top ends without any further special modeling.

c. Wall Spreadout

In this example, shown in Figure IV-4(c), shear walls from above spread out to a wider dimension below.

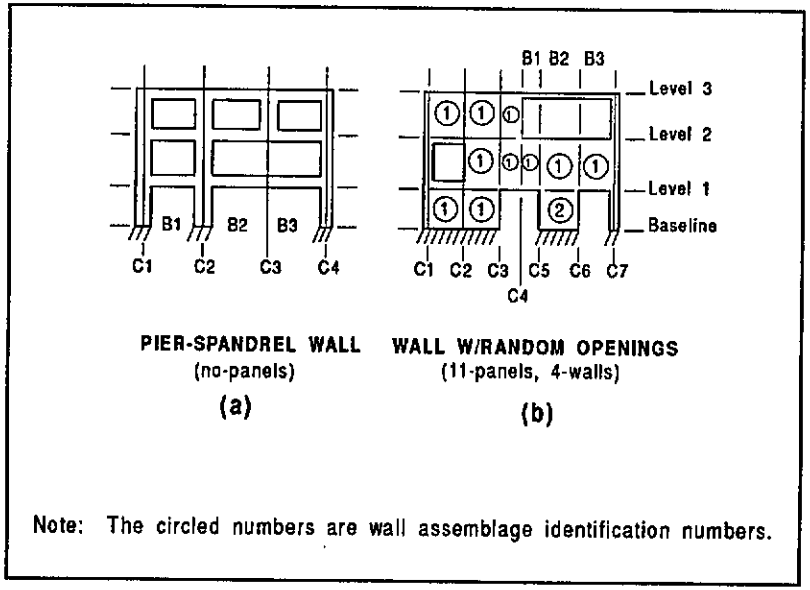
The model for this situation will require three column lines and four panel elements. No bays need be defined.

Each panel has been assigned a wall ID of 1, producing three "walls," one corresponding to each level, with a 2-panel "wall" at the bottom level.

d. Simple Pier-Spandrel System

A pier-spandrel system is simply a beam-column system in which the dimensions of the elements are large compared to the overall dimensions of the frame. Such systems are conveniently modeled with ETABS because the effects of the finite dimensions of the members on the stiffness of the frame are automatically considered. The pier-spandrel system shown in Figure IV-5(a) is modeled as a 4-column line 3-bay system, using default zero column property identifications to define missing elements.

The user should recognize, however, that attempts to describe small wall openings (such as those required for duct and pipe penetrations) as bays encompassed by wide columns and deep beams can introduce modeling difficulties into the analysis, resulting in unrealistic results. In general, it is better to ignore small openings. The loss of accuracy in neglecting them is much less than it is in trying to incorporate them into the structural model.



Planar Shear Wall Systems with Openings
Figure IV-5

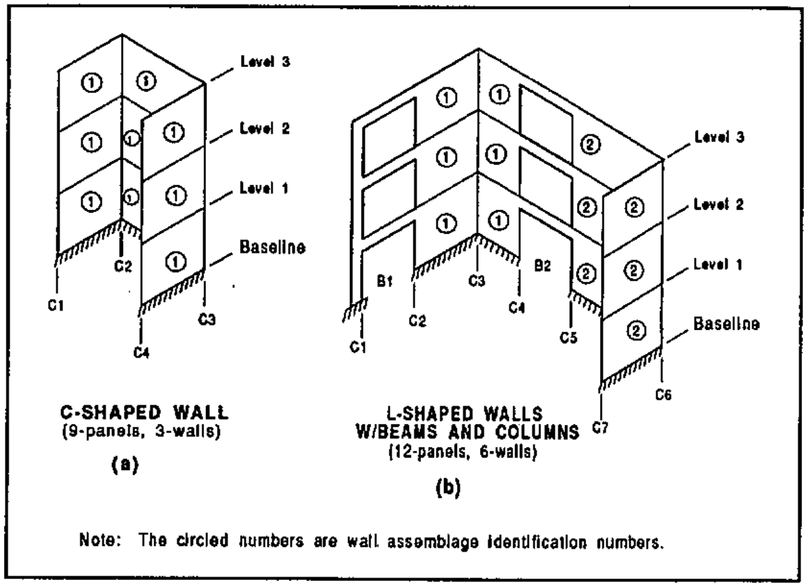
e. Wall with Random Openings

For this example, shown in Figure IV-5(b), the model will require seven column lines, three bays and eleven panel elements.

The bays are required for defining the beams at level 3.

There are two "walls" at level 1. The eleven panel elements produce a total of four "walls." Story levels identify locations of wall 1 at the three different levels.

Column elements are used for modeling the columns on column lines 1 and 7.



Three-dimensional Shear Wall Systems
Figure IV-6

f. Three-Dimensional Shear Wall Systems

The panel element can be very effectively used to model three-dimensional shear wall systems such as C-shaped (or E-shaped) or L-shaped walls, as shown in Figure IV-6.

The three-story C-shaped wall shown in Figure IV-6(a) is modeled with nine panel elements that define three C-shaped "walls," one corresponding to each level.

The output for each "wall" will consist of biaxial moments, torsion, axial force and biaxial shear forces about the center of gravity of the C-section, at each level.

Figure IV-6(b) illustrates the use of the program options to model L-shaped walls. As shown in this example, beam elements may frame into the panel elements to form complete shear wall/frame systems.

There are two L-shaped walls, each modeled with six panel elements. There are two "walls" defined at each level, to obtain the moments, shears, axial force and torque for each L-section at each level separately, about the center of gravity of each L-section.

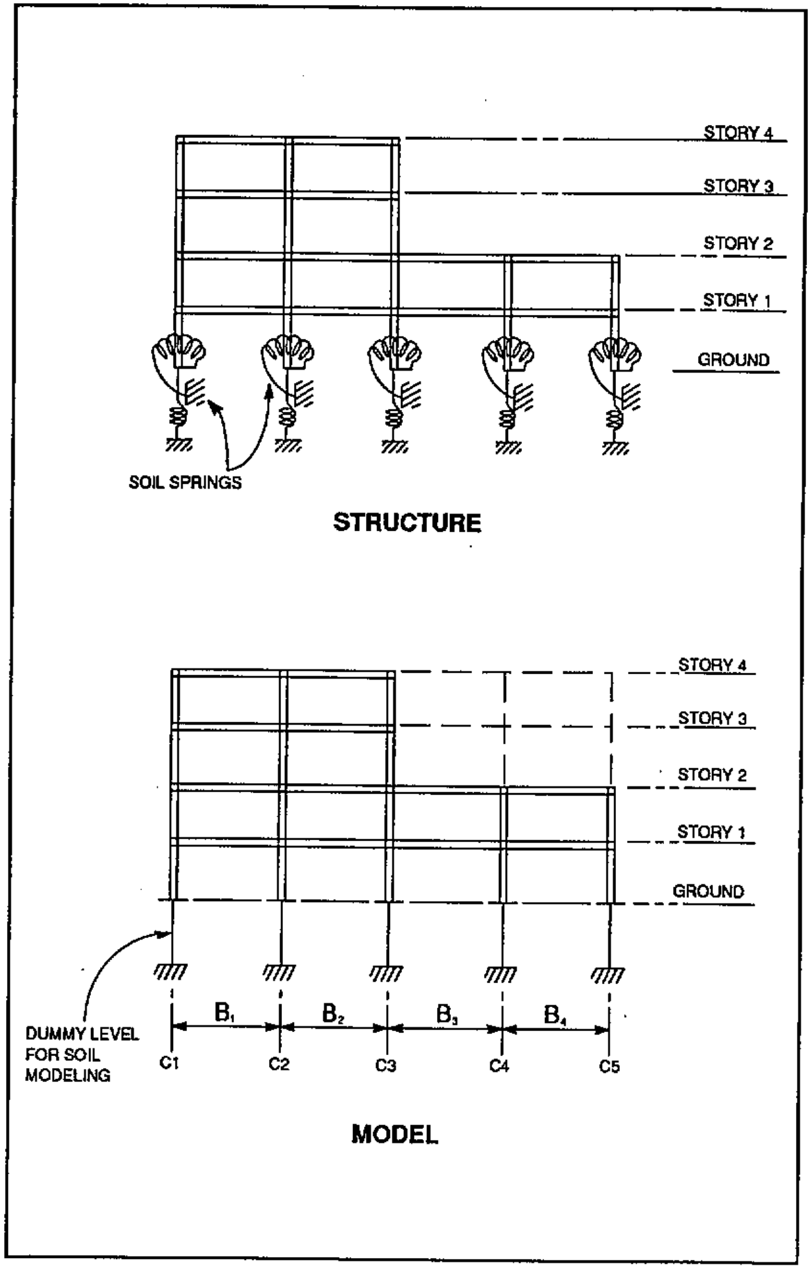
As shown, the model requires a total of seven column lines, two bays and twelve panel elements.

As mentioned earlier, for wall design convenience the wall identification numbers could be different for each planar segment.

Bay definition is required for beams and for those portions of walls which receive vertical loads.

D. FOUNDATION FLEXIBILITY

Vertical and rotational soil springs may be modeled under each column line of the frame by adding a "dummy" story to the structure at the foundation level, as shown in Figure IV-7. The properties of the beams and columns in this level are manipulated and input to simulate the desired restraint conditions. This procedure can be used very effectively to model base isolation systems. In such situations the analytical results tend to be very sensitive to the input restraint conditions and it is important that a practical solution to such problems be based on several analyses, such that the sensitivities of the restraint parameters are evaluated and their relative importance is established.



Foundation Flexibility Modeling
Figure IV-7

V.

ETABS INPUT DATA FILE

This chapter provides information associated with the preparation of the data file that numerically defines the structural geometry and loading associated with the building that is to be analyzed. Optionally, the input data file can be prepared through ETABSIN, the interactive graphic model generator, which will automatically generate the input file from the model, in the format described below.

A. DATA ACCUMULATION

Before starting the actual line-by-line coding of the input data, the user needs to accumulate and organize information needed for the building analysis. The following steps are recommended:

a. Determine the elements of the structural system (frames, shear walls, etc.) that are to be a part of the computer model.

b. Define the horizontal floor levels of the structure for story level definition.

c. Draw a plan of the structure. On the plan show the column lines and bays associated with frames (or other wall systems). Choose a global reference point (or origin).

d. Draw frame elevations for all the frames (and shear walls) in the building. Unfolded elevations may be developed for three-dimensional frames.

On the frame elevations select and show the following:

(1) Column lines and bays associated with the frame.

(2) Diaphragm level ID's associated with the frame and associated story heights.

(3) Member sizes.

(4) Vertical loading (if any) separated as dead load and live load.

(5) Member property identification numbers and beam span loading identification numbers.

e. Other information that needs to be provided either by input or by automatic program options include:

(1) Floor centers of mass.

(2) Story dynamic properties.

(3) Structural lateral loading (static or dynamic).

(4) Load cases. (Combinations of load conditions if required).

B. FREE FORMAT

All input data for ETABS is prepared in free format. In other words, the data on a particular line does not have to correspond with prespecified column locations. The data is input as a string of numbers which are separated by one or more blanks. It is important to enter all items even if they are zero; however, trailing zeros on any data line need not be input. No data line may be more than eighty characters in length. Also, the data file should not contain spacing tab characters that are generated by some editors while preparing a data file.

Decimal points for whole floating point numbers are not necessary. For example, the number (6.0) may be entered as (6).

Alphabetic characters may be uppercase or lowercase.

Any line having a $ (dollar) sign in Column 1 is treated as a comment line and ignored by the program.

The $ sign may also be used in any other column on any data line. In such cases entries to the right of the $ sign will be treated as comment data and ignored by the program. This option allows the user to effectively comment the data as it is being prepared.

Simple arithmetic statements are possible when entering floating point real numbers in the free format fields. The following types of operators can be used:

+ for addition
- for subtraction
/ for division
*** for multiplication**
P for raising to the power of

The following are typical data entries that are possible:

11.92*12
7.63/386.4
3P.5
150P1.5*33
6.66-1.11*7.66/12.2

The operators are applied as they are encountered in the scan from left to right, so that

11.92*12	is evaluated as 11.92×12
7.63/386.4	is evaluated as $\frac{7.63}{386.4}$
3P.5	is evaluated as $3^{.5}$
150P1.5*33	is evaluated as $150^{1.5} \times 33$
6.66-1.11*7.66/12.2	is evaluated as $\frac{(6.66 - 1.11) \times 7.66}{12.2}$

Scientific exponential notation is also allowed. For example, the number 1.5E10 is read as 1.5×10^{10}.

C. UNITS

There are no built-in units in the ETABS computer program. The user must prepare the input in a consistent set of units. The output produced by the program will then conform to the same set of units.

Therefore, if the user chooses to use kips (1000 pounds) and inches as the input units, all the dimensions of the structure must be entered in inches and all the loads in kips. The material properties should also conform to these units. The output units will then be in kips and inches, so that member axial forces and shear forces will be in kips, and all bending moments will be in kip-inches. Displacements will be in inches and joint rotations will be in radians.

However, if the user anticipates using any of the design processors of the ETABS system, such as CONKER [22], STEELER [23] or WALLER [24], the ETABS input data will need to be prepared in a specific set of units as defined in the corresponding postprocessor manuals.

D. DETAILED DESCRIPTION OF THE ETABS INPUT DATA

There are basically eleven data sections associated with the ETABS input. A summary of the data setup is shown in Figure V-1. This chapter details each section and the associated data lines.

The following is the convention used to define each data line:

First, the sequence of the entries of each data line is presented as a series of abbreviations of the options (or variables).

Each data section is then followed by a table in the form:

Variable Field Note Entry

The **Variable** is the abbreviation of the entry made on the data line.

The **Entry** is a brief description of the option.

The **Field** is a number that corresponds to the sequence in which the variable exists on the data line. Thus if a variable is the fourth entry on a data line, it will have a field number of 4.

The **Note** number refers to the series of notes that exist after each corresponding data section. The notes describe the data options in more detail and give important information to aid the user in better understanding the options of the program.

Data Block	When Needed
1. Control Data	always
2. Mass Data	only if NMASS >0
3. Story Data	always
4. Material Property Data	always (except restart)
5. Section Property Data	always (except restart)
6. Frame Definition Data	always (except restart)
7. Frame Location Data	always
8. Static Lateral Load Data	only if NLAT >0
9. Dynamic Spectrum Data	only if NDYN = 2
10. Dynamic Time History Data	only if NDYN=3
11. Load Case Definition Data	only if NLD >0

Typical Data Setup for ETABS
Figure V-1

It is recommended that the user be thoroughly familiar with the main control variables in Section 1b and the frame control variables in Section 6b.

Repeated references are made to these variables throughout this chapter.

1. CONTROL INFORMATION

Prepare the following data as defined in Sections a, b and c below. This data is always needed. A total of 4 data lines is required.

a. Heading Data

Prepare two lines of data for output labeling up to 70 characters per line. This information will appear on every page.

b. Control Data

Prepare one line of control data for the whole building in the following form:

NST NDF NTF NMASS NLD NPER NMAT NCP
NBP NDP NPP NLAT NDYN NSD NPD NRGD
NDSP NSLF NMD

Note: The 19 entries in the line above should be entered on one data line in the input. They are shown on three lines above because the abbreviations need that much space.

c. Miscellaneous Parameters

Provide one data line in the following form:

GRAV EVT CUT PDFAC PROPFILE

1. CONTROL INFORMATION (continued)

Control Data

Variable	Field	Note	Entry
NST	1	(1)	Number of stories in the building, not including the baseline.
NDF	2	(2)	Number of frames in the building with different properties or different loading.
NTF	3	(3)	Total number of frames in the building.
NMASS	4	(4)	Number of story mass types: = 0 No automatic mass properties calculated. > 0 Automatic calculation of NMASS mass type properties.
NLD	5	(5)	Total number of structural load cases.
NPER	6	(6)	Number of structural periods and mode shapes to be generated.
NMAT	7	(7)	Number of different material property types in all the frames.

1. CONTROL INFORMATION (continued)

Control Data (continued)

Variable	Field	Note	Entry
NCP	8	(8)	Number of different column section property types in all the frames.
NBP	9	(9)	Number of different beam section property types in all the frames.
NDP	10	(10)	Number of different brace section property types in all the frames.
NPP	11	(11)	Number of different panel section property types in all the frames.
NLAT	12	(12)	Static lateral analysis code: = 0 No lateral static loads. = 1 User-defined lateral loads. = 2 UBC 85 lateral seismic loads. = 3 ATC 3-06 lateral seismic loads. = 4 UBC 79 lateral wind loads. = 5 UBC 91 lateral wind loads. = 6 UBC 91 lateral seismic loads. = 7 BOCA 90 lateral wind loads. = 8 ASCE 7-88 lateral wind loads. = 9 BOCA 90 lateral seismic loads. = 10 NBCC 90 lateral seismic loads. = 11 NBCC 90 lateral wind loads.

1. CONTROL INFORMATION (continued)

Control Data (continued)

Variable	Field	Note	Entry
NDYN	13	(13)	Dynamic lateral analysis code: = 0 No dynamic analysis. = 1 Time periods and mode shapes. = 2 Response spectrum analysis. = 3 Time history analysis.
NSD	14	(14)	Structure type code: = 0 Three-dimensional, with story rotations (i.e. unlocked). = 1 Two-dimensional. All frames parallel to the global X-axis. = 2 Two-dimensional. All frames parallel to the global Y-axis. = 3 Three-dimensional, without story rotations (i.e. locked).
NPD	15	(15)	P-Delta analysis code: = 0 Do not include P-Delta effects. = 1 Include P-Delta effects. Story masses must be provided for P-Delta effects to be included.

1. CONTROL INFORMATION (continued)

Control Data (continued)

Variable	Field	Note	Entry
NRGD	16	(16)	Frame joint stiffness modification code: = 0 Do not reduce rigid end offset. = 1 Reduce rigid end offset by 25%. = 2 Reduce rigid end offset by 50%. = 3 Reduce rigid end offset by 75%. = 4 Reduce rigid end offset by 100%.
NDSP	17	(17)	Frame joint displacement code: = 0 No frame joint displacements printed. = 1 Frame joint displacements printed.
NSLF	18	(18)	Frame self weight calculation code: = 0 Frame self weight not included in analytical load conditions. = 1 Self weight calculated and included in structural load condition I. = 2 Self weight calculated and included in structural load condition II. = 3 Self weight calculated and included in structural load condition III.

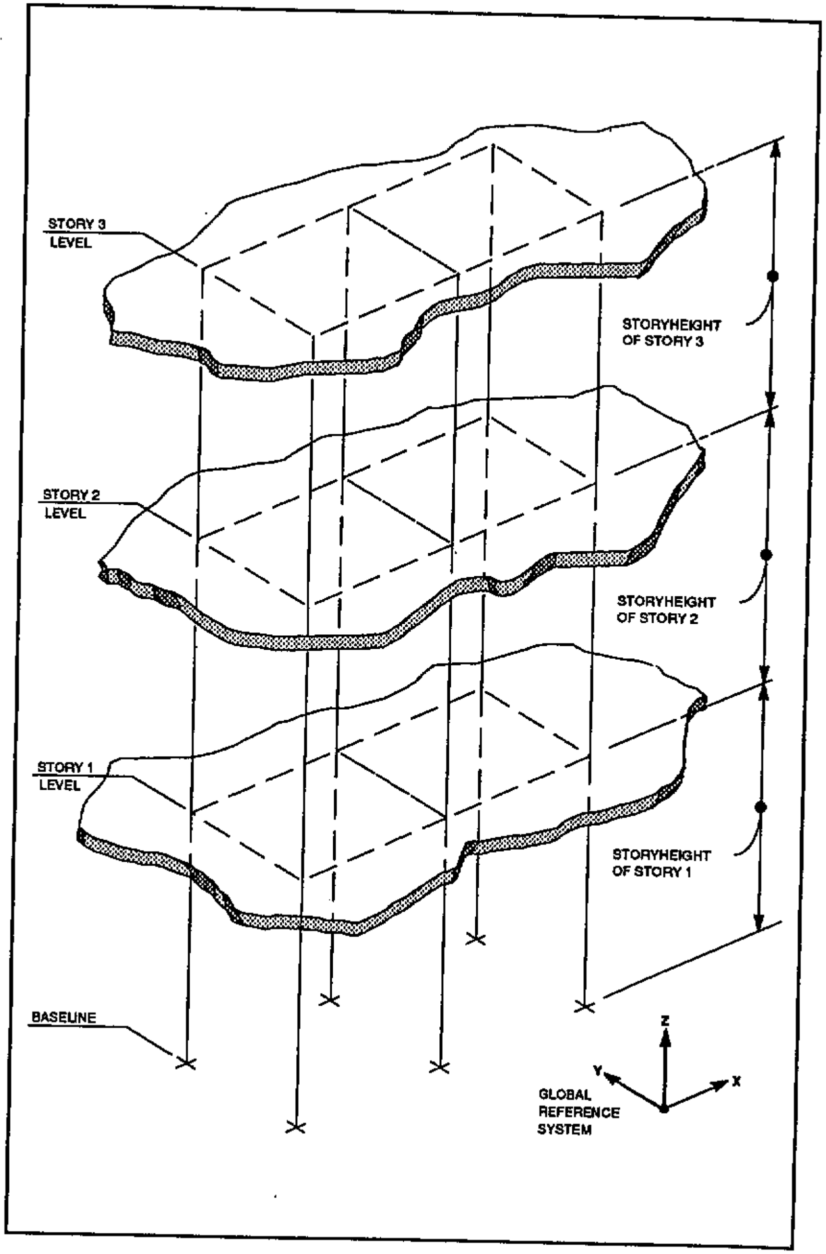
1. CONTROL INFORMATION (continued)

Control Data (continued)

Variable	Field	Note	Entry
NMD	19	(19)	Mode shape postprocessing code: = 0 Suppress recovery of mode shape vectors. = 1 Recover mode shape vectors for postprocessing.

Miscellaneous Parameters

Variable	Field	Note	Entry
GRAV	1	(20)	Gravitational acceleration.
EVT	2	(21)	Eigenvalue tolerance.
CUT	3	(22)	Cutoff time period.
PDFAC	4	(23)	Factor to be applied to P-Delta effects.
PROPFILE	5	(24)	User section property filename.



Typical Multistory Structure
Figure V-2

1 - NOTES :

1. The number of stories in the building is the number of levels above the baseline of the building. See Figure V-2.

2. This variable controls the number of data sets to be prepared in Section 6 below.

   Input data for frames with identical frame properties and frame loading need only be prepared once.

3. The **NTF** total frames consisting of **NDF** different frames, are located via the frame location data (Section 7) below. **NTF** can never be less than **NDF**.

4. This variable controls the number of data sets to be provided in Section 2 below.

5. Load cases are defined as linear combinations of the eight basic load conditions. See load case definition data (Section 11) below.

6. The maximum number of periods (modes) allowed is 3***NST** for 3-D structures and **NST** for 2-D structures. See Note 14 below.

7. This variable controls the number of data lines to be read in Section 4 below.

8. This variable controls the number of data sets to be read in Section 5(i) below.

9. This variable controls the number of data sets to be read in Section 5(ii) below.

1 - NOTES : (continued)

10. This variable controls the number of data sets to be read in Section 5(iii) below.

11. This variable controls the number of data sets to be read in Section 5(iv) below.

12. This variable controls the definition of the static lateral loading of the building to be defined in Section 8 below.

13. This variable triggers the dynamic analysis options of the program, thereby controlling the type of dynamic data required by the program in the input sequence. See Sections 9 and 10 below.

14. If **NSD** is 0, the structure is assumed to be three-dimensional and all the stories of the structure can laterally translate in the global X- and Y-directions and rotate about the global Z-direction.

    If **NSD** is 1, the structure is assumed to be two-dimensional and each floor is allowed to translate laterally only in the global X-direction. The global Y-translation and global Z-rotation are locked (i.e. set to zero).

    If **NSD** is 2, the structure is assumed to be two-dimensional and each floor is allowed to translate laterally only in the global Y-direction. The global X-translation and global Z-rotation are locked.

    If **NSD** is 3, the structure is assumed to be three-dimensional and each floor is allowed to translate in the global X- and Y-direction, with the global Z-rotation locked.

1 - NOTES : (continued)

This option can be used to lock the floors in rotation to study the effects the elimination of story rotations have on the distribution of the structural lateral shear forces.

15. Overall structural P-Delta effects are included as defined in Reference [18]. Also see Note 23 below.

    Caution is advised while using this option for structures where column line disconnections are extensively used to model stepped diaphragms, or to create dummy levels for modeling special situations.

16. The dimensions of beam and column rigid end offsets for member stiffness formulations are modified as defined in Chapter III.

17. Frame joint **vertical** displacements and rotations are printed level by level for each frame if **NDSP**=1. The volume of the frame output is approximately doubled by triggering this option.

18. The self weights of the frames can be added to any of the vertical load conditions.

19. Graphic displays of the structural mode shapes using the ETABS postprocessor PLOTTER are only possible if **NMD** is 1.

    If **NMD** is 0 and **NDYN** is 1, the execution time during the recovery phase is significantly reduced, particularly if **NPER** is large.

    IF **NDYN** is 2, **NMD** is set to 1 by the program.

1 - NOTES: (continued)

20. The gravitational acceleration (e.g. 32.2 ft/sec^2 or 386.4 in/sec^2) is needed to convert mass units to weight units at various steps in the program, such as in the evaluation of P-Delta effects and in the automatic calculation of the lateral static seismic forces.

21. The eigenvalues are evaluated by an accelerated subspace iteration algorithm. The iteration will continue until the change in the time period of a particular mode in successive iterations is less than **EVT**.

    EVT is only used if **NDYN** is not 0.

    If **EVT** is not specified, it is assumed to be 0.0001.

22. The program will terminate the eigensolution for the **NPER** time periods when all the modes having a time period greater than **CUT** have been found.

    Only the number of modes that are evaluated will be included in any subsequent response spectrum or time history analysis processing. **CUT** is only used if **NDYN** is not 0.

23. The P-Delta effects are automatically accounted for in the program (if **NPD** = 1) by calculating the effects of the story weights, obtained from the specified story masses and the gravitational constant, deflecting over the calculated elastic story displacements. The **PDFAC** is used as a multiplier for the P-Delta effects. This allows the user to account for the factored story weights and/or inelastic displacements.

    If **NPD** = 1 and **PDFAC** is left as zero it defaults to 1.

1 - NOTES: (continued)

24. **PROPFILE** is the name of a user section property file (maximum eight characters) with a .DAT extension which the program searches if a section property name is not found in the AISC.DAT file provided as part of the program. An ETABS compatible user section property file can be created by use of the program **PROPER**. This allows the user to conveniently use custom built and other non-AISC sections.

2. AUTOMATIC CALCULATION OF STORY MASS, MASS MOMENT OF INERTIA AND CENTER OF MASS

If **NMASS** is 0, no automatic calculation of story mass properties is to be made. Therefore, skip this data section.

Otherwise, provide one set of data (a and b below) for each of the **NMASS** mass types. Each mass type is discretized as a series of **NSEG** rectangular segments, each having its own mass, defined by mass intensity **AM**. See Figure V-3.

a. Control Line

Prepare one line of data in the following form:

MID NSEG SF

b. Segment Data Lines

Provide **NSEG** (defined above) data lines in the following form:

AM XC YC BB DD

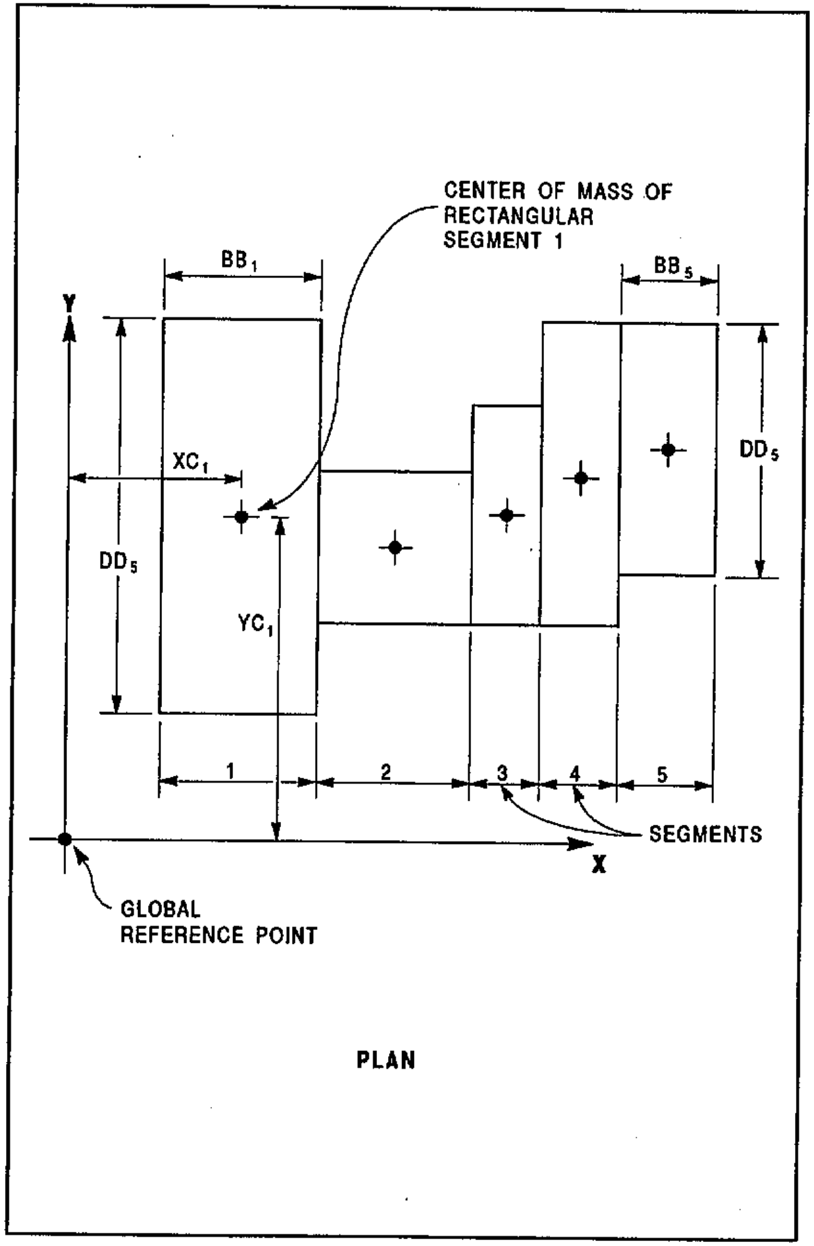
2. MASS DATA (continued)

Control Data (continued)

Variable	Field	Note	Entry
MID	1	(1)	Mass type identification number.
NSEG	2	(2)	Number of rectangular segments defining mass distribution.
SF	3	(3)	Scale factor for scaling mass AM.

Segment Data Lines

Variable	Field	Note	Entry
AM	1	(4,6)	Mass/unit area for rectangular segment, or mass/length for line segment, or mass for point segment.
XC	2	(5)	X-distance of center of mass of this segment from the global reference point.



Example of Mass Type with 5 Segments
Figure V-3

2. MASS DATA (continued)

Control Data (continued)

Variable	Field	Note	Entry
YC	3		Y-distance of center of mass of this segment from the global reference point.
BB	4	(6)	B-dimension of rectangular segment.
DD	5		D-dimension of rectangular segment.

2 - NOTES:

1. Mass type identification numbers must be input in ascending, consecutive sequence, starting with the number 1.

2. The story diaphragm is discretized as a series of rectangular segments, each having a mass/unit area **AM**, **BB** and **DD** dimensions and **XC** and **YC** centroidal distances from the global reference point. See Figure V-3. Using this data the program calculates for each story a total mass, the center of mass global coordinates of the floor, and a mass moment of inertia about a vertical axis passing through the center of mass of the floor. There is no limit on the number of rectangular segments used to define a mass type.

3. This number is a multiplier for all **AM** entries of this mass type. For instance, the user may input all the **AM** entries in weight units and then use a scale factor of **(1/GRAV)** to convert the weight quantities to mass quantities. If **SF** is not entered, a value of 1.0 is used.

4. Mass has units of force divided by gravitational acceleration (W/g).

5. The global reference point and reference axis are defined in Chapter III.

6. **BB** and **DD** are the two dimensions of the rectangle. **BB** and **DD** need not be parallel or perpendicular to the reference axis.

   If **BB** is zero, the mass becomes a line mass of length **DD** of mass intensity **AM**/unit length.

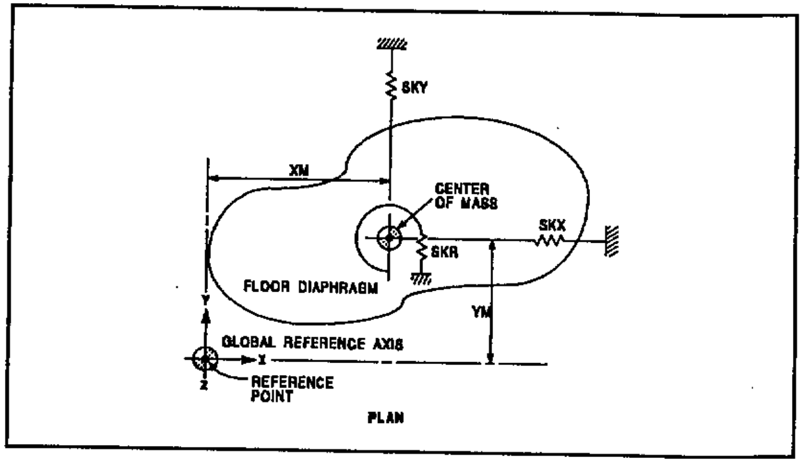
   If **DD** is zero, the mass becomes a line mass of length **BB** of mass intensity **AM**/unit length.

If both **BB** and **DD** are zero, the mass becomes a point mass having a total mass of **AM**.

3. STORY DATA

This data is always needed. Prepare one line of data corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence towards the bottom of the building. The data amounts to a total of NST data lines in the following form:

SDI SH IMST SMASS SMMI XM YM SKX SKY SKR



Typical Story Floor Plan
Figure V-4

3. STORY DATA (continued)

Variable	Field	Note	Entry
SDI	1	(1)	Story identification label for this level.
SH	2	(2)	Story height associated with this level.
IMST	3	(3)	Mass type code, enter 0 if NMASS=0: = 0 Mass properties of this story are as input in this data. > 0 Mass properties correspond to mass type IMST, as previously defined.
SMASS	4	(4)	Translational mass.
SMMI	5	(4)	Rotational mass moment of inertia of the story about a vertical axis through the center of mass of the story.
XM	6	(5)	X-distance to the center of mass measured from the reference point.
YM	7		Y-distance to the center of mass measured from the reference point.

3. STORY DATA (continued)

Variable	Field	Note	Entry
SKX	8	(6)	External story stiffness in the X-direction.
SKY	9		External story stiffness in the Y-direction.
SKR	10		External story stiffness in the story rotational direction.

3 - NOTES:

1. This entry may have up to eight characters with no embedded blanks. It is recommended that the user limit the identification label length to a minimum, as this label is referenced at various stages throughout the input. Identification labels for each level must be unique. The word **BASELINE** may not be used as a story identification label.

2. This entry is an interstory height. It defines the level of the horizontal rigid diaphragm of this story. Story lateral loads are assumed to be generated at this level. Frame levels must correspond to structural levels defined in the story data. A zero story height is not allowed. See Figure V-2.

3. The story mass properties **SMASS, SMMI, XM** and **YM** may be assigned either by defining the **IMST** entry or by explicitly specifying the mass properties on this data line. This entry must not be greater than **NMASS.** If this entry is nonzero, any **SMASS, SMMI, XM** and **YM** entries on this line are superseded by the corresponding values established by the **IMST** entry.

   Formulas for the calculation of the mass moment of inertia of typical floor configurations (if the automatic option is not used) are shown in Figure V-5.

4. The structural mass properties **SMASS, SMMI, XM** and **YM** must be defined if any one of the following is true:

   a. The entry for **NLAT** is 2,3 ,6, 9 or 10
   b. The entry for **NDYN** is 1,2 or 3
   c. The entry for **NPD** is 1.

3 - NOTES: (continued)

5. The center of mass is related to the following aspects of the solution process:

a. The dynamic lateral forces and torsional moments on the diaphragm are generated at this point.

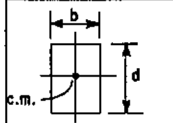
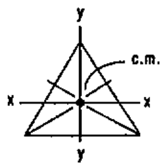
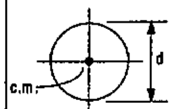
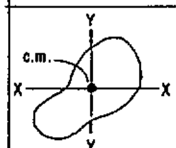
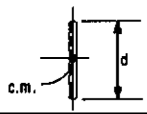
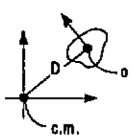
b. The external story stiffnesses, if any, are assumed to be at this point.

c. The story static structure displacements (lateral translations and rotations) are printed at this point.

If the center of mass is not defined, it is assumed to be (0,0), in which case the story static displacements will be printed at the global reference point.

6. These are external lateral spring constants that are located on the floor diaphragm at the center of mass.

These stiffnesses can be used to model lateral soil springs for levels that exist underground. See Figure V-4.

Shape in plan	Mass Moment of Inertia about vertical axis (normal to paper) through center of mass	Formula
	Rectangular diaphragm Uniformly distributed mass per unit area Total mass of diaphragm = M (or w/g)	$MMI_{cm} = M/12\ (b^2 + d^2)$
	Triangular diaphragm Uniformly distibuted mass per unit area Total mass of diaphragm = M (or w/g)	Use general diaphragm formula
	Circular diaphragm Uniformly distributed mass per unit area Total mass of diaphragm = M (or w/g)	$MMI_{cm} = \frac{Md^2}{8}$
	General diaphragm Uniformly distributed mass per unit area Total mass of diaphragm = M (or w/g) Area of diaphragm = A Moment of inertia of area about XX = I_x Moment of inertia of area about YY = I_y	$MMI_{cm} = M/A\ (I_x + I_y)$
	Line mass Uniformly distributed mass per unit length Total mass of line = M (or w/g)	$MMI_{cm} = \frac{Md^2}{12}$
	Axis transformation for a mass A If mass is a point mass, $MMI_o = 0$	$MMI_{cm} = MMI_o + MD^2$

Formulas For Mass Moment Of Inertia
Figure V-5

4. FRAME MEMBER MATERIAL PROPERTY DATA

Provide one data line for each of the **NMAT** material property types. This data section is mandatory. The data lines are to be prepared in the following form:

MID MTYPE E W U DP1 DP2 DP3

Variable	Field	Note	Entry
MID	1	(1)	Material identification number.
MTYPE	2	(2)	Material type: = S Steel = C Concrete (frames) = W Concrete (walls) = O Other
E	3	(3)	Modulus of elasticity.
W	4	(4)	Unit weight (weight/volume).
U	5	(5)	Poisson's ratio.

