COMPUTERS & STRUCTURES INC.

CONKER®

Design of Concrete Frames

A Post Processor for ETABS®

Version 6.2
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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 CONKER. 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 PROGRAMS IS A VERY PRACTICAL TOOL FOR THE DESIGN OF CONCRETE FRAMES STRUCTURES. PREVIOUS VERSIONS OF THIS PROGRAM HAVE BEEN VERY SUCCESSFULLY USED ON A VARIETY OF BUILDINGS. HOWEVER, THE USER MUST THOROUGHLY READ THE MANUAL AND CLEARLY RECOGNIZE THE ASPECTS OF CONCRETE DESIGN THAT THE PROGRAM ALGORITHMS DO **NOT** ADDRESS.

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

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Chapter I

Introduction

CONKER is a concrete design post processor for the three-dimensional static and dynamic building analysis computer program ETABS.

The program is intended for the automated ACI code design [1] of concrete frame structures that have been modeled for analysis using ETABS. Special seismic provisions in the ACI code and in the UBC94 [2] can be activated. An option for using the Canadian concrete code [3] is also available.

The design is based upon user-specified loading combinations.

Most of the data required by CONKER for the design processing, i. e. material and section properties, member forces and geometry, is recovered directly from the ETABS database. Therefore, the data input typically required by CONKER is very nominal and **if the program defaults are acceptable, no data input is required**.

In the design of the columns, the program calculates the required longitudinal steel or if the longitudinal steel is specified, the column stress condition is reported in terms of a column capacity ratio, which is a factor that gives an indication of the stress condition of the column with respect to the capacity of the column.

The biaxial column capacity check is based upon the generation of consistent three-dimensional interaction surfaces and does not use any empirical formulations that extrapolate uniaxial interaction curves to approximate biaxial action.

Interaction surfaces are generated for user specified column reinforcing configurations. The column configurations may be rectangular, square or circular. The calculation of moment magnification factors, unsupported lengths and strength reduction factors are automated in the algorithm.

Every beam member is designed for flexure and shear at five stations along the beam span.

All beam-column joints are investigated for existing shear conditions.

For special moment resisting frames (ductile frames), the shear design of the columns, beams and joints is based upon the probable moment capacities of the members.

Also, for special moment resisting frames, the program will produce ratios of the beam moment capacities with respect to the column moment capacities, to investigate the weak beam - strong column aspects of any beam-column intersection. Effects of axial force on the column moment capacities are included in the formulation.

The presentation of the output is in a format that not only allows the engineer to quickly study the stress conditions that exist in the structure but also aids the engineer in taking appropriate remedial measures in the event of member overstress. Backup design information for convenient verification of the results produced by the program is also provided.

Changes in structural member section properties is possible at the post processor level to study the effects of member changes without rerunning the ETABS analysis.

English as well as SI and MKS metric units are possible.

Chapter II

Installation and Execution Procedure

This chapter deals with the installation and execution of CONKER on a Windows 95 or Windows NT 4.0 based computer system.

User familiarity with Windows is assumed.

CONKER is an add on concrete frame design postprocessor to the building analysis program ETABS. It is included in the ETABS Plus and ETABS Nonlinear packages.

A. Installing and Testing

The program provided must first be installed on the hard disk. Follow the instructions for installing the ETABS program for this procedure.

Before putting the system into a production mode, the user should test the system by running the sample example provided on the disk. The output files produced should be compared with the corresponding output files that are also provided on this disk.

B. Input Preparation Before Executing CONKER

CONKER is a post processor for the ETABS analysis program. Therefore, before running CONKER the user must generate an ETABS input data file and execute ETABS to create the ETABS post processing file.

Say that the ETABS data associated with the structure the user wishes to analyze has been prepared and entered into a data file called EXCON. A successful execution of ETABS with the data file EXCON will create a post processing file EXCON.PST.

The user may then also prepare a CONKER input data file using any text editor. This data file must conform to the specifications detailed in Chapter IV of this manual. This data file is not required if all program defaults are acceptable. Sample data is provided on the disk (filenames EXCON for ETABS data and DESCON for CONKER data) associated with the complete CONKER package.

C. Executing The CONKER Program

This section explains how to execute the CONKER program.

CONKER is a DOS program which can be run in a DOS window or can be launched from the Windows Icon.

Running CONKER in a DOS Window

To execute CONKER in a DOS Window enter the following command at the DOS prompt:

CONKER ***etabsfile*** ***conkerfile***

Where ***etabsfile*** is the name of the ETABS input file which has already been run and for which the ETABS post processing file is available; and ***conkerfile*** is the name of the CONKER input file. If no CONKER input file is prepared because all program defaults were acceptable the ***conkerfile*** could be left blank. Both the ***etabsfile*** and the ***conkerfile*** can have paths included. Other command line options identical to options for executing ETABS (/M:nnnnn and /I) are also available. Refer to the ETABS manual for an explanation of these options.

As an example, say that ETABS has been run using an input data file named EXCON, to create the post processing file EXCON.PST; and that the data associated with the design of this structure for the CONKER post processor has been prepared and entered into a data file called DESCON. In order to execute the CONKER program, enter the following command at the DOS prompt:

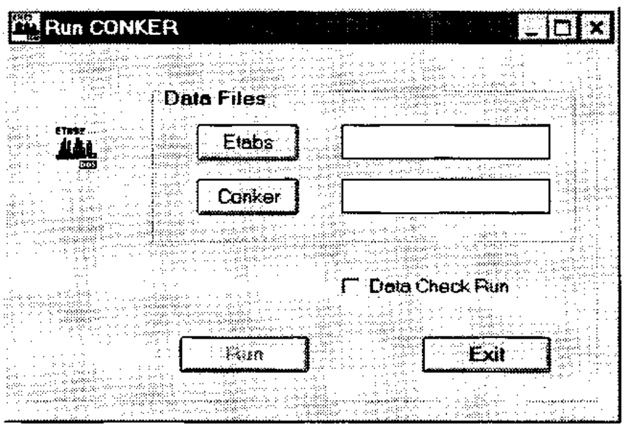
CONKER EXCON DESCON

Note: Since no paths have been specified with the input files the ETABS post processing file EXCON.PST and the CONKER input data file DESCON must reside in the current directory where the command is entered. Also the CONKER executable must reside in the same directory unless a path to the CONKER executable has been activated.

After a few seconds a copyright notice will appear on the screen. The program will then go into execution mode and a series of progress messages will be flashed to the screen until the job has been completed. If the job completes successfully the last screen displays the names of the input files used and the output files created.

Running CONKER from Windows

To execute CONKER from Windows double click on the CONKER icon in the ETABS program group installed by the setup program. The following dialog box will appear:



Click the **Etabs** button which brings up the Open File Dialog box. Select the ETABS postprocessing file. Similarly select the CONKER input file by clicking on the **Conker** button. If all program defaults are acceptable then the CONKER input filename can be left blank. Clicking on **Run** launches the CONKER program. The program runs minimized in a DOS window.

The output files created by the program are explained in Chapter V. The files can be viewed and printed using any text editor. To print an output file from DOS the **PRINT** command may be used. Appropriate line counts and page ejects are built into the files.

Chapter III

Design Algorithms

This chapter describes in detail the various aspects of the concrete design procedures that are used by the program CONKER.

Special terminology associated with the input and the output of the program is also described in the following sections.

An engineering background in the general area of multistory reinforced concrete design and user familiarity with References [1], [2] or [3] is assumed.

A description of the typical notations used throughout this chapter is presented in Figure III-1. References to pertinent sections and equations of the ACI Code [1] are indicated with the "ACI" prefix, and similarly for other codes. For simplicity, all equations and descriptions presented in this chapter correspond to inch-pound-second units unless otherwise noted.

The details of the algorithms presented in Section B for column design, Section C for beam design, Section D for joint design and Section E for beam / column capacity ratios are all based on the ACI318-89 (Revised 1992) [1] and UBC94 [2] codes. The two codes are very similar. Where they differ, differences are identified. Section F identifies the differences between these algorithms and those used for the Canadian [3] code.

A_{cv}	Area of concrete used to determine shear stress, sq-in
A_g	Gross area of concrete, sq-in
A_s	Area of tension reinforcement, sq-in
A_{st}	Total area of column longitudinal reinforcement, sq-in
A_v	Area of shear reinforcement, sq-in
a	Depth of compression block, in
b	Width of member, in
b_f	Effective width of flange (T-Beam section), in
b_w	Width of web (T-Beam section), in
C_m	Coefficient, dependent upon column curvature, used to calculate moment magnification factor
c	Depth to neutral axis, in
c_b	Depth to neutral axis at balanced conditions, in
d	Distance from compression face to tension reinforcement, in
d'	Concrete cover to center of reinforcing, in
d_s	Thickness of slab (T-Beam section), in
E_c	Modulus of elasticity of concrete, psi
E_s	Modulus of elasticity of reinforcement, assumed as 29,000,000 psi
f'_c	Specified compressive strength of concrete, psi
f_y	Specified yield strength of flexural reinforcement, psi
f_{ys}	Specified yield strength of shear reinforcement, psi
I_g	Moment of inertia of gross concrete section about centroidal axis, neglecting reinforcement, in^4
I_{se}	Moment of inertia of reinforcement about centroidal axis of member cross section, in^4
L	Clear unsupported length, in
M_b	Moment capacity at balanced strain conditions, lb-in
M_o	Moment capacity with no axial load, lb-in
P_b	Axial load capacity at balanced strain conditions, lb
P_c	Critical buckling strength of column, lb
P_{max}	Maximum axial load strength allowed, lb
P_o	Axial load capacity at zero eccentricity, lb
r	Radius of gyration of column section, in
V_c	Shear resisted by concrete, lb
α	Reinforcing steel overstrength factor
β_1	Factor for obtaining depth of compression block in concrete

Notation
Figure III-1

β_d Absolute value of ratio of maximum factored axial dead load to maximum factored axial total load

δ Moment magnification factor

ε_c Strain in concrete

ε_s Strain in reinforcing steel

φ Strength reduction factor

ρ_w A_s/bd

Notation
Figure III-1 (continued)

The program provides options to design or check Ordinary, Intermediate (moderate seismic risk areas) and Special (high seismic risk areas) moment resisting frames as required for seismic design. The details of the design criteria used for the different framing systems are described in the following sections and are summarized in the Design Criteria Table (Figure III-16).