4. MATERIAL PROPERTIES (continued)

Variable	Field	Note	Entry
DP1	6	(6)	Design parameter 1 (see Figure V-6).
DP2	7		Design parameter 2 (see Figure V-6).
DP3	8		Design parameter 3 (see Figure V-6)

MATERIAL TYPE CODE	DESIGN PATTERNS		
	DP1	DP2	DP3
S (STEEL)	F_y	*F_{bmaj}	*F_{bmin}
C (CONCRETE FRAMES)	f_y	f'_c	f_{ys}
W (CONCRETE WALLS)	f_y	f'_c	f_{ys}
M (MASONRY WALLS)	f_y	f'_m	f_{ys}
O (OTHER)	—	—	—

F_y	=	Yield stress of structural steel
F_{bmaj}, F_{bmin}	=	Allowable bending stresses for structural steel sections, in the major and minor directions
f_y	=	Yield stress of reinforcing steel
f'_c	=	Ultimate strength of concrete
f'_m	=	Specified strength of masonry
f_{ys}	=	Yield stress of shear reinforcing steel

*Provide these parameters only if these values are not to be calculated by STEELER

Material Design/Check Parameters
Figure V-6

4 - NOTES:

1. Material identification numbers must be input in ascending, consecutive sequence starting with the number 1.

2. A series of design/stress check postprocessors operating off the ETABS postprocessing data base are available. The material type designation is basically an indicator for the postprocessors.

   The steel checking postprocessor, for example, will only check those members that have a material type S and the concrete frame design postprocessor will only design the members having a material designation of C. Materials having a designation type O will not be processed by any of the postprocessors.

   Provide the corresponding entries even if no postprocessing is anticipated.

3. Remember consistent units.

4. The unit weight of the element material is in force/unit volume units (e.g. 150 pounds/ cubic foot for concrete). This is used to calculate the self weight of the element. The self weight is added into vertical load condition **NSLF**. The self weight is based upon the story to story heights for the column and the panel, and the story to story length for the diagonals. The self weight of the beam is based upon the clear length of the beam (column face to column face). For the purpose of determining the element volume for the self weight calculation, the axial area (not the shear area) is used. This entry is not associated in any way with the story mass calculation.

4 - NOTES: (continued)

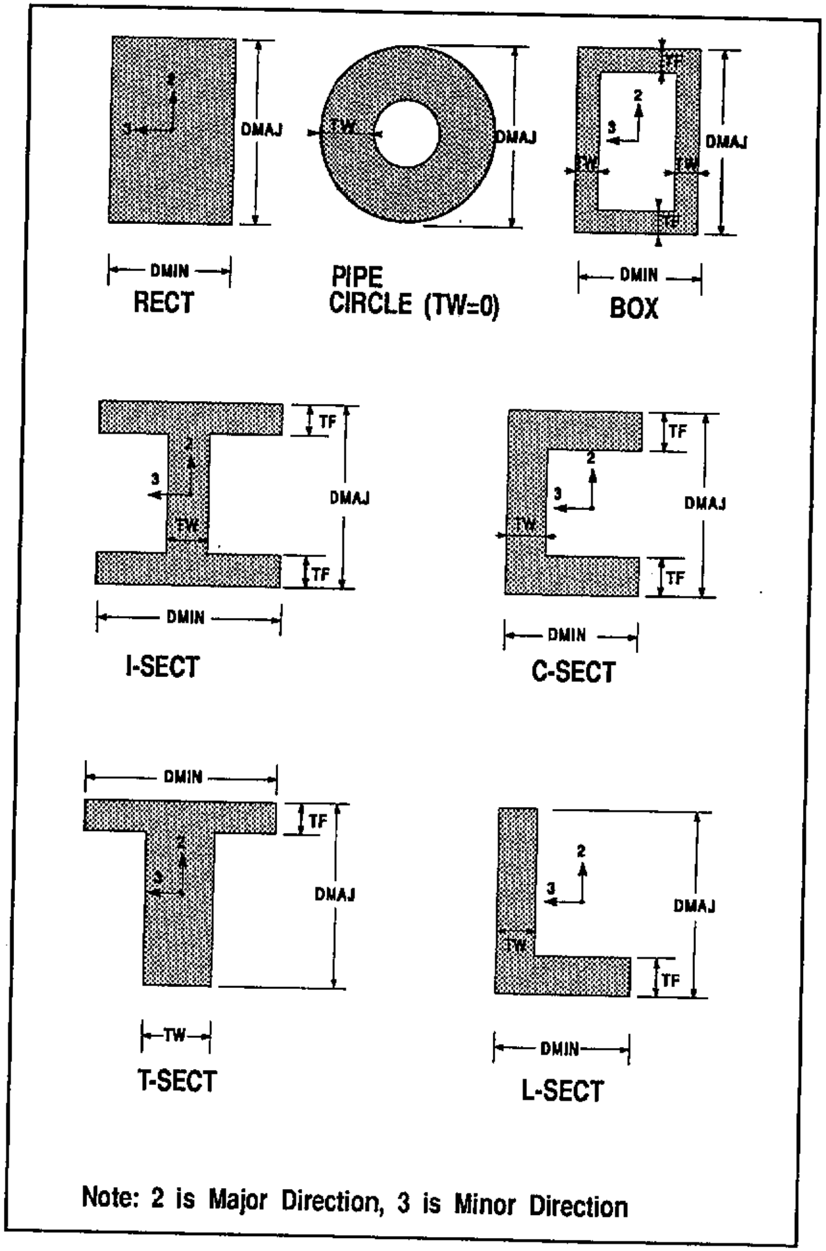
5. Poisson's ratio is used for calculating the shear modulus,

$$G = \frac{E}{2\ (1 + U)}$$

6. The design parameters depend upon the material type and are required by the postprocessors. These entries need not be provided if no postprocessing is anticipated.

5. FRAME MEMBER SECTION PROPERTY DATA

Prepare one (or up to four) of the following data sections, (i) through (iv) below, to define the section property tables of the various element types that make up the frames in the structure.



Required Dimensions for Automatic Section Property Generation
Figure V-7

W40X328	W40X298	W40X268	W40X244
W40X221	W40X192	W40X655	W40X593
W40X531	W40X480	W40X436	W40X397
W40X362	W40X324	W40X297	W40X277
W40X249	W40X215	W40X199	W40X183
W40X167	W40X149	W36X848	W36X798
W36X720	W36X650	W36X588	W36X527
W36X485	W36X439	W36X393	W36X359
W36X328	W36X300	W36X280	W36X260
W36X245	W36X230	W36X256	W36X232
W36X210	W36X194	W36X182	W36X170
W36X160	W36X150	W36X135	W33X619
W33X567	W33X515	W33X468	W33X424
W33X387	W33X354	W33X318	W33X291
W33X263	W33X241	W33X221	W33X201
W33X169	W33X152	W33X141	W33X130
W33X118	W30X581	W30X526	W30X477
W30X433	W30X391	W30X357	W30X326
W30X292	W30X261	W30X235	W30X211
W30X191	W30X173	W30X148	W30X132
W30X124	W30X116	W30X108	W30X99
W30X90	W27X539	W27X494	W27X448
W27X407	W27X368	W27X336	W27X307
W27X281	W27X258	W27X235	W27X217
W27X194	W27X178	W27X161	W27X146
W27X129	W27X114	W27X102	W27X94
W27X84	W24X492	W24X450	W24X408
W24X370	W24X335	W24X306	W24X279
W24X250	W24X229	W24X207	W24X192
W24X176	W24X162	W24X146	W24X131
W24X117	W24X104	W24X103	W24X94
W24X84	W24X76	W24X68	W24X62
W24X55	W21X402	W21X364	W21X333
W21X300	W21X275	W21X248	W21X223
W21X201	W21X182	W21X166	W21X147
W21X132	W21X122	W21X111	W21X101
W21X93	W21X83	W21X73	W21X68
W21X62	W21X57	W21X50	W21X44
W18X311	W18X283	W18X258	W18X234
W18X211	W18X192	W18X175	W18X158
W18X143	W18X130	W18X119	W18X106
W18X97	W18X86	W18X76	W18X71
W18X65	W18X60	W18X55	W18X50
W18X46	W18X40	W18X35	W16X100
W16X89	W16X77	W16X67	W16X57
W16X50	W16X45	W16X40	W16X36
W16X31	W16X26	W14X730	W14X665
W14X605	W14X550	W14X500	W14X455
W14X426	W14X398	W14X370	W14X342
W14X311	W14X283	W14X257	W14X233
W14X211	W14X193	W14X176	W14X159
W14X145	W14X132	W14X120	W14X109
W14X99	W14X90	W14X82	W14X74
W14X68	W14X61	W14X53	W14X48
W14X43	W14X38	W14X34	W14X30
W14X26	W14X22	W12X336	W12X305

Built-in AISC Property Designations
Figure V-8

W12X279	W12X252	W12X230	W12X210
W12X190	W12X170	W12X152	W12X136
W12X120	W12X106	W12X96	W12X87
W12X79	W12X72	W12X65	W12X58
W12X53	W12X50	W12X45	W12X40
W12X35	W12X30	W12X26	W12X22
W12X19	W12X16	W12X14	W10X112
W10X100	W10X88	W10X77	W10X68
W10X60	W10X54	W10X49	W10X45
W10X39	W10X33	W10X30	W10X26
W10X22	W10X19	W10X17	W10X15
W10X12	W8X67	W8X58	W8X48
W8X40	W8X35	W8X31	W8X28
W8X24	W8X21	W8X18	W8X15
W8X13	W8X10	W6X25	W6X20
W6X15	W6X16	W6X12	W6X9
W5X19	W5X16	W4X13	M14X18
M12X11.8	M10X9	M8X6.5	M6X20
M6X4.4	M5X18.9	M4X13	S24X121
S24X106	S24X100	S24X90	S24X80
S20X96	S20X86	S20X75	S20X66
S18X70	S18X54.7	S15X50	S15X42.9
S12X50	S12X40.8	S12X35	S12X31.8
S10X35	S10X25.4	S8X23	S8X18.4
S7X20	S7X15.3	S6X17.25	S6X12.5
S5X14.75	S5X10	S4X9.5	S4X7.7
S3X7.5	S3X5.7	HP14X117	HP14X102
HP14X89	HP14X73	HP13X100	HP13X87
HP13X73	HP13X60	HP12X84	HP12X74
HP12X63	HP12X53	HP10X57	HP10X42
HP8X36	C15X50	C15X40	C15X33.9
C12X30	C12X25	C12X20.7	C10X30
C10X25	C10X20	C10X15.3	C9X20
C9X15	C9X13.4	C8X18.75	C8X13.75
C8X11.5	C7X14.75	C7X12.25	C7X9.8
C6X13	C6X10.5	C6X8.2	C5X9
C5X6.7	C4X7.25	C4X5.4	C3X6
C3X5	C3X4.1	MC18X58	MC18X51.9
MC18X45.8	MC18X42.7	MC13X50	MC13X40
MC13X35	MC13X31.8	MC12X50	MC12X45
MC12X40	MC12X35	MC12X31	MC12X10.6
MC10X41.1	MC10X33.6	MC10X28.5	MC10X25
MC10X22	MC10X8.4	MC10X6.5	MC9X25.4
MC9X23.9	MC8X22.8	MC8X21.4	MC8X20
MC8X18.7	MC8X8.5	MC7X22.7	MC7X19.1
MC7X17.6	MC6X18	MC6X15.3	MC6X16.3
MC6X15.1	MC6X12	WT18X179.5	WT18X164
WT18X150	WT18X140	WT18X130	WT18X122.5
WT18X115	WT18X128	WT18X116	WT18X105
WT18X97	WT18X91	WT18X85	WT18X80
WT18X75	WT18X67.5	WT16.5X177	WT16.5X159
WT16.5X145.5	WT16.5X131.5	WT16.5X120.5	WT16.5X110.5
WT16.5X100.5	WT16.5X84.5	WT16.5X76	WT16.5X70.5
WT16.5X65	WT16.5X59	WT15X117.5	WT15X105.5
WT15X95.5	WT15X86.5	WT15X74	WT15X66
WT15X62	WT15X58	WT15X54	WT15X49.5

Built-in AISC Property Designations (continued)
Figure V-8

WT13.5X108.5	WT13.5X97	WT13.5X89	WT13.5X80.5
WT13.5X73	WT13.5X64.5	WT13.5X57	WT13.5X51
WT13.5X47	WT13.5X42	WT12X88	WT12X81
WT12X73	WT12X65.5	WT12X58.5	WT12X52
WT12X51.5	WT12X47	WT12X42	WT12X38
WT12X34	WT12X31	WT12X27.5	WT10.5X83
WT10.5X73.5	WT10.5X66	WT10.5X61	WT10.5X55.5
WT10.5X50.5	WT10.5X46.5	WT10.5X41.5	WT10.5X36.5
WT10.5X34	WT10.5X31	WT10.5X28.5	WT10.5X25
WT10.5X22	WT9X71.5	WT9X65	WT9X59.5
WT9X53	WT9X48.5	WT9X43	WT9X38
WT9X35.5	WT9X32.5	WT9X30	WT9X27.5
WT9X25	WT9X23	WT9X20	WT9X17.5
WT8X50	WT8X44.5	WT8X38.5	WT8X33.5
WT8X28.5	WT8X25	WT8X22.5	WT8X20
WT8X18	WT8X15.5	WT8X13	WT7X365
WT7X332.5	WT7X302.5	WT7X275	WT7X250
WT7X227.5	WT7X213	WT7X199	WT7X185
WT7X171	WT7X155.5	WT7X141.5	WT7X128.5
WT7X116.5	WT7X105.5	WT7X96.5	WT7X88
WT7X79.5	WT7X72.5	WT7X66	WT7X60
WT7X54.5	WT7X49.5	WT7X45	WT7X41
WT7X37	WT7X34	WT7X30.5	WT7X26.5
WT7X24	WT7X21.5	WT7X19	WT7X17
WT7X15	WT7X13	WT7X11	WT6X168
WT6X152.5	WT6X139.5	WT6X126	WT6X115
WT6X105	WT6X95	WT6X85	WT6X76
WT6X68	WT6X60	WT6X53	WT6X48
WT6X43.5	WT6X39.5	WT6X36	WT6X32.5
WT6X29	WT6X26.5	WT6X25	WT6X22.5
WT6X20	WT6X17.5	WT6X15	WT6X13
WT6X11	WT6X9.5	WT6X8	WT6X7
WT5X56	WT5X50	WT5X44	WT5X38.5
WT5X34	WT5X30	WT5X27	WT5X24.5
WT5X22.5	WT5X19.5	WT5X16.5	WT5X15
WT5X13	WT5X11	WT5X9.5	WT5X8.5
WT5X7.5	WT5X6	WT4X33.5	WT4X29
WT4X24	WT4X20	WT4X17.5	WT4X15.5
WT4X14	WT4X12	WT4X10.5	WT4X9
WT4X7.5	WT4X6.5	WT4X5	WT3X12.5
WT3X10	WT3X7.5	WT3X8	WT3X6
WT3X4.5	WT2.5X9.5	WT2.5X8	WT2X6.5
MT7X9	MT6X5.9	MT5X4.5	MT4X3.25
MT3X10	MT3X2.2	MT2.5X9.45	MT2X6.5
ST12X60.5	ST12X53	ST12X50	ST12X45
ST12X40	ST10X48	ST10X43	ST10X37.5
ST10X33	ST9X35	ST9X27.35	ST7.5X25
ST7.5X21.45	ST6X25	ST6X20.4	ST6X17.5
ST6X15.9	ST5X17.5	ST5X12.7	ST4X11.5
ST4X9.2	ST3.5X10	ST3.5X7.65	ST3X8.625
ST3X6.25	ST2.5X7.375	ST2.5X5	ST2X4.75
ST2X3.85	ST1.5X3.75	ST1.5X2.85	L9X4X5/8
L9X4X9/16	L9X4X1/2	L8X8X9/8	L8X8X1
L8X8X7/8	L8X8X3/4	L8X8X5/8	L8X8X9/16
L8X8X1/2	L8X6X1	L8X6X7/8	L8X6X3/4
L8X6X5/8	L8X6X9/16	L8X6X1/2	L8X6X7/16

Built-in AISC Property Designations (continued)
Figure V-8

L8X4X1	L8X4X3/4	L8X4X9/16	L8X4X1/2
L7X4X3	L7X4X5/8	L7X4X1/2	L7X4X3/8
L6X6X1	L6X6X7/8	L6X6X3/4	L6X6X5/8
L6X6X9/16	L6X6X1/2	L6X6X7/16	L6X6X3/8
L6X6X5/16	L6X4X7/8	L6X4X3/4	L6X4X5/8
L6X4X9/16	L6X4X1/2	L6X4X7/16	L6X4X3/8
L6X4X5/16	L6X3.5X1/2	L6X3.5X3/8	L6X3.5X5/16
L5X5X7/8	L5X5X3/4	L5X5X5/8	L5X5X1/2
L5X5X7/16	L5X5X3/8	L5X5X5/16	L5X3.5X3/4
L5X3.5X5/8	L5X3.5X1/2	L5X3.5X7/16	L5X3.5X3/8
L5X3.5X5/16	L5X3.5X1/4	L5X3X5/8	L5X3X1/2
L5X3X7/16	L5X3X3/8	L5X3X5/16	L5X3X1/4
L4X4X3/4	L4X4X5/8	L4X4X1/2	L4X4X7/16
L4X4X3/8	L4X4X5/16	L4X4X1/4	L4X3.5X5/8
L4X3.5X1/2	L4X3.5X7/16	L4X3.5X3/8	L4X3.5X5/16
L4X3.5X1/4	L4X3X5/8	L4X3X1/2	L4X3X7/16
L4X3X3/8	L4X3X5/16	L4X3X1/4	L3.5X3.5X1/2
L3.5X3.5X7/16	L3.5X3.5X3/8	L3.5X3.5X5/16	L3.5X3.5X1/4
L3.5X3X1/2	L3.5X3X7/16	L3.5X3X3/8	L3.5X3X5/16
L3.5X3X1/4	L3.5X2.5X1/2	L3.5X2.5X7/16	L3.5X2.5X3/8
L3.5X2.5X5/16	L3.5X2.5X1/4	L3X3X1/2	L3X3X7/16
L3X3X3/8	L3X3X5/16	L3X3X1/4	L3X3X3/16
L3X2.5X1/2	L3X2.5X7/16	L3X2.5X3/8	L3X2.5X5/16
L3X2.5X1/4	L3X2.5X3/16	L3X2X1/2	L3X2X7/16
L3X2X3/8	L3X2X5/16	L3X2X1/4	L3X2X3/16
L2.5X2.5X1/2	L2.5X2.5X3/8	L2.5X2.5X5/16	L2.5X2.5X1/4
L2.5X2.5X3/16	L2.5X2X3/8	L2.5X2X5/16	L2.5X2X1/4
L2.5X2X3/16	L2X2X3/8	L2X2X5/16	L2X2X1/4
L2X2X3/16	L2X2X1/8	2L8X8X9/8	2L8X8X9/8-3
2L8X8X9/8-6	2L8X8X1	2L8X8X1-3	2L8X8X1-6
2L8X8X7/8	2L8X8X7/8-3	2L8X8X7/8-6	2L8X8X3/4
2L8X8X3/4-3	2L8X8X3/4-6	2L8X8X5/8	2L8X8X5/8-3
2L8X8X5/8-6	2L8X8X1/2	2L8X8X1/2-3	2L8X8X1/2-6
2L6X6X1	2L6X6X1-3	2L6X6X1-6	2L6X6X7/8
2L6X6X7/8-3	2L6X6X7/8-6	2L6X6X3/4	2L6X6X3/4-3
2L6X6X3/4-6	2L6X6X5/8	2L6X6X5/8-3	2L6X6X5/8-6
2L6X6X1/2	2L6X6X1/2-3	2L6X6X1/2-6	2L6X6X3/8
2L6X6X3/8-3	2L6X6X3/8-6	2L5X5X7/8	2L5X5X7/8-3
2L5X5X7/8-6	2L5X5X3/4	2L5X5X3/4-3	2L5X5X3/4-6
2L5X5X1/2	2L5X5X1/2-3	2L5X5X1/2-6	2L5X5X3/8
2L5X5X3/8-3	2L5X5X3/8-6	2L5X5X5/16	2L5X5X5/16-3
2L5X5X5/16-6	2L4X4X3/4	2L4X4X3/4-3	2L4X4X3/4-6
2L4X4X5/8	2L4X4X5/8-3	2L4X4X5/8-6	2L4X4X1/2
2L4X4X1/2-3	2L4X4X1/2-6	2L4X4X3/8	2L4X4X3/8-3
2L4X4X3/8-6	2L4X4X5/16	2L4X4X5/16-3	2L4X4X5/16-6
2L4X4X1/4	2L4X4X1/4-3	2L4X4X1/4-6	2L3.5X3.5X3/8
2L3.5X3.5X3/8-3	2L3.5X3.5X3/8-6	2L3.5X3.5X5/16	2L3.5X3.5X5/16-3
2L3.5X3.5X5/16-6	2L3.5X3.5X1/4	2L3.5X3.5X1/4-3	2L3.5X3.5X1/4-6
2L3X3X1/2	2L3X3X1/2-3	2L3X3X1/2-6	2L3X3X3/8
2L3X3X3/8-3	2L3X3X3/8-6	2L3X3X5/16	2L3X3X5/16-3
2L3X3X5/16-6	2L3X3X1/4	2L3X3X1/4-3	2L3X3X1/4-6
2L3X3X3/16	2L3X3X3/16-3	2L3X3X3/16-6	2L2.5X2.5X3/8
2L2.5X2.5X3/8-3	2L2.5X2.5X3/8-6	2L2.5X2.5X5/16	2L2.5X2.5X5/16-3
2L2.5X2.5X5/16-6	2L2.5X2.5X1/4	2L2.5X2.5X1/4-3	2L2.5X2.5X1/4-6
2L2.5X2.5X3/16	2L2.5X2.5X3/16-3	2L2.5X2.5X3/16-6	2L2X2X3/8
2L2X2X3/8-3	2L2X2X3/8-6	2L2X2X5/16	2L2X2X5/16-3

Built-in AISC Property Designations (continued)
Figure V-8

2L2X2X5/16-6	2L2X2X1/4	2L2X2X1/4-3	2L2X2X1/4-6
2L2X2X3/16	2L2X2X3/16-3	2L2X2X3/16-6	2L2X2X1/8
2L2X2X1/8-3	2L2X2X1/8-6	2L8X6X1	2L8X6X1-3
2L8X6X1-6	2L8X6X3/4	2L8X6X3/4-3	2L8X6X3/4-6
2L8X6X1/2	2L8X6X1/2-3	2L8X6X1/2-6	2L8X4X1
2L8X4X1-3	2L8X4X1-6	2L8X4X3/4	2L8X4X3/4-3
2L8X4X3/4-6	2L8X4X1/2	2L8X4X1/2-3	2L8X4X1/2-6
2L7X4X3/4	2L7X4X3/4-3	2L7X4X3/4-6	2L7X4X1/2
2L7X4X1/2-3	2L7X4X1/2-6	2L7X4X3/8	2L7X4X3/8-3
2L7X4X3/8-6	2L6X4X3/4	2L6X4X3/4-3	2L6X4X3/4-6
2L6X4X5/8	2L6X4X5/8-3	2L6X4X5/8-6	2L6X4X1/2
2L6X4X1/2-3	2L6X4X1/2-6	2L6X4X3/8	2L6X4X3/8-3
2L6X4X3/8-6	2L6X3.5X3/8	2L6X3.5X3/8-3	2L6X3.5X3/8-6
2L6X3.5X5/16	2L6X3.5X5/16-3	2L6X3.5X5/16-6	2L5X3.5X3/4
2L5X3.5X3/4-3	2L5X3.5X3/4-6	2L5X3.5X1/2	2L5X3.5X1/2-3
2L5X3.5X1/2-6	2L5X3.5X3/8	2L5X3.5X3/8-3	2L5X3.5X3/8-6
2L5X3.5X5/16	2L5X3.5X5/16-3	2L5X3.5X5/16-6	2L5X3X1/2
2L5X3X1/2-3	2L5X3X1/2-6	2L5X3X3/8	2L5X3X3/8-3
2L5X3X3/8-6	2L5X3X5/16	2L5X3X5/16-3	2L5X3X5/16-6
2L5X3X1/4	2L5X3X1/4-3	2L5X3X1/4-6	2L4X3.5X1/2
2L4X3.5X1/2-3	2L4X3.5X1/2-6	2L4X3.5X3/8	2L4X3.5X3/8-3
2L4X3.5X3/8-6	2L4X3.5X5/16	2L4X3.5X5/16-3	2L4X3.5X5/16-6
2L4X3.5X1/4	2L4X3.5X1/4-3	2L4X3.5X1/4-6	2L4X3X1/2
2L4X3X1/2-3	2L4X3X1/2-6	2L4X3X3/8	2L4X3X3/8-3
2L4X3X3/8-6	2L4X3X5/16	2L4X3X5/16-3	2L4X3X5/16-6
2L4X3X1/4	2L4X3X1/4-3	2L4X3X1/4-6	2L3.5X3X3/8
2L3.5X3X3/8-3	2L3.5X3X3/8-6	2L3.5X3X5/16	2L3.5X3X5/16-3
2L3.5X3X5/16-6	2L3.5X3X1/4	2L3.5X3X1/4-3	2L3.5X3X1/4-6
2L3.5X2.5X3/8	2L3.5X2.5X3/8-3	2L3.5X2.5X3/8-6	2L3.5X2.5X5/16
2L3.5X2.5X5/16-3	2L3.5X2.5X5/16-6	2L3.5X2.5X1/4	2L3.5X2.5X1/4-3
2L3.5X2.5X1/4-6	2L3X2.5X3/8	2L3X2.5X3/8-3	2L3X2.5X3/8-6
2L3X2.5X1/4	2L3X2.5X1/4-3	2L3X2.5X1/4-6	2L3X2.5X3/16
2L3X2.5X3/16-3	2L3X2.5X3/16-6	2L3X2X3/8	2L3X2X3/8-3
2L3X2X3/8-6	2L3X2X5/16	2L3X2X5/16-3	2L3X2X5/16-6
2L3X2X1/4	2L3X2X1/4-3	2L3X2X1/4-6	2L3X2X3/16
2L3X2X3/16-3	2L3X2X3/16-6	2L2.5X2X3/8	2L2.5X2X3/8-3
2L2.5X2X3/8-6	2L2.5X2X5/16	2L2.5X2X5/16-3	2L2.5X2X5/16-6
2L2.5X2X1/4	2L2.5X2X1/4-3	2L2.5X2X1/4-6	2L2.5X2X3/16
2L2.5X2X3/16-3	2L2.5X2X3/16-6	2L6X8X1	2L6X8X1-3
2L6X8X1-6	2L6X8X3/4	2L6X8X3/4-3	2L6X8X3/4-6
2L6X8X1/2	2L6X8X1/2-3	2L6X8X1/2-6	2L4X8X1
2L4X8X1-3	2L4X8X1-6	2L4X8X3/4	2L4X8X3/4-3
2L4X8X3/4-6	2L4X8X1/2	2L4X8X1/2-3	2L4X8X1/2-6
2L4X7X3/4	2L4X7X3/4-3	2L4X7X3/4-6	2L4X7X1/2
2L4X7X1/2-3	2L4X7X1/2-6	2L4X7X3/8	2L4X7X3/8-3
2L4X7X3/8-6	2L4X6X3/4	2L4X6X3/4-3	2L4X6X3/4-6
2L4X6X5/8	2L4X6X5/8-3	2L4X6X5/8-6	2L4X6X1/2
2L4X6X1/2-3	2L4X6X1/2-6	2L4X6X3/8	2L4X6X3/8-3
2L4X6X3/8-6	2L3.5X6X3/8	2L3.5X6X3/8-3	2L3.5X6X3/8-6
2L3.5X6X5/16	2L3.5X6X5/16-3	2L3.5X6X5/16-6	2L3.5X5X3/4
2L3.5X5X3/4-3	2L3.5X5X3/4-6	2L3.5X5X1/2	2L3.5X5X1/2-3
2L3.5X5X1/2-6	2L3.5X5X3/8	2L3.5X5X3/8-3	2L3.5X5X3/8-6
2L3.5X5X5/16	2L3.5X5X5/16-3	2L3.5X5X5/16-6	2L3X5X1/2
2L3X5X1/2-3	2L3X5X1/2-6	2L3X5X3/8	2L3X5X3/8-3
2L3X5X3/8-6	2L3X5X5/16	2L3X5X5/16-3	2L3X5X5/16-6
2L3X5X1/4	2L3X5X1/4-3	2L3X5X1/4-6	2L3.5X4X1/2

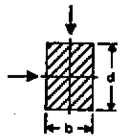
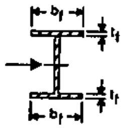
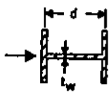
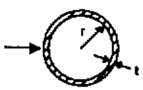
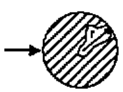
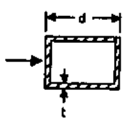
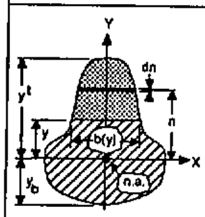
Built-in AISC Property Designations (continued)
Figure V-8

2L3.5X4X1/2-3	2L3.5X4X1/2-6	2L3.5X4X3/8	2L3.5X4X3/8-3
2L3.5X4X3/8-6	2L3.5X4X5/16	2L3.5X4X5/16-3	2L3.5X4X5/16-6
2L3.5X4X1/4	2L3.5X4X1/4-3	2L3.5X4X1/4-6	2L3X4X1/2
2L3X4X1/2-3	2L3X4X1/2-6	2L3X4X3/8	2L3X4X3/8-3
2L3X4X3/8-6	2L3X4X5/16	2L3X4X5/16-3	2L3X4X5/16-6
2L3X4X1/4	2L3X4X1/4-3	2L3X4X1/4-6	2L3X3.5X3/8
2L3X3.5X3/8-3	2L3X3.5X3/8-6	2L3X3.5X5/16	2L3X3.5X5/16-3
2L3X3.5X5/16-6	2L3X3.5X1/4	2L3X3.5X1/4-3	2L3X3.5X1/4-6
2L2.5X3.5X3/8	2L2.5X3.5X3/8-3	2L2.5X3.5X3/8-6	2L2.5X3.5X5/16
2L2.5X3.5X5/16-3	2L2.5X3.5X5/16-6	2L2.5X3.5X1/4	2L2.5X3.5X1/4-3
2L2.5X3.5X1/4-6	2L2.5X3X3/8	2L2.5X3X3/8-3	2L2.5X3X3/8-6
2L2.5X3X1/4	2L2.5X3X1/4-3	2L2.5X3X1/4-6	2L2.5X3X3/16
2L2.5X3X3/16-3	2L2.5X3X3/16-6	2L2X3X3/8	2L2X3X3/8-3
2L2X3X3/8-6	2L2X3X5/16	2L2X3X5/16-3	2L2X3X5/16-6
2L2X3X1/4	2L2X3X1/4-3	2L2X3X1/4-6	2L2X3X3/16
2L2X3X3/16-3	2L2X3X3/16-6	2L2X2.5X3/8	2L2X2.5X3/8-3
2L2X2.5X3/8-6	2L2X2.5X5/16	2L2X2.5X5/16-3	2L2X2.5X5/16-6
2L2X2.5X1/4	2L2X2.5X1/4-3	2L2X2.5X1/4-6	2L2X2.5X3/16
2L2X2.5X3/16-3	2L2X2.5X3/16-6	TS16X16X1/2	TS16X16X3/8
TS16X16X5/16	TS14X14X1/2	TS14X14X3/8	TS14X14X5/16
TS12X12X1/2	TS12X12X3/8	TS12X12X5/16	TS12X12X1/4
TS10X10X5/8	TS10X10X1/2	TS10X10X3/8	TS10X10X5/16
TS10X10X1/4	TS8X8X5/8	TS8X8X1/2	TS8X8X3/8
TS8X8X5/16	TS8X8X1/4	TS8X8X3/16	TS7X7X1/2
TS7X7X3/8	TS7X7X5/16	TS7X7X1/4	TS7X7X3/16
TS6X6X1/2	TS6X6X3/8	TS6X6X5/16	TS6X6X1/4
TS6X6X3/16	TS5X5X1/2	TS5X5X3/8	TS5X5X5/16
TS5X5X1/4	TS5X5X3/16	TS4X4X1/2	TS4X4X3/8
TS4X4X5/16	TS4X4X1/4	TS4X4X3/16	TS3.5X3.5X5/16
TS3.5X3.5X1/4	TS3.5X3.5X3/16	TS3X3X5/16	TS3X3X1/4
TS3X3X3/16	TS2.5X2.5X1/4	TS2.5X2.5X3/16	TS2X2X1/4
TS2X2X3/16	TS20X12X1/2	TS20X12X3/8	TS20X12X5/16
TS20X8X1/2	TS20X8X3/8	TS20X8X5/16	TS20X4X1/2
TS20X4X3/8	TS20X4X5/16	TS18X6X1/2	TS18X6X3/8
TS18X6X5/16	TS16X12X1/2	TS16X12X3/8	TS16X12X5/16
TS16X8X1/2	TS16X8X3/8	TS16X8X5/16	TS16X4X1/2
TS16X4X3/8	TS16X4X5/16	TS14X10X1/2	TS14X10X3/8
TS14X10X5/16	TS14X6X1/2	TS14X6X3/8	TS14X6X5/16
TS14X6X1/4	TS14X4X1/2	TS14X4X3/8	TS14X4X5/16
TS14X4X1/4	TS12X8X5/8	TS12X8X1/2	TS12X8X3/8
TS12X8X5/16	TS12X8X1/4	TS12X6X5/8	TS12X6X1/2
TS12X6X3/8	TS12X6X5/16	TS12X6X1/4	TS12X6X3/16
TS12X4X1/2	TS12X4X3/8	TS12X4X5/16	TS12X4X1/4
TS12X4X3/16	TS12X2X1/4	TS12X2X3/16	TS10X6X5/8
TS10X6X1/2	TS10X6X3/8	TS10X6X5/16	TS10X6X1/4
TS10X6X3/16	TS10X4X1/2	TS10X4X3/8	TS10X4X5/16
TS10X4X1/4	TS10X4X3/16	TS10X2X3/8	TS10X2X5/16
TS10X2X1/4	TS10X2X3/16	TS8X6X1/2	TS8X6X3/8
TS8X6X5/16	TS8X6X1/4	TS8X6X3/16	TS8X4X1/2
TS8X4X3/8	TS8X4X5/16	TS8X4X1/4	TS8X4X3/16
TS8X3X3/8	TS8X3X5/16	TS8X3X1/4	TS8X3X3/16
TS8X2X3/8	TS8X2X5/16	TS8X2X1/4	TS8X2X3/16
TS7X5X1/2	TS7X5X3/8	TS7X5X5/16	TS7X5X1/4
TS7X5X3/16	TS7X4X3/8	TS7X4X5/16	TS7X4X1/4
TS7X4X3/16	TS7X3X3/8	TS7X3X5/16	TS7X3X1/4
TS7X3X3/16	TS6X4X1/2	TS6X4X3/8	TS6X4X5/16

Built-in AISC Property Designations (continued)
Figure V-8

TS6X4X1/4	TS6X4X3/16	TS6X3X3/8	TS6X3X5/16
TS6X3X1/4	TS6X3X3/16	TS6X2X3/8	TS6X2X5/16
TS6X2X1/4	TS6X2X3/16	TS5X4X3/8	TS5X4X5/16
TS5X4X1/4	TS5X4X3/16	TS5X3X1/2	TS5X3X3/8
TS5X3X5/16	TS5X3X1/4	TS5X3X3/16	TS5X2X5/16
TS5X2X1/4	TS5X2X3/16	TS4X3X5/16	TS4X3X1/4
TS4X3X3/16	TS4X2X5/16	TS4X2X1/4	TS4X2X3/16
TS3X2X1/4	TS3X2X3/16	PS.5	PS.75
PS1	PS1.25	PS1.5	PS2
PS2.5	PS3	PS3.5	PS4
PS5	PS6	PS8	PS10
PS12	PE.5	PE.75	PE1
PE1.25	PE1.5	PE2	PE2.5
PE3	PE3.5	PE4	PE5
PE6	PE8	PE10	PE12
PD2	PD2.5	PD3	PD4
PD5	PD6	PD8	

Built-in AISC Property Designations (continued)
Figure V-8

Section	Description	Effective Shear Area
	Rectangular Section Shear Forces parallel to the b or d directions	$^5/_6\ bd$
	Wide Flange Section Shear Forces parallel to flange	$^5/_3\ t_f\, b_f$
	Wide Flange Section Shear Forces parallel to web	$t_w\, d$
	Thin Walled Circular Tube Section Shear Forces from any direction	$\pi\, r\, t$
	Solid Circular Section Shear Forces from any direction	$0.9\ \pi\, r^2$
	Thin Walled Rectangular Tube Section Shear Forces parallel to d-direction	$2\ t\ d$
	General Section Shear Forces parallel to Y-direction I_x = moment of inertia of section about X-X $Q(Y) = \int_{y}^{y^t} n\, b(n)\, dn$	$\dfrac{I_x^{\,2}}{\int_{y_b}^{y^t} \dfrac{Q^2(y)}{b(y)}\, dy}$

Formulas For Calculating Shear Areas
Figure V-9

5(i). COLUMN SECTION PROPERTY DATA

If **NCP** is 0, skip this data section. Otherwise, provide **NCP** data sets to define the **NCP** column property types.

Each data set consists of a first data line immediately followed by a possible second data line.

a. First Data Line

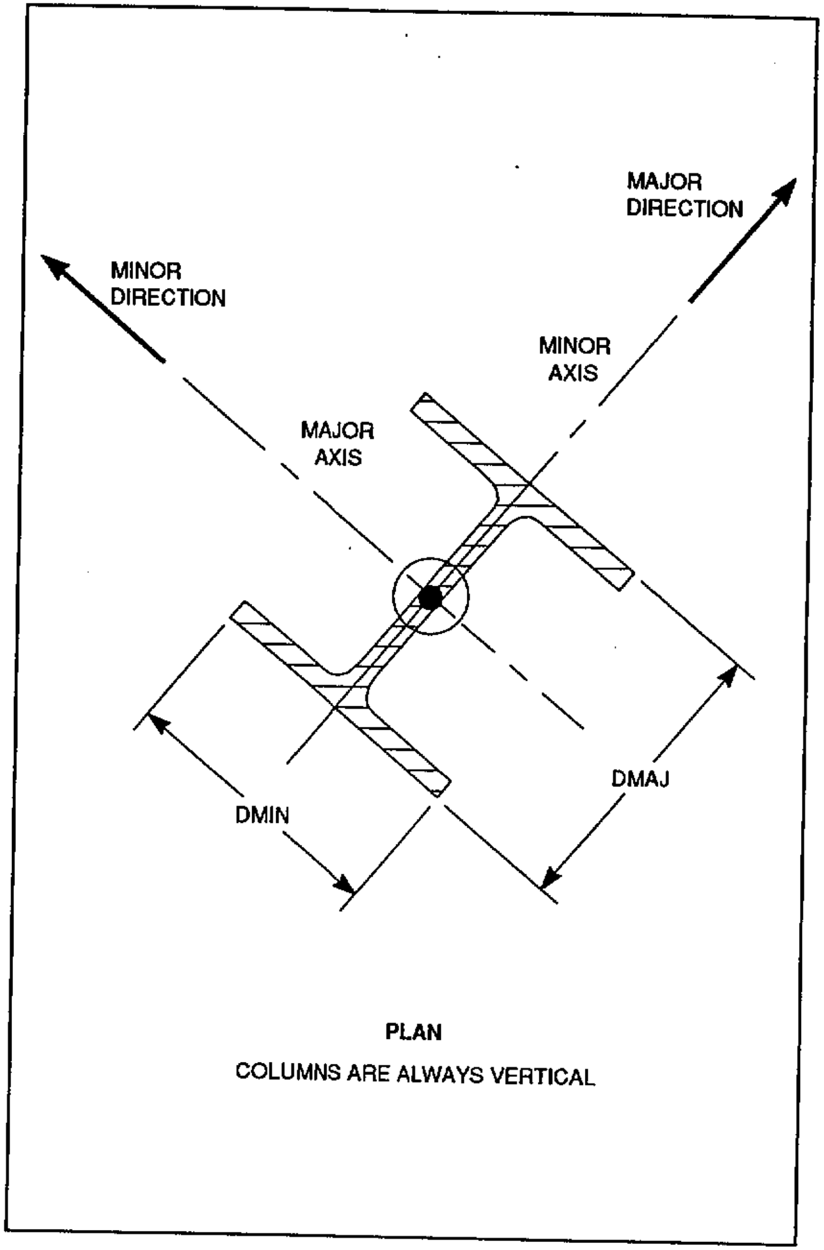
Prepare the first data line in the following form:

ID IMAT ITYPE DMAJ DMIN TF TW

b. Second Data Line

This data line is only needed if the entry for **ITYPE** on the first data line is equal to USER. If this line is needed, it should be prepared in the following form:

A A1 A2 J I1 I2 S1 S2 Z1 Z2 R1 R2



Column Section Orientation
Figure V-10

5(i). COLUMN SECTION PROPERTY DATA (continued)

First Data Line

Variable	Field	Note	Entry
ID	1	(1)	Identification number of column section property set.
IMAT	2	(2)	Material identification type for this section property.
ITYPE	3		Section type:
		(3)	= USER
		(4)	= RECT
			= CIRCLE
			= BOX
			= I-SECT
			= C-SECT
			= T-SECT
			= L-SECT
		(5)	= W14X230*
DMAJ	4	(6)	Section dimension in major direction.
DMIN	5	(6)	Section dimension in minor direction.

* or any of the other AISC designations listed in Figure V-8 or present in the user defined **PROPFILE.**

5(i). COLUMN SECTION PROPERTY DATA (continued)

First Data Line (continued)

Variable	Field	Note	Entry
TF	6	(4)	Flange thickness.
TW	7	(4)	Web thickness.

Second Data Line

Variable	Field	Note	Entry
A	1	(3)	Cross-sectional axial area.
A1	2	(9)	Shear area corresponding to major direction shear forces.
A2	3	(9)	Shear area corresponding to minor direction shear forces.
J	4		Torsional constant.

5(i). COLUMN SECTION PROPERTY DATA (continued)

Second Data Line (continued)

Variable	Field	Note	Entry
I1	5		Moment of inertia, about major axis.
I2	6		Moment of inertia, about minor axis.
S1	7		Section modulus, about major axis.
S2	8	(3)	Section modulus, about minor axis.
Z1	9		Plastic modulus, about major axis.
Z2	10		Plastic modulus, about minor axis.
R1	11		Radius of gyration, about major axis.
R2	12		Radius of gyration, about minor axis.

5(ii). BEAM SECTION PROPERTY DATA

If **NBP** is 0, skip this data section. Otherwise, provide **NBP** data sets to define the **NBP** beam property types.

Each data set consists of a first data line immediately followed by a possible second data line.

a. First Data Line

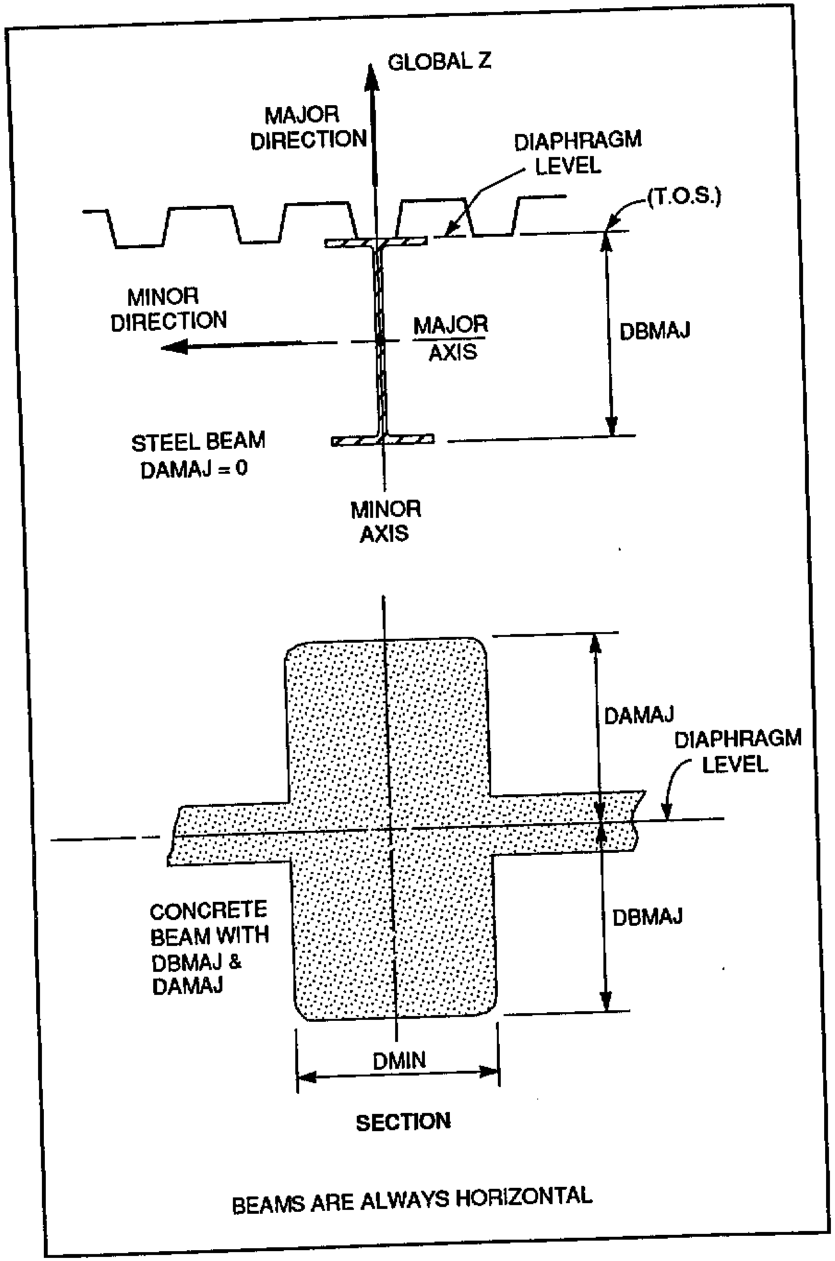
Prepare the first data line in the following form:

ID IMAT ITYPE DBMAJ DAMAJ DMIN TF TW

b. Second Data Line

This data line is only needed if the entry for **ITYPE** on the first data line is USER. If this line is needed, it should be prepared in the following form:

A A1 A2 J I1 I2 S1 S2 Z1 Z2 R1 R2



Beam Section Orientation
Figure V-11

5(ii). BEAM SECTION PROPERTY DATA (continued)

First Data Line

Variable	Field	Note	Entry
ID	1	(1)	Identification number of beam section property set.
IMAT	2	(2)	Material identification type for this section property.
ITYPE	3		Section type:
		(3)	= USER
		(4)	= RECT
			= CIRCLE
			= BOX
			= I-SECT
			= C-SECT
			= T-SECT
			= L-SECT
		(5)	= W14X230*
DBMAJ	4	(7)	Section dimension in major direction, depth below diaphragm.
DAMAJ	5	(7)	Section dimension in major direction, depth above diaphragm.

* or any of the other AISC designations listed in Figure V-8 or present in the user defined **PROPFILE**.

5(ii). BEAM SECTION PROPERTY DATA (continued)

First Data Line (continued)

Variable	Field	Note	Entry
DMIN	6	(7)	Section dimension in minor direction, width.
TF	7	(4)	Flange thickness.
TW	8	(4)	Web thickness.

Second Data Line

Variable	Field	Note	Entry
A	1	(3)	Cross-sectional axial area.
A1	2	(9)	Shear area corresponding to major direction shear forces.
A2	3	(9)	Shear area corresponding to minor direction shear forces.
J	4		Torsional constant.

5(ii). BEAM SECTION PROPERTY DATA (continued)

Second Data Line (continued)

Variable	Field	Note	Entry
I1	5	(3)	Moment of inertia, about major axis.
I2	6		Moment of inertia, about minor axis.
S1	7		Section modulus, about major axis.
S2	8		Section modulus, about minor axis.
Z1	9		Plastic modulus, about major axis.
Z2	10		Plastic modulus, about minor axis.
R1	11		Radius of gyration, about major axis.
R2	12		Radius of gyration, about minor axis.

5(iii). BRACE SECTION PROPERTY DATA

If **NDP** is 0, skip this data section. Otherwise, provide **NDP** data sets to define the **NDP** brace property data sets.

Each data set consists of a first data line immediately followed by a possible second data line.

a. First Data Line

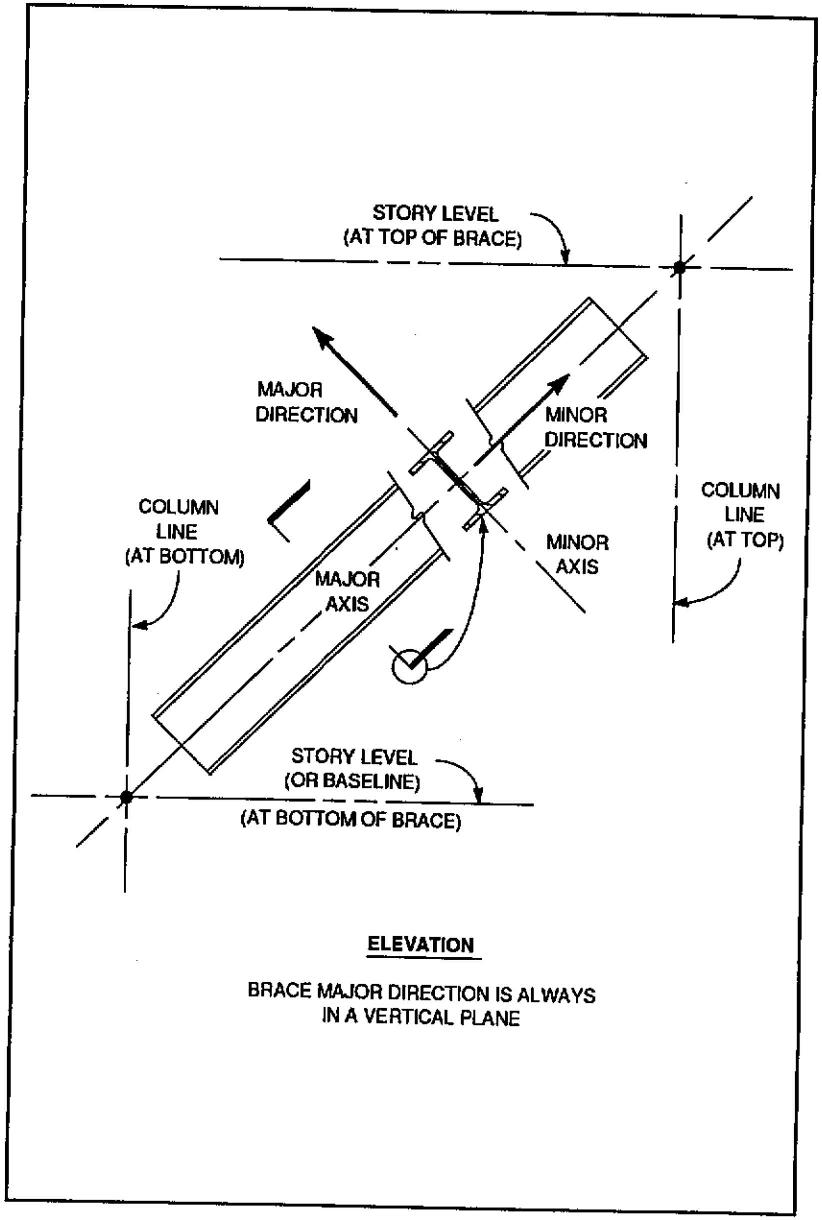
Prepare the first data line in the following form:

ID IMAT ITYPE DMAJ DMIN TF TW

b. Second Data Line

This data line is only needed if the entry for **ITYPE** on the first data line is equal to USER. If this line is needed, it should be prepared in the following form:

A A1 A2 J I1 I2 S1 S2 Z1 Z2 R1 R2



Brace Section Orientation
Figure V-12

5 (iii.) BRACE SECTION PROPERTY DATA (continued)

First Data Line

Variable	Field	Note	Entry
ID	1	(1)	Identification number of brace section property set.
IMAT	2	(2)	Material identification type for this section property.
ITYPE	3		Section type:
		(3)	= USER
		(4)	= RECT
			= CIRCLE
			= BOX
			= I-SECT
			= C-SECT
			= T-SECT
			= L-SECT
		(5)	= W14X230*
DMAJ	4	(8)	Section dimension in major direction.
DMIN	5	(8)	Section dimension in minor direction.
TF	6	(4)	Flange thickness.
TW	7	(4)	Web thickness.

* or any of the other AISC designations listed in Figure V-8 or present in the user defined **PROPFILE.**

5(iii.) BRACE SECTION PROPERTY DATA (continued)

Second Data Line

Variable	Field	Note	Entry
A	1	(3)	Cross-sectional axial area.
A1	2	(9)	Shear area corresponding to major direction shear forces.
A2	3	(9)	Shear area corresponding to minor direction shear forces.
J	4		Torsional constant.
I1	5		Moment of inertia, about major axis.
I2	6		Moment of inertia, about minor axis.
S1	7		Section modulus, about major axis.
S2	8		Section modulus, about minor axis.
Z1	9	(3)	Plastic modulus, about major axis.
Z2	10		Plastic modulus, about minor axis.

5(iii). BRACE SECTION PROPERTY DATA (continued)

Second Data Line (continued)

Variable	Field	Note	Entry
R1	11		Radius of gyration, about major axis.
R2	12		Radius of gyration, about minor axis.

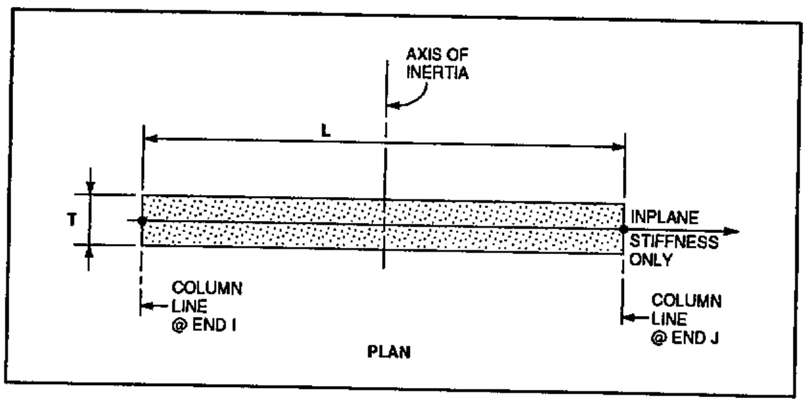
5(iv). PANEL SECTION PROPERTY DATA

If **NPP** is 0, skip this data section. Otherwise, provide **NPP** data lines to define the **NPP** panel property types.

Prepare one line of data for each panel property type in the following form:

ID IMAT T

Variable	Field	Note	Entry
ID	1	(1)	Identification number of panel section property set.
IMAT	2	(2)	Material identification type for this section property.
T	3	(10)	Panel thickness.



Panel Section Orientation
Figure V-13

5 - NOTES:

1. The section property numbers associated with each of the four data sections (i) through (iv) must individually start with the number 1 and proceed in ascending, consecutive sequence.

2. This entry references the material property types previously defined in Section 4 and must not be less than 1 and not greater than **NMAT**.

3. If **ITYPE** is USER, the user is to calculate all the section properties and provide them on the second data line (the second data line must immediately follow the first data line). Only the first six entries of the second data line are read if the material type associated with this section is not steel (S). The last six entries are needed only if the material type is steel and if steel stress check postprocessing is anticipated.

4. If ITYPE is RECT, CIRCLE, BOX, I-SECT, C-SECT, T-SECT or L-SECT, the program recognizes the shape given in Figure V-7 and calculates the section properties from the dimensions **DMAJ, DMIN, TF** and **TW**.

5. The program has a built-in data base of steel property sections conforming to the standard of the American Institute of Steel Construction (AISC). The available section properties are listed in Figure V-8.

   If **ITYPE** is an AISC identification label (with no embedded blanks), the complete property set associated with the section (including the dimensions of the section) is recovered by the program from the data base and assigned to the section property identification number.

5 - NOTES: (continued)

When the section properties are recovered from the AISC data base of wide flange options, it should be noted that the strong moment of inertia is assigned to correspond to the bending about the major axis, and the area of the web is assigned to correspond to the shear forces along the major direction. Similar for the other sections shown in Figure V-7.

The acceptable AISC names are given in Figure V-8. The naming convention is similar to the AISC designations except that starting characters of TS, PS, PE and PD are added to identify structural tubes, standard pipes, extra strong pipes and double extra strong pipes, respectively. Also, for the double angles the legs with the first dimension are back to back and the hyphenated number at the end of the name denotes the back to back distance in eighths of an inch.

6. In addition to being used by the automatic section property calculation options, the column dimensions, **DMAJ** and **DMIN**, are also used for determining the lengths of the rigid end offsets of the beams that frame into the columns defined with this property set. For column section orientation, see Figure V-10.

7. In addition to being used by the automatic section property calculation options, the beam dimensions, **DBMAJ**, **DAMAJ** and **DMIN** are also used for determining the lengths of the rigid end offsets on the ends of the columns that support the beams defined with this property set. Beam depths recovered from the AISC data base are assigned to **DBMAJ** (**DAMAJ** is set to 0). See Figure V-11.

5 - NOTES: (continued)

In calculating the section properties of shapes in Figure V-7 for beams, **DMAJ = DBMAJ + DAMAJ.**

8. The brace section dimensions **DMAJ** and **DMIN** are not used in the determination of any rigid end offsets. For brace element orientation see Figure V-12.

9. A shear area of pure zero will cause the program to exclude the effect of shear deformations. In other words, the shear deformations will be assumed to be zero. Effectively, a pure zero shear area is defaulted to an infinite shear area by the program. Formulas for calculating the shear areas of typical sections are given in Figure V-9.

10. The length of the panel, L, will be recovered from the locations of the columns at each end of the panel. The isoparametric formulation will be based upon the rectangular section T x L. For panel element orientation see Figure V-13.

    The panel element does not have any out-of-plane stiffness.

    The panel thickness must be greater than zero.

6. FRAME DATA

Prepare one set of frame data for each of the different frame types in the structure. Frames with different locations but identical properties and vertical loading need only be entered once. A total of **NDF** data sets need to be prepared. At least one set of frame data (Sections 6(i) through 6(viii)) is always needed.

6(i). FRAME CONTROL DATA

a. Frame Heading

Prepare one line of data having up to 80 characters of information for identification of this frame type.

b. Frame Control Data

Prepare one line of data in the following form:

NF NS NC NB NTRU NPAN NCLD NBSL MCONL

6(i). FRAME CONTROL DATA (continued)

Frame Control Data

Variable	Field	Note	Entry
NF	1	(1)	Frame identification number.
NS	2	(2)	Number of story levels in frame.
NC	3	(3)	Number of vertical column lines in frame.
NB	4	(4)	Number of bays in frame.
NTRU	5	(5)	Number of brace elements in frame.
NPAN	6	(6)	Number of panel elements in frame.
NCLD	7	(7)	Number of released column lateral load patterns in frame.
NBSL	8	(8)	Number of beam span loading patterns in frame.
MCONL	9	(9)	Maximum number of point loads in any one beam span loading pattern.

6 (i) - NOTES:

1. Frame identification numbers must be input in ascending, consecutive sequence starting with the number 1. This frame may be located (repeated) at different positions in the structure via the frame location data. See Section 7 below.

2. If a frame does not extend to the full height of the building, then **data for only those story levels actually existing in the frame are described** in the frame data. All frames are grounded at the structural baseline.

3. Beams, panels and bracing elements need at least two column lines for definition. Therefore, a single column line frame can have no beams, panels or braces.

   Application of vertical loads is only possible via beam span loads. Therefore, a single column line frame can have no superimposed vertical load applied.

4. If **NC** is 1, **NB** must be 0, however, **NB** can be 0 even if **NC** is greater than 1.

5. This entry defines the total number of brace elements that are input (and generated) in Section 6(vi)-c below. If **NC** is 1, this entry must be 0.

6. This entry defines the total number of panel elements that are input (and generated) in Section 6(vi)-d below. If **NC** is 1, this entry must be 0.

7. This entry controls the number of different disconnected column joint lateral load patterns that are to be defined in Section 6(iv) below. If there are no loaded disconnected column joints in the frame, enter 0 for this number and skip Section 6(iv).

6 (i) - NOTES: (continued)

8. This entry controls the number of different beam span loadings on the various beams of this frame.

   If no vertical loads are applied to the structure or if this is a single column frame, enter zero for this number and skip Section 6(v).

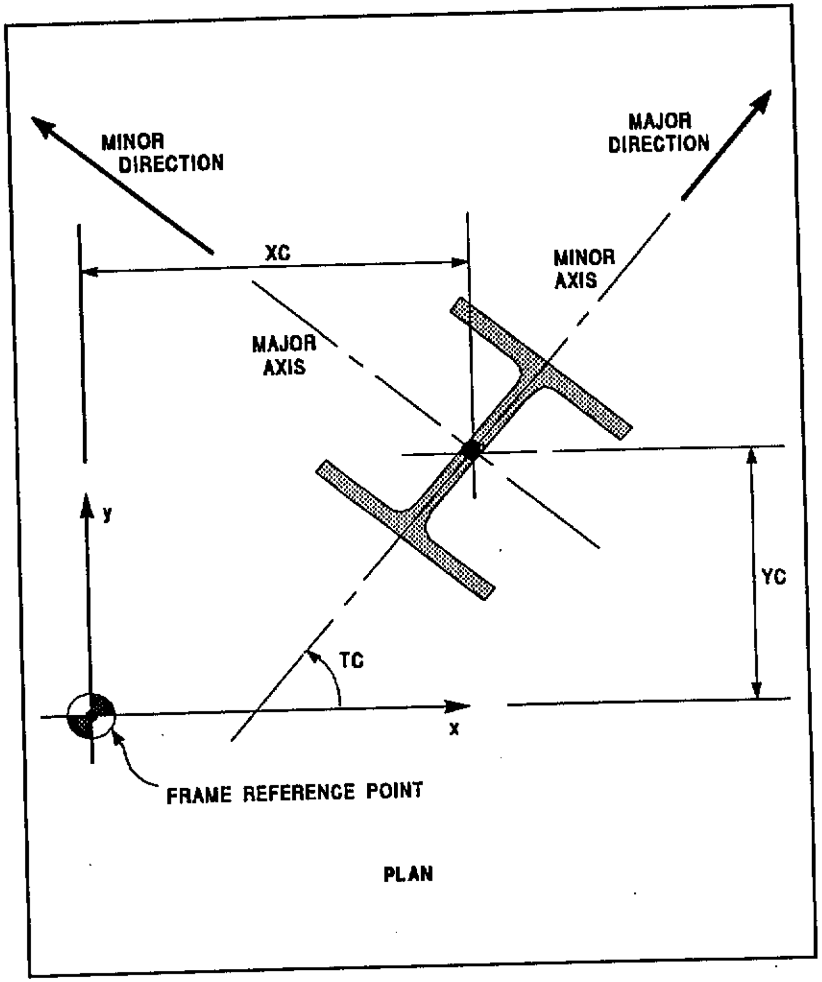
9. This number is required to preallocate memory storage for the concentrated loads that may exist in the beam span loading patterns.

6(ii). COLUMN LINE COORDINATES and ORIENTATION

Prepare a total of NC data lines to define the column line coordinates (in the frame local coordinate system) and orientation for the corresponding NC column lines that exist in the frame. See Figure V-14. The data should be prepared in the following form:

N XC YC TC

Variable	Field	Note	Entry
N	1	(1)	Column line identification number.
XC	2		X-distance to column line from frame reference point.
YC	3		Y-distance to column line from frame reference point.
TC	4	(2)	Orientation angle (in degrees) with the column major direction (not major axis). See Figure V-14.



Column Orientation
Figure V-14

6(ii) - NOTES:

1. The column line identification numbers must be input in ascending, consecutive sequence starting with the number 1.

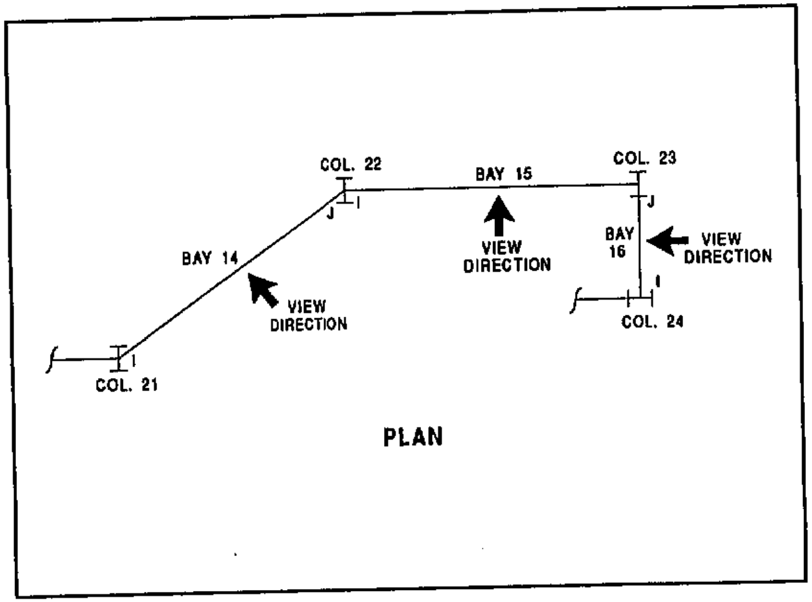
2. This number may be negative.

6(iii). BAY CONNECTIVITY

If **NB** is 0, no bays exist in the frame. Therefore skip this data section. Otherwise, prepare a total of **NB** data lines to define the column lines at the two ends of each of the **NB** bays that exist in the frame. See Figure V-15. The data should be provided in the following form:

N IC JC

Variable	Field	Note	Entry
N	1	(1)	Bay identification number.
IC	2	(2)	Column line number at End I.
JC	3		Column line number at End J.



Bay Connectivity
Figure V-15

6(iii) - NOTES:

1. The bay identification number must be input in ascending, consecutive sequence starting with the number 1.

2. The user must establish a direction to view the bay. The end of the bay to the left of the user is then End I and the end of the bay to the right of the user is then the End J. Once the view direction is established it should be consistently followed for the preparation of all the data associated with all the beams in a particular bay.

6(iv). LATERAL LOADING PATTERNS for DISCONNECTED COLUMNS

If **NCLD** is 0, no lateral load patterns need be defined. Therefore skip this data section. Otherwise, provide **NCLD** data lines to define the **NCLD** load patterns in the following form:

N FX FY MZ

Loads act at the top of the columns to which they are applied. These patterns are applied to the columns in Section 6(vii) below.

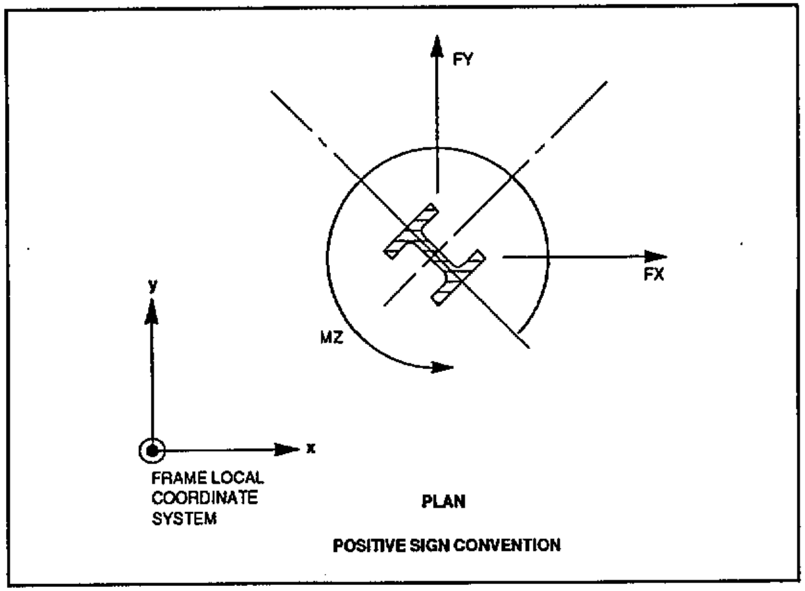
Disconnected column lateral loads should **not** be applied with automatically generated diaphragm loads.

Variable	Field	Note	Entry
N	1	(1)	Column lateral load pattern identification number.
FX	2	(2)	Force in the frame local x-direction.
FY	3		Force in the frame local y-direction.
MZ	4		Moment about the frame local z-axis.

6(iv) - NOTES:

1. The identification numbers must be input in ascending, consecutive sequence starting with the number 1.

2. These forces are input in the frame local coordinate system. The forces are in the local x,y plane. See Figure V-16.



Disconnected Column Lateral Loads
Figure V-16

6(v). BEAM SPAN VERTICAL LOADING PATTERNS

If **NBSL** is 0, no vertical load is to be defined for any of the beams of this frame. Therefore skip this data section. Otherwise, provide one set of data for each of the **NBSL** beam span loading types of this frame. Each data set consists of a first line followed by data lines for the point load data (if needed). See Figure V-17. These patterns are applied to the beams in Section 6(viii) below.

a. First Data Line

Prepare one data line in the following form:

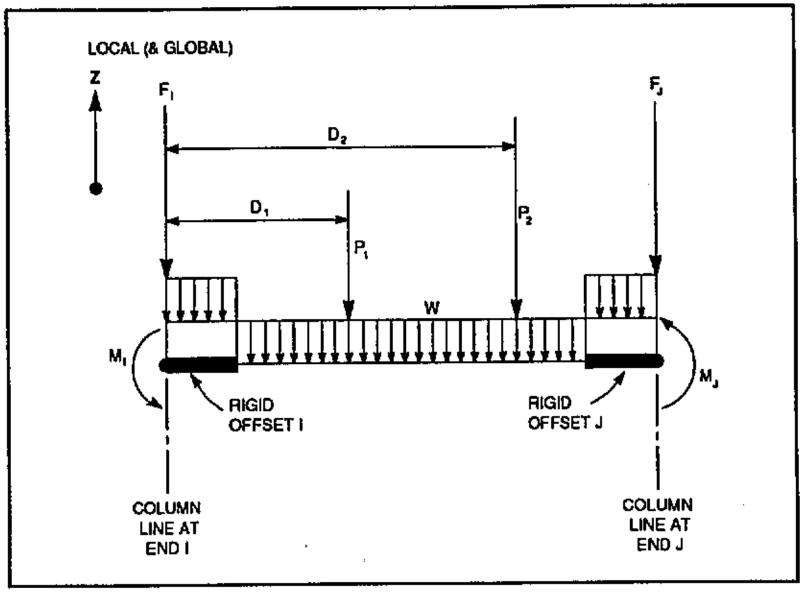
N NCON W FI FJ MI MJ

b. Point Load Data

If **NCON** is 0, skip this data section. Otherwise, provide up to four pairs of numbers (D,P) on each line to define the concentrated loads in sequence starting with the load closest to End I in the following form:

D1 P1 D2 P2 D3 P3 D4 P4

Skip to the next line if the number of point loads is greater than 4, and so forth.



Beam Span Loading
Figure V-17

6(v). BEAM SPAN VERTICAL LOADING PATTERNS (continued)

First Data Line

Variable	Field	Note	Entry
N	1	(1)	Identification number for this beam span loading set.
NCON	2	(2)	Number of concentrated point loads.
W	3	(3)	Uniform load per unit length, acting downward.
FI	4	(4)	Load acting downward at center of column at End I.
FJ	5		Load acting downward at center of column at End J.
MI	6	(4)	Cranked in moment at center of column at End I.
MJ	7		Cranked in moment at center of column at End J.

6(v). BEAM SPAN VERTICAL LOADING PATTERNS (continued)

Point Load Data

Variable	Field	Note	Entry
D1	1	(5)	Distance of 1st load acting downward from center of column line at End I.
P1	2		Magnitude of 1st load.
D4	3		Distance of 4th load acting downward from center of column line at End I.
P4	4		Magnitude of 4th load.

6(v) - NOTES:

1. The identification numbers must be input in ascending, consecutive sequence starting with the number 1.

2. **NCON** should be less than or equal to **MCONL**. **NCON** controls the number of concentrated load entries to be made in the point load data below this first data line.

3. Uniform load that occurs on the beam rigid end zone is lumped at the corresponding column center line by the program.

4. There may be loads that are to be carried by the frame, but are generated by beams that are not a part of the model (secondary framing). Such loads may be applied to the frame via the entries **FI, FJ, MI** and **MJ**. Note the positive sign convention in Figure V-17.

5. Positive loads act downward. The distances **D1, D2, . . .** which define the points of load application will be interpreted as a ratio of the total bay width if **D1, D2, . . .** are less than 0 (negative), and actual distances measured from the left column centerline if **D1, D2, . . .** are greater than 0. Therefore, on a bay width of 12 feet, a concentrated load of 2k at midspan may be input as either

   D1 = 6.0 and **P1** = 2. or
   D1 = -0.5 and **P1** = 2.

   Concentrated loads cannot be applied within rigid end zones of the beams.

6(vi). MEMBER LOCATION DATA

Prepare one (or up to four) of the following data sections a through d below, to define the locations of the various element types in this frame.

a. COLUMN LOCATION DATA

In this section provide as many data lines as needed to define the column property assignment on the column lines of this frame. If the property of any column at any level is not defined, it will be assumed to be 0. Therefore, zero (or dummy) columns need not be defined. The order of input is immaterial. Property assignments for any column may be repeated. The last values read (or generated) will be used. **End this data section with a blank line.** Prepare the data in the following form:

MC NSAME SD ID IG IP IR

6(vi)-a . COLUMN LOCATION DATA (continued)

Variable	Field	Note	Entry
MC	1	(1)	Column line number of column being defined.
NSAME	2	(2)	Column line number, the properties of which are to be repeated at column line MC.
SD	3	(3)	Identification of the story level at top of column being defined.
ID	4	(4)	Column section property identification number of column being defined.
IG	5	(5)	Number of columns in sequence below having the same properties and pin-ended release conditions.
IP	6	(6)	Control for pin-ended conditions: = 0 Continuity at both ends. = 1 Pin at bottom end of column. = 2 Pin at top end of column. = 3 Pin at both ends of column.

6(vi)-a. COLUMN LOCATION DATA (continued)

Variable	Field	Note	Entry
IR	7	(7)	Diaphragm release code: = 0 Top of column connected to diaphragm at level SD. = 1 Top of column disconnected from diaphragm at level SD.

6(vi)-a. - NOTES:

1. The column lines may be defined in any sequence. This number must be positive and not greater than **NC**.

2. If **NSAME** is nonzero, it is a column line number, the member properties of which the user has already defined in preceding data lines of this data section. The nonzero entry for **NSAME** puts the program into a duplication mode. In this mode the member properties (including the pin-ended and release conditions) of the current column line MC are set identical to that of column line NSAME (for all levels) as it stands defined at the time of this entry.

   Subsequent redefinitions of member properties of column line **NSAME** in later data lines will not result in automatic corresponding redefinitions of the member properties on column line **MC**, or vice versa. In this duplication mode (i.e. when NSAME is nonzero), the entries for **SD, ID, IG, IP** and **IR** on this data line are meaningless and must not be entered. These entries are only used if **NSAME** is 0.

3. This entry is the alphanumeric story identifier. The story level identifiers have been previously defined in Section 3. The columns may be defined in any order of story levels.

4. This entry refers to the column section property table defined in Section 5(i) above. This entry may never be negative and must not be greater than **NCP**. Missing elements may be redefined as having a property set identification number 0.

6(vi)-a. - NOTES: (continued)

5. The generation count does not include the current column being defined. It only includes the extra columns to be generated in the levels **below**. Generation is always downward and is limited to the number of levels existing below the level of the top of the current column. Generation is allowed only within the current column line. Every new column line must start with a new data line.

6. The pins created at the ends of the columns set the major and minor bending moments at the corresponding ends to 0. The torsional moments are not affected.

7. If **IR** is 1, the frame joint at the top of the column being defined is released from the diaphragm to which it was connected. The lateral displacements of released column lines are independent of the lateral displacements of the corresponding structural diaphragm.

6(vi)-b. BEAM LOCATION DATA

If **NB** is 0, there are no bays defined in this frame. Therefore skip this data section completely (including the blank termination line described below). Otherwise, provide as many data lines as needed to define the beam property assignment in the bays of this frame. If the property of any beam in any bay at any level is not defined, it will be assumed to be 0. Therefore, zero (or dummy) beams need not be defined. The order of input is immaterial. Property assignments for any beam may be repeated. The last values read or generated will be used. **End this data section with a blank line.** Prepare the data in the following form:

MB NSAME SD ID IG IP

6(vi)-b. BEAM LOCATION DATA (continued)

Variable	Field	Note	Entry
MB	1	(1)	Bay number of beam being defined.
NSAME	2	(2)	Bay number, the properties of which are to be repeated at bay number MB.
SD	3	(3)	Identification of the story level of the beam being defined.
ID	4	(4)	Beam section property identification number of beam being defined.
IG	5	(5)	Number of beams in sequence below having the same properties and pin conditions.
IP	6	(6)	Control for pin-ended conditions: = 0 Continuity at both ends. = 1 Pin at End I of beam. = 2 Pin at End J of beam. = 3 Pin at both ends of beam.

6(vi)-b. - NOTES:

1. The bays may be defined in any sequence. This number must be positive and not greater than **NB**.

2. If **NSAME** is nonzero, it is a bay number, the beam properties of which the user has already defined in the previous data lines of this data section. The nonzero entry for **NSAME** puts the program into a duplication mode. In this mode the beam properties (including the pin-ended conditions) of the bay **MB** are set identical to those of bay **NSAME** (for all levels) as it stands defined at the time of this entry.