A. Design Loading Combinations

The design loading combinations define the various factored combinations of the load conditions for which the structure is to be checked. The user is referred to the ETABS manual for the definition of load conditions and load cases.

The load combination data that is specified in the CONKER input data is totally independent of the load case data that is specified in the ETABS manual.

The post processing file brings across forces and moments associated with the eight independent load conditions (I, II, III, A, B, C, D1, D2) for each of the members. The load combination multipliers are applied to the forces and moments from the load conditions to form the factored design forces and moments for each load combination. There is one exception to the above. For dynamic analysis and for SRSS combinations, any correspondence between the signs of the moments and axial loads is lost. The program uses two loading combinations for each such loading combination specified, reversing the sign of axial loads in one of them.

If a building is subjected to dead load (DL) and live load (LL) only, the design will need only one loading combination, namely 1.4 DL + 1.7 LL.

However, in addition to the dead load and live load, if the structure is subjected to seismic forces from two mutually perpendicular directions (EQX and EQY), and considering that seismic forces are subject to reversals, the following load combinations may have to be considered when using the UBC94 code:

1. $1.4\ DL + 1.7\ LL$
2. $1.4\ DL + 1.4\ LL + \sqrt{(1.4\ EQX)^2 + (1.4\ EQY)^2}$
3. $1.4\ DL + 1.4\ LL - \sqrt{(1.4\ EQX)^2 + (1.4\ EQY)^2}$
4. $0.9\ DL + \sqrt{(1.4\ EQX)^2 + (1.4\ EQY)^2}$
5. $0.9\ DL - \sqrt{(1.4\ EQX)^2 + (1.4\ EQY)^2}$

For other codes the loading combinations would be different and appropriate combinations must be used.

Further, it must be noted that the program assumes that a P-Delta analysis has been performed in ETABS so that moment magnification factors for moments causing sidesway can be taken as unity. The codes would require that the P-Delta analysis be done at the factored load level [11]. The ETABS program uses the specified story masses to calculate the P for the P-Delta analysis, but allows an input factor to modify it.

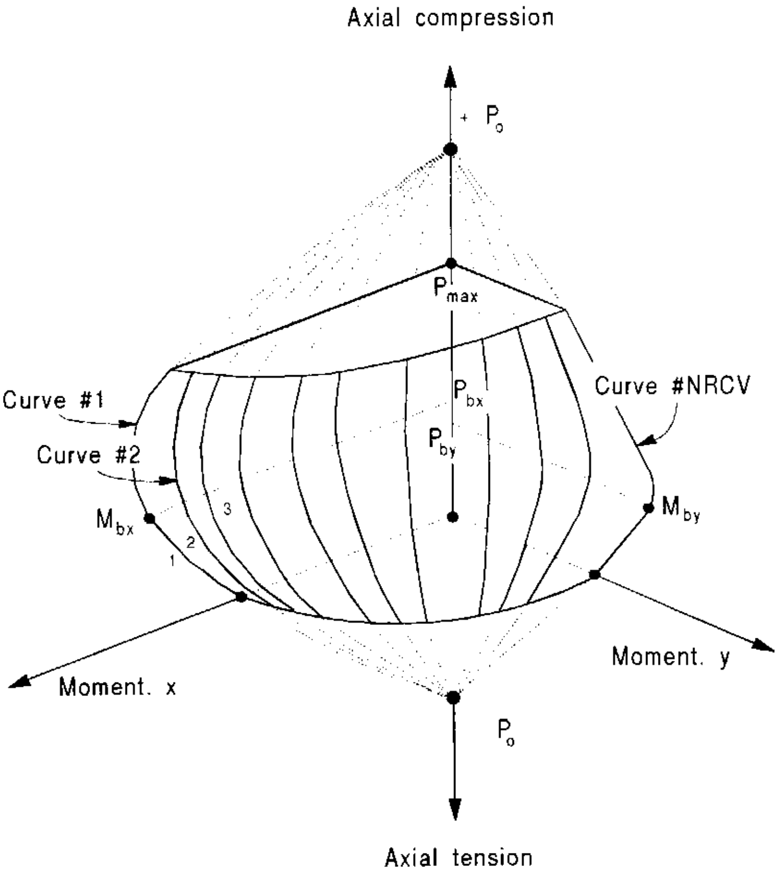
It is recommended that when using the UBC94 code a factor be used to obtain a P equivalent to (1.4 dead load + 1.4 live load) /0.7. The 0.7 is the understrength factor, φ. This would give amplification of moments similar to using ACI code Equation 10-8. Similarly, when using ACI318-89, it is recommended that a P-Delta factor in ETABS be used to obtain a P equivalent to 0.75 (1.4 dead load + 1.7 live load)/ 0.7. The necessary factor for a P-Delta analysis for the CAN3-A23.2-M84 code would be (1.25 dead load + 1.05 live load)/0.65.

Of the three vertical load conditions I, II or III, one is usually identified as being associated with the dead load and another is identified as the live load condition. By identifying the load conditions in this manner, live load reduction factors as allowed by Reference [2] can be applied to the member forces of the live load condition on a level-by-level basis to reduce the contribution of the live load to the factored loading. Also, the dead load condition needs to be identified to calculate β_d.

B. Column Design (ACI318-89 and UBC94)

In the column design strategy of CONKER, the user can either define the geometry of the rebar configuration of each different concrete column section type that exists in the structure or let the program calculate the amount of steel required for the individual columns. The design procedure for the reinforced concrete columns of the structure involves the following steps:

1. Generate load-biaxial moment interaction surfaces for all of the different concrete section types of the model. A typical biaxial interaction surface is shown in Figure III-2. When the steel is undefined, the program generates the interaction surfaces for the range of allowable reinforcement (1 to 8 percent, except for special moment resisting frames 1 to 6 percent).



Typical Column Interaction Surface
Figure III-2

2. Check the capacity of each column for the factored axial force and biaxial (or uniaxial) bending moments obtained from each loading combination at each end of the column. This step is also used to calculate the required reinforcement (if none was specified) that will produce a capacity ratio of 1.0 (0.99 is conservatively used by the program).

3. Design the column shear reinforcing.

The following three sections describe in detail the algorithms associated with the above-mentioned steps, 1, 2 and 3.

1. Generation of Biaxial Interaction Surfaces

The column capacity interaction volume is numerically described by a series of discrete points that are generated on the three-dimensional interaction failure surface. In addition to axial compression and biaxial bending, the formulation allows for axial tension and biaxial bending considerations as shown in Figure III-2.

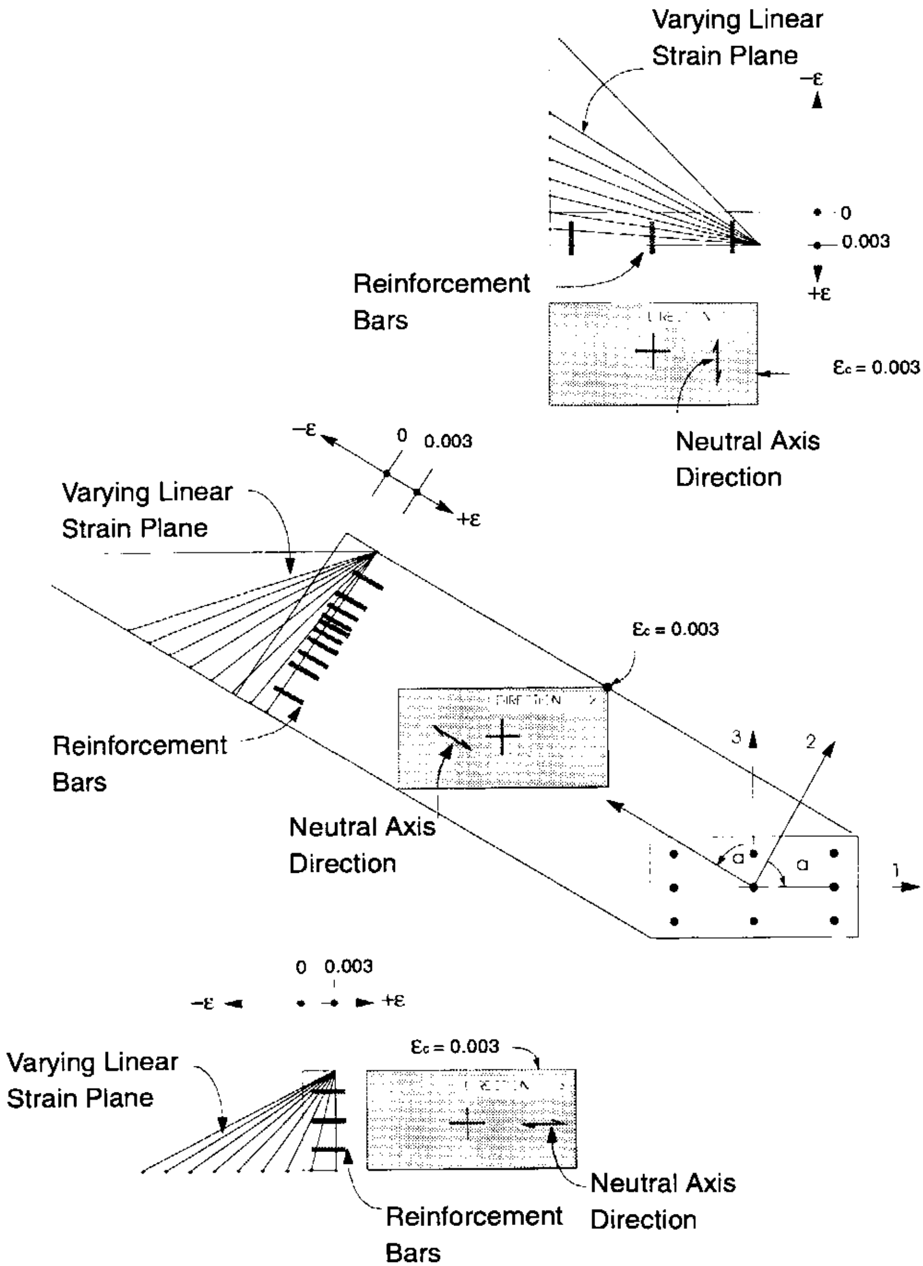
The coordinates of these points are determined by rotating a plane of linear strain in three dimensions on the section of the column. See Figure III-3.

The formulation is based consistently upon the general principles of ultimate strength design, (ACI 10.3), and allows for rectangular, square or circular, doubly symmetric column sections.

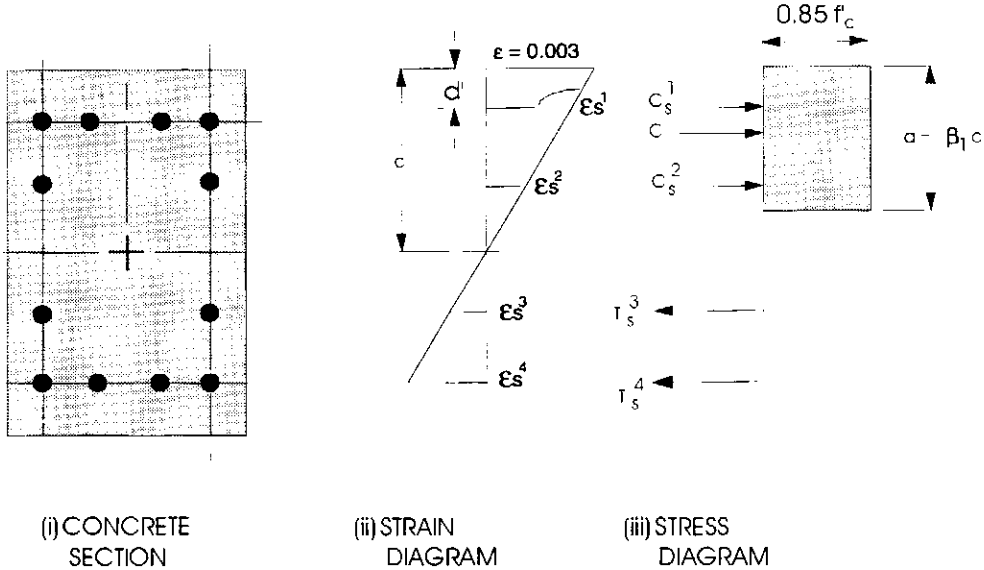
The linear strain diagram limits the maximum concrete strain, ε_c, at the extremity of the section, to .003.

The stress in the steel is given by the product of the steel strain and the steel modulus of elasticity, $\varepsilon_s E_s$, and is limited to the yield stress of the steel, f_y. The area associated with each rebar is placed at the actual location of the center of the bar and the algorithm does not assume any simplifications in the manner in which the area of steel is distributed over the cross section of the column (such as an equivalent steel tube or cylinder).

The concrete compression stress block is assumed to be rectangular, with a stress value of 0.85 f'_c. See Figure III-4. The interaction algorithm provides corrections to account for the concrete area that is displaced by the reinforcing in the compression zone.



Generation of Interaction Surfaces
Figure III-3



Concrete Stress-strain Relationships
Figure III-4

The effects of the strength reduction factor, ϕ , are included in the generation of the interaction surfaces. The maximum compressive axial load is limited to P_{max}, where

P_{max} = $0.80\ P_o$ for columns with rectangular reinforcement patterns (i.e. the program assumes tied columns)

P_{max} = $0.85\ P_o$ for columns with circular reinforcement patterns (i.e. the program assumes spiral reinforcing)

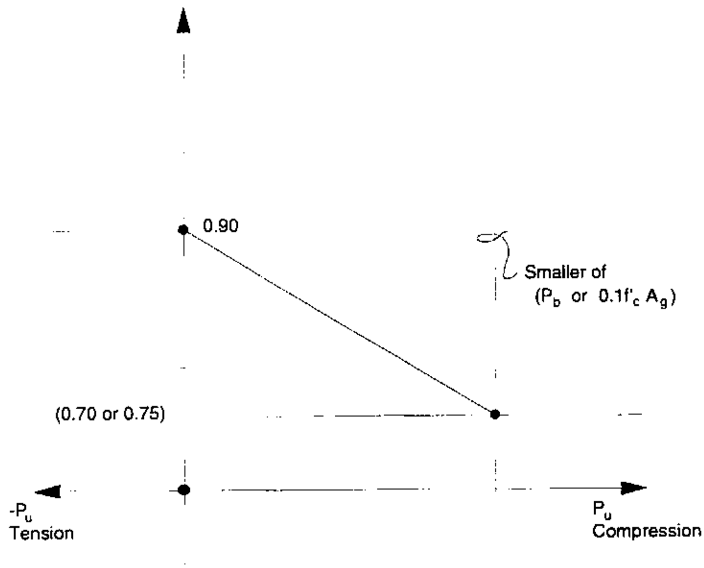
where

$$P_o = \varphi_{min}\,[\,0.85\,f'_c\,(A_g - A_{st}) + f_y\,A_{st}]$$

and

$\varphi_{min} = 0.70$ for tied columns and

$\varphi_{min} = 0.75$ for spirally reinforced columns.



Strength Reduction Factor, φ
Figure III-5

The value of φ used in the interaction diagram varies from φ_{min} to 0.9 based on the axial load. For low values of axial load, φ is increased linearly from φ_{min} to 0.9 as the axial load decreases from the smaller of $0.1\ f'_c\ A_g$ or P_b to zero. In cases involving axial tension, φ is always 0.9 (ACI 9.3.2.2). See Figure III-5.

2. Checking Column Capacity

The column capacity is checked for each loading combination at the top and bottom ends of each column. In checking a particular column for a particular loading combination at a particular location, the following steps are involved.

a. Determine the factored moments and forces from the analysis load conditions and the specified load combination factors to give P_u, M_{ux} and M_{uy}.

b. Determine moment magnification factors for the column moments.

c. Apply the moment magnification factors to the factored loads obtained in Step a. Determine if the point, defined by the resulting axial load and biaxial moment set, lies within the interaction volume.

The following three sections describe in detail the algorithms associated with the above-mentioned steps a, b, and c.

a. Determine Factored Moments and Forces

Each load combination is defined with a set of load factors corresponding to the eight ETABS load conditions. The analysis results associated with the ETABS load conditions are recovered from the post processing data file that was created by the corresponding ETABS analysis run. The factored loads for a particular load combination are obtained by applying the corresponding load factors to the ETABS load conditions, giving P_u, M_{ux} and M_{uy}. The factored moments are further increased, if required, to obtain minimum eccentricities of (0.6 + 0.03h) inches, where h is the depth of the column in the corresponding direction (ACI 10.11.5.5). Minimum eccentricity checks are performed for each direction moments separately.

In the design mode for seismic design using special moment resisting frames, the design is carried out for one other moment value about each axis separately. The moment is obtained by distributing to the top and bottom columns at a joint, a moment equal to 6/5ths the sum of the moment capacities of the beams framing into the joint. In calculating the moment capacities of the beams for this purpose, no yield overstrength factors are used and φ values are used. The program assumes a point of contraflexure at mid height of the columns to distribute this moment to top and bottom columns at a joint. The design for these moments is done in conjunction with the factored axial loads.

b. Determine Moment Magnification Factors

The moment magnification factors are different for moments causing sidesway and for moments not causing sidesway. Also the moment magnification factors in the major and minor directions can be different.

The moment magnification factors for moments causing sidesway, δ_{sx} and δ_{sy}, can be taken as 1.0 if a P-Delta analysis is carried out [11]. **The program assumes a P-Delta analysis has been made in ETABS and δ_{sx} and δ_{sy} are taken as 1.0.** The user is reminded of the special analysis requirements, especially those related to the value of EI used in analysis. (See Sections 10.10.1 and R10.10.1 of References [2 and 3].) If the program assumptions are not valid for a particular member the user can explicitly specify values of δ_{sx} and δ_{sy}.

The moment magnification factors for moments not causing sidesway associated with the major or minor direction of the column is given by

$$\delta_b = \frac{C_m}{1 - \frac{P_u}{\varphi P_c}} \qquad \text{(ACI 10.11.5.1 \& 10.11.7)}$$

where

$$P_c = \frac{\pi^2 EI}{(KL)^2} \text{ with } K = 1.0$$

and EI associated with a particular column direction given by the larger of:

$$EI = \frac{\frac{E_c I_g}{5} + E_s I_{se}}{1 + \beta_d} \qquad \text{(ACI 10.11.5.2)}$$

or

$$EI = \frac{E_c I_g}{2.5\,(1 + \beta_d)}$$

See Figure III-1 for definition of β_d

and $C_m = 0.6 + 0.4 \frac{M_1}{M_2}$ but not less than 0.4

M_1 and M_2 are the moments at the ends of the column and M_2 is numerically larger than M_1.

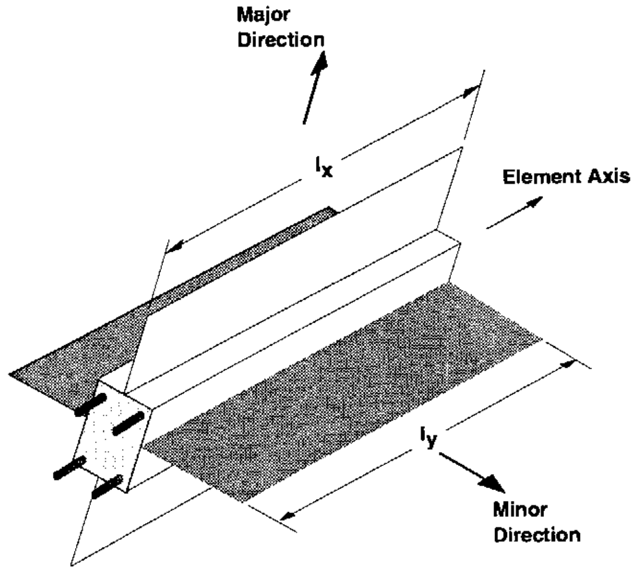
The magnification factor, δ_b , must be a positive number greater than one. Therefore P_u must be less than φ P_c. If P_u is found to be greater than or equal to φ P_c, a failure condition is declared.

The above calculations use the unsupported length of the column.