   Subsequent redefinitions of member properties of bay **NSAME** in later data lines will not result in automatic corresponding redefinitions of the member properties of bay **MB** or vice versa.

   In the duplication mode (i.e. when **NSAME** is nonzero) the entries for **SD, ID, IG** and **IP** on this data line are meaningless and must not be entered. These entries are only used if **NSAME** is 0.

3. This entry is the alphanumeric story identifier associated with the level of the beam being defined. The story level identifiers have been previously defined in Section 3. The beams may be defined in any order of story levels.

4. This entry refers to the beam section property table defined in Section 5(ii) above. This entry may never be negative and must not be greater than **NBP**. Missing beams are input as having a beam property set identification number 0.

6(vi)-b. - NOTES:

5. The generation count does not include the current beam being defined. It only includes the extra beams to be generated in the levels **below**. Generation is always downward and is limited to the number of levels existing below the level of the current beam being defined.

   Generation is allowed only within the current bay. Every new bay must start with a new data line.

6. The pins created at the ends of the beams set the major and minor bending moments at the corresponding ends to 0. The torsional moments are not affected.

6(vi)-c. BRACE LOCATION DATA

If **NTRU** is 0, there are no diagonal braces in this frame. Therefore skip this section of data. Otherwise, provide (or generate) data for each of the **NTRU** diagonal braces in this frame. **No blank line is required to terminate this data section.** Prepare the data in the following form:

MD SD IL IU ID IG IP

Variable	Field	Note	Entry
MD	1	(1)	Brace identification number.
SD	2	(2)	Story identification of level at the top of this brace.
IL	3	(3)	Column line number at the lower end of this brace.
IU	4		Column line number at the upper end of this brace.
ID	5	(4)	Brace section property identification number defining properties of this brace.

6(vi)-c. BRACE LOCATION DATA (continued)

Variable	Field	Note	Entry
IG	6	(5)	Number of braces to be generated below, having the same location and properties (including pin-ended conditions) in the lower levels.
IP	7	(6)	Control for pin-ended conditions: = 0 Continuity at both ends. = 1 Pin at lower end. = 2 Pin at upper end. = 3 Pin at both ends.

6(vi)-c. - NOTES:

1. This entry is any unique number between 1 and 9999 that identifies this brace.

2. This entry is the alphanumeric story identifier of the level at the top of the brace being defined. These identifiers have been previously defined in Section 3. The braces may be defined in any order of story levels.

3. The **IL** and **IU** entries must be positive numbers not greater than **NC**.

4. This entry refers to the brace section property table defined in Section 5(iii) above. This entry may never be negative and must not be greater than **NDP**. Braces having property set identification numbers of 0 are ignored by the program.

5. The generation count does not include the current brace being defined. It only includes the extra braces to be defined in the levels below. Generation is always downward and is limited to the number of levels existing below the level of the top of the current brace. The brace identification numbers of the generated elements are obtained by repetitively incrementing the brace identification number of the current brace by 1. It is important that this be recognized in subsequent identification specifications to prevent duplication of identification numbers.

   The generated elements will have the same **IL, IU, ID** and **IP** assignments.

6. The pins created at the ends of the braces set the major and minor bending moments at the corresponding ends to 0. Torsional moments are not affected.

6(vi)-d. PANEL LOCATION DATA

If NPAN is 0, there are no panel elements in this frame. Therefore skip this section of data. Otherwise, enter (or generate) data for each of the panels in this frame. **No blank line is required to terminate this data section.** Provide the data in the following form:

MW SD IC JC ID IG

Variable	Field	Note	Entry
MW	1	(1)	Wall identification number for this panel.
SD	2	(2)	Story identification of level at the top of this panel.
IC	3	(3)	Column line number at End I of this panel.
JC	4		Column line number at End J of this panel.
ID	5	(4)	Panel section property identification number defining properties of this panel.
IG	6	(5)	Number of panels to be generated below, having the same location and properties in the lower levels.

6(vi)-d. - NOTES:

1. This entry is a wall identification number between 1 and 9999.

   All the panel elements **at a particular level** having the same wall identification number form an assemblage that defines a "wall" at that level.

   It is important to recognize that a "wall" with a particular ID at a particular level is created by an assemblage of only those panel elements that exist at the particular level and have the particular wall ID.

   Therefore, panels that have identical wall ID numbers but exist at different levels, will be associated with different "wall" assemblages that correspond to the respective levels.

   The moments and forces produced by the program will be for the top and bottom of each "wall" at the center of gravity of the wall, in the wall local coordinate system.

   As previously mentioned, a "wall" is defined as an assemblage of panel elements. The local major direction of the wall is defined by the I-J direction of that panel element of the "wall" which is first defined (or generated) in the panel data input sequence.

2. This entry is the alphanumeric story identifier of the level at the top of the panel. These identifiers have been previously defined in Section 3.

3. The **IC** and **JC** entries must be positive numbers not greater than **NC**.

6(vi)-d. - NOTES:

4. This entry refers to the panel section property table defined in Section 5(iv) above. This entry may never be negative and must not be greater than **NPP**. Panels having a property identification number of 0 are ignored by the program.

   All panels corresponding to a particular wall need not have the same panel section property identification (or thickness).

5. The generation count does not include the current panel being defined. It only includes the extra panels to be generated in the levels **below**. Generation is always downward and is limited to the number of levels existing below the level of the top of the current panel.

   The generated elements will have the same **MW, IC, JC** and **ID** assignments.

6(vii). DATA FOR ASSIGNMENT OF LATERAL LOADING PATTERNS TO DISCONNECTED COLUMN JOINTS

If **NCLD** is 0, there are no lateral loads to be applied to the disconnected column joints of this frame. Therefore skip this data section completely (including the blank termination line described below). Otherwise, provide as many data lines as needed to assign all the lateral loads to the disconnected column joints of this frame. Only column joints that are loaded need be defined. The order of input is immaterial. Load assignments may be repeated. The last values read or generated will be used. **End this data section with a blank line.** Prepare the data in the following form:

MC NSAME SD LA LB IG

6(vii). DATA FOR ASSIGNMENT OF LATERAL LOADING PATTERNS TO DISCONNECTED COLUMN JOINTS (continued)

Variable	Field	Note	Entry
MC	1	(1)	Column line number for which loading is being defined.
NSAME	2	(2)	Column line number, the loadings of which are to be repeated at column line MC.
SD	3	(3)	Identification of story level at top of column, the loading of which is being defined.
LA	4	(4)	Column lateral load pattern identification number defining lateral loads at the top of this column for lateral load condition A.
LB	5	(4)	Column lateral load pattern identification number defining lateral loads at the top of this column for lateral load condition B.
IG	6	(5)	Number of columns in sequence below having the same lateral loading patterns.

6(vii) - NOTES:

1. The column lines may be defined in any sequence. This number must be positive and not greater than **NC**.

2. If **NSAME** is nonzero, it is the column line number, the lateral loading of which the user has already defined in preceding data lines of this data section. The nonzero entry for **NSAME** puts the program into a duplication mode. In this mode the lateral loading (for both lateral load conditions A and B) of the current column line **MC** is set identical to that of column line **NSAME** (for all levels), as it stands defined at the time of this entry.

   Subsequent redefinitions of the lateral loading of column line **NSAME** in later data lines will not result in automatic corresponding redefinitions of the lateral loading on column line **MC**, and vice versa.

   In the duplication mode (i.e. when **NSAME** is nonzero) the entries for **SD, LA, LB** and **IG** on this data line are meaningless and must not be entered. These entries are only used if **NSAME** is 0.

3. This entry is the alphanumeric story identifier of the level at the top of the column. The story identifiers have been previously defined in Section 3.

   The column line must be disconnected at the diaphragm from this level. See Section 6(vi)-a.

   The column loading may be defined in any order of story levels.

6. (vii) - NOTES (continued)

4. This entry refers to the lateral loading pattern table (for disconnected columns) defined in Section 6 (iv) above. This entry may never be negative and must not be greater than **NCLD**. Loading pattern identification numbers of 0 will null previous definitions.

5. The generation count does not include the current column. It only includes the extra columns to be generated in the levels **below**. Generation is always downward and is limited to the number of levels existing below the level of the top of the current column line. Every new column must start with a new data line.

6(viii). DATA FOR ASSIGNMENT OF BEAM SPAN VERTICAL LOADING PATTERNS TO THE BEAMS

If **NB** is 0, or **NBSL** is 0, there are no bays or beam span loading patterns defined for this frame. Therefore skip this data section completely (including the blank termination line described below). Otherwise, provide as many data lines as needed to define the assignment of the vertical beam span loading patterns of all the loaded beams of this frame. If the loading for any beam in any bay at any level is not defined, it is assumed to have no load. The order of input is immaterial. Loading pattern assignments may be repeated. The last values read or generated will be used. **End this data section with a blank line.** Prepare the data in the following form:

MB NSAME SD LI LII LIII IG

6(viii). DATA FOR ASSIGNMENT OF BEAM SPAN VERTICAL LOADING PATTERNS TO THE BEAMS (continued)

Variable	Field	Note	Entry
MB	1	(1)	Bay number for which loading is being defined.
NSAME	2	(2)	Bay number, the loading of which is to be repeated at bay number MB.
SD	3	(3)	Identification of story level of the beam, the loading of which is being defined.
LI	4	(4)	Beam span vertical loading pattern identification number defining vertical loads of this beam for vertical load condition I.
LII	5	(4)	Beam span vertical loading pattern identification number defining vertical loads of this beam for vertical load condition II.

6(viii). DATA FOR ASSIGNMENT OF BEAM SPAN VERTICAL LOADING PATTERNS TO THE BEAMS (continued)

Variable	Field	Note	Entry
LIII	6	(4)	Beam span vertical loading pattern identification number defining vertical loads of this beam for vertical load condition III.
IG	7	(5)	Number of beams in sequence below having the same vertical loading patterns.

6(viii) - NOTES:

1. The bays may be defined in any sequence. This number must be positive and not greater than **NB**.

2. If **NSAME** is nonzero, it is a bay number, the vertical loading of which the user has already defined in preceding data entries of this section. The nonzero entry for **NSAME** puts the program into a duplication mode. In this mode the vertical loading (for all conditions I, II and III) of the current bay **MB** is set identical to that of bay **NSAME** (for all levels) as it stands defined at the time of this entry.

   Subsequent redefinitions of the vertical loading of bay **NSAME** in later data lines will not result in automatic corresponding redefinitions of the vertical loading on bay **MB**, and vice versa.

   In the duplication mode (i.e. when **NSAME** is nonzero), the entries for **SD**, **LI**, **LII**, **LIII** and **IG** on this data line are meaningless and must not be entered. These entries are only used if **NSAME** is 0.

3. This entry is the alphanumeric story identifier of the level of the beam, the loading of which is being defined. The story level identifiers have been previously defined in Section 3. The beam loading may be defined in any order of story levels.

4. This entry refers to the beam span vertical loading pattern table defined in Section 6(v) above. This entry may never be negative and must not be greater than **NBSL**. Load pattern identification numbers of 0 will null previous definitions.

6(viii) - NOTES: (continued)

The beam self weight loading may be added as a uniform load on the beam span in addition to the beam span loading pattern. This, however, may be used for only one of the vertical load conditions, depending upon the value of **NSLF.**

Vertical loads may not be applied to beams having zero (0) beam property identifications.

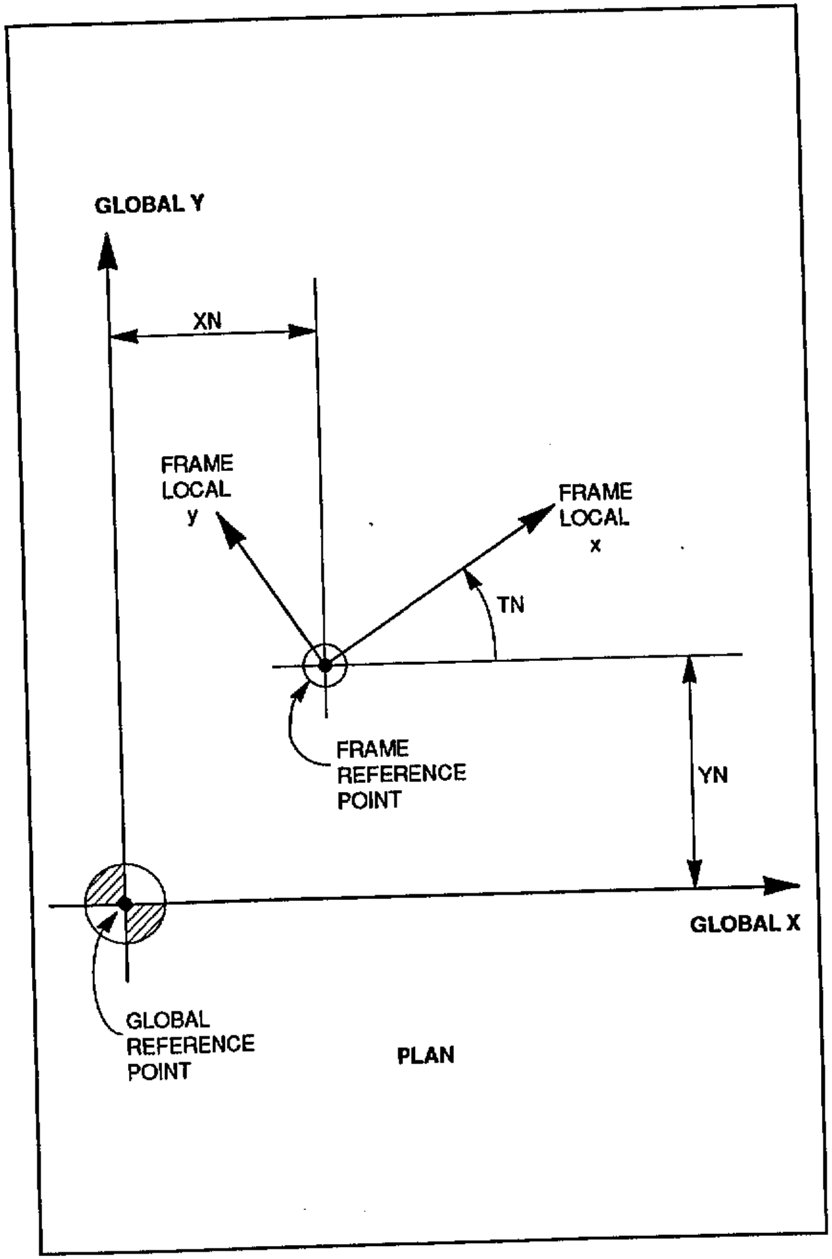
5. The generation count does not include the current beam. It only includes the extra beams to be generated in the levels below. Generation is always downward and is limited to the number of levels existing below the level of the current beam. Generation is only allowed within the current bay. The loading of every new bay must start with a new data line.

7. FRAME LOCATION DATA

Provide one line of data to place each of the **NTF** (see Figure V-18) frames that exist in the structure. A total of **NTF** data lines must be prepared in the following form:

IF IFC XN YN TN FHED

Variable	Field	Note	Entry
IF	1	(1)	Frame type identification number.
IFC	2	(2)	Frame output control: = 0 Print output for this frame. = 1 Suppress output for this frame.
XN	3		Global X-ordinate of the frame local reference point.
YN	4		Global Y-ordinate of the frame local reference point.
TN	5		Angle (in degrees) between the frame local x-axis and the global X-axis, measured from the global X-axis, counterclockwise positive.
FHED	6		Alphanumeric information to identify the output associated with frame, up to 32 characters.



Frame Orientation
Figure V-18

7 - NOTES:

1. This entry refers to the frame type identification number (see Section 6(i)-b) of the frame being placed via this frame location data line. Frame identification numbers may be repeated, but the location data lines must be input such that the frame identification numbers are in an ascending numerical sequence starting with 1, so that the first of the **NTF** frames that is located **must** have a frame type identification number of 1 and the last of the **NTF** frames that is located must have a frame type identification number of **NDF**. All of the **NDF** frame types must be referenced by the **NTF** frames.

2. If **IFC** is 1, all output associated with this frame is suppressed. For large frames the execution time can be significantly reduced by setting this parameter to 1, if the user is not interested in the member force or joint displacement output of this particular frame.

8. STRUCTURAL STATIC LATERAL LOAD DATA

This data section is for defining the lateral loads that are to be applied to the building story levels for lateral load conditions A and B.

If **NLAT** is 0, no lateral loads are applied to the structure. Therefore skip this data section completely. If **NLAT** is between 1 and 11, prepare data for one of the following data sections, (i) through (iii), as described below for user defined loads and UBC91 wind and seismic loads or data sections, B(i) through B(viii) of Appendix B for the other code loads automated in ETABS.

8(i). USER-DEFINED LATERAL LOADS

Skip this section of data if **NLAT** is not 1. Otherwise, prepare one line of data to define the lateral loads corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building. The data amounts to a total of **NST** data lines in the following form:

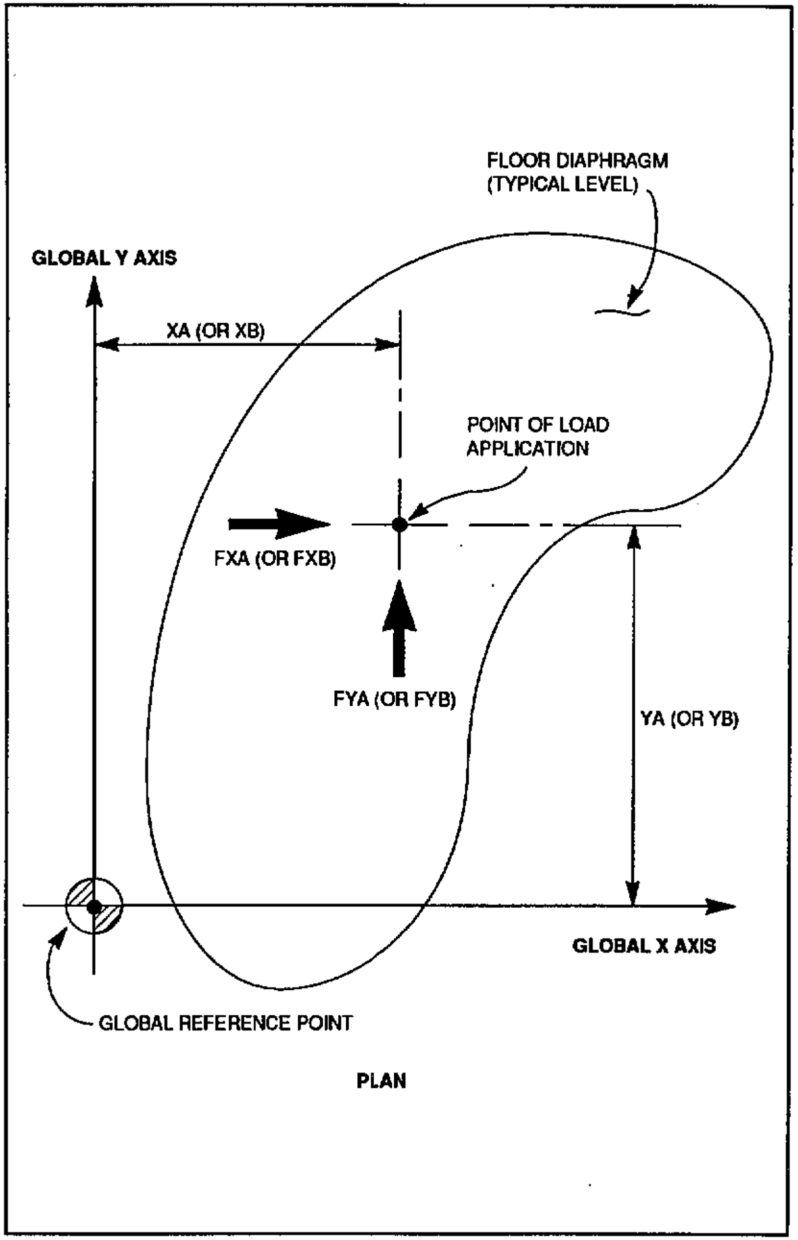
FXA FYA XA YA FXB FYB XB YB

8(i). USER LOADS (continued)

Variable	Field	Note	Entry
FXA	1	(1)	X-direction load for lateral load condition A.
FYA	2		Y-direction load for lateral load condition A.
XA	3		X-ordinate of the point of load application for load condition A.
YA	4		Y-ordinate of the point of load application for load condition A.
FXB	5		X-direction load for lateral load condition B.
FYB	6		Y-direction load for lateral load condition B.
XB	7		X-ordinate of the point of load application for load condition B.
YB	8		Y-ordinate of the point of load application for load condition B.

8(i) - NOTES:

1. Either of the load conditions (A or B) can have X and Y forces specified concurrently at any level, to give resultants acting at an angle. See Figure V-19 for positive directions of forces. All axis references are global.



User-defined Lateral Loading
Figure V-19

8(ii). WIND LATERAL LOADS AS DEFINED BY THE UNIFORM BUILDING CODE, 1991

Skip this section of data if **NLAT** is not 5. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have UBC wind loads in the global X-direction and load condition B will have UBC wind loads in the global Y-direction.

The building story heights defined in the story data (Section 3 above) are used to generate these loads.

a. Wind Pressure Parameters

Prepare one line of data in the following form to define the UBC wind pressure parameters:

V ET I CFH CFP

b. Wind Load Exposure

Provide two lines of data, one corresponding to each of the two global directions, to define the extent of the structural height that is exposed to the wind. Prepare the data in the following form:

SBOTX
SBOTY

8(ii). UBC 91 WIND LOADS (continued)

c. Story Wind Exposure Widths and Corresponding Centers of Pressure

This data defines the dimensions of the exposed faces, normal to the global X- and Y-directions, and locates the corresponding centers of pressure to determine the magnitude of the wind loads and their corresponding points of application for each story.

Provide one line of data corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building.

The data amounts to a total of NST data lines in the following form:

BYA DYA DFXA BXB DXB DFYB

8(ii). UBC 91 WIND LOADS (continued)

Variable	Field	Note	Entry

Wind Pressure Parameters

Variable	Field	Note	Entry
V	1	(1)	Basic wind speed (between 70 and 130 mph).
ET	2	(1)	Exposure type (B, C or D).
I	3	(1)	Importance factor.
CFH	4	(2)	Conversion factor for height.
CFP	5	(2)	Conversion factor for pressure.

Wind Load Exposure - X-Direction

Variable	Field	Note	Entry
SBOTX	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for X-direction wind loads.

Wind Load Exposure - Y-Direction

Variable	Field	Note	Entry
SBOTY	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for Y-direction wind loads.

8(ii). UBC 91 WIND LOADS (continued)

Variable	Field	Note	Entry
Story Wind Exposure			
BYA	1	(4)	Projected length of the floor level for X-direction loads (projection is on the Y-axis).
DYA	2	(4)	Y-ordinate of the center of the projected length **BYA.**
DFXA	3	(5)	Additional load in the X-direction (load condition A).
BXB	4		Projected length of the floor level for Y-direction loads (projection is on the X-axis).
DXB	5		X-ordinate of the center of the projected length **BXB.**
DFYB	6		Additional load in the Y-direction (load condition B).

8(ii) - NOTES:

1. The basic wind speed values as identified in Chapter 23, Table 23-F, of the 1991 edition of Reference [14] are between 70 and 130 mph.

   These values must always be entered in miles per hour (mph), irrespective of the input units of ETABS. The basic wind speed is converted into pressure, q_s, by linearly interpolating the values defined in Table 23-F of Reference [14].

   The exposure type determines the combined height, exposure and gust factor coefficient, C_e, at a particular height above the ground level as defined by Table 23-G of Reference [14].

   The wind pressure p for a particular height above the ground level is then established as:

   $$P = C_e\, C_q\, q_s\, I$$

   where C_q is based upon the projected area method (Method 2) and is assumed to be 1.3 for structures up to 40 feet in height, and 1.4 for structures over 40 feet in height. The height is taken from the ground level.

   The importance factor, **I**, is defined in Table 23-L of Reference [14].

2. The wind distribution heights and associated wind pressures as specified in the UBC are in feet and pounds per square foot units, respectively.

   CFH is the multiplication factor that will convert the user-input story height to feet units.

Consistent Input Units Being Used	Conversion Factor	
	CFH	CFP
Pounds-Feet	1	1
Kips-Feet	1	1/1000
Kips-inches	1/12	1/144000
Pounds-inches	1/12	1/144
kg-Meters	3.28	4.89
kN-Meters	3.28	0.0478

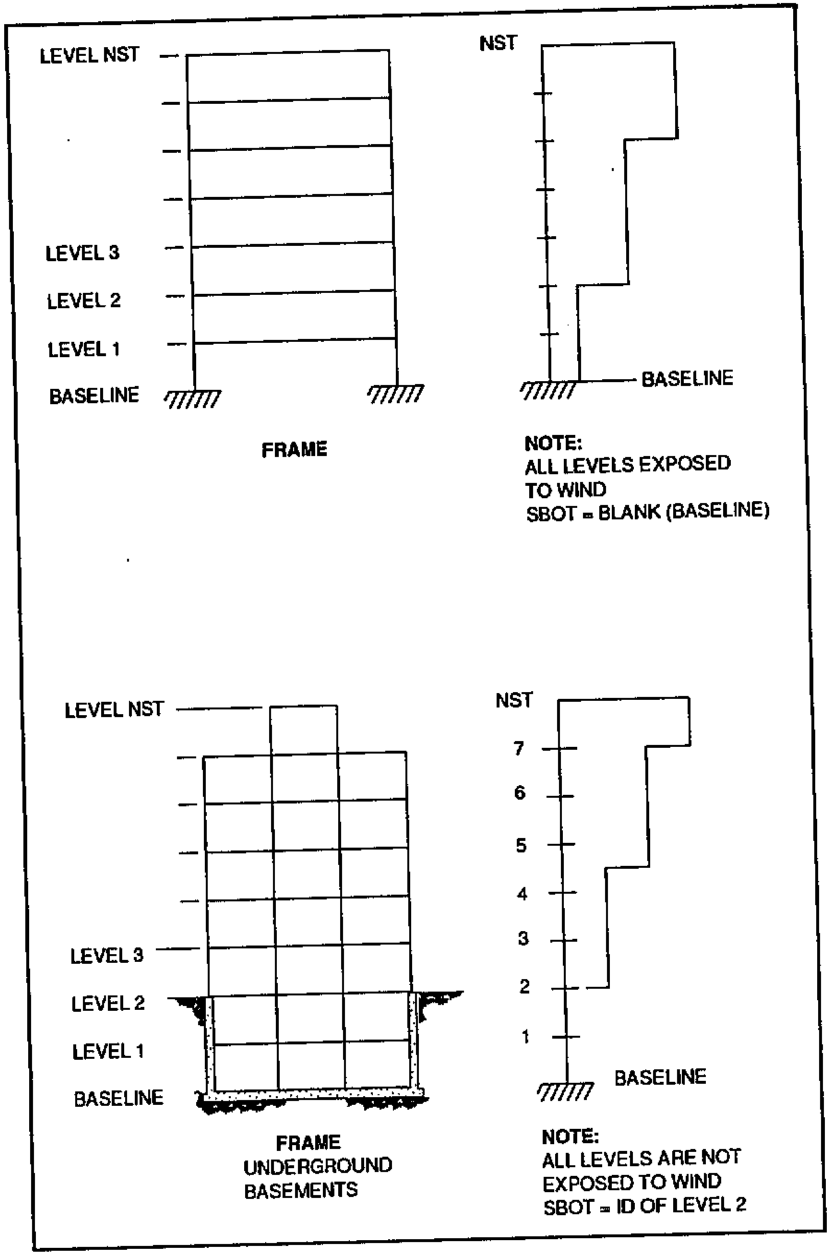
Conversion Factors when using UBC, BOCA or ASCE wind loads
Figure V-20

8(ii) - NOTES: (continued)

CFP is the conversion factor that will convert pounds per square foot to the consistent units being used in the preparation of this input. See Figure V-20 for examples.

3. The part of the structure below the level line associated with the story identification **SBOTX** will receive no wind exposure in the X-direction. See Figure V-21. If **SBOTX** is blank, **SBOTX** is assumed to be the structural baseline.

   The same is true for **SBOTY** as it corresponds to the Y-direction.



Wind Lateral Load Distribution
Figure V-21

8(ii) - NOTES: (continued)

4. The wind loads are calculated as follows. The wind pressure is as defined in Note 1 above. For the X-direction loads the elevation of a particular story line above the ground is determined using **SBOTX**.

   The wind pressures over the story height (including stepped pressure variations, if any) are established.

   The wind forces are then calculated as a product of the wind pressure variations and story widths **BYA**.

   The loads are then lumped at the story levels in a statically consistent manner, including the effect of pressure variations within a story height.

   The line of action of the load is in the X-direction through the center of pressure as defined by the entry **DYA**.

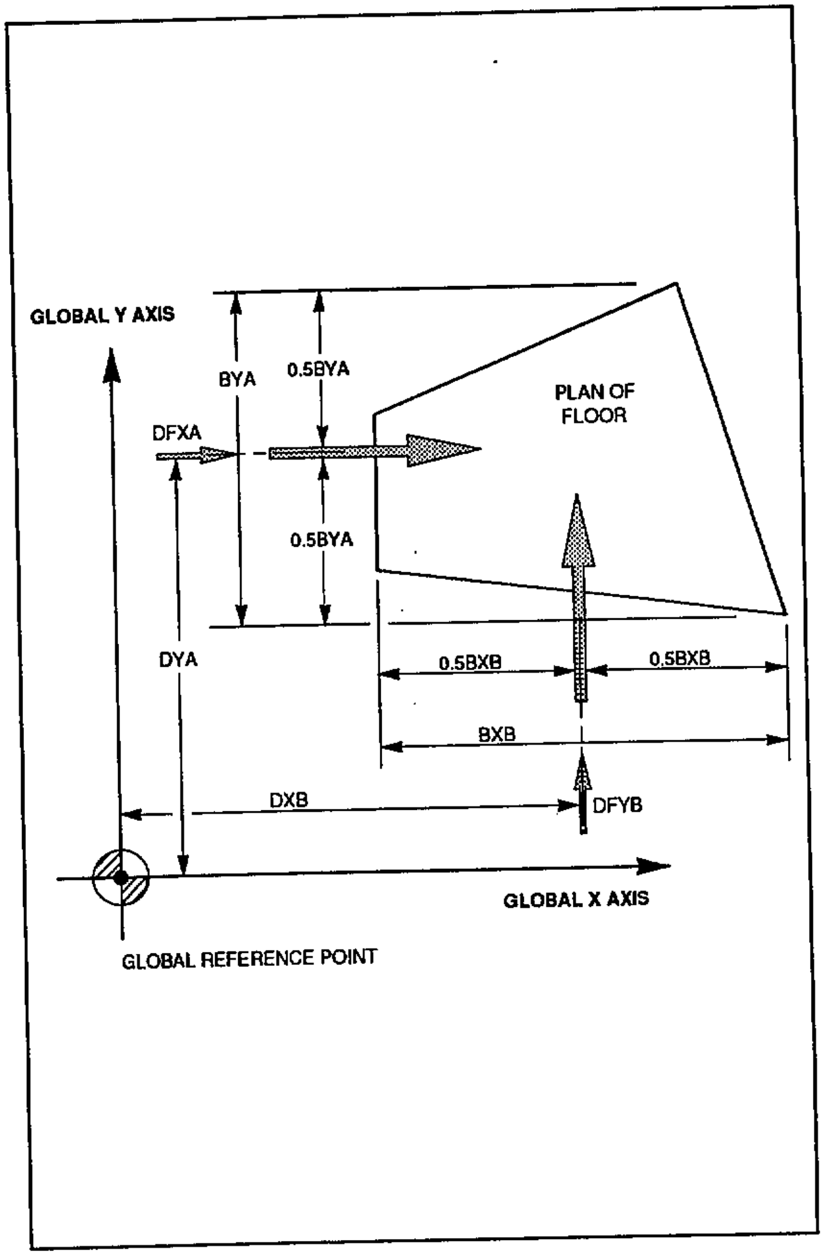
   The same is true for **SBOTY**, **BXB** and **DXB** as they correspond to the Y-direction loading.

5. Entry **DFXA** is usually 0.

   The user may, however, use this entry to apply additional lateral wind load in the X-direction to the associated story level, if needed. This load will be added to the wind load calculated by the program, in the X-direction at the associated story level.

   The same is true for **DFYB** as it corresponds to the Y-direction.

   See Figure V-22 for positive direction of forces.



Wind Lateral Loading
Figure V-22

8(iii). SEISMIC LATERAL LOADS AS DEFINED BY THE UNIFORM BUILDING CODE, 1991

Skip this section of data if **NLAT** is not 6. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have UBC lateral loads in the global X-direction and load condition B will have UBC lateral loads in the global Y-direction.

The building story heights and story masses defined in the story data (Section 3 above) or as calculated by the program (Section 2 above) and the gravitational acceleration (Section 1 above) are used to generate these loads.

a. UBC 91 Seismic Coefficients

Prepare one line of data in the following form to define the UBC site-dependent coefficients:

Z I S

b. Triangular Lateral Load Distribution Data

Provide two lines of data, one corresponding to each of the two global directions, to define the structural time period maxima and the extent of the lateral load distributions over the height of the building.

Prepare the data in the following form:

TX TAX RWX STOPX SBOTX
TY TAY RWY STOPY SBOTY

8(iii). UBC 91 SEISMIC LOADS (continued)

c. Story Eccentricities and Extra Loading

This data defines the eccentricities of the UBC generated story loads on any particular story with respect to the center of mass of that story. This data also gives the user the option of applying extra loads to a particular story level if needed. If the eccentricities are zero, the loads are applied at the center of mass.

Prepare one line of data to define the eccentricities and extra loading corresponding to each story of the building.

The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building. The data amounts to a total of NST data lines in the following form:

EYA EXB DFXA DFYB

8(iii). UBC 91 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

UBC 1991 Seismic Coefficients

Z	1	(1)	Zone Factor
I	2		Importance Factor
S	3		Soil Profile Factor

Triangular Lateral Load Distribution Data

Data associated with X-direction loads or load condition A. Y-direction loads in load condition A are set to 0.

TX	1	(2)	Time period of the structural mode predominant in the X-direction
TAX	2	(2)	The UBC 91 Method A time period associated with the X-direction.
RWX	3	(2)	UBC 91 structural system coefficient for X-direction.

8(iii). UBC 91 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Triangular Lateral Load Distribution Data (continued)

STOPX	4	(3)	Story identification for the level defining the top of the triangular distribution for X-direction loads.
SBOTX	5	(3)	Story identification for the level defining the bottom of the triangular distribution for X-direction loads.

Data associated with Y-direction loads or load condition B. X-direction loads in load condition B are set to 0.

TY	1	(2)	Time period of the structural mode predominant in the Y-direction.
TAY	2	(2)	The UBC 91 Method A time period associated with the Y-direction.
RWY	3	(2)	UBC 91 structural system coefficient for Y-direction

8(iii). UBC 91 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Triangular Lateral Load Distribution Data (continued)

Variable	Field	Note	Entry
STOPY	4	(3)	Story identification for the level defining the top of the triangular distribution for Y-direction loads.
SBOTY	4	(3)	Story identification for the level defining the bottom of the triangular distribution for Y-direction loads.

Additional Story Eccentricities and Loading

Variable	Field	Note	Entry
EYA	1	(4)	Additional eccentricity for X-direction loads (load condition A).
EXB	2	(4)	Additional eccentricity for Y-direction loads (load condition B).
DFXA	3	(5)	Additional load in the X-direction (load condition A).
DFYB	4	(5)	Additional load in the Y-direction (load condition B).

8(iii) - NOTES:

1. Details associated with the seismic load calculation methodology and the definitions of the various UBC coefficients and factors are given in Chapter 23 of the 1991 edition of Reference [14].

2. For each of the global X- and Y-directions, the program needs to calculate the UBC coefficient C.

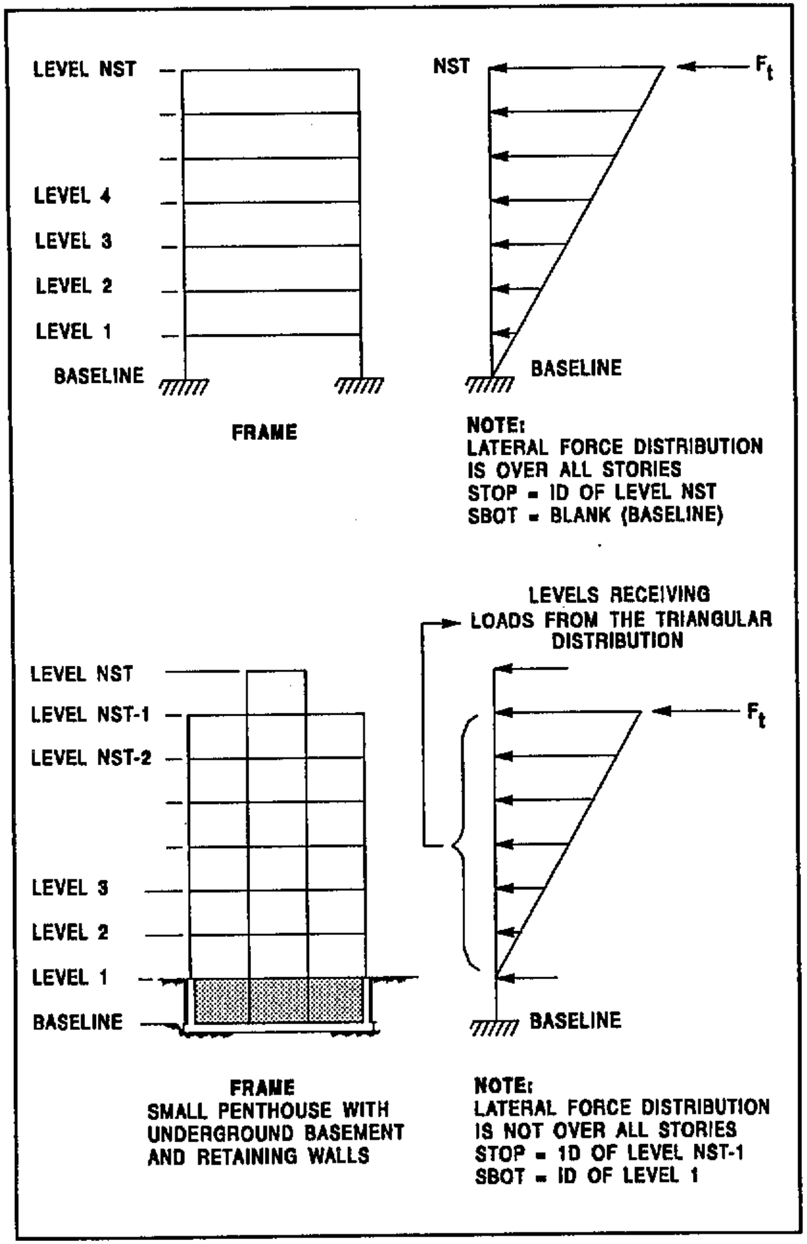
   Consider the X-direction, $C = \dfrac{1.25\ S}{TX^{2/3}}$

   The value of **TX** must be defined. Therefore, if the time periods of the structure are not being calculated by the program (i.e. **NDYN** is 0), **TX** must be provided by the user. If **TX** is set to 0 and **NDYN** is not 0, the program will set **TX** equal to the period of the calculated mode having the largest participation factor in the X-direction. Positive nonzero user input values for **TX** and **TY** will always supersede any values generated by the program.