This section outlines the procedures used for the determination of the unsupported lengths of the column elements.

The two unsupported lengths are l_x and l_y, corresponding to instability in the major and minor directions of the element, respectively. See Figure III-6.

These are the lengths between the support points of the element in the corresponding directions.



Element Unsupported Lengths
Figure III-6

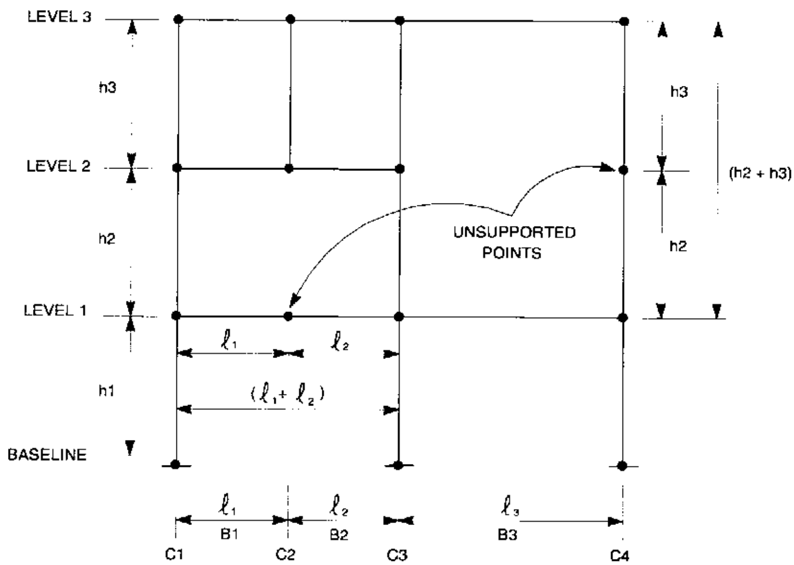
For column elements, the program will actually travel past any unsupported ends of the elements to automatically locate the element support point, and evaluate the corresponding unsupported element length.

Therefore, the unsupported length of a column may actually be evaluated as being greater than the corresponding story height. As shown in Figure III-7 the unsupported length for the column at Column line 4 at level 3 will not be h_3, but $(h_2 + h_3)$.

Therefore, in determining the values for l_x and l_y for the column elements, the program recognizes various aspects of the structure that have an effect on these lengths, such as member connectivity and diaphragm disconnections as described in this section.

Typically for columns, all floor diaphragms are assumed to be lateral support points, therefore, the unsupported length of a column is equal to the story height associated with the level. However, if a column is disconnected from any level, the unsupported lengths of the column are automatically recognized as being longer as a lateral support point is eliminated.

The program also recognizes that the columns can have different unsupported lengths corresponding to the major and minor directions. For example, beams



Tracing Unsupported Element Lengths
Figure III-7

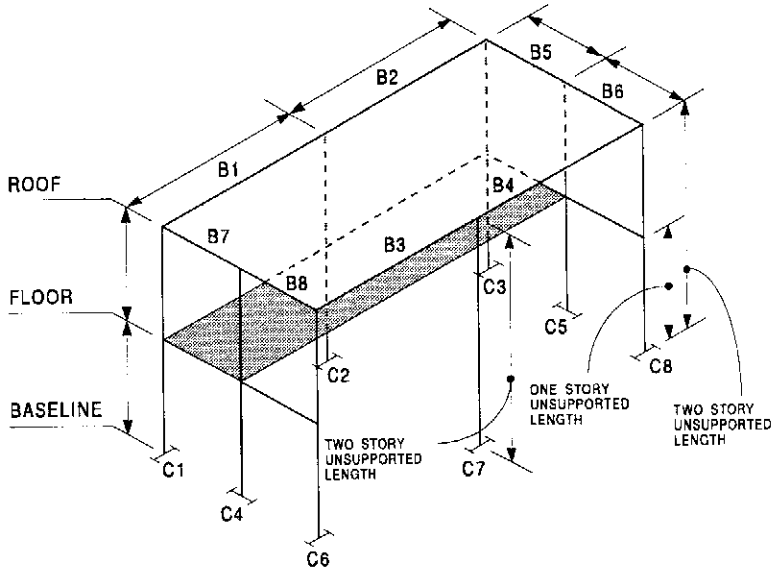
framing into disconnected column points in the column major or minor directions will give lateral support in the corresponding directions. However, if a beam frames into only one direction of the column at the level where the column has been disconnected from the diaphragm, the beam is assumed to give lateral support only in that direction. As shown in Figure III-8, Column line C8 laterally spans two stories in the column major direction and only spans one story in the column minor direction. Column line C1 is laterally supported at both levels in both directions and Column line C7 is laterally unsupported for two levels in both directions.

In all such situations, lateral support points and associated lateral unsupported lengths in corresponding directions are automatically recognized by the program and included in the calculation of the unsupported lengths of the columns.

c. Capacity Check

Before entering the interaction diagram to check the column capacity, the moment amplification factors are applied to the factored loads to obtain P, M_x and M_y, so that:

$$P = P_u$$



Conditions Affecting Unsupported Lengths
Figure III-8

$$M_x = \delta_{bx} M_{uxb} + \delta_{sx} M_{uxs}$$

$$M_y = \delta_{by} M_{uyb} + \delta_{sy} M_{uys}$$

where

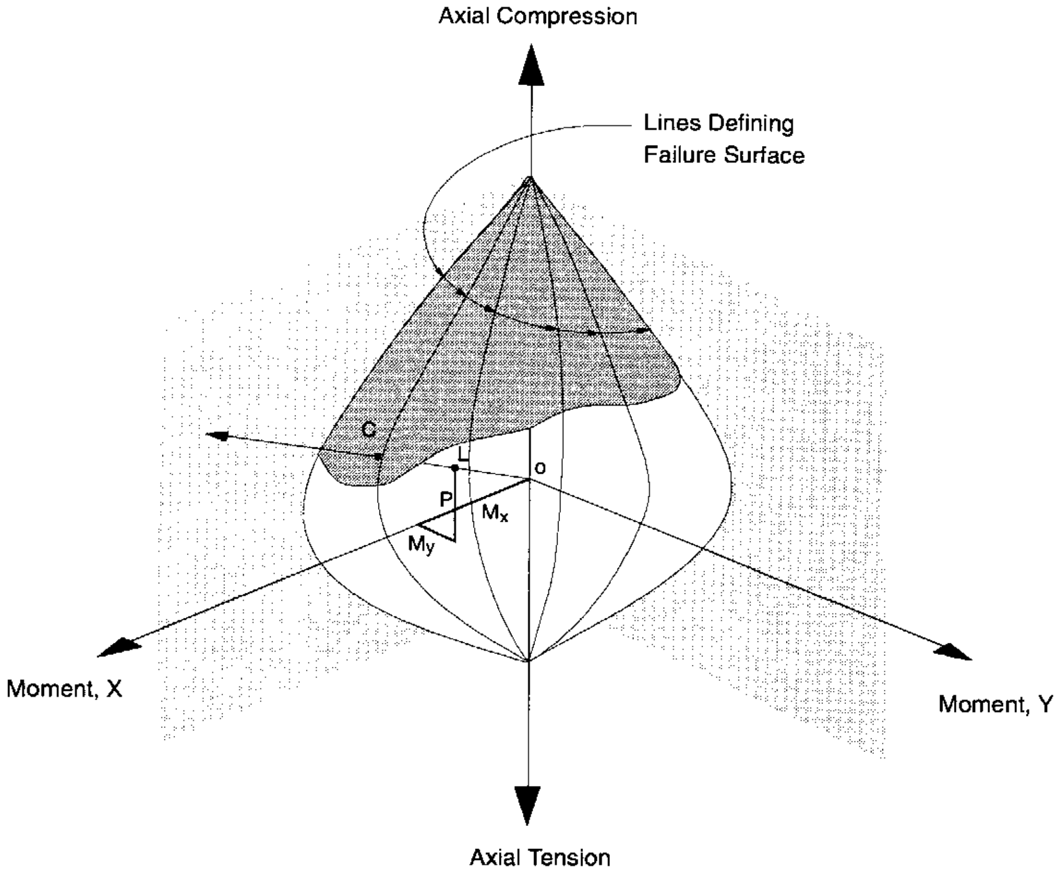
P_u is the factored axial load;

M_{uxb} and M_{uyb} are factored moments in the major and minor directions caused by gravity loads (Load Conditions I, II, and III) increased if necessary such that total moments satisfy minimum eccentricity requirements;

M_{uxs} and M_{uys} are factored moments in the major and minor directions caused by lateral loads (Load Conditions A, B, C, D1 and D2);

and δ_{bx}, δ_{by}, δ_{sx} and δ_{sy} are moment magnification factors as calculated earlier or as specified by the user.

The point P, M_x, M_y is then placed in the interaction space shown as Point L in Figure III-9. If the point lies within the interaction volume, the column capacity is



Geometric Representation of the Column Capacity Ratio
Figure III-9

adequate; however, if the point lies outside the interaction volume, the column is overstressed.

As a measure of the stress condition of the column, a capacity ratio is calculated.

This ratio is achieved by plotting the point L, defined by P, M_x and M_y, and determining the location of point C. The point C is defined as the point where the line OL (if extended outwards) will intersect the failure surface. This point is determined by three-dimensional linear interpolation between the points that define the failure surface. See Figure III-9.

The capacity ratio, CR, is given by the ratio $\frac{OL}{OC}$.

If OL = OC (or CR=1) the point lies on the interaction surface and the column is stressed to capacity.

If OL < OC (or CR<1) the point lies within the interaction volume and the column capacity is adequate.

If OL > OC (or CR>1) the point lies outside the interaction volume and the column is overstressed.

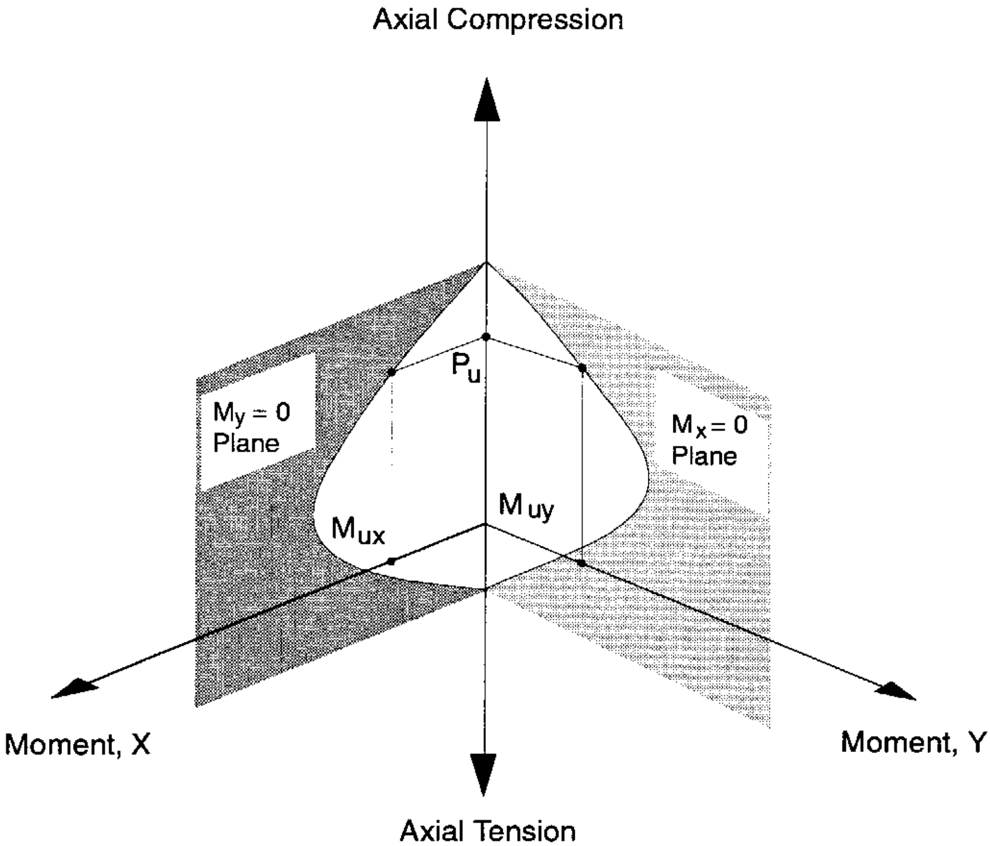
The maximum of all the values of CR calculated from each load combination is reported for each end of the column along with the controlling P, M_x and M_y set and associated load combination number.

The capacity ratio is basically a factor that gives an indication of the stress condition of the column with respect to the capacity of the column.

In other words, if the axial force and biaxial moment set for which the column is being checked is amplified by dividing it by the reported capacity ratio, the point defined by the resulting axial force and biaxial moment set will lie on the failure (or interaction volume) surface.

3. Design Column Shear Reinforcing

The shear reinforcing is designed for each loading combination in the major and minor directions of the column. In designing the shear reinforcing for a particular column for a particular loading combination due to shear forces in a particular direction, the following steps are involved:



Moment Capacity, M_u, at a Given Axial Load, P_u
Figure III-10

a. Determine the factored forces acting on the section, P_u and V_u. Note that P_u is needed for the calculation of V_c.

b. Determine the shear force, V_c, that can be resisted by the concrete.

c. Calculate the reinforcing steel required to carry the balance.

The following three sections describe in detail the algorithms associated with the above-mentioned steps, a, b and c.

a. Determine Section Forces

In the design of the column shear reinforcing of an ordinary moment resisting concrete frame, the forces for a particular load combination, namely, the column axial force, P_u, and the column shear force, V_u, in a particular direction are obtained by factoring the ETABS analysis load conditions with the corresponding load combination factors.

In the shear design of special and intermediate moment resisting frames (seismic design) additional checks are required.

In the design of intermediate moment resisting concrete frames, the shear force V_u in a particular direction is also calculated from the moment capacities of the column associated with the factored axial force acting on the column. For each load combination, the factored axial load P_u is calculated, using the ETABS analysis load conditions and the corresponding load combination factors.

Then, the moment capacity M_u of the column in a particular direction under the influence of the axial force P_u is calculated, using the uniaxial interaction diagram in the corresponding direction as shown in Figure III-10. The shear force V_u is then calculated as:

$$V_u = \frac{\sum M_u}{H}$$

where

H = the clear height of the column and

$\sum M_u$ is the sum of top and bottom

moment capacities.

It should be noted that the program will calculate a column unsupported height that is larger than the story height, if column line disconnects are present. In order to prevent inconsistency, it is strongly recommended that the column section properties between support points of the column be kept constant.

Other values required to be checked for Intermediate moment resisting frames are based on the specified load factors except the earthquake loads are doubled. (The program doubles the factors for Load Conditions A, B, C, D1 and D2 in the combinations.)

In the design of special moment resisting frames, the force V_u in a particular direction is also calculated from the probable moment capacities of the beams that frame into the column (ACI 21.4.5.1). The probable moment capacities are based on the steel yield overstrength factor, α, and the use of φ of 1.0. To obtain the column shear from the beam moments, the program first calculates column shear for columns above and below a joint (bottom shear for column above and top shear for column below), assuming point of contraflexure in the columns at mid heights. See Figure III-15. Since the top and bottom shear so computed could differ in value, an average of the two is used in design.

The minimum P_u from among the factored loads is used in conjunction with the above V_u.

This completes the required design force set, P_u and V_u.

b. Determine the Concrete Shear Capacity

Given the design force set P_u and V_u, the shear force carried by the concrete, V_c, is calculated as follows:

i. If the column is subjected to axial compression, P_u is positive, (ACI 11.3.1.2)

$$V_c = 2\sqrt{f'_c}\left(1 + \frac{P_u}{2000A_g}\right)A_{cv}$$

where V_c may not be greater than

$$V_c = 3.5\sqrt{f'_c}\sqrt{\left(1 + \frac{P_u}{500A_g}\right)}\,A_{cv}$$

ii. If the column is subjected to axial tension, P_u is negative, (ACI 11.3.2.3)

$$V_c = 2\sqrt{f'_c}\left(1 + \frac{P_u}{500A_g}\right)A_{cv} \geq 0$$

The term $\frac{P_u}{A_g}$ must have psi units.

See Figure III-11 for A_{cv}.

For special moment resisting frame concrete design, V_c is set to zero if $P_u < 0.05\, f'_c\, A_g$ (ACI 21.4.5.2).

c. Determine the Required Shear Reinforcing

Given V_u and V_c, the required shear reinforcing in area/unit length (e.g. square inches/foot) is given by

$$A_v = \frac{\frac{V_u}{\varphi} - V_c}{f_{ys}\, d}$$

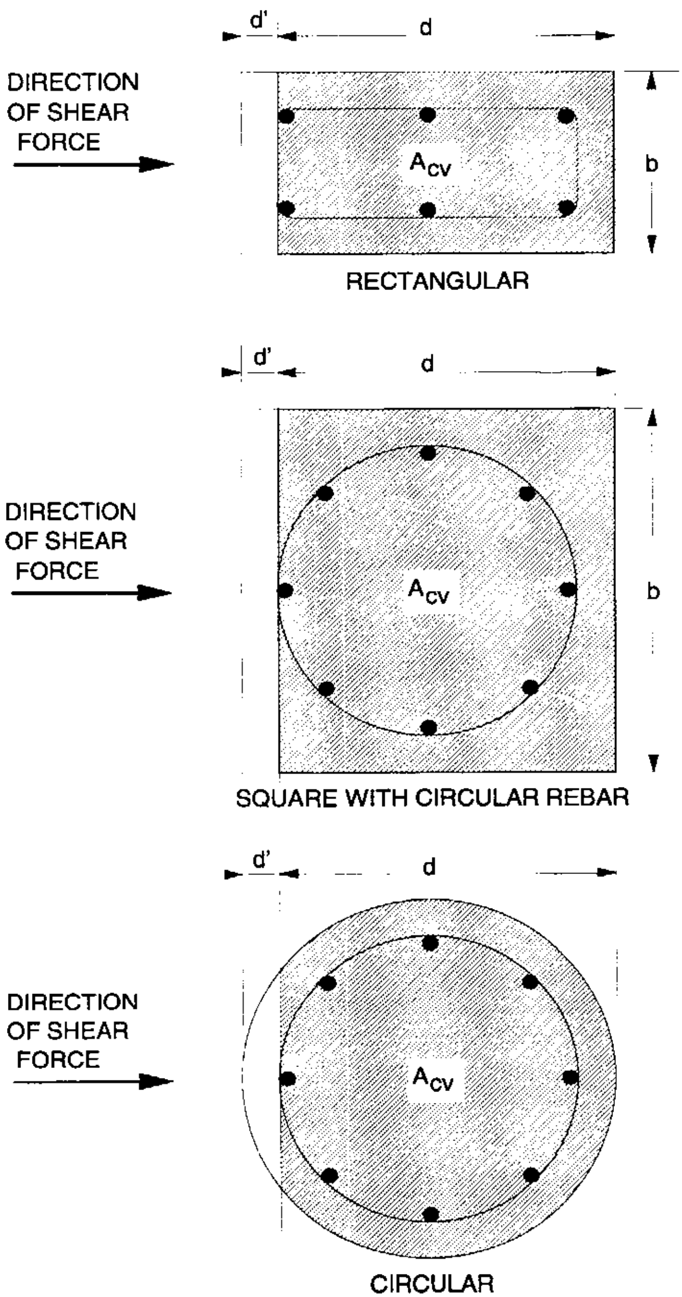
where $\frac{V_u}{\varphi} - V_c$ must not exceed $8\sqrt{f'_c}\, A_{cv}$ (ACI 11.5.6.8).

where φ, the strength reduction factor, is 0.85 (ACI 9.3.2.3). The maximum of all the calculated A_v values obtained from each load combination are reported for the major and minor directions of the column along with the controlling shear force and associated load condition number.

The column shear reinforcing requirements reported by the program are based purely upon shear strength consideration. Any minimum stirrup requirements to satisfy spacing considerations or transverse reinforcing volumetric considerations must be investigated independently of the program by the user.