   The coefficient C is also calculated using the specified UBC Method A time period, **TAX** instead of **TX** and 80% of this value is used as a lower bound for coefficient C.

   The same is true for **TY** and **TAY** as they correspond to the Y-direction.

3. It is possible for a structural model to have levels for penthouses, basements or dummy stories for special modeling. The engineer may not want to include such levels in the overall structural triangular lateral force distribution as defined by the UBC. See Figure V-23. If there are any levels above **STOPX**, they do not receive any loading from the triangular distribution.



Seismic Lateral Load Distribution
Figure V-23

8(iii) - NOTES: (continued)

The triangular distribution will not generate any loads for any level below and including level **SBOTX**.

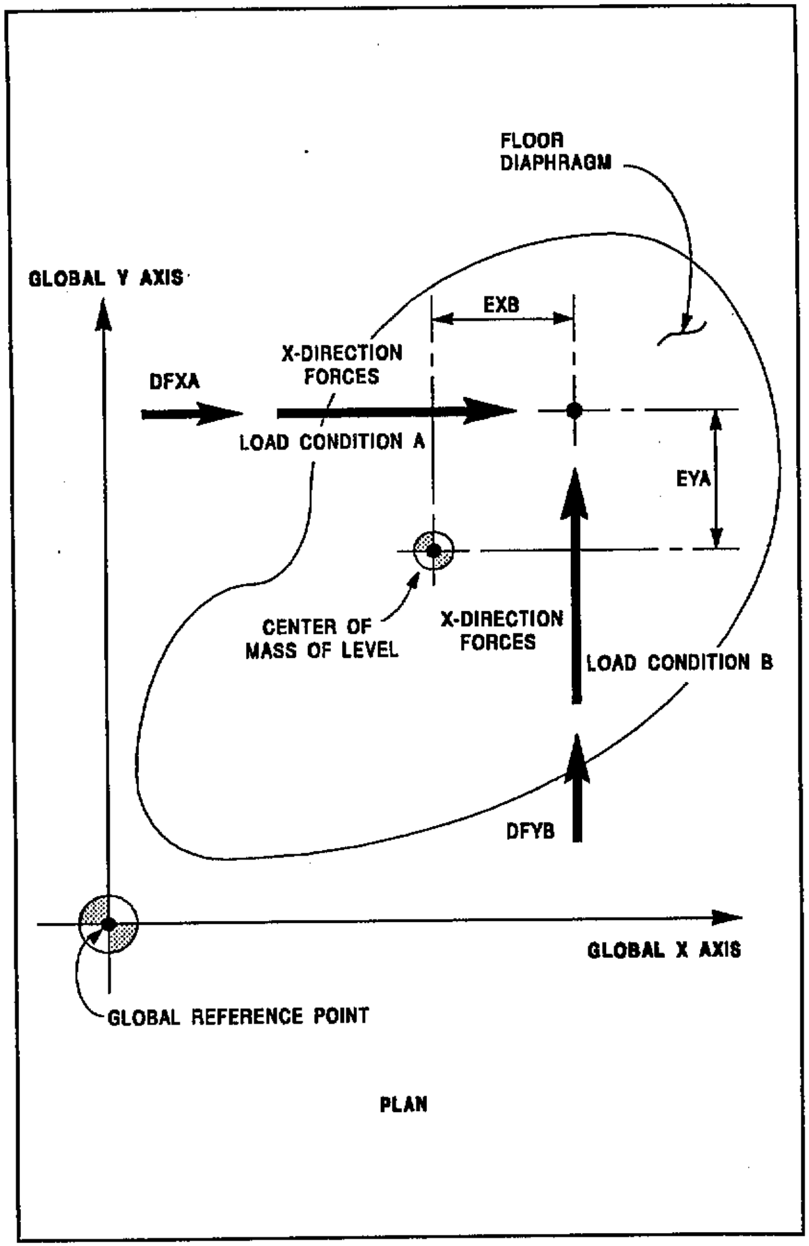
If **SBOTX** is left blank, **SBOTX** is assumed to be the structural baseline.

If **STOPX** and **SBOTX** are both left blank, **STOPX** is assumed to be the top level of the structure and **SBOTX** is assumed to be the structural baseline.

All the above is true for **STOPY** and **SBOTY** as it corresponds to the Y-Direction.

4. If the additional eccentricity values are entered as 0, the generated story loads will be applied at the centers of mass of the respective levels. The additional eccentricity values are for moving the point of application of the applied loads at each level, if desired. See Figure V-24.

5. Entries for **DFXA** and **DFYB** are usually 0 for levels which receive loading from the UBC triangular distribution. These entries are basically used for applying loads to the levels that do not receive any loading from the UBC distribution. See Note 3 above. These forces are applied with the corresponding eccentricities **EYA** and **EXB**. If **DFXA** and **DFYB** have nonzero values for levels that receive loading from the UBC distribution, **DFXA** will be added to the X-direction loads and **DFYB** will be added to the Y-direction loads generated by the UBC option in the corresponding load conditions A and B, respectively. See Figure V-24 for the positive directions of the eccentricities and forces.



Seismic Lateral Loading
Figure V-24

9. DATA FOR RESPONSE SPECTRUM DYNAMIC ANALYSIS

This data is for defining the ground acceleration spectrum curve for a dynamic response spectrum analysis.

Skip this section of data if **NDYN** is not 2. Otherwise, prepare the following data as defined in Sections a, b, c and d below.

a. Title Information

Prepare one line of data with title information to identify the response spectrum curve. Up to 50 characters of information may be provided.

b. Control Data

Prepare one line of data of control information in the following form:

NDIR NPC ICQC SF DAMP

c. Excitation Direction Data

Provide one line of data with entries to define **NDIR** ground excitation directions (**NDIR** cannot exceed 3). See Figure V-25. Prepare the data line in the following form:

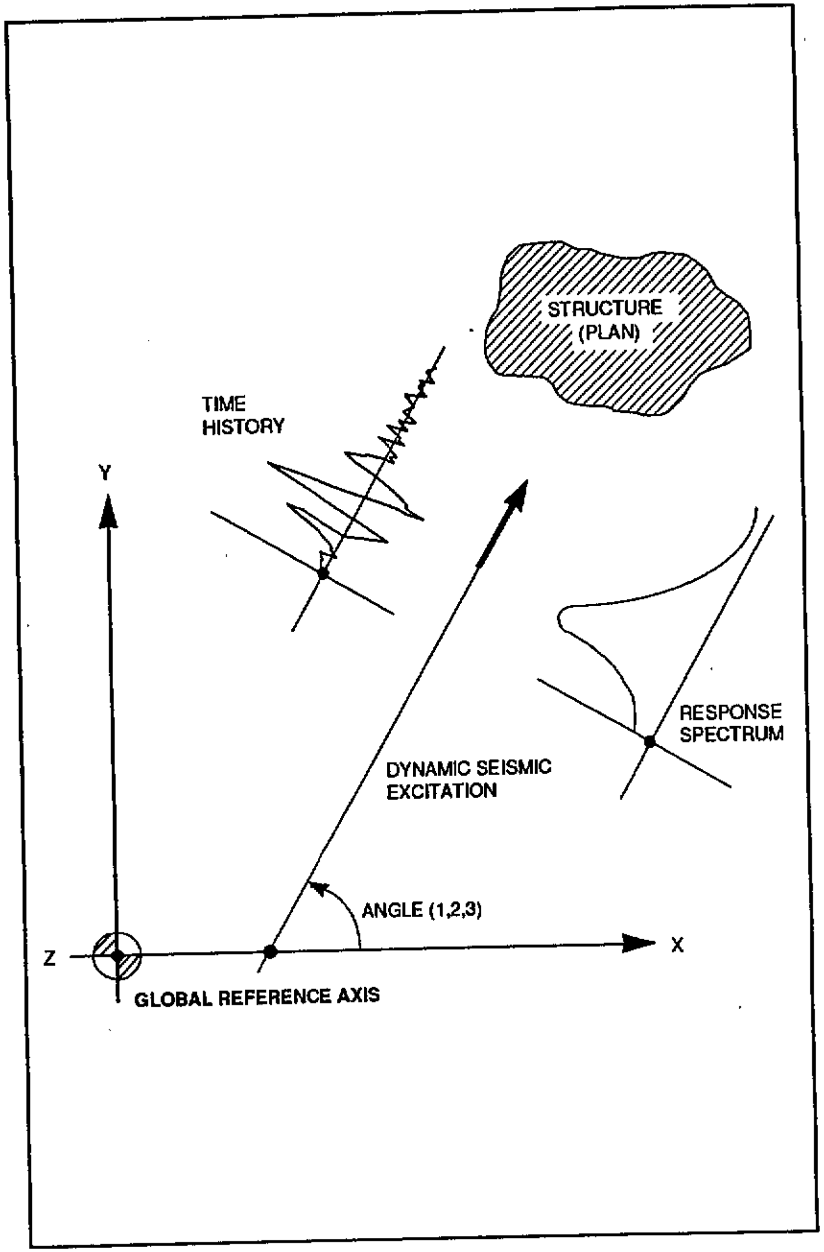
ANG1 ANG2 ANG3

9. DATA FOR RESPONSE SPECTRUM DYNAMIC ANALYSIS (continued)

d. Response Spectrum Curve Data

Provide NPC data lines, each having a pair of entries, each data line defining a point on the response spectrum curve. See Figure V-26. Prepare the data in the following form:

TP SA



Dynamic Seismic Excitation Direction Convention
Figure V-25

9. DATA FOR RESPONSE SPECTRUM DYNAMIC ANALYSIS (continued)

Control Data

Variable	Field	Note	Entry
NDIR	1	(1)	Number of response spectrum excitation directions.
NPC	2	(2)	Number of points on the response spectrum curve.
ICQC	3	(3)	Modal combination technique control: = SRSS SRSS modal combination = CQC CQC modal combination
SF	4	(4)	Scale factor (or multiplier) for accelerations.
DAMP	5	(5)	Damping ratio associated with response spectrum.

9. DATA FOR RESPONSE SPECTRUM DYNAMIC ANALYSIS (continued)

Control Data (continued)

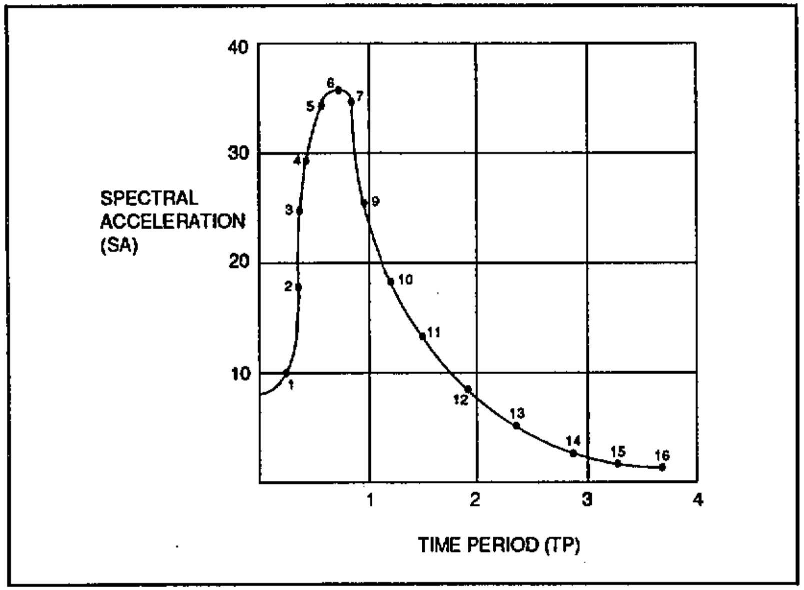
Variable	Field	Note	Entry

Excitation Direction Data

ANG1	1	(6)	Excitation direction angle 1.
ANG2	2	(6)	Excitation direction angle 2.
ANG3	3	(6)	Excitation direction angle 3.

Response Spectrum Curve Data

TP	1	(7)	Period entered in increasing numerical sequence.
SA	2		Spectrum acceleration corresponding to period.



Typical Response Spectrum Curve
Figure V-26

9 - NOTES:

1. The dynamic excitation can be applied from three different directions in any one run. The directions correspond to the three independent dynamic load conditions DYN-1, DYN-2 and DYN-3. The directions of excitation are all of a lateral nature (in the X-Y plane). No vertical dynamic options are available.

2. At least two data lines must be provided.

3. All modal combinations (for all dynamic load conditions) will be formed by either the square-root-of-the-sum-of-the-squares (SRSS) or the complete-quadratic-combination technique (CQC), depending upon this entry.

4. This is a multiplying factor to scale the spectrum acceleration values input below, to amplify or reduce the spectrum intensity or to transform the accelerations into consistent units.

5. The damping ratio is required for use in the CQC combination technique as defined in Reference [10].

6. The direction angle is measured positively counter-clockwise from the global X-direction. Input is in degrees. See Figure V-25.

7. If the period of the mode being considered is out of the range covered by the period range of the spectrum curve, the spectral value for the mode will be set equal to that associated with the closest time period on the spectrum data that is provided.

10. DATA FOR TIME HISTORY DYNAMIC ANALYSIS

This data is for defining the ground motion accelerogram for a dynamic time history analysis.

Skip this section of data if **NDYN** is not 3. Otherwise, prepare the following data as defined in Sections a, b, c and d below.

a. Title Information

Prepare one line of data with title information to identify the acceleration time history. Up to 50 characters of information may be provided.

b. Control Data

Prepare one line of data of control information in the following form:

ANG NTIME DT

c. Damping Data

Provide one data line for each of the **NPER** dynamic modes that are being included in the analysis. Prepare the data in the following form:

N DAMP

10. DATA FOR TIME HISTORY DYNAMIC ANALYSIS (CONTINUED)

d. Acceleration History Data

Prepare two lines of data to specify base acceleration histories in the following form:

HISTFIL1 SF1 IHTYP1 HDT1 NPL1
HISTFIL2 SF2 IHTYP2 HDT2 NPL2

10. DATA FOR TIME HISTORY DYNAMIC ANALYSIS (continued)

Variable	Field	Note	Entry
Control Data			
ANG	1	(1)	Direction of earthquake input (degrees).
NTIME	2	(2)	Number of output sampling values.
DT	3	(2)	Time increment for output sampling.
Damping Data			
N	1	(3)	Mode number (in ascending order).
DAMP	2	(3)	Damping ratio (must always be less than 1.0).

10. DATA FOR TIME HISTORY DYNAMIC ANALYSIS (continued)

Variable	Field	Note	Entry

Acceleration History Data

Variable	Field	Note	Entry
HISTFIL1 HISTFIL2	1	(4)	Filename containing acceleration values.
SF1 SF2	2	(5)	Scale factor for accelerations.
IHTYP1 IHTYP2	3	(6)	Time history type code: = U Variable time interval. = E Constant time interval.
HDT1 HDT2	4	(6)	Time interval spacing for IHTYP = E type history (must be greater than zero).
NPL1 NPL2	5	(7)	Number of entries per line for history data.
IPRN1 IPRN2	6		Input time history print flag = 0 Print = 1 Do not Print

10 - NOTES:

1. The direction angle is measured positively counter-clockwise from the global X-direction. See Figure V-25. Time history dynamic excitations are applied **concurrently** in two horizontal directions. One is applied in the specified direction and the other at 90° to it.

2 The time span over which the time history analysis is carried out is given by **NTIME*DT**. Member forces and displacements are calculated after every **DT** seconds, ending up with **NTIME** values for each output component. The maximum of the **NTIME** values for each component is printed. Since explicit integration is used in computing the response, numerical instability problems are not encountered and the time increment may be any desired sampling value that is deemed fine enough to capture the maximum response values. One-tenth of the time period of the highest mode is usually recommended; however, a larger value may give just as accurate a sampling if the contribution of the higher modes is small.

3. The damping is represented as a fraction of the critical damping. Therefore, **DAMP** must always be less than 1.0. A damping ratio should be specified for each of the **NPER** modes calculated.

4. The **HISTFIL1** and **HISTFIL2** are text files containing the input acceleration time histories. The acceleration time history represented by file **HISTFIL1** is applied at the base of the structure at an angle **ANG** to the X-axis. The acceleration time history represented by file **HISTFIL2** is applied concurrently to the base of the structure at an angle **ANG**+ 90° to the X-axis. If unidirectional motion is to be applied, one of these two lines specifying the time history files should be left blank.

10 - NOTES: (continued)

The format of each file is dependent on the corresponding **IHTYP** and **NPL** parameters as described below in notes 6 and 7.

5. **SF1** and **SF2** are the multiplying factors to scale the time history acceleration values input through files **HISTFIL1 and HISTFIL2**, respectively. These can be used to amplify or reduce the acceleration intensity or to transform the accelerations into consistent units.

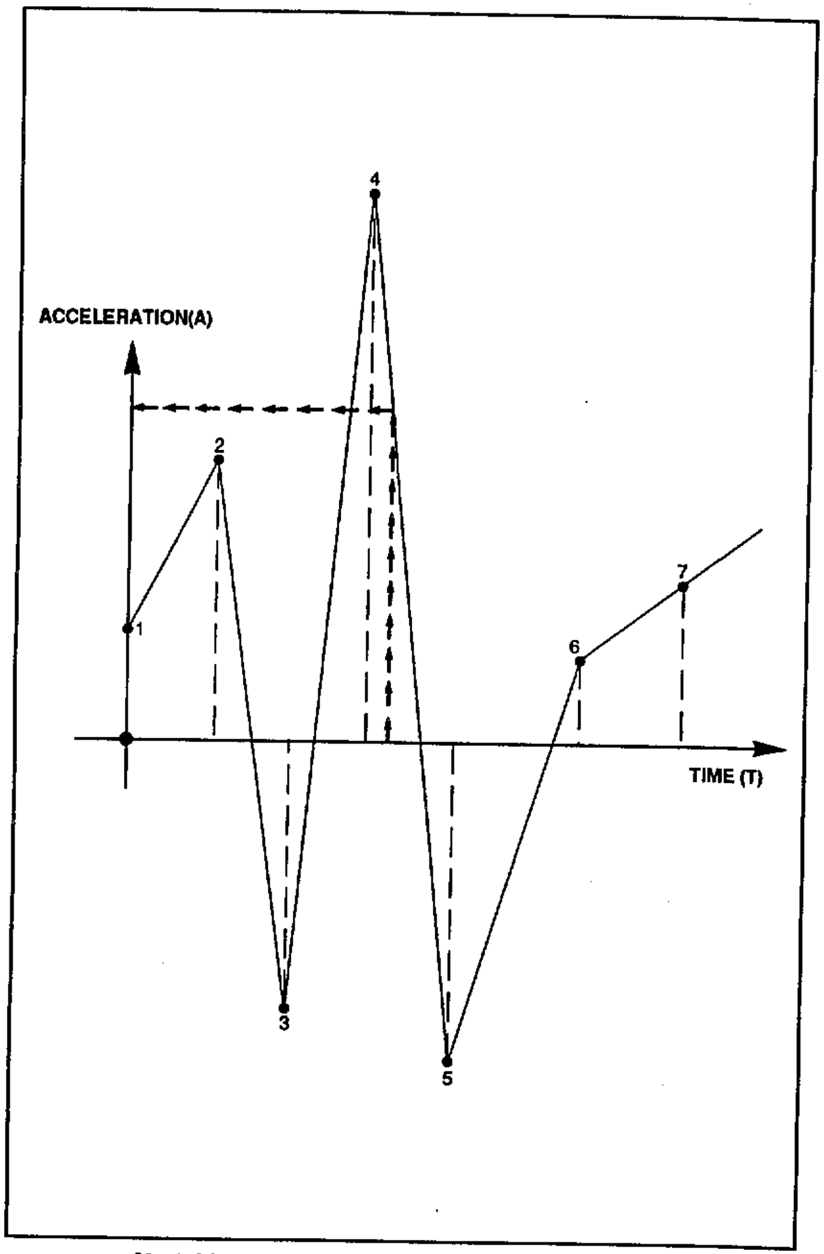
6. **IHTYP** (**IHTYP1** or **IHTYP2**) defines the method that the program uses to read the time history input. If **IHTYP** is "U", the program expects to read pairs of time and associated history values at the rate of **NPL** (corresponding **NPL1** or **NPL2**) entries per line. With this method of input **HDT** (corresponding **HDT1** or **HDT2**) is ignored by the program.

   If **IHTYPE** is "E", the program will read history values (only) at equal intervals along the t-axis at the rate of **NPL** entries per line. **HDT** is the t-axis spacing for acceleration input values.

   For either "U" and "E" type inputs the first value should be at time equal 0.0.

   Comment lines are possible in the time-history files. Any line beginning with a $ sign is ignored by the program.

7. This entry must be even for **IHTYP**= U type history. It is the number of entries (not pairs of entries) on any one line.



Variable Time Interval Acceleration Time History
Figure V-27

11. LOAD CASE DEFINITION DATA

Load cases for the building are defined as linear combinations of the eight basic load conditions, namely:

a. The vertical static load conditions, I, II and III.

b. The lateral static load conditions, A and B.

c. The lateral dynamic load conditions, DYN-1, DYN-2 and DYN-3.

If **NLD** is zero, skip this data section. Otherwise, provide one data line to define each of the NLD load cases in the following form:

L LTYP XI XII XIII XA XB XD1 XD2 XD3

11. LOAD CASE DEFINITION DATA (continued)

Variable	Field	Note	Entry
L	1	(1)	Load case number.
LTYP	2	(2)	Load combination type: = 0 Linear combination, consider all signs = 1 Linear combination, use absolute value of responses, but consider sign of multipliers. = 2 SRSS A and B load conditions, combine linearly with others. = 3 SRSS Dyn-1 and Dyn-2 load conditions, combine linearly with other
XI	3	(3)	Multiplier for vertical load condition I.
XII	4		Multiplier for vertical load condition II.
XIII	5		Multiplier for vertical load condition III.

11. LOAD CASE DEFINITION DATA (continued)

Variable	Field	Note	Entry
XA	6		Multiplier for lateral load condition A.
XB	7		Multiplier for lateral load condition B.
XD1	8		Multiplier for dynamic load condition 1.
XD2	9		Multiplier for dynamic load condition 2.
XD3	10		Multiplier for dynamic load condition 3.

11 - NOTES:

1. This number must be input in ascending, consecutive sequence, starting with the number 1.

2. If this entry is zero, linear combinations are produced and all signs are considered.

   If this entry is 1, linear combinations are produced, except that absolute values of responses are used, although signs of multipliers are considered.

   If this entry is 2, a square root of the sum of the squares (SRSS) combination of the Load Conditions A and B responses with the specified multipliers is first made, before combining linearly with the other load conditions. The SRSS value is assigned the sign of XA. This type of combination is required in some design codes to consider orthogonal effects of seismic excitations.

   If this entry is 3, a SRSS combination of the Load Conditions Dyn-1 and Dyn-2 responses with the specified multiplier is first made before combining linearly with the other load conditions. The SRSS value is assigned the sign of XD1. This type of combination is commonly used for dynamic analysis and is required by some design codes to consider orthogonal effects of seismic excitations.

3. Any multipliers entered in the fields associated with inactive load conditions will have a null effect on the load case.

   The vertical load conditions are only active if vertical loading has been defined on the frames.

   The lateral static load conditions are only active if **NLAT** is greater than zero.

11 - NOTES: (continued)

If **NDYN** is less than 2, none of the dynamic load conditions will be active.

If **NDYN** is 2 (i.e. response spectrum analysis), the state of the dynamic load conditions DYN-1, DYN-2 and DYN-3 will be determined by the number of excitation directions that have been defined in the response spectrum data section. All three dynamic load conditions will only be active if three excitation directions have been defined.

If **NDYN** is 3, in time history analysis, only dynamic loading DYN-1 is active and contains the response maxima from the time history analysis.

It should also be noted that all results for response spectrum analysis are positive. When dynamic loads are combined with static loads the loading combinations should be duplicated, once with the dynamic loads added and once with the dynamic loads subtracted.

VI.

ETABS OUTPUT FILES

Depending upon the options that are activated by the ETABS input data, the program will produce up to six output files containing information produced by the different phases of the analysis.

The names of these output files are built from the input filename with unique filename extensions. For instance, if the name of the ETABS input data filename is EXAMPLE, the six output files produced by ETABS will be

1.	EXAMPLE.EKO	Echo of Input Data
2.	EXAMPLE.EIG	Eigenvalue Output
3.	EXAMPLE.STR	Story Level Output
4.	EXAMPLE.DSP	Frame Displacement Output
5.	EXAMPLE.FRM	Frame Member Output
6.	EXAMPLE.PST	Postprocessing File

In addition to the above output files, the ETABS program will also produce the following intermediate data base and execution files:

1. ETABS.SYS
2. ETABS.DB1
3. ETABS.DB2
4. ETABS.DB3
5. ETABS.DB4
6. ETABS.ERR
7. EGO.BAT

The ETABS files EXAMPLE.EKO, EXAMPLE.EIG, EXAMPLE.STR, EXAMPLE.DSP, EXAMPLE.FRM, ETABS.ERR and EGO.BAT are ASCII files and can be printed or scanned with an editor.

The files EXAMPLE.PST, ETABS.SYS, ETABS.DB1, ETABS.DB2, ETABS.DB3 and ETABS.DB4 are intermediate internal files in binary format that cannot be printed or scanned with an editor.

The following is a short description of the contents of each of the abovementioned files.

A. THE EXAMPLE.EKO FILE

The output file EXAMPLE.EKO is created by the ETABS preprocessor and contains a tabulated and labeled listing of the input data as it has been read and generated from the input data file EXAMPLE.

This file also contains additional information about the model that has been generated by the preprocessor from the input data. This data is helpful in cross-checking the accuracy of the input data. The additional information includes calculated story mass data, section properties as recovered from the AISC data base or calculated section properties, wall assemblage properties and calculated element lengths, summations of frame vertical loads and element self weights.

Calculated lateral wind loads are also output. Seismic loads are output if the structural time periods are specified, otherwise, this information appears in the EXAMPLE.STR file.

B. THE EXAMPLE.EIG FILE

This output file contains information from the eigenvalue solution of the building.

This file contains tables of the time periods and frequencies, the modal participation factors, the modal direction factors and the modal effective mass factors.

Structural mode shape components associated with the centers of mass of each story level are tabulated. See Figure VI-1 for the positive sign convention.

As all dynamic analysis options in ETABS are of a lateral nature, only the global X- and Y-translation and Z-rotation components are included.

The modal participation factors, modal direction factors and the modal effective mass factors corresponding to the global X-translation, Y-translation and Z-rotation are created.

All the modes are mass normalized, i.e., for each mode:

$$\sum M\,\Phi^2 = 1$$

1. The modal participation factors corresponding to the X, Y and ΘZ directions for a particular mode are given by:

$$PF_X = \sum M\,\Phi_X$$

$$PF_Y = \sum M\,\Phi_Y$$

$$PF_{\Theta Z} = \sum M_\Theta\,\Phi_{\Theta Z}$$

   where M represents the translational mass, Φ_X represents the X-translational mode shape components, Φ_Y represents the Y-translational mode shape components, M_Θ represents the mass moment of inertia, and $\Phi_{\Theta Z}$ represents the Z-rotational mode shape components.

   All summations are over the number of stories.

2. The modal direction factors identify the predominant direction of excitation associated with each of the modes. The factors are percentages associated with the X- and Y-translational and Z-rotational directions. The sum of the three values will always add up to 100.

The factors for a particular mode are given by:

$$\%X = 100 \sum M \Phi_X^2$$

$$\%Y = 100 \sum M \Phi_Y^2$$

$$\%\Phi Z = 100 \sum M_\Theta \Phi_{\Theta z}^2$$

where

$$\sum M \Phi^2 = \sum M \Phi_X^2 + \sum M \Phi_Y^2 + \sum M_\Theta \Phi_{\Theta Z}^2 = \mathbf{1.0}$$

All summations are over the number of stories.

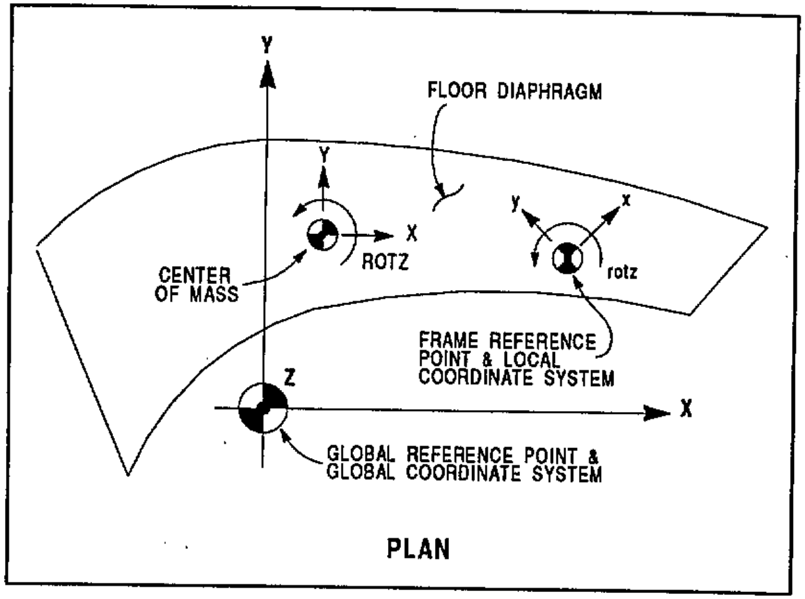
3. The modal effective mass factors identify the percentage of the total mass that is mobilized by each of the modes when the structure is subjected to a constant unity response spectrum applied in a particular global direction.

The factors for a particular mode are calculated from the participation factors as follows:

$$EM_X = 100 \frac{(PF_X)^2}{\sum M}$$

$$EM_Y = 100 \frac{(PF_Y)^2}{\sum M}$$

$$EM_{\Theta Z} = 100 \frac{(PF_{\Theta Z})^2}{\sum M_{\Theta Z}}$$



Positive Directions for Structural and Frame Lateral Displacements
Figure VI-1

This information is helpful in determining the number of modes that need to be included in the implementation of a dynamic analysis.

It is recommended that the cumulative mass percentage from all the modes that are included in the analysis should not be less than 90% for any direction of excitation.

If all modes are included, the sum of the mass percentages from each direction will equal 100%.

C. THE EXAMPLE.STR FILE

This file contains story information associated with the analysis of the structure.

Depending upon the analytical options that are activated, this file can contain the following information.

1. If the automated seismic loads are to be based upon time periods calculated by the ETABS eigensolver, the program will produce details of these calculations and the associated seismic loads.

2. If **NLAT** is not 0, the program will produce total (not interstory) lateral story displacements at the centers of mass of each story for each of the five static load conditions I, II, III, A and B. The displacements are in the global coordinate system. See Figure VI-1 for the positive sign convention.

3. For a response spectrum analysis, **NDYN** = 2, the program will produce the maximum story inertia forces and story shears generated by the inertia forces for the whole structure at the center of mass of each floor level for each of the response spectrum dynamic load conditions, DYN-1, DYN-2 and DYN-3. These forces and moments are always positive and are in the global coordinate system. The story inertia forces will generally not add up to the story shears because they do not occur at the same time.

4. For each frame in the structure, the program will produce lateral story displacements and lateral interstory drift ratios for each level in the frame at the point in the plan of the structure that corresponds to the origin of the frame.

The interstory drift ratio for a level is defined as the difference between the lateral story displacements at that level and the level below, divided by the story height associated with that level.

If **NLAT** is not 0, the program will produce this information for each of the five load conditions I, II, III, A and B.

For a response spectrum analysis, **NDYN** = 2, the lateral displacements and drifts are calculated for each mode and the modal combinations are reported for each of the dynamic load conditions, DYN-1, DYN-2, and DYN-3.

For a time history analysis, **NDYN** = 3, the lateral displacements and drifts are calculated for each time step and the maximum and minimum values are reported, along with the corresponding times of occurrence.

All displacement and drift values are output in the local coordinate system that corresponds to the frame. See Figure VI-1 for the positive sign convention.

5. For each frame in the structure, the program will produce total static story shear summations and story moment summations for each level in the frame at the point in the plan of the structure that corresponds to the origin of the frame.

   These summations do **not** include contributions from lateral loads applied to disconnected column lines.

   If **NLAT** is not 0, the program will produce this information for each of the five load conditions I, II, III, A and B.

For a response spectrum analysis, **NDYN** = 2, the story shears and moments are calculated for each mode and the modal combinations are reported for each of the dynamic load conditions, DYN-1, DYN-2 and DYN-3.

For a time history analysis, **NDYN** = 3, the story shears and moments are calculated for each time step and the maximum and minimum values are reported, along with the corresponding times of occurrence.

All story shears and moments are output in the local coordinate system that corresponds to the frame. See Figure VI-1 for the positive sign convention.

D. THE EXAMPLE.DSP FILE

This file contains frame displacements and reactions for each of the **NLD** load cases.

1. For each frame, the total (not interstory) lateral frame displacements are output at the origin of the frame, in the frame local coordinate system. See Figure VI-1 for the positive sign convention.

2. For each joint in each frame, vertical displacements and rotations are output. Lateral displacements and rotations are produced for all disconnected column lines.

Reaction forces and moments for all column lines at the baseline of each frame also exist in this file.

All displacements and reactions are in the frame local coordinate system. See Figure VI-2 for the positive sign convention.

All output is in the same sequence as the frame location data (see Chapter V). Output associated with the first frame is printed first, starting with the top story and progressing downward.

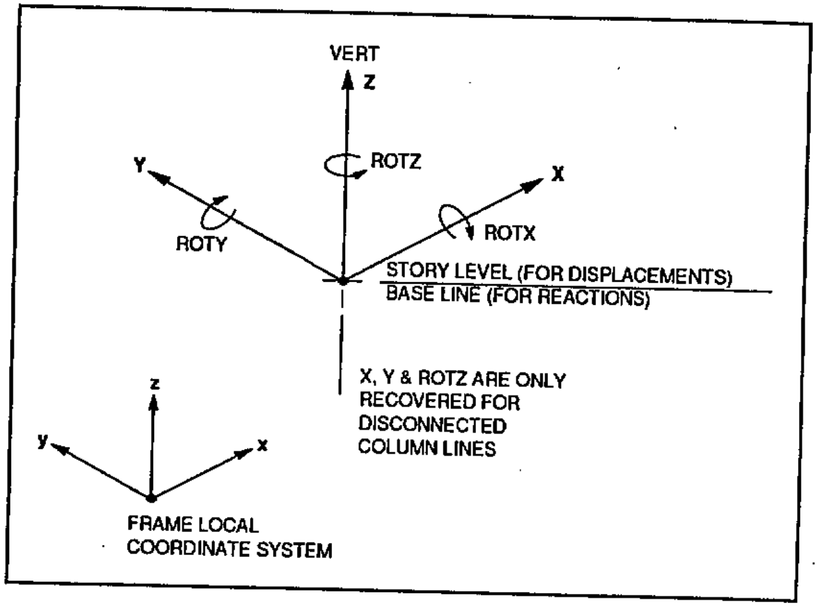
If **NLD** is 0, this file will be empty.

E. THE EXAMPLE.FRM FILE

This file contains all member forces for each element type for each of the **NLD** load cases. The beams associated with any story, of course, exist at the story level line. However, the columns, braces and wall assemblages associated with a particular story exist below the corresponding story level line.

1. For each column element, major and minor moments are output at each end of the column, at the outer faces of the beams framing into the column. Axial force, shear forces and torsion are constant over the column height and are therefore only printed once, i.e., at the top end. See Figure VI-3 for the positive sign convention.

2. For each beam element, major and minor moments are output at each end of the beam at the outer faces of the columns framing into the beam. If the beam has vertical loading in the major plane for a particular load case, the beam bending moments and shear forces are output at three additional stations, namely the 1/4, 1/2 and 3/4 clear span points. Axial forces, shear forces and torsions that are constant over the beam length are only printed once, i.e. at End I of the beam. See Figure VI-4 for the positive sign convention.



Positive Directions for Frame Joint Displacements and Reactions
Figure VI-2

Axial forces in a beam will only be recovered if at least one of the column lines at the end of the beam is released from the rigid diaphragm and the beam axial properties are specified. In many cases, such as in braced frames, the structural behavior can cause large axial forces to be generated in a beam, but these forces are not recovered by the program if both ends of the beam connect to a rigid diaphragm, because the rigid diaphragm assumption forces the axial deformations in the beam to zero. In reality, the beams have axial forces and deformations, and situations involving heavy axial action should be closely examined.

3. For each brace element, major and minor moments are output at each end of the brace at the floor levels (or baseline). Axial forces, shear forces and torsions are constant over the length of the brace and are therefore only

printed once, i.e., at the top end. See Figure VI-5 for the positive sign convention.

4. For each wall section (assemblage of panel elements), major and minor moments are output at each end of the assemblage at the floor levels. Axial forces, shear forces and torsions are constant over the height of the wall and are therefore only printed once, i.e., at the top end. See Figure VI-6 for the positive sign convention.

   The wall section major direction is defined by the orientation of the panel element that is first in the input (or generated) sequence among the panel elements that define the particular wall section (at the particular level, of course).

The frame output is in the same sequence as the frame location data (see Chapter V). Output associated with the first frame is printed first, starting with the top story and progressing downward.

If **NLD** is 0, this file will be empty.

F. THE EXAMPLE.PST FILE

This file is the ETABS postprocessing file.

This file contains information pertaining to the building geometry and loading and the analytical results from the corresponding ETABS analysis.

This file forms the interface between ETABS and the ETABS postprocessors.

G. THE ETABS.SYS FILE

This is a system file that forms the linkage between the various modules of the ETABS program.

H. THE ETABS.DB? FILES

These are the data base files associated with the ETABS program.