C. Beam Design (ACI318-89 and UBC94)

In the design of concrete beams, the CONKER program will calculate and report the required areas of steel for flexure and shear based upon the beam moments and shears, load combination factors and other criteria described below. The reinforcing requirements are calculated at five stations along the beam span.



Shear Stress Area, A_{CV}
Figure III-11

All the beams are only designed for major direction flexure and shear. Effects due to any axial forces, minor direction bending and torsion that may exist in the beams (e.g. due to column disconnections) must be investigated independently of the program by the user.

The beam design procedure involves the following steps:

1. Design Beam Flexural Reinforcing

2. Design Beam Shear Reinforcing

1. Design Beam Flexural Reinforcing

The beam top and bottom flexural steel is designed at five stations along the beam span, namely END I, 1/4-PT, MIDDLE, 3/4-PT and END J.

In designing the flexural reinforcing for a particular beam for a particular section, for the beam major moment, the following steps are involved:

a. Determine the maximum factored moments

b. Determine the reinforcing steel

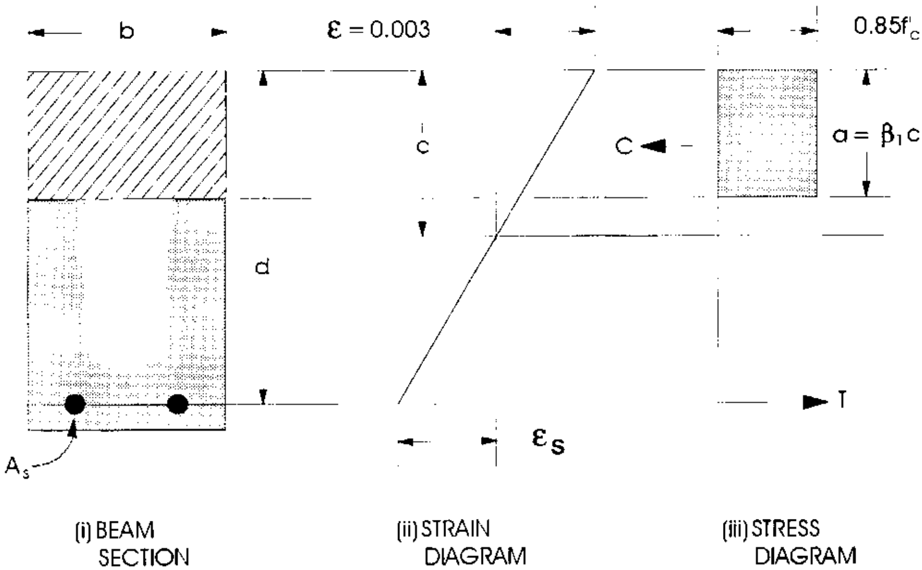
a. Determine the Factored Moments

In the design of flexural reinforcing of special, intermediate or ordinary moment resisting concrete frame beams, the factored moments for each load combination at a particular beam station are obtained by factoring the ETABS analysis load conditions with the corresponding load factors.

The beam section is then designed for the maximum positive M_u^+ and maximum negative M_u^- factored moments obtained from all of the load combinations.

Negative beam moments produce top steel. In such cases the beam is always designed as a rectangular section.

Positive beam moments produce bottom steel. In such cases the beam may be designed as a rectangular section, or T-Beam effects may be included.



Rectangular Beam Section Design
Figure III-12

b. Determine the Required Flexural Reinforcing

In the flexural reinforcing design process, the program assumes that all sections are singly reinforced. In other words, no compression reinforcing is designed and the effects of any reinforcing in the compression zone of the beam section are neglected.

In designing for a factored negative moment, M_u (i.e. designing top steel) the depth of the compression block is given by

$$a = d - \sqrt{d^2 + \frac{2M_u}{0.85\, f'_c\, \varphi\, b}}$$

where M_u is negative in the above equations.

If $a > 0.75\, \beta_1 c_b$, a concrete compression overstress is declared (ACI 10.3.3), where

$$\beta_1 = 0.85 - 0.05\left(\frac{f'_c - 4000}{1000}\right) \qquad \text{(ACI 10.2.7.3)}$$

with a maximum of 0.85 and a minimum of 0.65, and

$$c_b = \frac{87000}{87000 + f_y} d$$

The area of steel is then given by

$$A_s = \frac{M_u}{\varphi\, f_y \left(d - \frac{a}{2}\right)}$$

where the value of φ in the above equation is 0.90, (ACI 9.3.2.1).

In designing for a factored positive moment, M_u, (i.e. designing bottom steel), the formulation for calculating the area of steel is exactly the same as above if the beam section is rectangular, i.e. no T-Beam data has been specified. See Figure III-12.

If the member is a T-Beam, the depth of the compression block is given by

$$a = d - \sqrt{d^2 - \frac{2M_u}{0.85f'_c\, \varphi\, b_f}}$$

where $a < 0.75\, \beta_1\, c_b$

If $a < d_s$, the subsequent calculations for A_s are exactly as previously defined for the rectangular section design.

If $a > d_s$, calculation for A_s is in two parts. The first part is for balancing the compressive force from the flange, C_f, and the second part is for balancing the compressive force from the web, C_w.

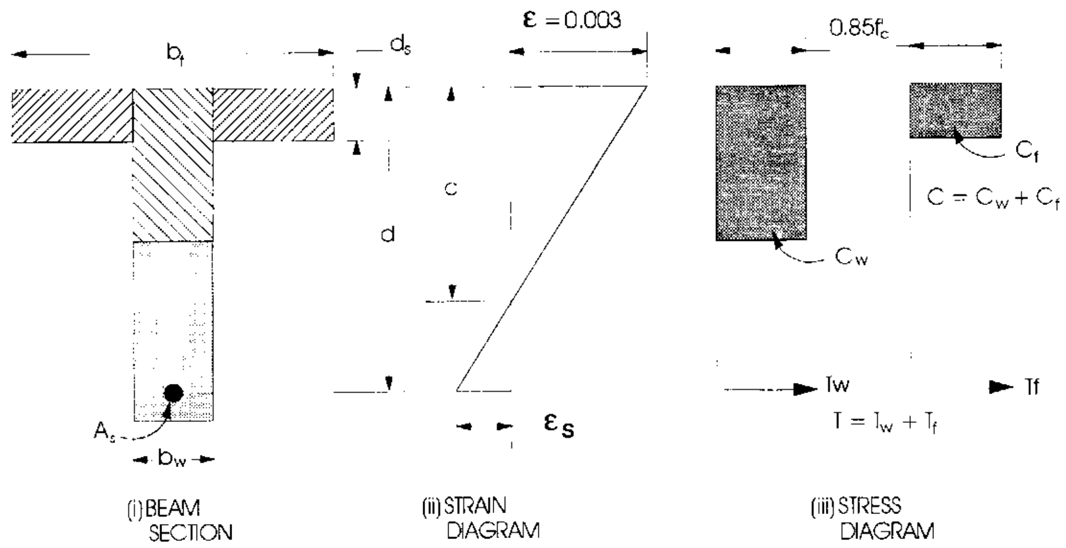
As shown in Figure III-13,

$$C_f = 0.85\, f'_c\, (b_f - b_w)\, d_s$$

Therefore $A_{s1} = \dfrac{C_f}{f_y}$

and the portion of M_u that is resisted by the flange is given by

$$M_{uf} = C_f \left(d - \frac{d_s}{2} \right) \varphi$$



T-Beam Section Design
Figure III-13

Therefore, the balance of the moment, M_u to be carried by the web is given by

$$M_{uw} = M_u - M_{uf}$$

The web is a rectangular section of dimensions b_w and d, for which the depth of the compression block is recalculated as

$$a_1 = d - \sqrt{d^2 - \frac{2M_{uw}}{0.85\, f'_c\, \varphi\, b_w}}$$

where $a_1 \leq 0.75\ \beta_1 c_b$

from which the second part of the reinforcing is calculated, giving

$$A_{s2} = \frac{M_{uw}}{\varphi\, f_y \left(d - \frac{a_1}{2}\right)}$$

The total required reinforcing for the T-section is then given by

$$A_s = A_{s1} + A_{s2}$$

Again, the value for φ is 0.90.

The minimum flexural steel provided in a section is given by

$$A_s\,(\min) = \frac{200\, b_w\, d}{f_y} \qquad \text{(ACI 10.5.1 and 21.3.2.1)}$$

For special moment resisting concrete frames (seismic design), the beam design will satisfy the following conditions:

i. The beam flexural steel is limited to a maximum given by

$$A_s\,(\max) = 0.025\ bd \qquad \text{(ACI 21.3.2.1)}$$

ii. At any end (support) of the beam, the beam positive moment capacity (i.e. associated with the bottom steel) will not be less than 50 percent of the beam negative moment capacity (i.e. associated with the top steel) at that end (ACI 21.3.2.2).

iii. The negative moment capacity at any of the beam span stations will not be less than one fourth of the negative moment capacity of any of the beam end (support) stations. Similarly, the positive moment capacity of the beam span stations will not be less than one fourth of the positive moment capacity of any of the beam end (support) stations, (ACI 21.3.2.2).

For intermediate moment resisting concrete frames (seismic design), the beam design will satisfy the following conditions:

i. At any support of the beam, the beam positive moment capacity will not be less than 1/3rd of the beam negative moment capacity at that end (ACI 21.8.4.1).

ii. The negative moment capacity at any of the beam span stations will not be less than 1/5th of the negative moment capacity of any beam support stations. Similarly, the positive moment capacity of the beam span stations will not be less than 1/5th of the positive moment capacity of any of the beam support stations (ACI 21.8.4.1.).

2. Design Beam Shear Reinforcing

The shear reinforcing is designed for each loading combination at five stations along the beam span, namely END I, 1/4-PT, MIDDLE, 3/4-PT and END J.

In designing the shear reinforcing for a particular beam for a particular loading combination at a particular station due to the beam major shear, the following steps are involved:

a. Determine the factored shear force, V_u.

b. Determine the shear force, V_c, that can be resisted by the concrete.

c. Determine the reinforcing steel required to carry the balance.

The following three sections describe in detail the algorithms associated with the above-mentioned steps a, b and c.

a. Determine the Shear Force and Moment

In the design of the beam shear reinforcing of an ordinary moment resisting concrete frame, the shear forces and moments for a particular load combination at a particular beam station are obtained by factoring the ETABS analysis load conditions with the corresponding load combination factors, to get the factored design shear V_u.