I. THE ETABS.ERR FILE

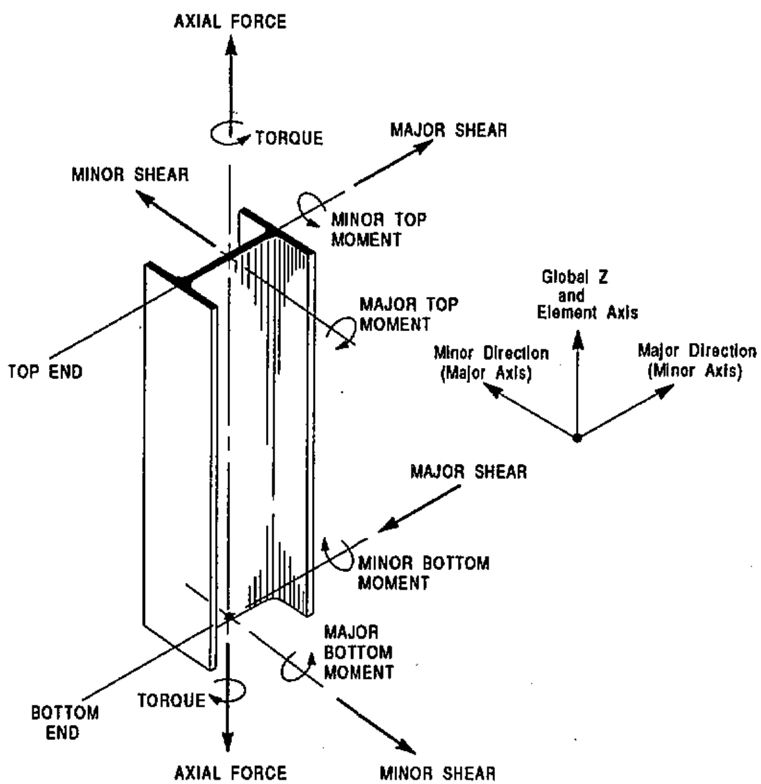
This file is created if there is an abnormal termination of the ETABS program after the input phase. In such a situation, the file will contain a message pointing to the reason for the abnormal termination.

J. THE EGO.BAT FILE

This batch file is created by the ETABS input processor of ETABS (or RETABS).

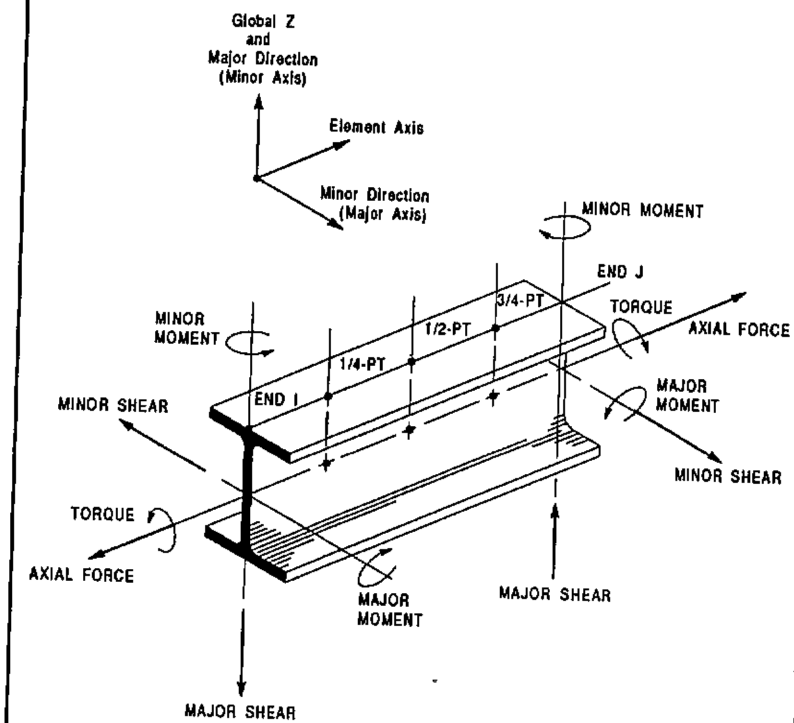
It contains the command sequence for executing the subsequent modules of ETABS.

This file is only created if there are no data errors detected by the input processor.



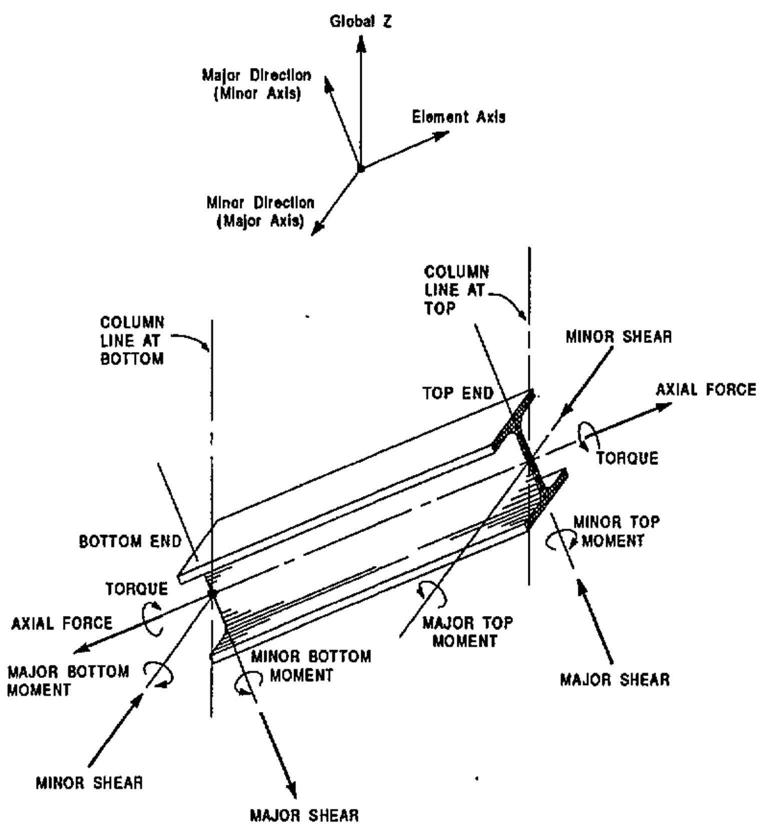
NOTE: Positive moments cause compression on the positive face, i.e. the element face on the side of the positive axis.

Column Member Forces
Figure VI-3



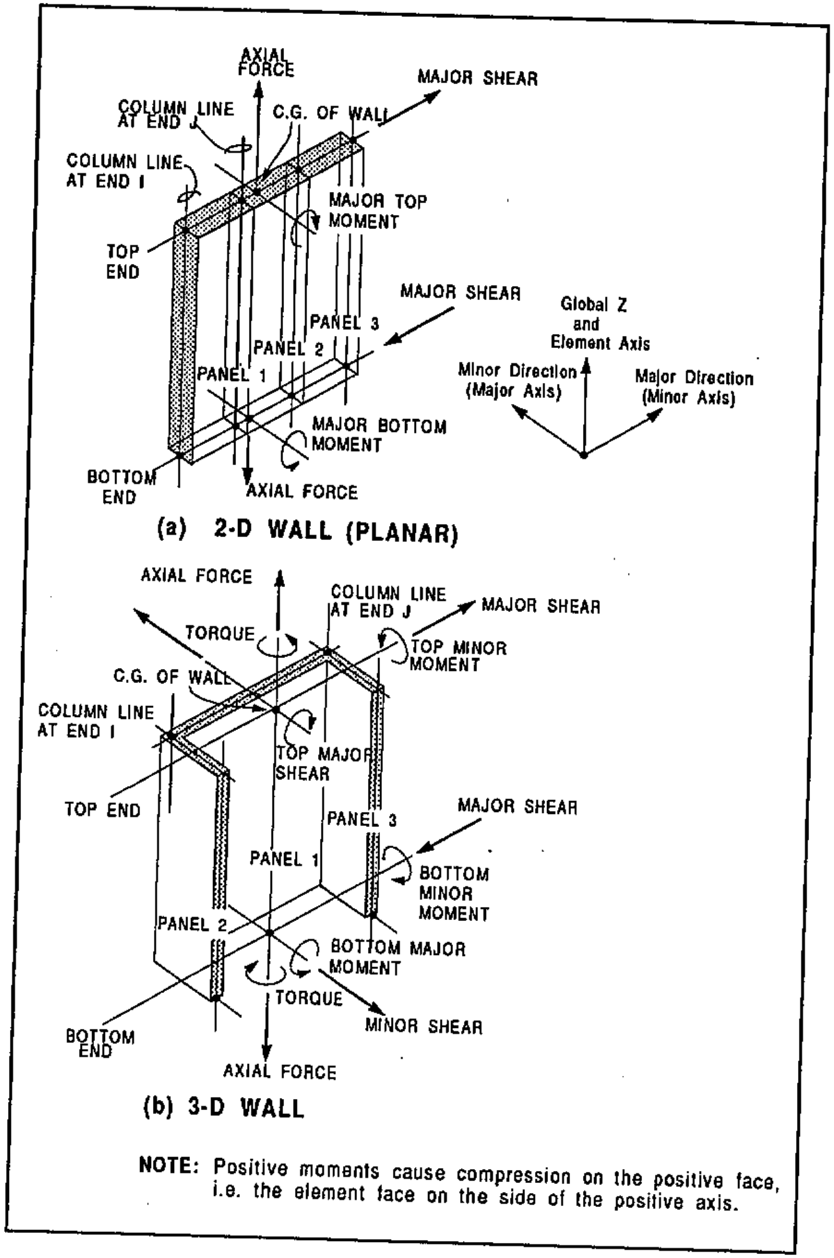
NOTE: Positive moments cause compression on the positive face, i.e. the element face on the side of the positive axis.

Beam Member Forces
Figure VI-4



NOTE: Positive moments cause compression on the positive face, i.e. the element face on the side of the positive axis.

Brace Member Forces
Figure VI-5



Wall Assemblage Member Forces
Figure VI-6

VII.

ETABS RESTART

The frame stiffness formulation and reduction phase is one of the most time-consuming phases of the ETABS execution sequence.

In subsequent reruns of the same model, this phase of the execution may be bypassed if there are no changes in the input data that affect the frame geometry or loading.

Input data files that are to be executed in a restart mode are set up in exactly the same manner as a normal execution data file, except that all data associated with the following three data blocks must be omitted:

a. Material Property Data (Chapter V, Section D.4)

b. Section Property Data (Chapter V, Section D.5)

c. Frame Definition Data (Chapter V, Section D.6)

This information will be obtained from the data base files of the previous ETABS run.

The following control parameters must also remain unchanged in the restart input (see Chapter V, Section D.1b).

NST	Number of stories
NDF	Number of different frames
NMAT	Number of material properties
NCP	Number of column section properties
NBP	Number of beam section properties
NDP	Number of brace section properties
NPP	Number of panel section properties
NRGD	Frame joint stiffness code
NSLF	Frame self weight calculation code

Also, in the story data, Chapter V, Section D.3, the following two parameters must remain unchanged.

SDI	Story identification
SH	Story height

Any illegal parameter changes will be checked and replaced by values that were defined in the normal ETABS execution.

The name of the restart input data filename need not be the same as the normal execution input data filename.

The restart execution sequence is defined in Chapter II, Section D. The ETABS execution files, ETABS.SYS, ETABS.DB1 and ETABS.DB2 from the normal execution run must be resident on disk.

The user may make as many restart runs as needed from the data base files of a normal execution run.

The restart mode allows the user a wide variety of re-run options along with significantly reduced execution times, such as:

a. Different static lateral load options

b. Analysis of the structure with locked and unlocked story rotations

c. Extension of the static analysis to dynamic analysis

d. Multiple response spectrum and time history runs

e. Inclusion of P-delta effects

f. Evaluation of additional mode shapes and frequencies

g. Modification of story masses

In general, any parameter that does not affect the frame geometry or loading may be modified at the restart level.

VIII.

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Appendix A

SAMPLE EXAMPLE

This appendix includes the complete output for a small two-story building structure analyzed using ETABS. The input data file for this sample example, called EXAMPLE, and the corresponding output files EXAMPLE.EKO, EXAMPLE.EIG, EXAMPLE.STR, EXAMPLE.DSP and EXAMPLE.FRM are presented in this appendix.

The example building, shown in the figure, was chosen to illustrate the output associated with the various options available in the ETABS programs.

The building is analyzed for three loading conditions: gravity loads including beam span loads and member self weights; automatically generated UBC specified static wind loads; and dynamic loads resulting from the El Centro 1940 earthquake (N-S component) response spectra.

The example building consists of two identical concrete shear wall frames along the east and west faces of the building, and two identical steel braced frames along the north and south faces of the building.

Each shear wall frame is modeled with four column lines, a single bay to input the gravity loads, one wall section consisting of three panels at the roof level and two wall sections consisting of one panel each at the first story level. A modulus of elasticity of 3000 ksi and a Poisson's ratio of 0.2 is used for the concrete.

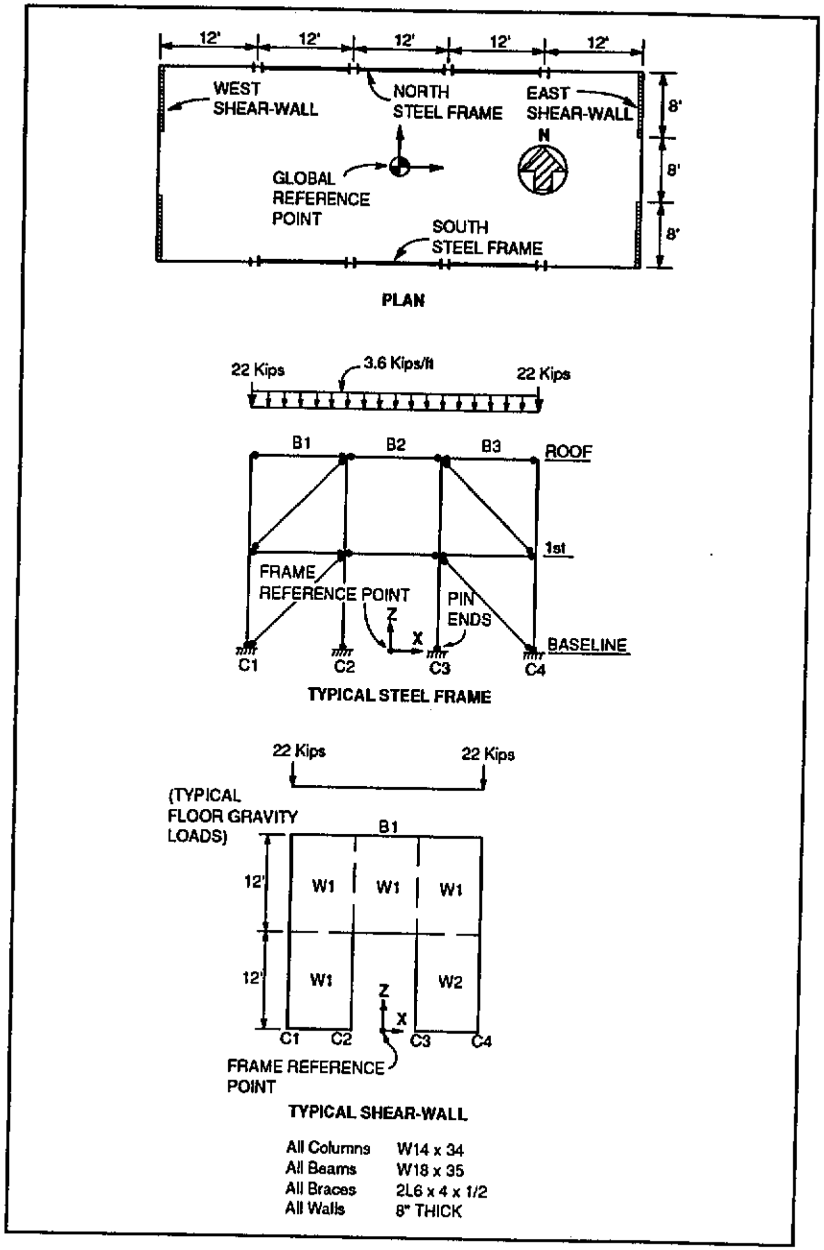
Each steel braced frame is modeled with four column lines with pin-based columns, three bays with pin-ended beams and four pin-ended brace members. A modulus of elasticity of 29500 ksi and a Poisson's ratio of 0.3 is used for the steel.

Story mass properties are automatically calculated by specifying a story weight density of 100 psf.

Gravity loads are included as beam span loads and the self weights of the members are automatically included. A weight density of 150 pcf for concrete and 490 pcf for steel is used for self weight calculations. UBC 1991 wind loads are automatically included by specifying a basic wind speed of 70 mph and an exposure type of C. Earthquake loads are specified by inputting the El Centro 1940 N-S component, 5 percent damping, response spectra. All six natural modes of the structure are used for the response spectrum analysis.

Detailed member forces and frame displacement output is requested only for the north steel braced frame and the east shear wall frame for the load combinations of gravity with Y-direction wind loads and gravity with X-direction seismic loads.

All input and output is in kip-inch-second units.



Sample EXAMPLE

```
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS
$                                     CONTROL DATA
 2  2  4  1  2  6  2  1  2  1  1  5  2  0  0  0  0  1  1
 386.4
$                                     MASS DATA
 1  1  1/386.4
 .1/144  0  0  60*12  24*12
                                      STORY DATA
$
 ROOF  12*12  1
 1ST   12*12  1
                                      MATERIAL PROPERTY DATA
$
 1  S  29500  0.49/1728  0.3
 2  C  3000   0.15/1728  0.2
                                      COLUMN SECTION PROPERTIES
$
 1  1  W14X34
$                                     BEAM SECTION PROPERTIES
 1  1  W18X35
 2  2  USER

$                                     BRACE SECTION PROPERTES
 1  1  USER
 9.50                              $  2 L 6x4x1/2
$                                     PANEL SECTION PROPERTIES
 1  2  8
$                                     FRAME DATA
$                                     DATA FOR TYPICAL STEEL BRACED FRAME
 TYPICAL STEEL BRACED FRAME
 1  2  4  3  4  0  0  3
$                                     COLUMN LINE LOCATIONS
 1  -18*12
 2   -6*12
 3    6*12
 4   18*12
$                                     BAY CONNECTIVITY
 1  1  2
 2  2  3
 3  3  4
$                                     BEAM SPAN VERTICAL LOADING PATTERNS
 1  0  .3  22
 2  0  .3
 3  0  .3   0  22
$                                     COLUMN ASSIGNMENTS
 1  0  ROOF  1  0
 1  0  1ST   1  0  1
 2  1
 3  1
 4  1

$                                     BEAM ASSIGNMENTS
 1  0  ROOF  1  1  3
 2  1
 3  1

$                                     BRACE LOCATION DATA
 1  ROOF  1  2  1  1  3
 3  ROOF  4  3  1  1  3
$                                     ASSIGNMENT OF BEAM SPAN LOADINGS
 1  0  ROOF  1  0  0  1
 2  0  ROOF  2  0  0  1
 3  0  ROOF  3  0  0  1
```

Sample Input Data
File: EXAMPLE

```
$                                         DATA FOR TYPICAL SHEAR WALL FRAME
 TYPICAL SHEAR WALL FRAME
 2  2  4  1  0  5  0  1
$                                         COLUMN LINE LOCATIONS
 1   -12*12
 2    -4*12
 3     4*12
 4    12*12
$                                         BAY CONNECTIVITY
 1  1  4
$                                         BEAM SPAN LOADING PATTERNS
 1  0  0  22  22
$                                         COLUMN ASSIGNMENTS

$                                         BEAM ASSIGNMENTS
 1  0  ROOF  2  1  3

$                                         PANEL LOCATION DATA
 1  ROOF  1  2  1  1
 1  ROOF  2  3  1  0
 1  ROOF  3  4  1  0
 2  1ST   3  4  1  0
$                                         ASSIGNMENT OF BEAM SPAN LOADING
 1  0  ROOF  1  0  0  1

$                                         FRAME LOCATION DATA
 1  0  0          12*12  0  /NORTH STEEL BRACED FRAME
 1  1  0         -12*12  0  /SOUTH STEEL BRACED FRAME
 2  1 -30*12          0 90  /WEST SHEAR-WALL
 2  0  30*12          0 90  /EAST SHEAR-WALL
$                                         UBC 1991 WIND LOADING DATA
 70  C  1.0  1/12  1/144000


 24*12 0  0  60*12  0  0
 24*12 0  0  60*12  0  0
$                                         RESPONSE SPECTRUM DATA
 ELCENTRO RESPONSE SPECTRUM
 2  11  CQC  386.4  0.05
 0  90.
        .0    .3275
     .0500    .3542
     .1460    .6885
     .1575    .8712
     .1709    .8167
     .1869    .9879
     .5405    .9824
     .7407    .4761
    1.1765    .2713
    2.8571    .1983
   1000.0     .0000
$                                         LOAD CASE DEFINITION DATA
 1  0  1  0  0  0  1              $       GRAVITY + Y-WIND
 2  0  1  0  0  0  0  1           $       GRAVITY + X-SEISMIC
$                                         END OF INPUT DATA
```

Sample Input Data (continued)
File: EXAMPLE

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    1
                                                   PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


NUMBER OF STORIES----------------------------    2
NUMBER OF DIFFERENT FRAMES-------------------    2
NUMBER OF TOTAL FRAMES-----------------------    4
NUMBER OF MASS TYPES-------------------------    1
NUMBER OF LOAD CASES-------------------------    2
NUMBER OF STRUCTURAL PERIODS-----------------    6
NUMBER OF MATERIAL PROPERTIES----------------    2
NUMBER OF SECTION PROPERTIES FOR COLUMNS-----    1
NUMBER OF SECTION PROPERTIES FOR BEAMS-------    2
NUMBER OF SECTION PROPERTIES FOR DIAGONALS---    1
NUMBER OF SECTION PROPERTIES FOR PANELS------    1
CODE FOR STATIC LATERAL ANALYSIS-------------    5
CODE FOR DYNAMIC LATERAL ANALYSIS------------    2
CODE FOR STRUCTURE TYPE----------------------    0
CODE FOR P-DELTA ANALYSIS -------------------    0
CODE FOR FRAME JOINT STIFFNESS MODIFICATION--    0
CODE FOR FRAME JOINT DISPLACEMENT------------    0
CODE FOR FRAME SELF WEIGHT LOAD CONDITION----    1
CODE FOR POST PROCESSING MODE SHAPES---------    1


GRAVITATIONAL ACCELERATION-----------------    .3864E+03
EIGEN CONVERGENCE TOLERANCE----------------    .1000E-03
EIGEN CUTOFF TIME PERIOD-------------------    .0000E+00
P-DELTA FACTOR-----------------------------    .1000E+01
```

Sample Output
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     2
                                                  PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STORY MASS TYPE NUMBER----------------------             1
NUMBER OF MASS SEGMENTS---------------------             1
MASS SCALE FACTOR---------------------------     .259E-02


SEGMENT     SEGMENT    COORDINATES OF CENTER        DIMENSIONS OF SEGMENT
 NUMBER       MASS              X          Y                X          Y
    1      .000694            .00        .00           720.00     288.00


CALCULATED STORY MASS PROPERTIES

STORY MASS----------------------------------               .37
MASS MOMENT OF INERTIA----------------------           18675.3
X-ORDINATE OF CENTER OF MASS----------------               .00
Y-ORDINATE OF CENTER OF MASS----------------               .00
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     3
                                                  PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STRUCTURAL STORY HEIGHTS AND MASS DATA . . .

LEVEL         HEIGHT  MASS TYPE      MASS        MMI         XM         YM
ROOF          144.00          1      .373    18675.3        .00        .00
1ST           144.00          1      .373    18675.3        .00        .00
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     4
                                                  PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STRUCTURAL EXTERNAL STORY STIFFNESS DATA . . .

LEVEL              K-X          K-Y       K-ROTN
ROOF       0.0000E+00   0.0000E+00   0.0000E+00
1ST        0.0000E+00   0.0000E+00   0.0000E+00
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     5
                                              PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


MATERIAL PROPERTIES

  ID TYPE        ELASTIC        UNIT    POISSONS
                 MODULUS      WEIGHT       RATIO
   1    S      .295E+05    .284E-03        .300
   2    C      .300E+04    .868E-04        .200


MATERIAL PROPERTIES FOR DESIGN

  ID TYPE             FY          FC         FYS       FBMAJ       FBMIN
   1    S      .000E+00                             .000E+00    .000E+00
   2    C      .000E+00    .000E+00    .000E+00
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    6
                                                     PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


SECTION PROPERTIES FOR COLUMNS

      MAT  SECTION                      MAJOR     MINOR    FLANGE       WEB
  ID   ID  TYPE                           DIM       DIM     THICK     THICK
   1    1  W14X34                      13.980     6.745      .455      .285

ANALYSIS SECTION PROPERTIES FOR   COLUMNS

             AXIAL        MAJOR        MINOR      TORSION        MAJOR        MINOR
  ID             A           AV           AV            J            I            I
   1        10.000        3.980        5.110    .5700E+00    .3400E+03    .2330E+02

AISC STRESS CHECK SECTION PROPERTIES FOR   COLUMNS

             MAJOR        MINOR        MAJOR        MINOR        MAJOR        MINOR
  ID             S            S            Z            Z            R            R
   1        48.641        6.909       54.600       10.600        5.831        1.526
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    7
                                                  PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


SECTION PROPERTIES FOR BEAMS

      MAT  SECTION                     DEPTH      DEPTH       BEAM   FLANGE      WEB
 ID    ID  TYPE                        BELOW      ABOVE      WIDTH    THICK    THICK
  1     1  W18X35                     17.700       .000      6.000     .425     .300
  2     2  USER                         .000       .000       .000     .000     .000


ANALYSIS SECTION PROPERTIES FOR   BEAMS

              AXIAL       MAJOR       MINOR      TORSION       MAJOR       MINOR
 ID               A          AV          AV            J           I           I
  1          10.300       5.310       4.250   .5100E+00   .5100E+03   .1530E+02
  2            .000        .000        .000   .0000E+00   .0000E+00   .0000E+00


AISC STRESS CHECK SECTION PROPERTIES FOR    BEAMS

              MAJOR       MINOR       MAJOR       MINOR       MAJOR       MINOR
 ID               S           S           Z           Z           R           R
  1          57.627       5.100      66.500       8.060       7.037       1.219
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    8
                                               PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

SECTION PROPERTIES FOR BRACES

      MAT  SECTION                   MAJOR    MINOR    FLANGE     WEB
  ID   ID  TYPE                        DIM      DIM     THICK   THICK
   1    1  USER                       .000     .000      .000    .000

ANALYSIS SECTION PROPERTIES FOR   BRACES

             AXIAL       MAJOR       MINOR      TORSION       MAJOR       MINOR
  ID             A          AV          AV            J           I           I
   1         9.500        .000        .000    .0000E+00   .0000E+00   .0000E+00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    9
                                               PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

SECTION PROPERTIES FOR   PANELS

      MAT      PANEL
  ID   ID      THICK
   1    2      8.000
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   10
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


TYPICAL STEEL BRACED FRAME

FRAME ID NUMBER----------------------------     1
NUMBER OF STORY LEVELS---------------------     2
NUMBER OF COLUMN LINES---------------------     4
NUMBER OF BAYS-----------------------------     3
NUMBER OF BRACING ELEMENTS-----------------     4
NUMBER OF PANEL ELEMENTS-------------------     0
NUMBER OF COLUMN LATERAL LOAD PATTERNS-----     0
NUMBER OF BEAM SPAN LOAD PATTERNS----------     3
MAXIMUM NUMBER OF LOADS PER BEAM SPAN------     0


COLUMN LINE COORDINATES AND ORIENTATIONS

   COLUMN          X-ORD           Y-ORD           ANGLE
        1       -216.000            .000          .00000
        2        -72.000            .000          .00000
        3         72.000            .000          .00000
        4        216.000            .000          .00000


BAY CONNECTIVITY DATA

      BAY       I-COLUMN        J-COLUMN      BAY LENGTH
        1              1               2         144.000
        2              2               3         144.000
        3              3               4         144.000


BEAM SPAN LOADING PATTERNS

  ID NCON        UNIFORM   LOAD-I   LOAD-J     MOM-I     MOM-J
   1    0    .30000E+00    22.00      .00       .00       .00
   2    0    .30000E+00      .00      .00       .00       .00
   3    0    .30000E+00      .00    22.00       .00       .00


INPUT AND/OR GENERATED COLUMN PROPERTY ID*S

LEVEL        1   2   3   4

ROOF         1   1   1   1
1ST          1   1   1   1


INPUT AND/OR GENERATED COLUMN PIN ENDS

LEVEL        1   2   3   4

ROOF         0   0   0   0
1ST          1   1   1   1
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   11
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


INPUT AND/OR GENERATED COLUMN STORY DISCONNECTIONS

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO


INPUT AND/OR GENERATED BAY PROPERTY ID*S

LEVEL        1   2   3

ROOF         1   1   1
1ST          1   1   1


INPUT AND/OR GENERATED BAY PIN ENDS

LEVEL        1   2   3

ROOF         3   3   3
1ST          3   3   3


INPUT AND/OR GENERATED BRACING DATA

    BRACE     LEVEL     COLUMN   COLUMN     PROP      PIN          BRACE
       ID     AT TOP    AT BOT   AT TOP       ID      END         LENGTH
        1     ROOF           1        2        1        3         203.65
        2     1ST            1        2        1        3         203.65
        3     ROOF           4        3        1        3         203.65
        4     1ST            4        3        1        3         203.65


INPUT AND/OR GENERATED BEAM LOADS ... LOAD CONDITION I

LEVEL        1   2   3

ROOF         1   2   3
1ST          1   2   3


INPUT AND/OR GENERATED BEAM LOADS ... LOAD CONDITION II

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO


INPUT AND/OR GENERATED BEAM LOADS ... LOAD CONDITION III

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO



CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   12
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME VERTICAL LOADING AND SELF WEIGHTS

LEVEL     /--VERTICAL LOAD CONDITION--/ /---------ELEMENT SELF WEIGHTS--------/
ID                I        II       III    COLUMN      BEAM     BRACE     PANEL
ROOF          177.6        .0        .0       1.6       1.3       1.1        .0
1ST           177.6        .0        .0       1.6       1.3       1.1        .0

TOTALS        355.2        .0        .0       3.3       2.5       2.2        .0
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   13
                                                 PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


TYPICAL SHEAR WALL FRAME

FRAME ID NUMBER----------------------------     2
NUMBER OF STORY LEVELS---------------------     2
NUMBER OF COLUMN LINES---------------------     4
NUMBER OF BAYS-----------------------------     1
NUMBER OF BRACING ELEMENTS-----------------     0
NUMBER OF PANEL ELEMENTS-------------------     5
NUMBER OF COLUMN LATERAL LOAD PATTERNS-----     0
NUMBER OF BEAM SPAN LOAD PATTERNS----------     1
MAXIMUM NUMBER OF LOADS PER BEAM SPAN------     0

COLUMN LINE COORDINATES AND ORIENTATIONS

   COLUMN           X-ORD            Y-ORD            ANGLE
        1        -144.000             .000           .00000
        2         -48.000             .000           .00000
        3          48.000             .000           .00000
        4         144.000             .000           .00000

BAY CONNECTIVITY DATA

        BAY       I-COLUMN        J-COLUMN      BAY LENGTH
          1              1               4         288.000

BEAM SPAN LOADING PATTERNS

  ID NCON       UNIFORM    LOAD-I    LOAD-J      MOM-I     MOM-J
   1    0   .00000E+00     22.00     22.00        .00       .00

INPUT AND/OR GENERATED COLUMN PROPERTY ID*S

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO

INPUT AND/OR GENERATED COLUMN PIN ENDS

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO

INPUT AND/OR GENERATED COLUMN STORY DISCONNECTIONS

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   14
                                                  PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


INPUT AND/OR GENERATED BAY PROPERTY ID*S

LEVEL         1

ROOF          2
1ST           2


INPUT AND/OR GENERATED BAY PIN ENDS

LEVEL         1

ROOF          3
1ST           3


INPUT AND/OR GENERATED PANEL DATA

    WALL      LEVEL     COLUMN   COLUMN      PROP          PANEL    PANEL
      ID      AT TOP      AT I     AT J        ID         LENGTH       ID
       1      ROOF           1        2         1          96.00        1
       1      1ST            1        2         1          96.00        2
       1      ROOF           2        3         1          96.00        3
       1      ROOF           3        4         1          96.00        4
       2      1ST            3        4         1          96.00        5

GENERATED WALL ASSEMBLAGE DATA

    WALL      STORY     NUMBER OF  PANEL ID    WALL-CG    WALL-CG      WALL
      ID      LEVEL        PANELS  FOR AXIS      X-ORD      Y-ORD      AREA
       1      ROOF              3         1       .000       .000  2304.000
       1      1ST               1         2    -96.000       .000   768.000
       2      1ST               1         5     96.000       .000   768.000

INPUT AND/OR GENERATED BEAM LOADS ... LOAD CONDITION I

LEVEL         1

ROOF          1
1ST           1

INPUT AND/OR GENERATED BEAM LOADS ... LOAD CONDITION II

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   15
                                                  PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


INPUT AND/OR GENERATED BEAM LOADS ... LOAD CONDITION III

DATA SPECIFIED FOR THIS OPTION IS ALL ZERO
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   16
                                               PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME VERTICAL LOADING AND SELF WEIGHTS

LEVEL    /--VERTICAL LOAD CONDITION--/ /---------ELEMENT SELF WEIGHTS--------/
ID              I         II        III     COLUMN       BEAM     BRACE      PANEL
ROOF         72.8         .0         .0         .0         .0        .0       28.8
1ST          63.2         .0         .0         .0         .0        .0       19.2

TOTALS      136.0         .0         .0         .0         .0        .0       48.0


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   17
                                               PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME POSITION DATA

FRAME FRAME OUTPT /----FRAME ORIENTATION----/ /--------FRAME HEADING--------/
COUNT    ID  CODE      X-ORD      Y-ORD    ANGLE
    1     1     0        .00     144.00     .000 /NORTH STEEL BRACED FRAME
    2     1     1        .00    -144.00     .000 /SOUTH STEEL BRACED FRAME
    3     2     1    -360.00        .00   90.000 /WEST SHEAR-WALL
    4     2     0     360.00        .00   90.000 /EAST SHEAR-WALL
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE  18
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC WIND LOAD CALCULATION DATA . . .

UNIFORM BUILDING CODE (1991)
BASIC WIND SPEED (MPH)-----------------------     70.000
EXPOSURE TYPE--------------------------------          C
IMPORTANCE FACTOR----------------------------    .100E+01
STORY HEIGHT CONVERSION FACTOR---------------    .833E-01
WIND PRESSURE CONVERSION FACTOR--------------    .694E-05

LOAD CONDITION A (X-DIRECTION) . . .
BOTTOM LEVEL FOR WIND EXPOSURE---------------

LOAD CONDITION B (Y-DIRECTION) . . .
BOTTOM LEVEL FOR WIND EXPOSURE---------------


STORY WIND EXPOSURE WIDTHS AND PRESSURE CENTERS . . .

LEVEL          BYA        DYA       DFXA       BXB       DXB       DFYB
ROOF        288.00        .00        .00    720.00       .00        .00
1ST         288.00        .00        .00    720.00       .00        .00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE  19
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STRUCTURAL LATERAL LOAD CONDITIONS
PER UBC '91 WIND LOAD REQUIREMENTS


STRUCTURAL LATERAL LOAD CONDITION A (X-DIRECTION). . .

LEVEL             FX          FY           X           Y
ROOF            2.74         .00         .00         .00
1ST             5.11         .00         .00         .00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE  20
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STRUCTURAL LATERAL LOAD CONDITIONS
PER UBC '91 WIND LOAD REQUIREMENTS


STRUCTURAL LATERAL LOAD CONDITION B (Y-DIRECTION). . .

LEVEL             FX          FY           X           Y
ROOF             .00        6.84         .00         .00
1ST              .00       12.78         .00         .00
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   21
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


DYNAMIC RESPONSE SPECTRUM ANALYSIS

ELCENTRO RESPONSE SPECTRUM

NUMBER OF EXCITATION DIRECTIONS-------------         2

NUMBER OF POINTS ON SPECTRUM CURVE----------        11

MODAL COMBINATION TECHNIQUE-----------------       CQC

SCALE FACTOR FOR SPECTRUM CURVE-------------   386.400

DAMPING ASSOCIATED WITH SPECTRUM CURVE------      .050


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   22
                                                PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


DYNAMIC EXCITATION DIRECTIONS

DIRECTION FOR DYNAMIC LOAD CONDITION 1------      .000

DIRECTION FOR DYNAMIC LOAD CONDITION 2------    90.000


RESPONSE SPECTRUM CURVE DATA

POINT           TIME       SPECTRAL
  NO          PERIOD   ACCELERATION
   1            .000           .328
   2            .050           .354
   3            .146           .689
   4            .158           .871
   5            .171           .817
   6            .187           .988
   7            .541           .982
   8            .741           .476
   9           1.177           .271
  10           2.857           .198
  11        1000.000           .000
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   23
                                           PROGRAM:ETABS/FILE:EXAMPLE.EKO
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


LOAD CASE DEFINITION DATA

LOAD LABS       I       II      III       A       B   DYN-1   DYN-2   DYN-3
   1    0   1.000     .000     .000    .000   1.000    .000    .000    .000
   2    0   1.000     .000     .000    .000    .000   1.000    .000    .000


FOR DYNAMICS BY THE RESPONSE SPECTRUM METHOD

DYNAMIC 1 . . . SPECTRAL DIRECTION 1
DYNAMIC 2 . . . SPECTRAL DIRECTION 2
DYNAMIC 3 . . . SPECTRAL DIRECTION 3

FOR DYNAMICS BY THE TIME HISTORY METHOD

DYNAMIC 1 . . . TIME HISTORY MODAL ANALYSIS
DYNAMIC 2 . . . NOT USED
DYNAMIC 3 . . . NOT USED
```

Sample Output (continued)
File: EXAMPLE.EKO

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    1
                                          PROGRAM:ETABS/FILE:EXAMPLE.EIG
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STRUCTURAL TIME PERIODS AND FREQUENCIES

  MODE                   PERIOD         FREQUENCY      CIRCULAR/FREQ
 NUMBER                  (TIME)   (CYCLES/UNIT TIME) (RADIANS/UNIT TIME)
    1                    .16047          6.23161          39.15435
    2                    .05222         19.14834         120.31259
    3                    .05150         19.41646         121.99722
    4                    .03176         31.48199         197.80717
    5                    .01545         64.72658         406.68910
    6                    .00954        104.80805         658.52840


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    2
                                          PROGRAM:ETABS/FILE:EXAMPLE.EIG
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


MODAL PARTICIPATION FACTORS

  MODE                X-TRANS          Y-TRANS           Z-ROTN
 NUMBER              DIRECTION        DIRECTION         DIRECTION
    1                  .81477           .00000            .00000
    2                 -.28548           .00000            .00000
    3                  .00000           .82009            .00000
    4                  .00000           .00000         183.56751
    5                  .00000          -.26980            .00000
    6                  .00000           .00000         -60.44444


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    3
                                          PROGRAM:ETABS/FILE:EXAMPLE.EIG
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