In the design of special and intermediate moment resisting concrete frames (seismic design), however, the shear force V_u is calculated from the moment capacities of each end of the beam and the gravity shear forces.

Therefore, for each load combination, at every beam station, the gravity beam shear force is calculated using only the ETABS analysis load conditions I, II and III to give unfactored V_{D+L}, for UBC code. However, for ACI code, the factored gravity loads are used to obtain V_{D+L}.

The design shear force V_u is then given by

$$V_p + V_{D+L} \qquad \text{(ACI 21.3.4.1)}$$

where V_P is the shear force obtained by applying the calculated ultimate moment capacities of the beams, acting in opposite directions, at the corresponding ends of the beams.

Therefore, V_P is the maximum of V_{P_1} and V_{P_2}

where $$V_{P_1} = \frac{M_I^- + M_J^+}{L}$$

and $$V_{P_2} = \frac{M_I^+ + M_J^-}{L}$$

where

M_I^- = Moment capacity at end I, with top steel in tension, using a steel yield stress value of $\alpha\, f_y$ and no φ factors.

M_J^+ = Moment capacity at end J, with bottom steel in tension, using a steel yield stress value of $\alpha\, f_y$ and no φ factors.

M_I^+ = Moment capacity at end I, with bottom steel in tension, using a steel yield stress value of $\alpha\, f_y$ and no φ factors.

M_J^- = Moment capacity at end J, with top steel in tension, using a steel yield stress value of $\alpha\, f_y$ and no φ factors.

L = Clear span of beam.

The overstrength factor α is always taken as 1.0 for intermediate moment resisting frames. For special moment resisting frames α is taken as 1.25, but the user has the option of overwriting this value.

It should be noted that the clear span of the beam is calculated by the program as the distance between actual beam support points (i.e. bypassing zero column lines) and may be longer than the bay length of the beam element. See Figure III-7. Similarly, the moment capacities M_I^-, M_J^+, M_I^+, and M_J^-, are evaluated at actual support points for the beam.

For intermediate moment resisting frames, an additional design shear force is calculated based on the specified load factors except the earthquake loads are doubled. (The program doubles the factors for Load Conditions A, B, C, D1 and D2 in the combinations.)

b. Determine the Concrete Shear Capacity

The allowable concrete shear capacity is given by

$$V_c = 2.0 \sqrt{f'_c}\, b_w d \qquad \text{(ACI 11.3.1.1)}$$

For special moment resisting frames, V_c is set to zero if $V_p > 0.5\ V_u$ (ACI 21.3.4.2).

c. Determine the Required Shear Reinforcing

Given V_u and V_c, the required shear reinforcing in area/unit length is calculated as

$$A_v = \frac{\frac{V_u}{\varphi} - V_c}{f_{ys}\ d}$$

$$\left(\frac{V_u}{\varphi} - V_c\right) \text{ must not exceed } 8 \sqrt{f'_c}\, bd \qquad \text{(ACI 11.5.6.8).}$$

where φ, the strength reduction factor, is 0.85, (ACI 9.3.2.3). The maximum of all the calculated A_v values, obtained from each load combination for each location, are reported along with the controlling shear force and associated load condition number.

The beam shear reinforcing requirements reported by the program are based purely upon shear strength considerations. Any minimum stirrup requirements to satisfy spacing considerations must be investigated independently of the program by the user.

D. Joint Design

To ensure that the beam-column joint of special moment resisting frames possesses adequate shear strength, the program performs a rational analysis of the beam-column panel zone to determine the shear forces that are generated in the joint. The program then checks this against allowable shear stress.

Only joints having a column below the joint are designed.

The material properties of the joint are assumed to be the same as those of the column below the joint.

The joint analysis is done in the major and the minor directions of the column. The joint design procedure involves the following steps:

1. Determine the panel zone design shear force V_u^h
2. Determine the effective area of the joint
3. Check panel zone shear stress

The following three sections describe in detail the algorithms associated with the above mentioned steps, 1, 2 and 3.

1. Determine the Panel Zone Shear Force

For a particular column direction, major or minor, the free body stress condition of a typical beam-column intersection is shown in Figure III-14.

The force V_u^h is the horizontal panel zone shear force that is to be calculated.

The forces that act on the joint are P_u, V_u, M_u^L and M_u^R. The forces P_u and V_u are axial force and shear force, respectively, from the column framing into the top of the joint. The moments M_u^L and M_u^R are obtained from the beams framing into the joint. The joint shear force V_u^h is calculated by resolving the moments into C and T forces.

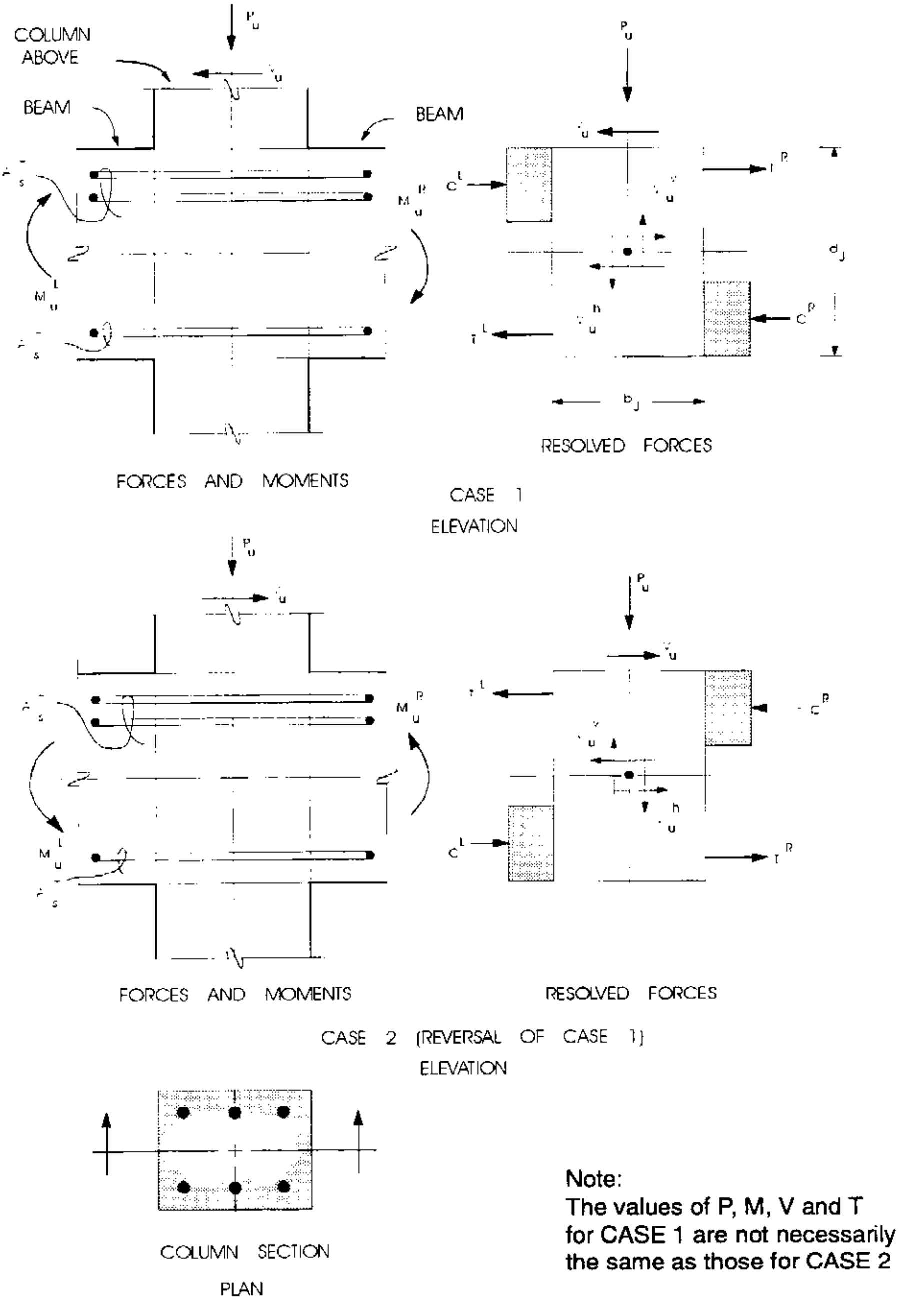
The location of C or T forces is determined by the direction of the moment using basic principles of ultimate strength theory.

Noting that $T_L = C_L$ and $T_R = C_R$,

$$V_u^h = T_L + T_R - V_u$$

The moments and the C and T forces from beams that frame into the joint in a direction that is not parallel to the major or minor directions of the column are resolved along the direction that is being investigated, thereby contributing force components to the analysis.

In the design of special moment resisting concrete frames, the evaluation of the design shear force is based upon the moment capacities, (with reinforcing steel



Beam-Column Joint Analysis
Figure III-14

overstrength factor, α , and no φ factors) of the beams framing into the joint, (ACI 21.5.1.1). The C and T forces are based upon these moment capacities. The column shear force V_u is calculated from the beam moment capacities as follows:

$$V_u = \frac{M_u^L + M_u^R}{H}$$

See Figure III-15.

It should be noted that the points of inflection shown on Figure III-15 are taken as midway between actual lateral support points for the columns, i.e. considering any column line disconnections.

The effects of load reversals, as illustrated in Case 1 and Case 2 of Figure III-14 are investigated and the design is based upon the maximum of the joint shears obtained from the two cases.