MODAL DIRECTION FACTORS

  MODE                X-TRANS          Y-TRANS           Z-ROTN
 NUMBER              DIRECTION        DIRECTION         DIRECTION
    1               100.00000           .00000            .00000
    2               100.00000           .00000            .00000
    3                  .00000        100.00000            .00000
    4                  .00000           .00000         100.00000
    5                  .00000        100.00000            .00000
    6                  .00000           .00000         100.00000
```

Sample Output
File: EXAMPLE.EIG

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    4
                                               PROGRAM:ETABS/FILE:EXAMPLE.EIG
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


EFFECTIVE MASS FACTORS

  MODE     /--X  TRANSLATION--//--Y  TRANSLATION--//----Z ROTATION----/
NUMBER          %-MASS  <%-SUM>       %-MASS  <%-SUM>       %-MASS <%-SUM>
     1           89.07  < 89.1>          .00  <    .0>         .00 <    .0>
     2           10.93  <100.0>          .00  <    .0>         .00 <    .0>
     3             .00  <100.0>        90.23  < 90.2>          .00 <    .0>
     4             .00  <100.0>          .00  < 90.2>        90.22 < 90.2>
     5             .00  <100.0>         9.77  <100.0>          .00 < 90.2>
     6             .00  <100.0>          .00  <100.0>         9.78 <100.0>
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    5
                                               PROGRAM:ETABS/FILE:EXAMPLE.EIG
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STRUCTURAL MODE SHAPES

VALUES ARE AT THE CENTERS OF MASS OF THE
CORRESPONDING LEVELS IN GLOBAL COORDINATES

LEVEL      DIRN      MODE  1      MODE  2      MODE  3      MODE  4      MODE  5
ID           ID

ROOF          X      1.47616       .71013       .00000       .00000       .00000
ROOF          Y       .00000       .00000      1.46227       .00000       .73831
ROOF       ROTZ       .00000       .00000       .00000       .00653       .00000

1ST           X       .71013     -1.47616       .00000       .00000       .00000
1ST           Y       .00000       .00000       .73831       .00000     -1.46227
1ST        ROTZ       .00000       .00000       .00000       .00330       .00000

LEVEL      DIRN      MODE  6
ID           ID

ROOF          X       .00000
ROOF          Y       .00000
ROOF       ROTZ       .00330

1ST           X       .00000
1ST           Y       .00000
1ST        ROTZ      -.00653
```

Sample Output (continued)
File: EXAMPLE.EIG

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    1
                                      PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC LOAD CONDITION LATERAL STORY DISPLACEMENTS

DISPLACEMENTS ARE AT THE CENTERS OF MASS OF THE RESPECTIVE STORY LEVELS

                  /--------------------LOAD CONDITIONS--------------------/
LEVEL     DIRN          I          II          III          A          B

ROOF        X        .0000       .0000       .0000       .0071      .0000
ROOF        Y        .0000       .0000       .0000       .0000      .0018
ROOF     ROTZ        .0000       .0000       .0000       .0000      .0000

1ST         X        .0000       .0000       .0000       .0041      .0000
1ST         Y        .0000       .0000       .0000       .0000      .0011
1ST      ROTZ        .0000       .0000       .0000       .0000      .0000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    2
                                      PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


RESPONSE SPECTRUM LATERAL STORY DISPLACEMENTS

DISPLACEMENTS ARE AT THE CENTERS OF MASS OF THE RESPECTIVE STORY LEVELS

                  /---------LOAD  CONDITIONS---------/
LEVEL     DIRN        DYN-1       DYN-2       DYN-3

ROOF        X        .2604       .0000       .0000
ROOF        Y        .0000       .0112       .0000
ROOF     ROTZ        .0000       .0000       .0000

1ST         X        .1254       .0000       .0000
1ST         Y        .0000       .0057       .0000
1ST      ROTZ        .0000       .0000       .0000
```

Sample Output
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    3
                                                  PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

DYNAMIC STORY INERTIA LOADS/TORSIONS

LOADS ARE AT THE CENTERS OF MASS OF THE RESPECTIVE STORY LEVELS

                      /---------LOAD  CONDITIONS---------/
LEVEL      DIRN            DYN-1         DYN-2         DYN-3

ROOF          X           149.10           .00           .00
ROOF          Y              .00         62.76           .00
ROOF       ROTZ              .00           .00           .00

1ST           X            75.00           .00           .00
1ST           Y              .00         36.77           .00
1ST        ROTZ              .00           .00           .00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    4
                                                  PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

DYNAMIC STORY SHEARS

                      /---------LOAD  CONDITIONS---------/
LEVEL      DIRN            DYN-1         DYN-2         DYN-3

ROOF          X           149.10           .00           .00
ROOF          Y              .00         62.76           .00

1ST           X           220.73           .00           .00
1ST           Y              .00         93.93           .00
```

Sample Output (continued)
File: EXAMPLE.STR

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 5
PROGRAM:ETABS/FILE:EXAMPLE.STR

EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STATIC LOAD CONDITION LATERAL FRAME DISPLACEMENTS

FRAME ID .... /NORTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

		LOAD CONDITIONS				
LEVEL	DIRN	I	II	III	A	B
ROOF	X	.0000	.0000	.0000	.0071	.0000
ROOF	Y	.0000	.0000	.0000	.0000	.0018
ROOF	ROTZ	.0000	.0000	.0000	.0000	.0000
1ST	X	.0000	.0000	.0000	.0041	.0000
1ST	Y	.0000	.0000	.0000	.0000	.0011
1ST	ROTZ	.0000	.0000	.0000	.0000	.0000

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 6
PROGRAM:ETABS/FILE:EXAMPLE.STR

EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

RESPONSE SPECTRUM LATERAL FRAME DISPLACEMENTS

FRAME ID .... /NORTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

		LOAD CONDITIONS		
LEVEL	DIRN	DYN-1	DYN-2	DYN-3
ROOF	X	.2604	.0000	.0000
ROOF	Y	.0000	.0112	.0000
ROOF	ROTZ	.0000	.0000	.0000
1ST	X	.1254	.0000	.0000
1ST	Y	.0000	.0057	.0000
1ST	ROTZ	.0000	.0000	.0000

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     7
                                           PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STATIC LOAD CONDITION LATERAL FRAME DISPLACEMENTS

FRAME ID .... /SOUTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                     /--------------------LOAD CONDITIONS--------------------/
LEVEL     DIRN              I           II          III           A          B

ROOF         X          .0000        .0000        .0000        .0071      .0000
ROOF         Y          .0000        .0000        .0000        .0000      .0018
ROOF      ROTZ          .0000        .0000        .0000        .0000      .0000

1ST          X          .0000        .0000        .0000        .0041      .0000
1ST          Y          .0000        .0000        .0000        .0000      .0011
1ST       ROTZ          .0000        .0000        .0000        .0000      .0000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     8
                                           PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

RESPONSE SPECTRUM LATERAL FRAME DISPLACEMENTS

FRAME ID .... /SOUTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                     /---------LOAD  CONDITIONS---------/
LEVEL     DIRN          DYN-1        DYN-2        DYN-3

ROOF         X          .2604        .0000        .0000
ROOF         Y          .0000        .0112        .0000
ROOF      ROTZ          .0000        .0000        .0000

1ST          X          .1254        .0000        .0000
1ST          Y          .0000        .0057        .0000
1ST       ROTZ          .0000        .0000        .0000
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    9
                                              PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC LOAD CONDITION LATERAL FRAME DISPLACEMENTS

FRAME ID .... /WEST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                /---------------------LOAD CONDITIONS---------------------/
LEVEL    DIRN             I           II          III           A          B

ROOF        X         .0000        .0000        .0000        .0000      .0018
ROOF        Y         .0000        .0000        .0000      -.0071       .0000
ROOF     ROTZ         .0000        .0000        .0000        .0000      .0000

1ST         X         .0000        .0000        .0000        .0000      .0011
1ST         Y         .0000        .0000        .0000      -.0041       .0000
1ST      ROTZ         .0000        .0000        .0000        .0000      .0000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   10
                                              PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


RESPONSE SPECTRUM LATERAL FRAME DISPLACEMENTS

FRAME ID .... /WEST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                /----------LOAD  CONDITIONS----------/
LEVEL    DIRN         DYN-1        DYN-2        DYN-3

ROOF        X         .0000        .0112        .0000
ROOF        Y         .2604        .0000        .0000
ROOF     ROTZ         .0000        .0000        .0000

1ST         X         .0000        .0057        .0000
1ST         Y         .1254        .0000        .0000
1ST      ROTZ         .0000        .0000        .0000
```

Sample Output (continued)
File: EXAMPLE.STR

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 11
PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STATIC LOAD CONDITION LATERAL FRAME DISPLACEMENTS

FRAME ID .... /EAST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

LEVEL	DIRN	LOAD CONDITIONS				
		I	II	III	A	B
ROOF	X	.0000	.0000	.0000	.0000	.0018
ROOF	Y	.0000	.0000	.0000	-.0071	.0000
ROOF	ROTZ	.0000	.0000	.0000	.0000	.0000
1ST	X	.0000	.0000	.0000	.0000	.0011
1ST	Y	.0000	.0000	.0000	-.0041	.0000
1ST	ROTZ	.0000	.0000	.0000	.0000	.0000

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 12
PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

RESPONSE SPECTRUM LATERAL FRAME DISPLACEMENTS

FRAME ID .... /EAST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

LEVEL	DIRN	LOAD CONDITIONS		
		DYN-1	DYN-2	DYN-3
ROOF	X	.0000	.0112	.0000
ROOF	Y	.2604	.0000	.0000
ROOF	ROTZ	.0000	.0000	.0000
1ST	X	.0000	.0057	.0000
1ST	Y	.1254	.0000	.0000
1ST	ROTZ	.0000	.0000	.0000

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   13
                                                PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC LOAD CONDITION LATERAL FRAME DRIFT RATIOS

FRAME ID .... /NORTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                  /---------------------LOAD CONDITIONS---------------------/
LEVEL     DIRN              I           II           III          A          B

ROOF         X         .00000       .00000        .00000     .00002     .00000
ROOF         Y         .00000       .00000        .00000     .00000     .00001
ROOF      ROTZ         .00000       .00000        .00000     .00000     .00000

1ST          X         .00000       .00000        .00000     .00003     .00000
1ST          Y         .00000       .00000        .00000     .00000     .00001
1ST       ROTZ         .00000       .00000        .00000     .00000     .00000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   14
                                                PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


RESPONSE SPECTRUM LATERAL FRAME DRIFT RATIOS

FRAME ID .... /NORTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                  /---------LOAD  CONDITIONS---------/
LEVEL     DIRN          DYN-1        DYN-2        DYN-3

ROOF         X         .00094       .00000       .00000
ROOF         Y         .00000       .00004       .00000
ROOF      ROTZ         .00000       .00000       .00000

1ST          X         .00087       .00000       .00000
1ST          Y         .00000       .00004       .00000
1ST       ROTZ         .00000       .00000       .00000
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   15
                                                PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC LOAD CONDITION LATERAL FRAME DRIFT RATIOS

FRAME ID .... /SOUTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                 /--------------------LOAD CONDITIONS--------------------/
LEVEL     DIRN              I          II         III          A          B

ROOF         X         .00000      .00000      .00000      .00002      .00000
ROOF         Y         .00000      .00000      .00000      .00000      .00001
ROOF      ROTZ         .00000      .00000      .00000      .00000      .00000

1ST          X         .00000      .00000      .00000      .00003      .00000
1ST          Y         .00000      .00000      .00000      .00000      .00001
1ST       ROTZ         .00000      .00000      .00000      .00000      .00000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   16
                                                PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


RESPONSE SPECTRUM LATERAL FRAME DRIFT RATIOS

FRAME ID .... /SOUTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                 /---------LOAD  CONDITIONS---------/
LEVEL     DIRN          DYN-1       DYN-2       DYN-3

ROOF         X         .00094      .00000      .00000
ROOF         Y         .00000      .00004      .00000
ROOF      ROTZ         .00000      .00000      .00000

1ST          X         .00087      .00000      .00000
1ST          Y         .00000      .00004      .00000
1ST       ROTZ         .00000      .00000      .00000
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   17
                                                PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS
```

STATIC LOAD CONDITION LATERAL FRAME DRIFT RATIOS

FRAME ID .... /WEST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

LEVEL	DIRN	LOAD CONDITIONS I	II	III	A	B
ROOF	X	.00000	.00000	.00000	.00000	.00001
ROOF	Y	.00000	.00000	.00000	-.00002	.00000
ROOF	ROTZ	.00000	.00000	.00000	.00000	.00000
1ST	X	.00000	.00000	.00000	.00000	.00001
1ST	Y	.00000	.00000	.00000	-.00003	.00000
1ST	ROTZ	.00000	.00000	.00000	.00000	.00000

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   18
                                                PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS
```

RESPONSE SPECTRUM LATERAL FRAME DRIFT RATIOS

FRAME ID .... /WEST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

LEVEL	DIRN	LOAD CONDITIONS DYN-1	DYN-2	DYN-3
ROOF	X	.00000	.00004	.00000
ROOF	Y	.00094	.00000	.00000
ROOF	ROTZ	.00000	.00000	.00000
1ST	X	.00000	.00004	.00000
1ST	Y	.00087	.00000	.00000
1ST	ROTZ	.00000	.00000	.00000

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   19
                                          PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC LOAD CONDITION LATERAL FRAME DRIFT RATIOS

FRAME ID .... /EAST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                 /--------------------LOAD CONDITIONS--------------------/
LEVEL    DIRN              I          II          III          A          B

ROOF        X         .00000      .00000      .00000      .00000     .00001
ROOF        Y         .00000      .00000      .00000     -.00002     .00000
ROOF     ROTZ         .00000      .00000      .00000      .00000     .00000

1ST         X         .00000      .00000      .00000      .00000     .00001
1ST         Y         .00000      .00000      .00000     -.00003     .00000
1ST      ROTZ         .00000      .00000      .00000      .00000     .00000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   20
                                          PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


RESPONSE SPECTRUM LATERAL FRAME DRIFT RATIOS

FRAME ID .... /EAST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                 /---------LOAD  CONDITIONS---------/
LEVEL    DIRN          DYN-1       DYN-2       DYN-3

ROOF        X         .00000      .00004      .00000
ROOF        Y         .00094      .00000      .00000
ROOF     ROTZ         .00000      .00000      .00000

1ST         X         .00000      .00004      .00000
1ST         Y         .00087      .00000      .00000
1ST      ROTZ         .00000      .00000      .00000
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    21
                                              PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


STATIC LOAD CONDITION LATERAL FRAME STORY SHEARS & TORSIONS

FRAME ID .... /NORTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                 /--------------------LOAD CONDITIONS--------------------/
LEVEL     DIRN              I          II          III          A          B

ROOF         X            .00         .00          .00       1.37        .00
ROOF         Y            .00         .00          .00        .00        .00
ROOF      ROTZ            .00         .00          .00        .00        .00

1ST          X            .00         .00          .00       3.92        .00
1ST          Y            .00         .00          .00        .00        .00
1ST       ROTZ            .00         .00          .00        .00        .00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    22
                                              PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


RESPONSE SPECTRUM LATERAL FRAME STORY SHEARS

FRAME ID .... /NORTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                 /---------LOAD  CONDITIONS---------/
LEVEL     DIRN          DYN-1       DYN-2       DYN-3

ROOF         X          74.55         .00         .00
ROOF         Y            .00         .00         .00
ROOF      ROTZ            .00         .00         .00

1ST          X         110.37         .00         .00
1ST          Y            .00         .00         .00
1ST       ROTZ            .00         .00         .00
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   23
                                           PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STATIC LOAD CONDITION LATERAL FRAME STORY SHEARS & TORSIONS

FRAME ID .... /SOUTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                  /--------------------LOAD CONDITIONS--------------------/
LEVEL    DIRN            I           II           III          A          B

ROOF        X          .00          .00          .00        1.37        .00
ROOF        Y          .00          .00          .00         .00        .00
ROOF     ROTZ          .00          .00          .00         .00        .00

1ST         X          .00          .00          .00        3.92        .00
1ST         Y          .00          .00          .00         .00        .00
1ST      ROTZ          .00          .00          .00         .00        .00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   24
                                           PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

RESPONSE SPECTRUM LATERAL FRAME STORY SHEARS

FRAME ID .... /SOUTH STEEL BRACED FRAME

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                  /---------LOAD CONDITIONS---------/
LEVEL    DIRN        DYN-1       DYN-2       DYN-3

ROOF        X        74.55         .00         .00
ROOF        Y          .00         .00         .00
ROOF     ROTZ          .00         .00         .00

1ST         X       110.37         .00         .00
1ST         Y          .00         .00         .00
1ST      ROTZ          .00         .00         .00
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    25
                                                  PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

STATIC LOAD CONDITION LATERAL FRAME STORY SHEARS & TORSIONS

FRAME ID .... /WEST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                  /--------------------LOAD CONDITIONS--------------------/
LEVEL      DIRN            I           II          III           A          B

ROOF          X          .00          .00          .00         .00       3.42
ROOF          Y          .00          .00          .00         .00        .00
ROOF       ROTZ          .00          .00          .00         .00        .00

1ST           X          .00          .00          .00         .00       9.81
1ST           Y          .00          .00          .00         .00        .00
1ST        ROTZ          .00          .00          .00         .00        .00


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    26
                                                  PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

RESPONSE SPECTRUM LATERAL FRAME STORY SHEARS

FRAME ID .... /WEST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

                  /---------LOAD  CONDITIONS---------/
LEVEL      DIRN        DYN-1        DYN-2        DYN-3

ROOF          X          .00        31.38          .00
ROOF          Y          .00          .00          .00
ROOF       ROTZ          .00          .00          .00

1ST           X          .00        46.97          .00
1ST           Y          .00          .00          .00
1ST        ROTZ          .00          .00          .00
```

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   27
                                              PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS
```

STATIC LOAD CONDITION LATERAL FRAME STORY SHEARS & TORSIONS

FRAME ID .... /EAST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

LEVEL	DIRN	LOAD CONDITIONS I	II	III	A	B
ROOF	X	.00	.00	.00	.00	3.42
ROOF	Y	.00	.00	.00	.00	.00
ROOF	ROTZ	.00	.00	.00	.00	.00
1ST	X	.00	.00	.00	.00	9.81
1ST	Y	.00	.00	.00	.00	.00
1ST	ROTZ	.00	.00	.00	.00	.00

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   28
                                              PROGRAM:ETABS/FILE:EXAMPLE.STR
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS
```

RESPONSE SPECTRUM LATERAL FRAME STORY SHEARS

FRAME ID .... /EAST SHEAR-WALL

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

LEVEL	DIRN	LOAD CONDITIONS DYN-1	DYN-2	DYN-3
ROOF	X	.00	31.38	.00
ROOF	Y	.00	.00	.00
ROOF	ROTZ	.00	.00	.00
1ST	X	.00	46.97	.00
1ST	Y	.00	.00	.00
1ST	ROTZ	.00	.00	.00

Sample Output (continued)
File: EXAMPLE.STR

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     1
                                          PROGRAM:ETABS/FILE:EXAMPLE.DSP
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME LATERAL STORY DISPLACEMENTS

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

FRAME ID  .... /NORTH STEEL BRACED FRAME

LEVEL      DIRN       CASE 1      CASE 2
ID           ID
ROOF          X       .00000      .26043
ROOF          Y       .00185      .00000
ROOF       ROTZ       .00000      .00000

1ST           X       .00000      .12538
1ST           Y       .00108      .00000
1ST        ROTZ       .00000      .00000
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     2
                                          PROGRAM:ETABS/FILE:EXAMPLE.DSP
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME REACTION FORCES AT BASELINE (AT EACH COLUMN LINE)

VALUES ARE IN THE LOCAL COORDINATE SYSTEM OF THE FRAME

FRAME ID .... /NORTH STEEL BRACED FRAME

 COL OUTPUT     FORCE     FORCE     FORCE    MOMENT    MOMENT    MOMENT
  ID     ID   ALONG-X   ALONG-Y   ALONG-Z  ABOUT-XX  ABOUT-YY  ABOUT-ZZ
   1 CASE 1     21.41       .00    113.84       .00       .00       .00
   1 CASE 2     76.65       .00    206.14       .00       .00       .00

   2 CASE 1       .00       .00     63.75       .00       .00       .00
   2 CASE 2       .08       .00    156.04       .00       .00       .00

   3 CASE 1       .00       .00     63.75       .00       .00       .00
   3 CASE 2       .08       .00    156.04       .00       .00       .00

   4 CASE 1    -21.41       .00    113.84       .00       .00       .00
   4 CASE 2     33.83       .00    206.14       .00       .00       .00
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     3
                                          PROGRAM:ETABS/FILE:EXAMPLE.DSP
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


SUMMATION OF FRAME REACTION FORCES AT BASELINE

VALUES ARE IN THE LOCAL COORDINATE SYSTEM OF THE FRAME

FRAME ID .... /NORTH STEEL BRACED FRAME

      OUTPUT     FORCE     FORCE     FORCE
          ID   ALONG-X   ALONG-Y   ALONG-Z
      CASE 1       .00       .00    355.18
      CASE 2    110.37       .00    355.18
```

Sample Output
File: EXAMPLE.DSP

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     4
                                              PROGRAM:ETABS/FILE:EXAMPLE.DSP
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME LATERAL STORY DISPLACEMENTS

VALUES ARE AT THE FRAME ORIGIN IN THE FRAME LOCAL COORDINATES

FRAME ID  .... /EAST SHEAR-WALL

LEVEL      DIRN      CASE 1       CASE 2
ID           ID
ROOF          X      .00185       .00000
ROOF          Y      .00000       .26043
ROOF       ROTZ      .00000       .00000

1ST           X      .00108       .00000
1ST           Y      .00000       .12538
1ST        ROTZ      .00000       .00000



CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     5
                                              PROGRAM:ETABS/FILE:EXAMPLE.DSP
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


FRAME REACTION FORCES AT BASELINE (AT EACH COLUMN LINE)

VALUES ARE IN THE LOCAL COORDINATE SYSTEM OF THE FRAME

FRAME ID .... /EAST SHEAR-WALL

 COL OUTPUT     FORCE     FORCE     FORCE    MOMENT    MOMENT   MOMENT
  ID     ID   ALONG-X   ALONG-Y   ALONG-Z  ABOUT-XX  ABOUT-YY ABOUT-ZZ
   1 CASE 1      6.38       .00     26.38       .00       .00      .00
   1 CASE 2      9.68       .00     33.49       .00       .00      .00

   2 CASE 1    -12.33       .00     35.99       .00       .00      .00
   2 CASE 2    -10.72       .00     34.51       .00       .00      .00

   3 CASE 1      9.11       .00     33.02       .00       .00      .00
   3 CASE 2     10.72       .00     34.51       .00       .00      .00

   4 CASE 1    -12.97       .00     40.61       .00       .00      .00
   4 CASE 2     -9.68       .00     33.49       .00       .00      .00



CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     6
                                              PROGRAM:ETABS/FILE:EXAMPLE.DSP
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING     UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


SUMMATION OF FRAME REACTION FORCES AT BASELINE

VALUES ARE IN THE LOCAL COORDINATE SYSTEM OF THE FRAME

FRAME ID .... /EAST SHEAR-WALL

     OUTPUT     FORCE     FORCE     FORCE
         ID   ALONG-X   ALONG-Y   ALONG-Z
     CASE 1     -9.81       .00    136.00
     CASE 2       .00       .00    136.00
```

Sample Output (continued)
File: EXAMPLE.DSP

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 1
PROGRAM:ETABS/FILE:EXAMPLE.FRM

EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

COLUMN FORCES AT LEVEL ROOF IN FRAME /NORTH STEEL BRACED FRAME

COL ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	TOP	.00	.00	.00	.00	-44.22	.00
		BOTTOM	.00		-.02			
1	CASE 2	TOP	1.45	.08	.00	.00	-44.22	.00
		BOTTOM	11.81		.00			
2	CASE 1	TOP	.00	.00	.00	.00	-40.58	.00
		BOTTOM	.00		-.02			
2	CASE 2	TOP	1.45	.08	.00	.00	-3.43	.00
		BOTTOM	11.81		.00			
3	CASE 1	TOP	.00	.00	.00	.00	-40.58	.00
		BOTTOM	.00		-.02			
3	CASE 2	TOP	1.45	.08	.00	.00	-3.43	.00
		BOTTOM	11.81		.00			
4	CASE 1	TOP	.00	.00	.00	.00	-44.22	.00
		BOTTOM	.00		-.02			
4	CASE 2	TOP	1.45	.08	.00	.00	-44.22	.00
		BOTTOM	11.81		.00			

BEAM FORCES AT LEVEL ROOF IN FRAME /NORTH STEEL BRACED FRAME

BAY ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			
1	CASE 2	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			
2	CASE 1	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			
2	CASE 2	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			

Sample Output
File: EXAMPLE.FRM

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE     2
                                                   PROGRAM:ETABS/FILE:EXAMPLE.FRM
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS


BEAM FORCES AT LEVEL ROOF      IN FRAME /NORTH STEEL BRACED FRAME

 BAY OUTPUT OUTPUT       MAJOR       MAJOR       MINOR       MINOR     AXIAL TORSIONAL
  ID     ID  POINT      MOMENT       SHEAR      MOMENT       SHEAR     FORCE    MOMENT
   3 CASE 1  END-I         .00      -21.81         .00         .00       .00       .00
            1/4-PT      588.88      -10.91         .00
            1/2-PT      785.17         .00         .00
            3/4-PT      588.88       10.91         .00
             END-J         .00       21.81         .00
   3 CASE 2  END-I         .00      -21.81         .00         .00       .00       .00
            1/4-PT      588.88      -10.91         .00
            1/2-PT      785.17         .00         .00
            3/4-PT      588.88       10.91         .00
             END-J         .00       21.81         .00


BRACE FORCES AT LEVEL ROOF      IN FRAME /NORTH STEEL BRACED FRAME

 BRC OUTPUT OUTPUT       MAJOR       MAJOR       MINOR       MINOR     AXIAL TORSIONAL
  ID     ID  POINT      MOMENT       SHEAR      MOMENT       SHEAR     FORCE    MOMENT
   1 CASE 1    TOP         .00         .00         .00         .00     -5.65       .00
            BOTTOM         .00                     .00
   1 CASE 2    TOP         .00         .00         .00         .00     46.89       .00
            BOTTOM         .00                     .00

   3 CASE 1    TOP         .00         .00         .00         .00     -5.65       .00
            BOTTOM         .00                     .00
   3 CASE 2    TOP         .00         .00         .00         .00     46.89       .00
            BOTTOM         .00                     .00
```

Sample Output (continued)
File: EXAMPLE.FRM

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 3
PROGRAM:ETABS/FILE:EXAMPLE.FRM

EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

COLUMN FORCES AT LEVEL 1ST IN FRAME /NORTH STEEL BRACED FRAME

COL ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	TOP	.00	.00	-.02	.00	-92.43	.00
		BOTTOM	.00		.00			
1	CASE 2	TOP	10.36	.08	.00	.00	-55.28	.00
		BOTTOM	.00		.00			
2	CASE 1	TOP	.00	.00	-.02	.00	-63.75	.00
		BOTTOM	.00		.00			
2	CASE 2	TOP	10.36	.08	.00	.00	28.54	.00
		BOTTOM	.00		.00			
3	CASE 1	TOP	.00	.00	-.02	.00	-63.75	.00
		BOTTOM	.00		.00			
3	CASE 2	TOP	10.36	.08	.00	.00	28.54	.00
		BOTTOM	.00		.00			
4	CASE 1	TOP	.00	.00	-.02	.00	-92.43	.00
		BOTTOM	.00		.00			
4	CASE 2	TOP	10.36	.08	.00	.00	-55.28	.00
		BOTTOM	.00		.00			

BEAM FORCES AT LEVEL 1ST IN FRAME /NORTH STEEL BRACED FRAME

BAY ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			
1	CASE 2	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			
2	CASE 1	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			
2	CASE 2	END-I	.00	-21.81	.00	.00	.00	.00
		1/4-PT	588.88	-10.91	.00			
		1/2-PT	785.17	.00	.00			
		3/4-PT	588.88	10.91	.00			
		END-J	.00	21.81	.00			

Sample Output (continued)
File: EXAMPLE.FRM

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    4
                                                  PROGRAM:ETABS/FILE:EXAMPLE.FRM
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING    UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

BEAM FORCES AT LEVEL 1ST      IN FRAME /NORTH STEEL BRACED FRAME

 BAY OUTPUT OUTPUT      MAJOR      MAJOR      MINOR      MINOR     AXIAL TORSIONAL
  ID     ID  POINT     MOMENT      SHEAR     MOMENT      SHEAR     FORCE    MOMENT
   3 CASE 1  END-I        .00     -21.81        .00        .00       .00       .00
            1/4-PT     588.88     -10.91        .00
            1/2-PT     785.17        .00        .00
            3/4-PT     588.88      10.91        .00
             END-J        .00      21.81        .00
   3 CASE 2  END-I        .00     -21.81        .00        .00       .00       .00
            1/4-PT     588.88     -10.91        .00
            1/2-PT     785.17        .00        .00
            3/4-PT     588.88      10.91        .00
             END-J        .00      21.81        .00


BRACE FORCES AT LEVEL 1ST      IN FRAME /NORTH STEEL BRACED FRAME

 BRC OUTPUT OUTPUT      MAJOR      MAJOR      MINOR      MINOR     AXIAL TORSIONAL
  ID     ID  POINT     MOMENT      SHEAR     MOMENT      SHEAR     FORCE    MOMENT
   2 CASE 1    TOP        .00        .00        .00        .00    -30.28       .00
            BOTTOM        .00                   .00
   2 CASE 2    TOP        .00        .00        .00        .00     47.91       .00
            BOTTOM        .00                   .00

   4 CASE 1    TOP        .00        .00        .00        .00    -30.28       .00
            BOTTOM        .00                   .00
   4 CASE 2    TOP        .00        .00        .00        .00     47.91       .00
            BOTTOM        .00                   .00
```

Sample Output (continued)
File: EXAMPLE.FRM

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 5
PROGRAM:ETABS/FILE:EXAMPLE.FRM
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

BEAM FORCES AT LEVEL ROOF IN FRAME /EAST SHEAR-WALL

BAY ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	END-I	.00	.00	.00	.00	.00	.00
		1/4-PT	.00	.00	.00			
		1/2-PT	.00	.00	.00			
		3/4-PT	.00	.00	.00			
		END-J	.00	.00	.00			
1	CASE 2	END-I	.00	.00	.00	.00	.00	.00
		1/4-PT	.00	.00	.00			
		1/2-PT	.00	.00	.00			
		3/4-PT	.00	.00	.00			
		END-J	.00	.00	.00			

WALL FORCES AT LEVEL ROOF IN FRAME /EAST SHEAR-WALL

WALL ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	TOP	.00	3.42	.00	.00	-72.80	.00
		BOTTOM	492.68		.00			
1	CASE 2	TOP	.00	.00	.00	.00	-72.80	.00
		BOTTOM	.00		.00			

Sample Output (continued)
File: EXAMPLE.FRM

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS PAGE 6
PROGRAM:ETABS/FILE:EXAMPLE.FRM
EXAMPLE FOR ETABS MANUAL - TWO-STORY BUILDING UNITS:KIP-INCH-SEC
GRAVITY, UBC91 WIND AND DYNAMIC SEISMIC RESPONSE SPECTRUM ANALYSIS

BEAM FORCES AT LEVEL 1ST IN FRAME /EAST SHEAR-WALL

BAY ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	END-I	.00	.00	.00	.00	.00	.00
		1/4-PT	.00	.00	.00			
		1/2-PT	.00	.00	.00			
		3/4-PT	.00	.00	.00			
		END-J	.00	.00	.00			
1	CASE 2	END-I	.00	.00	.00	.00	.00	.00
		1/4-PT	.00	.00	.00			
		1/2-PT	.00	.00	.00			
		3/4-PT	.00	.00	.00			
		END-J	.00	.00	.00			

WALL FORCES AT LEVEL 1ST IN FRAME /EAST SHEAR-WALL

WALL ID	OUTPUT ID	OUTPUT POINT	MAJOR MOMENT	MAJOR SHEAR	MINOR MOMENT	MINOR SHEAR	AXIAL FORCE	TORSIONAL MOMENT
1	CASE 1	TOP	-395.66	5.95	.00	.00	-62.38	.00
		BOTTOM	461.25		.00			
1	CASE 2	TOP	-102.12	1.05	.00	.00	-68.00	.00
		BOTTOM	48.55		.00			
2	CASE 1	TOP	-191.42	3.86	.00	.00	-73.62	.00
		BOTTOM	364.15		.00			
2	CASE 2	TOP	102.12	-1.05	.00	.00	-68.00	.00
		BOTTOM	-48.55		.00			

Sample Output (continued)
File: EXAMPLE.FRM

Appendix B

AUTOMATED CODE LATERAL LOADS

This appendix describes the input data for defining the static lateral loads based on the codes automated in ETABS except the UBC91 wind and seismic loads. The UBC91 wind and seismic load inputs are described in Chapter V, Section D. 8(ii) and D. 8(iii) of the manual. The input described here for the other codes replaces the corresponding input described in Chapter V, Section 8 of the manual. The lateral loads defined by this input data are applied to the building story levels for lateral load conditions A and B.

If **NLAT** is 0, no static lateral loads are applied to the structure. Therefore skip this data section completely. If **NLAT** is between 1 and 11, prepare data for one of the following data sections, (i) through (viii), as described below in this appendix or data sections V-D.8(i) through 8(iii) described earlier in the manual.

B(i). SEISMIC LATERAL LOADS AS DEFINED BY THE UNIFORM BUILDING CODE, 1985

Skip this section of data if **NLAT** is not 2. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have UBC85 seismic lateral loads in the global X-direction and load condition B will have UBC85 seismic lateral loads in the global Y-direction.

The building story heights and story mass defined in the story data (Section V-D.3 of the manual) or as calculated by the program (Section V-D.2) and the gravitational acceleration (Section V-D.1) are used to generate these loads.

a. UBC 1985 Seismic Coefficients

Prepare one line of data in the following form to define the UBC site-dependent coefficients:

Z TS I

b. Triangular Lateral Load Distribution Data

Provide two lines of data, one corresponding to each of the two global directions, to define the structural time periods, the UBC structural type factors and the extent of the lateral load distributions over the height of the building.

Prepare the data in the following form:

TX KX STOPX SBOTX
TY KY STOPY SBOTY

B(i). UBC 85 SEISMIC LOADS (continued)

c. Story Eccentricities and Extra Loading

This data defines the eccentricities of the UBC85 generated story loads on any particular story with respect to the center of mass of that story. This data also gives the user the option of applying extra loads to a particular story level if needed. If the eccentricities are zero, the loads are applied at the center of mass.

Prepare one line of data to define the eccentricities and extra loading corresponding to each story of the building.

The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building. The data amounts to a total of NST data lines in the following form:

EYA EXB DFXA DFYB

B(i). UBC 85 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

UBC 1985 Seismic Coefficients

Variable	Field	Note	Entry
Z	1	(1)	UBC zone factor, Z.
TS	2	(2)	Predominant time period of soil.
I	3	(3)	UBC importance factor, I.

Triangular Lateral Load Distribution Data

Data associated with X-direction loads or load condition A. Y-direction loads in load condition A are set to 0.

Variable	Field	Note	Entry
TX	1	(4)	Time period of the structural mode predominant in the X-direction.
KX	2	(5)	UBC structure type factor K, for X-direction.

B(i). UBC 85 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Triangular Lateral Load Distribution Data (continued)

Variable	Field	Note	Entry
STOPX	3	(6)	Story identification for the level defining the top of the triangular distribution for X-direction loads.
SBOTX	4	(6)	Story identification for the level defining the bottom of the triangular distribution for X-direction loads.

Data associated with Y-direction loads or load condition B. X-direction loads in load condition B are set to 0.

Variable	Field	Note	Entry
TY	1	(4)	Time period of the structural mode predominant in the Y-direction.
KY	2	(5)	UBC structure type factor K, for Y-direction.
STOPY	3	(6)	Story identification for the level defining the top of the triangular distribution for Y-direction loads.
SBOTY	4	(6)	Story identification for the level defining the bottom of the triangular distribution for the Y-direction loads.

B(i). UBC 85 SEISMIC LOADS (continued)

Variable	Field	Note	Entry
Additional Story Eccentricities and Loading			
EYA	1	(7)	Additional eccentricity for X-direction loads (load condition A).
EXB	2	(7)	Additional eccentricity for Y-direction loads (load condition B).
DFXA	3	(8)	Additional load in the X-direction (load condition A).
DFYB	4	(8)	Additional load in the Y-direction (load condition B).

B(i) - NOTES:

1. Details of the seismic load calculation method and the definitions of the various UBC factors are presented in Chapter 23 of the 1985 edition of Reference [14]. If **Z** is entered as 0, Z is set to 1.

2. **TS** is required for calculating the UBC soil factor, S. If **TS** is entered as 0, S is assumed to be 1.5.

3. If **I** is entered as 0, **I** is assumed to be 1.0.

4. **TX** must be provided if the time periods of the structure are not being calculated by the program (i.e. **NDYN** is 0). If **TX** is set to 0 and **NDYN** is not 0, the program will set **TX** equal to the period of the calculated mode having the largest participation factor in the X-direction.

   Similarly, **TY** corresponds to the Y-direction.

   Positive nonzero user input values for **TX** and **TY** will always supersede any values generated by the program.

5. If **KX** is entered as 0, **KX** is assumed to be 0.67. The same is true for **KY**.

6. It is possible for a structural model to have levels for penthouses, basements or dummy stories for special modeling. The engineer may not want to include such levels in the overall structural triangular lateral force distribution as defined by the UBC. See Figure V-23.

   If there are any levels above **STOPX**, they do not receive any loading from the triangular distribution.

B(i) - NOTES: (continued)

The triangular distribution will not generate any loads for any level below and including level **SBOTX**.

If **SBOTX** is left blank, **SBOTX** is assumed to be the structural baseline.

If **STOPX** and **SBOTX** are both left blank, **STOPX** is assumed to be the top level of the structure and **SBOTX** is assumed to be the structural baseline.

All the above is true for **STOPY** and **SBOTY** as it corresponds to the Y-direction.

7. If the additional eccentricity values are entered as 0, the generated story loads will be applied at the centers of mass of the respective levels. The additional eccentricity values are for moving the point of application of the applied loads at each level, if desired. See Figure V-24.

8. Entries for **DFXA** and **DFYB** are usually 0 for levels which receive loading from the UBC triangular distribution. These entries are basically used for applying loads to the levels that do not receive any loading from the UBC triangular distribution. See Note 6 above. These forces are applied with the corresponding eccentricities **EYA** and **EXB**. If **DFXA** and **DFYB** have nonzero values for levels that receive loading from the UBC triangular distribution, **DFXA** will be added to the X-direction loads and **DFYB** will be added to the Y-direction loads generated by the UBC option in the corresponding load conditions A and B, respectively. See Figure V-24 for the positive directions of the eccentricities and forces.

B(ii). SEISMIC LATERAL LOADS AS DEFINED BY THE APPLIED TECHNOLOGY COUNCIL

Skip this section of data if **NLAT** is not 3. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have ATC Seismic lateral loads in the global X-direction and load condition B will have ATC Seismic lateral loads in the global Y-direction.

The building story heights and story masses defined in the story data (Section V-5.3 of the manual) or as calculated by the program (Section V-5.2) and the gravitational acceleration (Section V-5.1) are used to generate these loads.

a. ATC Seismic Coefficients

Prepare one line of data in the following form to define the ATC site-dependent coefficients:

AV S R

b. Linear/Parabolic Lateral Load Distribution Data

Provide two lines of data, one corresponding to each of the two global directions, to define the structural time period maxima and the extent of the lateral load distributions over the height of the building.

Prepare the data in the following form:

TX TAX STOPX SBOTX
TY TAY STOPY SBOTY

B(ii). ATC 3-06 SEISMIC LOADS (continued)

c. Additional Story Eccentricities and Loading

This data defines the eccentricities of the ATC generated story loads on any particular story with respect to the center of mass of that story. This data also gives the user the option of applying extra loads to a particular story level if needed. If the eccentricities are zero, the loads are applied at the center of mass.

Prepare one line of data to define the eccentricities and extra loading corresponding to each story of the building.

The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building. The data amounts to a total of **NST** data lines in the following form:

EYA EXB DFXA DFYB

B(ii). ATC 3-06 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

ATC 3-06 Seismic Coefficients

Variable	Field	Note	Entry
AV	1	(1)	The ATC coefficient, Av, representing the effective peak velocity related acceleration.
S	2		The ATC coefficient, S, for soil profile characteristics of the site.
R	3		The ATC response spectrum modification factor, R.

Linear/Parabolic Load Distribution Data

Data associated with X-direction loads or load condition A. Y-direction loads in load condition A are set to 0.

Variable	Field	Note	Entry
TX	1	(2)	Time period of the structural mode predominant in the X-direction
TAX	2	(2)	The ATC time period T_a associated with the X-direction.

B(ii). ATC 3-06 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Linear/Parabolic Load Distribution Data (continued)

Variable	Field	Note	Entry
STOPX	3	(3)	Story identification for the level defining the top of the linear/parabolic distribution for X-direction loads.
SBOTX	4	(3)	Story identification for the level defining the bottom of the linear/parabolic distribution for X-direction loads.

Data associated with Y-direction loads or load condition B. X-direction loads in load condition B are set to 0.

Variable	Field	Note	Entry
TY	1	(2)	Time period of the structural mode predominant in the Y-direction.
TAY	2	(2)	The ATC time period T_a associated with the Y-direction.
STOPY	3	(3)	Story identification for the level defining the top of the linear/parabolic distribution for Y-direction loads.
SBOTY	4	(3)	Story identification for the level defining the bottom of the linear/parabolic distribution for Y-direction loads.

B(ii). ATC 3-06 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Additional Story Eccentricities and Loading

Variable	Field	Note	Entry
EYA	1	(4)	Additional eccentricity for X-direction loads (load condition A).
EXB	2	(4)	Additional eccentricity for Y-direction loads (load condition B).
DFXA	3	(5)	Additional load in the X-direction (load condition A).
DFYB	4	(5)	Additional load in the Y-direction (load condition B).

B(ii) - NOTES:

1. Details associated with the seismic load calculation methodology and the definitions of the various ATC coefficients and factors are given in Chapter 4 of ATC provisions in Reference [19].

2. For each of the global X- and Y-directions, the program needs to calculate the ATC coefficient C_S.

   Consider the X-direction

$$C_s = \frac{1.2\ AV\ S}{R\ TX^{2/3}}$$

   The value of **TX** must be defined. Therefore, if the time periods of the structure are not being calculated by the program (i.e. **NDYN** is 0), **TX** must be provided by the user. If **TX** is set to 0 and **NDYN** is not 0, the program will set **TX** equal to the period of the calculated mode having the largest participation factor in the X-direction. Positive nonzero user input values for **TX** and **TY** will always supersede any values generated by the program.

   If **TX** is greater than 1.2 times **TAX**, **TX** is set equal to 1.2 times **TAX**.

   The same is true for **TY** and **TAY** as they correspond to the Y-direction.

   For calculating the upper limits for C_S the program uses **AV** also as the effective peak acceleration of A_a.

B(ii) - NOTES: (continued)

3. It is possible for a structural model to have levels for penthouses, basements or dummy stories for special modeling. The engineer may not want to include such levels in the overall structural linear/parabolic lateral force distribution as defined by the ATC. See Figure B-1.

   If there are any levels above **STOPX**, they do not receive any loading from the linear/parabolic distribution.

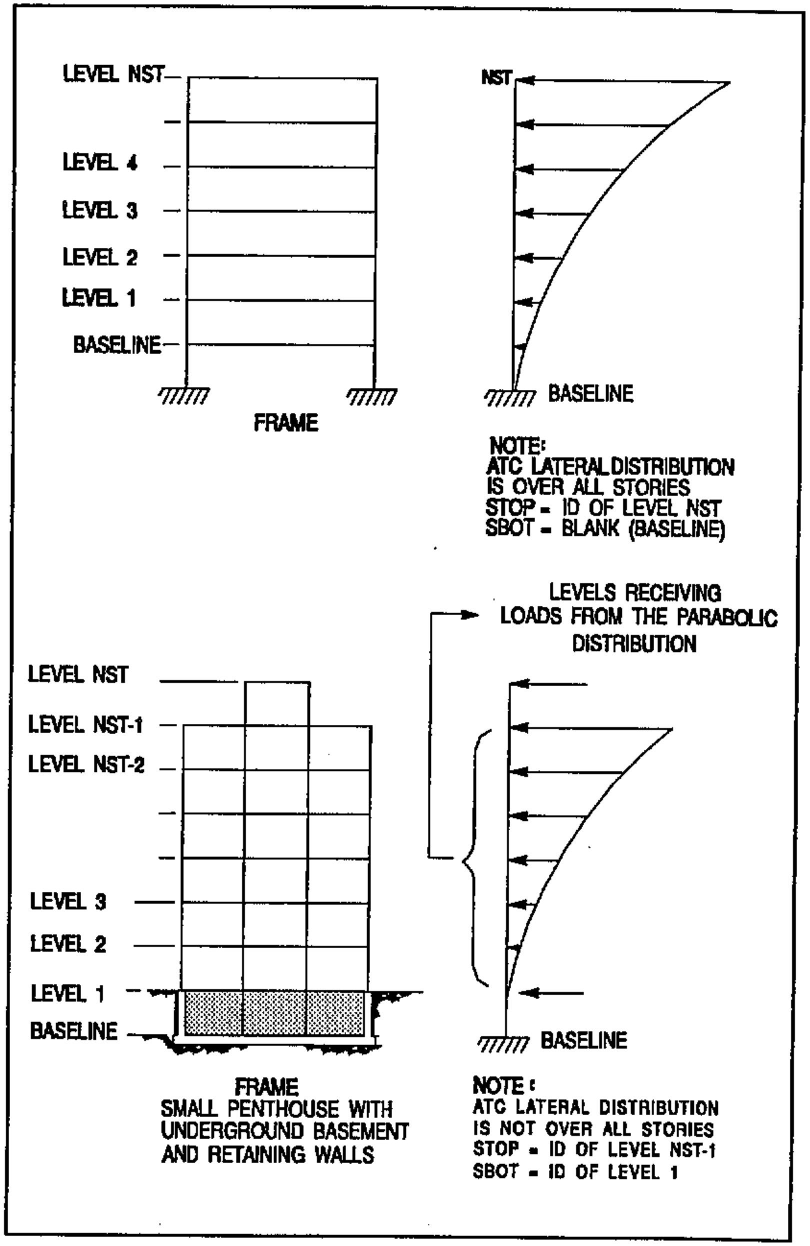
   The linear/parabolic distribution will not generate any loads for any level below and including level **SBOTX**.

   If **SBOTX** is left blank, **SBOTX** is assumed to be the structural baseline.

   If **STOPX** and **SBOTX** are both left blank, **STOPX** is assumed to be the top level of the structure and **SBOTX** is assumed to be the structural baseline.

   All the above is true for **STOPY** and **SBOTY** as it corresponds to the Y-direction.

4. If the additional eccentricity values are entered as 0, the generated story loads will be applied at the centers of mass of the respective levels. The additional eccentricity values are for moving the point of application of the applied loads at each level, if desired. The eccentricity can be positive or negative. See Figure V-24.



ATC Seismic Lateral Load Distribution
Figure B-1

B(ii) - NOTES: (continued)

5. Entries for **DFXA** and **DFYB** are usually 0 for levels which receive loading from the ATC linear/parabolic distribution. These entries are basically used for applying loads to the levels that do not receive any loading from the ATC distribution. See Note 3 above. These forces are applied with the corresponding eccentricities **EYA** and **EXB**. If **DFXA** and **DFYB** have nonzero values for levels that receive loading from the ATC distribution, **DFXA** will be added to the X-direction loads and **DFYB** will be added to the Y-direction loads generated by the ATC option in the corresponding load conditions A and B, respectively. See Figure V-24 for the positive directions of the eccentricities and forces.

B(iii). WIND LATERAL LOADS AS DEFINED BY THE UNIFORM BUILDING CODE, 1979

Skip this section of data if **NLAT** is not 4. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have UBC wind loads in the global X-direction and load condition B will have UBC wind loads in the global Y-direction.

The building story heights defined in the story data (Section V-D.3 of the manual) are used to generate these loads.

a. Wind Pressure Map Area Identification Number

Prepare one line of data in the following form to define the UBC wind pressure map area identification number:

MAREA CFH CFP

b. Wind Load Exposure

Provide two lines of data, one corresponding to each of the two global directions, to define the extent of the structural height that is exposed to the wind. Prepare the data in the following form:

SBOTX
SBOTY

B(iii). UBC 79 WIND LOADS (continued)

c. Story Wind Exposure Widths and Corresponding Centers of Pressure

This data defines the dimensions of the exposed faces, normal to the global X- and Y-directions, and locates the corresponding centers of pressure to determine the magnitude of the wind loads and their corresponding points of application for each story.

Provide one line of data corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building.

The data amounts to a total of **NST** data lines in the following form:

BYA DYA DFXA BXB DXB DFYB

B(iii). UBC 79 WIND LOADS (continued)

Variable	Field	Note	Entry
Wind Pressure Map Area			
MAREA	1	(1)	The UBC wind pressure map area identification number.
CFH	2	(2)	Conversion factor for height.
CFP	3	(2)	Conversion factor for pressure.
Wind Load Exposure - X-Direction			
SBOTX	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for X-direction wind loads.
Wind Load Exposure - Y-Direction			
SBOTY	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for Y-direction wind loads.

B(iii). UBC 79 WIND LOADS (continued)

Variable	Field	Note	Entry
Story Wind Exposure			
BYA	1	(4)	Projected length of the floor level for X-direction loads (projection is on the Y-axis).
DYA	2	(4)	Y-ordinate of the center of the projected length **BYA**
DFXA	3	(5)	Additional load in the X-direction (load condition A).
BXB	4		Projected length of the floor level for Y-direction loads (projection is on the X-axis).
DXB	5		X-ordinate of the center of the projected length **BXB.**
DFYB	6		Additional load in the Y-direction (load condition B).

B(iii) - NOTES:

1. The valid UBC wind pressure map area identification number entries as defined in Chapter 23, Table 23F, of the 1979 edition of Reference [14] are:

   20 25 30 35 40 45 50

2. The wind distribution heights and associated wind pressures as specified in the UBC are in feet and pounds per square foot units, respectively.

   CFH is the multiplication factor that will convert the user-input story height to feet units.

   CFP is the conversion factor that will convert pounds per square foot to the consistent units being used in the preparation of this input. See Figure V-20 for examples.

3. The part of the structure below the level line associated with the story identification **SBOTX** will receive no wind exposure in the X-direction. See Figure V-21. If **SBOTX** is blank, **SBOTX** is assumed to be the structural baseline.

   The same is true for **SBOTY** as it corresponds to the Y-direction.

4. The wind loads are calculated as follows. The wind pressure map area identification number is established by **MAREA**. For the X-direction loads the elevation of a particular story line above the ground is determined using **SBOTX**.

   The wind pressures over the story height (including stepped pressure variations, if any) are established.

B(iii) - NOTES: (continued)

The wind forces are then calculated as a product of the wind pressure variations and story widths **BYA**.

The loads are then lumped at the story levels in a statically consistent manner, including the effect of pressure variations within a story height.

The line of action of the load is in the X-direction through the center of pressure as defined by the entry **DYA**.

The same is true for **SBOTY**, **BXB** and **DXB** as they correspond to the Y-direction loading.

5. Entry **DFXA** is usually 0.

   The user may, however, use this entry to apply additional lateral wind load in the X-direction to the associated story level, if needed. This load will be added to the wind load calculated by the program in the X-direction, at the associated story level.

   The same is true for **DFYB** as it corresponds to the Y-direction.

   See Figure V-22 for positive direction of forces.

B(iv). WIND LATERAL LOADS AS DEFINED BY THE BOCA NATIONAL BULDING CODE, 1990

Skip this section of data if NLAT is not 7. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have BOCA wind loads in the global X-direction and load condition B will have BOCA wind loads in the global Y-direction.

The building story heights defined in the story data (Section V-D.3 of the manual) are used to generate these loads.

a. Wind Pressure Parameters

Prepare one line of data in the following form to define the BOCA wind pressure parameters:

V ET I AR CFH CFP

b. Wind Load Exposure

Provide two lines of data, one corresponding to each of the two global directions, to define the extent of the structural height that is exposed to the wind. Prepare the data in the following form:

SBOTX
SBOTY

B(iv). BOCA 90 WIND LOADS (continued)

c. Story Wind Exposure Widths and Corresponding Centers of Pressure

This data defines the dimensions of the exposed faces, normal to the global X- and Y-directions, and locates the corresponding centers of pressure to determine the magnitude of the wind loads and their corresponding points of application for each story.

Provide one line of data corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building.

The data amounts to a total of **NST** data lines in the following form:

BYA DYA DFXA BXB DXB DFYB

B(iv). BOCA 90 WIND LOADS (continued)

Variable	Field	Note	Entry
Wind Pressure Parameters			
V	1	(1)	Basic wind speed (between 70 and 110 mph).
ET	2	(1)	Exposure type (B or C).
I	3	(1)	Importance factor.
AR	4	(1)	Aspect Ratio. (Building dimension in X-direction divided by building dimension in Y-direction.)
CFH	5	(2)	Conversion factor for height.
CFP	6	(2)	Conversion factor for pressure.

B(iv.) BOCA 90 WIND LOADS (continued)

Variable	Field	Note	Entry

Wind Load Exposure - X-Direction

Variable	Field	Note	Entry
SBOTX	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for X-direction wind loads.

Wind Load Exposure - Y-Direction

Variable	Field	Note	Entry
SBOTY	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for Y-direction wind loads.

B(iv). BOCA 90 WIND LOADS (continued)

Variable	Field	Note	Entry

Story Wind Exposure

Variable	Field	Note	Entry
BYA	1	(4)	Projected length of the floor level for X-direction loads (projection is on the Y-axis).
DYA	2	(4)	Y-ordinate of the center of the projected length **BYA.**
DFXA	3	(5)	Additional load in the X-direction (load condition A).
BXB	4		Projected length of the floor level for Y-direction loads (projection is on the X-axis).
DXB	5		X-ordinate of the center of the projected length **BXB.**
DFYB	6		Additional load in the Y-direction (load condition B).

B(iv) - NOTES:

1. The basic wind speed values as identified in Table 1112.3.3a and b of Reference [26] are between 70 and 110 mph.

   These values must always be entered in miles per hour (mph), irrespective of the input units of ETABS. The basic wind speed is converted into effective velocity pressure, P_e, at a given height and a given exposure type, by linearly interpolating the values defined in Reference [26], Table 1112.3.3a for exposure type B and Table 1112.3.3b for exposure type C.

   The wind pressure p for a particular height above the ground level is then given as:

   $$p = P_e \ C_p \ I^2$$

   where C_p is tabulated in Table 1112.2a (2) of Reference [26]. For the windward wall C_p is constant and is taken as 0.8. For the leeward wall C_p is dependent on the aspect ratio of the building but the pressure at all heights is computed based on the full building height. The heights are taken from the ground level.

   The importance factor, **I**, is defined in Table 1112.2a (1) of Reference [26].

2. The wind distribution heights and associated wind pressures as specified in the BOCA code are in feet and pounds per square foot units, respectively.

   CFH is the multiplication factor that will convert the user-input story height to feet units.

B(iv) - NOTES:

CFP is the conversion factor that will convert pounds per square foot to the consistent units being used in the preparation of this input. See Figure V-20 for examples.

3. The part of the structure below the level line associated with the story identification **SBOTX** will receive no wind exposure in the X-direction. See Figure V-21. If **SBOTX** is blank, **SBOTX** is assumed to be the structural baseline.

   The same is true for **SBOTY** as it corresponds to the Y-direction.

4. The wind loads are calculated as follows. The wind pressure is as defined in Note 1 above. For the X-direction loads the elevation of a particular story line above the ground is determined using **SBOTX**.

   The wind pressures over the story height (including stepped pressure variations, if any) are established.

   The wind forces are then calculated as a product of the wind pressure variations and story widths **BYA**.

   The loads are then lumped at the story levels in a statically consistent manner, including the effect of pressure variations within a story height.

   The line of action of the load is in the X-direction through the center of pressure as defined by the entry **DYA**.

   The same is true for **SBOTY, BXB** and **DXB** as they correspond to the Y-direction loading.

B(iv) - NOTES:

5. Entry **DFXA** is usually 0.

   The user may, however, use this entry to apply additional lateral wind load in the X-direction to the associated story level, if needed. This load will be added to the wind load calculated by the program, in the X-direction at the associated story level.

   The same is true for **DFYB** as it corresponds to the Y-direction.

   See Figure V-22 for positive direction of forces.

B(v). WIND LATERAL LOADS AS DEFINED BY THE ASCE 7-88

Skip this section of data if **NLAT** is not 8. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have ASCE wind loads in the global X-direction and load condition B will have ASCE wind loads in the global Y-direction.

The building story heights defined in the story data (Section V-D.3 of the manual) are used to generate these loads.

a. Wind Pressure Parameters

Prepare one line of data in the following form to define the ASCE wind pressure parameters:

V ET I AR GBAR CFH CFP

b. Wind Load Exposure

Provide two lines of data, one corresponding to each of the two global directions, to define the extent of the structural height that is exposed to the wind. Prepare the data in the following form:

SBOTX
SBOTY

B(v). ASCE 7-88 WIND LOADS (continued)

c. Story Wind Exposure Widths and Corresponding Centers of Pressure

This data defines the dimensions of the exposed faces, normal to the global X- and Y-directions, and locates the corresponding centers of pressure to determine the magnitude of the wind loads and their corresponding points of application for each story.

Provide one line of data corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building.

The data amounts to a total of **NST** data lines in the following form:

BYA DYA DFXA BXB DXB DFYB

B(v). ASCE 7-88 WIND LOADS (continued)

Variable	Field	Note	Entry
Wind Pressure Parameters			
V	1	(1)	Basic wind speed.
ET	2	(1)	Exposure type (A, B, C or D).
I	3	(1)	Importance factor.
AR	4	(1)	Aspect Ratio. (Building dimension in X-direction divided by building dimension in Y-direction.)
GBAR	5	(1)	Gust Factor for flexible buildings and slender structures.
CFH	6	(2)	Conversion factor for height.
CFP	7	(2)	Conversion factor for pressure.

B(v). ASCE 7-88 WIND LOADS (continued)

Variable	Field	Note	Entry

Wind Load Exposure - X-Direction

Variable	Field	Note	Entry
SBOTX	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for X-direction loads

Wind Load Exposure - Y-Direction

Variable	Field	Note	Entry
SBOTY	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for Y-direction wind loads.

B(v). ASCE 7-88 WIND LOADS (continued)

Variable	Field	Note	Entry
Story Wind Exposure			
BYA	1	(4)	Projected length of the floor level for X-direction loads (projection is on the Y-axis).
DYA	2	(4)	Y-ordinate of the center of the projected length **BYA.**
DFXA	3	(5)	Additional load in the X-direction (load condition A).
BXB	4		Projected length of the floor level for Y-direction loads (projection is on the X-axis).
DXB	5		X-ordinate of the center of the projected length **BXB.**
DFYB	6		Additional load in the Y-direction (load condition B).

B(v) - NOTES:

1. These values are used by ETABS to compute the wind pressure at a given height of the building as per the ASCE 7-88 (Reference [27]). The program utilizes the procedure for calculating the design wind pressure given in Table 4 of Reference [27] for the main wind-force resisting systems. The procedure is utilized in conjunction with Equations C1 and C3, Figure 2 and Table C6 of Reference [27].

   If the gust factor, **GBAR**, is given as 0, the program computes it using Equations C5 and C6, and Table C6 of Reference [27]. However, if the building is flexible with time periods above 1 second or has a height to least width ratio above 5, the value of **GBAR** should be evaluated by the user using Equation C7 of Reference [27], or another appropriate method, and provided to the program.

2. The wind distribution heights and associated wind pressures as specified in the ASCE 7-88 are in feet and pounds per square foot units, respectively.

   CFH is the multiplication factor that will convert the user-input story height to feet units.

   CFP is the conversion factor that will convert pounds per square foot to the consistent units being used in the preparation of this input. See Figure V-20 for examples.

3. The part of the structure below the level line associated with the story identification **SBOTX** will receive no wind exposure in the X-direction. See Figure V-21. If **SBOTX** is blank, **SBOTX** is assumed to be the structural baseline.

   The same is true for **SBOTY** as it corresponds to the Y-direction.

B(v) - NOTES:

4. The wind loads are calculated as follows. The wind pressure is as defined in Note 1 above. For the X-direction loads the elevation of a particular story line above the ground is determined using **SBOTX**.

   The wind pressures over the story height (including pressure variations) are established.

   The wind forces are then calculated as a product of the wind pressure variations and story widths **BYA**.

   The loads are then lumped at the story levels in a statically consistent manner, including the effect of pressure variations within a story height.

   The line of action of the load is in the X-direction through the center of pressure as defined by the entry **DYA**.

   The same is true for **SBOTY**, **BXB** and **DXB** as they correspond to the Y-direction loading.

5. Entry **DFXA** is usually 0.

   The user may, however, use this entry to apply additional lateral wind load in the X-direction to the associated story level, if needed. This load will be added to the wind load calculated by the program, in the X-direction at the associated story level.

   The same is true for **DFYB** as it corresponds to the Y-direction.

   See Figure V-22 for positive direction of forces.

B(vi). SEISMIC LATERAL LOADS AS DEFINED BY THE BOCA NATIONAL BUILDING CODE, 1990

Skip this section of data if **NLAT** is not 9. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have BOCA seismic lateral loads in the global X-direction and load condition B will have BOCA seismic lateral loads in the global Y-direction.

The building story heights and story mass defined in the story data (Section V-D.3 of the manual) or as calculated by the program (Section V-D.2) and the gravitational acceleration (Section V-D.1) are used to generate these loads.

a. BOCA 1990 Seismic Coefficients

Prepare one line of data in the following form to define the BOCA site-dependent coefficients:

AV S I

b. Triangular Lateral Load Distribution Data

Provide two lines of data, one corresponding to each of the two global directions, to define the structural time periods, the BOCA structural type factors and the extent of the lateral load distributions over the height of the building.

Prepare the data in the following form:

TX KX STOPX SBOTX
TY KY STOPY SBOTY

B(vi). BOCA 90 SEISMIC LOADS (continued)

c. Story Eccentricities and Extra Loading

This data defines the eccentricities of the BOCA generated story loads on any particular story with respect to the center of mass of that story. This data also gives the user the option of applying extra loads to a particular story level if needed. If the eccentricities are zero, the loads are applied at the center of mass.

Prepare one line of data to define the eccentricities and extra loading corresponding to each story of the building.

The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building. The data amounts to a total of NST data lines in the following form:

EYA EXB DFXA DFYB

B(vi). BOCA 90 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

BOCA 1990 Seismic Coefficients

Variable	Field	Note	Entry
AV	1	(1)	BOCA effective peak velocity-related acceleration coefficient, A_v
S	2	(2)	BOCA soil factor, S.
I	3	(3)	BOCA importance factor, I.

Triangular Lateral Load Distribution Data

Data associated with X-direction loads or load condition A. Y-direction loads in load condition A are set to 0.

Variable	Field	Note	Entry
TX	1	(4)	Time period of the structural mode predominant in the X-direction.
KX	2	(5)	BOCA horizontal force factor, K for X-direction.

B(vi). BOCA 90 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Triangular Lateral Load Distribution Data (continued)

Variable	Field	Note	Entry
STOPX	3	(6)	Story identification for the level defining the top of the triangular distribution for X-direction loads.
SBOTX	4	(6)	Story identification for the level defining the bottom of the triangular distribution for X-direction loads.

Data associated with Y-direction loads or load condition B. X-direction loads in load condition B are set to 0.

Variable	Field	Note	Entry
TY	1	(4)	Time period of the structural mode predominant in the Y-direction.
KY	2	(5)	BOCA horizontal force factor, K for Y-direction.
STOPY	3	(6)	Story identification for the level defining the top of the triangular distribution for Y-direction loads.
SBOTY	4	(6)	Story identification for the level defining the bottom of the triangular distribution for the Y-direction loads.

B(vi). BOCA 90 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Additional Story Eccentricities and Loading

Variable	Field	Note	Entry
EYA	1	(7)	Additional eccentricity for X-direction loads (load condition A).
EXB	2	(7)	Additional eccentricity for Y-direction loads (load condition B).
DFXA	3	(8)	Additional load in the X-direction (load condition A).
DFYB	4	(8)	Additional load in the Y-direction (load condition B).

B(vi) - NOTES:

1. Details of the seismic load calculation method and the definitions of the various BOCA factors are presented in Section 1113 of Reference [26]. If **AV** is entered as 0, **AV** is set to 0.4.

2. If **S** is entered as 0, **S** is assumed to be 1.5.

3. If **I** is entered as 0, **I** is assumed to be 1.0.

4. **TX** must be provided if the time periods of the structure are not being calculated by the program (i.e. **NDYN** is 0). If **TX** is set to 0 and **NDYN** is not 0, the program will set **TX** equal to the period of the calculated mode having the largest participation factor in the X-direction.

   Similarly, **TY** corresponds to the Y-direction.

   Positive nonzero user input values for **TX** and **TY** will always supersede any values generated by the program.

5. If **KX** is entered as 0, **KX** is assumed to be 0.67. The same is true for **KY**.

6. It is possible for a structural model to have levels for penthouses, basements or dummy stories for special modeling. The engineer may not want to include such levels in the overall structural triangular lateral force distribution as defined by the BOCA. See Figure V-23.

   If there are any levels above **STOPX**, they do not receive any loading from the triangular distribution.

B(vi) - NOTES: (continued)

The triangular distribution will not generate any loads for any level below and including level **SBOTX**.

If **SBOTX** is left blank, **SBOTX** is assumed to be the structural baseline.

If **STOPX** and **SBOTX** are both left blank, **STOPX** is assumed to be the top level of the structure and **SBOTX** is assumed to be the structural baseline.

All the above is true for **STOPY** and **SBOTY** as it corresponds to the Y-direction.

7. If the additional eccentricity values are entered as 0, the generated story loads will be applied at the centers of mass of the respective levels. The additional eccentricity values are for moving the point of application of the applied loads at each level, if desired. See Figure V-24.

8. Entries for **DFXA** and **DFYB** are usually 0 for levels which receive loading from the BOCA triangular distribution. These entries are basically used for applying loads to the levels that do not receive any loading from the BOCA triangular distribution. See Note 6 above. These forces are applied with the corresponding eccentricities **EYA** and **EXB**. If **DFXA** and **DFYB** have nonzero values for levels that receive loading from the BOCA triangular distribution, **DFXA** will be added to the X-direction loads and **DFYB** will be added to the Y-direction loads generated by the BOCA option in the corresponding load conditions A and B, respectively. See Figure V-24 for the positive directions of the eccentricities and forces.

B(vii). SEISMIC LATERAL LOADS AS DEFINED BY THE NATIONAL BUILDING CODE OF CANADA, 1990

Skip this section of data if NLAT is not 10. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have NBCC lateral loads in the global X-direction and load condition B will have NBCC lateral loads in the global Y-direction.

The building story heights and story mass defined in the story data (Section V-D.3 of the manual) or as calculated by the program (Section V-D.2) and the gravitational acceleration (Section V-D.1) are used to generate these loads.

a. NBCC 1990 Seismic Coefficients

Prepare one line of data in the following form to define the NBCC site-dependent coefficients:

VR ZR F I

b. Triangular Lateral Load Distribution Data

Provide two lines of data, one corresponding to each of the two global directions, to define the structural time periods and their maximum allowed values, the NBCC force modification factors and the extent of the lateral load distributions over the height of the building.

Prepare the data in the following form:

TX TAX RX STOPX SBOTX
TY TAY RY STOPY SBOTY

B(vii). NBCC 90 SEISMIC LOADS (continued)

c. Story Eccentricities and Extra Loading

This data defines the eccentricities of the NBCC generated story loads on any particular story with respect to the center of mass of that story. This data also gives the user the option of applying extra loads to a particular story level if needed. If the eccentricities are zero, the loads are applied at the center of mass.

Prepare one line of data to define the eccentricities and extra loading corresponding to each story of the building.

The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building. The data amounts to a total of **NST** data lines in the following form:

EYA EXB DFXA DFYB

B(vii). NBCC 90 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

NBCC Seismic Coefficients

Variable	Field	Note	Entry
VR	1	(1)	NBCC zonal velocity ratio, v.
ZR	2	(1)	NBCC ratio Z_a/Z_v
F	3	(2)	NBCC foundation factor, F.
I	4	(3)	NBCC seismic importance factor, I.

Triangular Lateral Load Distribution Data

Data associated with X-direction loads or load condition A. Y-direction loads in load condition A are set to 0.

Variable	Field	Note	Entry
TX	1	(4)	Time period of the structural mode predominant in the X-direction.
TAX	2	(5)	NBCC maximum allowed time period associated with the X-direction.
RX	2	(5)	NBCC force modification factor R, for X-direction.

B(vii). NBCC 90 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Triangular Lateral Load Distribution Data (continued)

Variable	Field	Note	Entry
STOPX	4	(7)	Story identification for the level defining the top of the triangular distribution for X-direction loads.
SBOTX	5	(7)	Story identification for the level defining the bottom of the triangular distribution for X-direction loads.

Data associated with Y-direction loads or load condition B. X-direction loads in load condition B are set to 0.

Variable	Field	Note	Entry
TY	1	(4)	Time period of the structural mode predominant in the Y-direction.
TAY	2	(5)	NBCC maximum allowed time period associated with the Y-direction.
RY	3	(6)	NBCC force modification factor, R, for Y-direction.
STOPY	4	(7)	Story identification for the level defining the top of the triangular distribution for Y-direction loads.

B(vii). NBCC 90 SEISMIC LOADS (continued)

Variable	Field	Note	Entry

Triangular Lateral Load Distribution Data (continued)

SBOTY	5	(7)	Story identification for the level defining the bottom of the triangular distribution for the Y-direction loads.

Additional Story Eccentricities and Loading

EYA	1	(8)	Additional eccentricity for X-direction loads (load condition A).
EXB	2	(8)	Additional eccentricity for Y-direction loads (load condition B).
DFXA	3	(9)	Additional load in the X-direction (load condition A).
DFYB	4	(9)	Additional load in the Y-direction (load condition B).

B(vii) - NOTES:

1. Details of the seismic load calculation method and the definitions of the various NBCC factors are presented in Section 4.1.9 of Reference [28]. If **VR** is entered as 0, **VR** is set to 0.4. The program uses **ZR,** the ratio of the acceleration-related seismic zone, $\mathbf{Z_a}$, to the velocity-related seismic zone, $\mathbf{Z_v}$, to calculate the NBCC seismic response factor, **S.** If **ZR** is entered as 0, **ZR** is set to 1.0.

2. If **F** is entered as 0, **F** is assumed to be 1.5.

3. If **I** is entered as 0, **I** is assumed to be 1.0.

4. **TX** must be provided if the time periods of the structure are not being calculated by the program (i.e. **NDYN** is 0). If **TX** is set to 0 and **NDYN** is not 0, the program will set **TX** equal to the period of the calculated mode having the largest participation factor in the X-direction.

   Similarly, **TY** corresponds to the Y-direction.

   Positive nonzero user input values for **TX** and **TY** will always supersede any values generated by the program.

5. NBCC section 4.1.9.1.(7).(c) requires that the building periods used in the lateral loads calculations not be greater than 1.2 times those calculated using procedures in sections 4.1.9.1.(7).(a) or (b) as applicable. If non-zero **TAX** and **TAY** are provided the program will limit the calculated **TX** and **TY** values to these maxima.

6. If **RX** is entered as 0, **RX** is assumed to be 4. The same is true for **RY**.

B(vii) - NOTES: (continued)

7. It is possible for a structural model to have levels for penthouses, basements or dummy stories for special modeling. The engineer may not want to include such levels in the overall structural triangular lateral force distribution as defined by the NBCC. See Figure V-23.

   If there are any levels above **STOPX**, they do not receive any loading from the triangular distribution.

   The triangular distribution will not generate any loads for any level below and including level **SBOTX**.

   If **SBOTX** is left blank, **SBOTX** is assumed to be the structural baseline.

   If **STOPX** and **SBOTX** are both left blank, **STOPX** is assumed to be the top level of the structure and **SBOTX** is assumed to be the structural baseline.

   All the above is true for **STOPY** and **SBOTY** as it corresponds to the Y-direction.

8. If the additional eccentricity values are entered as 0, the generated story loads will be applied at the centers of mass of the respective levels. The additional eccentricity values are for moving the point of application of the applied loads at each level, if desired. See Figure V-24.

B(vii) - NOTES: (continued)

9. Entries for **DFXA** and **DFYB** are usually 0 for levels which receive loading from the NBCC triangular distribution. These entries are basically used for applying loads to the levels that do not receive any loading from the NBCC triangular distribution. See Note 7 above. These forces are applied with the corresponding eccentricities **EYA** and **EXB.** If **DFXA** and **DFYB** have nonzero values for levels that receive loading from the UBC triangular distribution, **DFXA** will be added to the X-direction loads and **DFYB** will be added to the Y-direction loads generated by the NBCC option in the corresponding load conditions A and B, respectively. See Figure V-24 for the positive directions of the eccentricities and forces.

8(viii). WIND LATERAL LOADS AS DEFINED BY THE NATIONAL BUILDING CODE OF CANADA, 1990

Skip this section of data if **NLAT** is not 11. Otherwise, prepare the following data as defined in Sections a, b and c below. This data will activate structural lateral load conditions A and B. Load condition A will have NBCC wind loads in the global X-direction and load condition B will have NBCC wind loads in the global Y-direction.

The building story heights defined in the story data (Section V-D-3 of the manual) are used to generate these loads.

a. Wind Pressure Parameters

Prepare one line of data in the following form to define the NBCC wind pressure parameters:

Q CP CFH CFP

b. Wind Load Exposure

Provide two lines of data, one corresponding to each of the two global directions, to define the extent of the structural height that is exposed to the wind. Prepare the data in the following form:

SBOTX
SBOTY

B(viii). NBCC 90 WIND LOADS (continued)

c. Story Wind Exposure Widths and Corresponding Centers of Pressure

This data defines the dimensions of the exposed faces, normal to the global X- and Y-directions, and locates the corresponding centers of pressure to determine the magnitude of the wind loads and their corresponding points of application for each story.

Provide one line of data corresponding to each story of the building. The data is to be prepared starting from the top story of the building and progressing in sequence toward the bottom of the building.

The data amounts to a total of NST data lines in the following form:

BYA DYA DFXA BXB DXB DFYB

B(viii). NBCC 90 WIND LOADS (continued)

Variable	Field	Note	Entry
Wind Pressure Parameters			
Q	1	(1)	NBCC reference velocity pressure, q, in kPa.
CP	2	(1)	NBCC averaged external pressure coefficient, C_p.
CFH	3	(2)	Conversion factor for height.
CFP	4	(2)	Conversion factor for pressure.

B(viii). NBCC 90 WIND LOADS (continued)

Variable	Field	Note	Entry
Wind Load Exposure - X-Direction			
SBOTX	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for X-direction loads
Wind Load Exposure - Y-Direction			
SBOTY	1	(3)	Story identification for level corresponding to the ground level for the wind exposure for Y-direction wind loads.

B(viii). NBCC 90 WIND LOADS (continued)

Story Wind Exposure

Variable	Field	Note	Entry
BYA	1	(4)	Projected length of the floor level for X-direction loads (projection is on the Y-axis).
DYA	2	(4)	Y-ordinate of the center of the projected length **BYA.**
DFXA	3	(5)	Additional load in the X-direction (load condition A).
BXB	4		Projected length of the floor level for Y-direction loads (projection is on the X-axis).
DXB	5		X-ordinate of the center of the projected length **BXB.**
DFYB	6		Additional load in the Y-direction (load condition B).

B(viii) - NOTES:

1. These values are used by ETABS to compute the wind pressure at a given height of the building as per the NBCC (Reference [28]). The program computes the wind pressure at a given height as:

   $$p = q\, C_e\, C_g\, C_p$$

   where q and C_p are as specified by the user, C_g is assumed as 2.0 as per NBCC Section 4.1.8.1.(6).(b)., and C_e is computed as $C_e = (h/10)^{1/5} \geq 0.9$ as per NBCC Section 4.1.8.1.(5).(b) where h is the height above ground in meters where pressure is being computed.

2. The wind distribution heights and associated wind pressures as specified in the NBCC code are in meter and kilo pascals units, respectively.

   CFH is the multiplication factor that will convert the user-input story height to meter units.

   CFP is the conversion factor that will convert kilo pascals to the consistent units being used in the preparation of this input.

   If kilo Newton-meter units are being used in the input data **CFH** and **CFP** will be 1.0, the default values.

   If kilogram (force) - meter units are being used in the input data **CFH** will be 1.0 and **CFP** will be 1000/9.81.

   If kip-inch units are being used in the input data **CFH** will be 0.0254 and **CFP** will be 0.000145.

B(viii) - NOTES: (continued)

3. The part of the structure below the level line associated with the story identification **SBOTX** will receive no wind exposure in the X-direction. See Figure V-21. If **SBOTX** is blank, **SBOTX** is assumed to be the structural baseline.

   The same is true for **SBOTY** as it corresponds to the Y-direction.

4. The wind loads are calculated as follows. The wind pressure is as defined in Note 1 above. For the X-direction loads the elevation of a particular story line above the ground is determined using **SBOTX**.

   The wind pressures over the story height (including pressure variations) are established.

   The wind forces are then calculated as a product of the wind pressure variations and story widths **BYA**.

   The loads are then lumped at the story levels in a statically consistent manner, including the effect of pressure variations within a story height.

   The line of action of the load is in the X-direction through the center of pressure as defined by the entry **DYA**.

   The same is true for **SBOTY**, **BXB** and **DXB** as they correspond to the Y-direction loading.

B(viii) - NOTES: (continued)

5. Entry **DFXA** is usually 0.

   The user may, however, use this entry to apply additional lateral wind load in the X-direction to the associated story level, if needed. This load will be added to the wind load calculated by the program, in the X-direction at the associated story level.

   The same is true for **DFYB** as it corresponds to the Y-direction.

   See Figure V-22 for positive direction of forces.