2. Determine the Effective Area of Joint

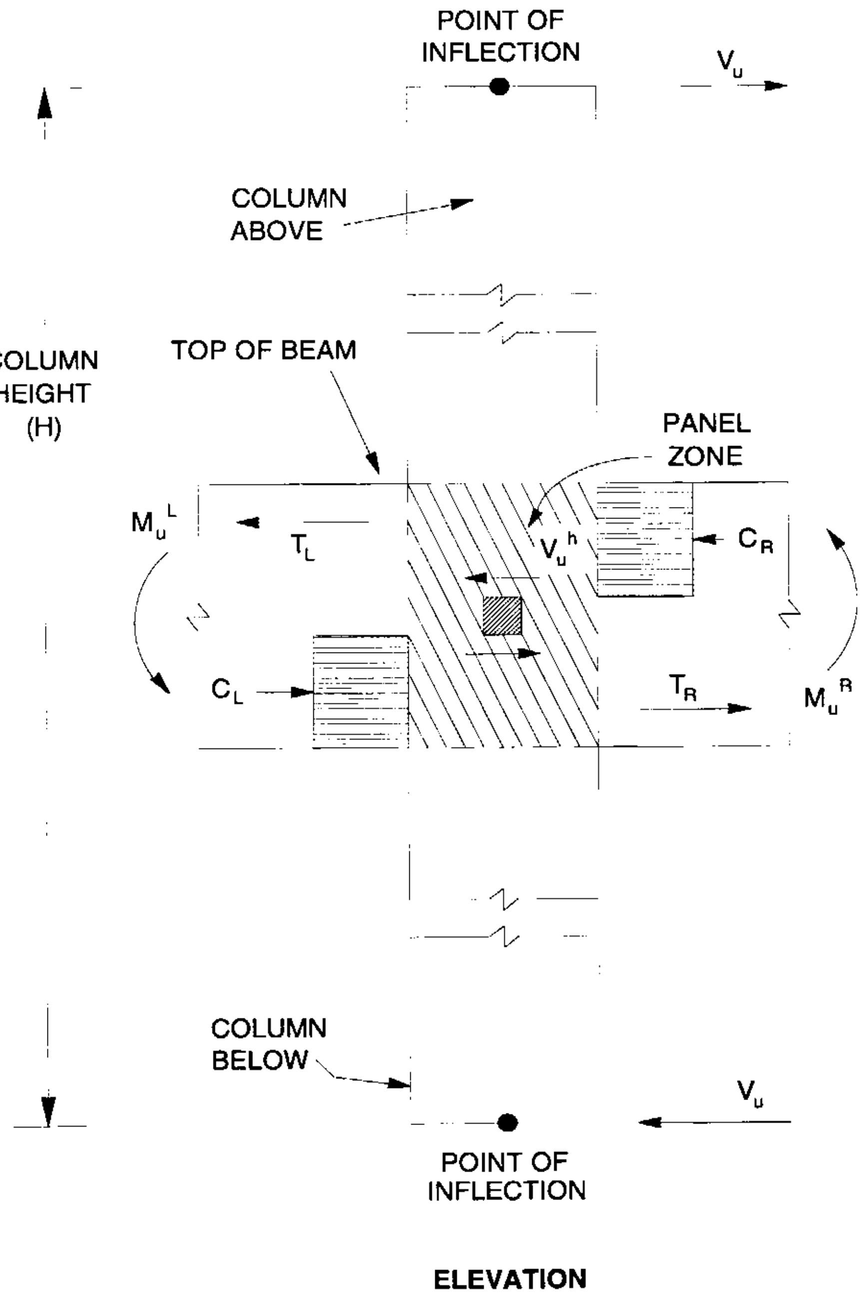
The joint area that resists the shear forces is assumed always to be rectangular. The dimensions of the rectangle correspond to the major and minor dimensions of the column below the joint, except that if the beam framing into the joint is very narrow, the width of the joint is limited to the depth of the joint plus the width of the beam. The area of the joint is assumed not to exceed the area of the column below.

It should be noted that if the beam frames into the joint eccentrically, the above assumptions may be unconservative and the user should investigate the acceptability of the particular joint.

3. Check Panel Zone Shear Stress

The panel zone shear stress is evaluated by dividing the shear force V_u^h by the effective area of the joint and comparing it with the following allowables: (ACI 21.5.3)

For joints confined on all four faces	$20\ \varphi \sqrt{f'_c}$
For joints confined on three faces or on two opposite faces	$15\ \varphi \sqrt{f'_c}$
For all other joints	$12\ \varphi \sqrt{f'_c}$



Column Shear Force, V_u
Figure III-15

Where $\varphi = 0.85$.

For joint design, the program reports the joint shear, the joint shear stress, the allowable joint shear stress and a capacity ratio.

E. Beam/Column Flexural Capacity Ratios

At a particular joint for a particular column direction, major or minor, the program will calculate the ratio of the sum of the beam moment capacities to the sum of the column moment capacities, (ACI 21.4.2.2). The capacities are calculated with no reinforcing overstrength factor, α , and including φ factors.

The beam capacities are calculated for reversed situations (Cases 1 and 2) as illustrated in Figure III-14 and the maximum summation obtained is used.

The moment capacities of beams that frame into the joint in a direction that is not parallel to the major or minor direction of the column are resolved along the direction that is being investigated and the resolved components are added to the summation.

The column capacity summation includes the column above and the column below the joint. For each load combination the axial force, P_u, in each of the columns is calculated from the ETABS analysis load conditions and the corresponding load combination factors. For each load combination, the moment capacity of each column under the influence of the corresponding axial load P_u is then determined for the major and minor directions of the column, using the uniaxial column interaction diagram, see Figure III-10. The moment capacities of the two columns are added to give the capacity summation for the corresponding load combination. The minimum capacity summations obtained from all of the load combinations is used for the beam/column capacity ratio.

The beam/column flexural capacity ratios are only reported for special moment resisting frames (seismic design).

F. Canadian Code Differences

Design criteria/algorithms for Canadian standards CAN-A23.3-M84 are the same as ACI318-89 except for the following modified formulas (expressed in millimeter-Newton units).

1. φ Factors

φ factors are material dependent and are defined as

$\varphi_c = 0.60$ for concrete and $\varphi_s = 0.85$ for steel (CAN 9.3.2 and 9.3.3)

2. Column Design

i. Maximum factored axial load resistance

for tied columns

$$P_{max} = 0.80\,[0.85\,\varphi_c\,f'_c\,(A_g - A_s) + \varphi_s\,f_y\,A_s]$$

(CAN 10.3.5.3)

and for columns with spiral reinforcement

$$P_{max} = 0.85\,[0.85\,\varphi_c\,f'_c\,(A_g - A_s) + \varphi_s\,f_y\,A_s] \qquad \text{(CAN 10.3.5.2)}$$

ii. Moment magnification factors

$$\delta_b = \frac{C_m}{1 - \dfrac{P_u}{\varphi_m\,P_c}} \qquad \text{(CAN 10.11.6.1)}$$

where $\varphi_m = 0.65$ and EI (to be used in the calculation of P_c) is given as

$$EI = \frac{0.2\,E_c\,I_g + E_s\,I_{se}}{1 + \beta_d} \quad \text{or} \quad EI = 0.25\,E_c\,I_g \qquad \text{(CAN 10.11.6.2)}$$

$$\text{and } \beta_d = \frac{\text{Max. factored dead load moment}}{\text{Max. factored total load moment}}$$

iii. Shear

For axial compression, P_u is positive and

$$V_c = 0.2\, \varphi_c \sqrt{f'_c} \left(1 + 3 \frac{P_u}{A_g\, f'_c} \right) b_w\, d \qquad \text{(CAN 11.3.4.3)}$$

For axial tension, P_u is negative and

$$V_c = 0.2\, \varphi_c \sqrt{f'_c} \left(1 + \frac{P_u}{0.6\, \varphi_c \sqrt{f'_c}\, A_g} \right) b_w\, d \qquad \text{(CAN 11.3.4.2)}$$

The shear in the reinforcing, V_s, is not to exceed

$$0.8\, \varphi_c \sqrt{f'_c}\, b_w\, d$$

3. Beam Design

i. Flexure

The depth of the compression block for a rectangular beam is computed as

$$a = d - \sqrt{d^2 - \frac{2\, M_u}{0.85\, f'_c\, \varphi_c\, b}}$$

$$a > \beta_1\, c_b$$

where

$$\beta_1 = 0.85 - \frac{0.08\, (\, f'_c - 30)}{10} \text{ except } 0.65 \le \beta_1 \le 0.85 \qquad \text{(CAN 10.2.7.C)}$$

and

$$c_b = \frac{600}{600 + f_y}\, d \qquad \text{(CAN 10.3.3)}$$

The area of steel is then given by

$$A_s = \frac{M_u}{\varphi_s\, f_y\, (\, d - \frac{a}{2})}$$

For a T-beam

$$a = d - \sqrt{d^2 - \frac{2M_u}{0.85\, f'_c\, \varphi_c\, b_f}}$$

If $a < d_s$ (see Figure III-13) calculations for A_s are exactly as previously defined for the rectangular section design.

If $a > d_s$, then A_{s1} (area of steel to balance compressive force from flange) and A_{s2} (area of steel to balance compressive force from web) are defined as

$$A_{s1} = \frac{C_f}{\varphi_s\, f_y}$$

$$A_{s2} = \frac{M_{uw}}{\varphi_s\, f_y \left(d - \frac{a_1}{2}\right)}$$

where

$$A_s = A_{s1} + A_{s2}$$

$$C_f = 0.85\, f'_c\, \varphi_c\, (b_f - b_w)\, d_s$$

$$M_{uf} = C_f\, (d - \frac{d_s}{2})$$

$$M_{uw} = M_u - M_{uf}$$

$$a_1 = d - \sqrt{d^2 - \frac{2\, M_{uw}}{0.85\, f'_c\, \varphi_c\, b_w}}$$

where

$$a_1 \leq \beta_1\, c_b$$

and

$$A_{s_{min}} = \frac{1.4\, b_w\, d}{f_y} \qquad \text{(CAN 10.5.1)}$$

ii. Shear

$$V_c = 0.2\, \varphi_c \sqrt{f'_c}\, bd \qquad \text{(CAN 11.3.4.1)}$$

and

$$V_s < 0.8\, \varphi_c \sqrt{f'_c}\, bd \qquad \text{(CAN 11.3.6.6)}$$

4. Special Moment Resisting Frames (ductile moment resisting frames)

For ductile moment resisting frames, the following conditions should be satisfied:

i. Columns

Column moments ≥ 1.1 Beam moments

$$V_c = 0 \quad \text{if} \quad P_u \leq 0.10\, f'_c\, A_g$$

ii. Beams

$$V_c = 0 \quad \text{if} \quad P_u \leq 0.10\, f'_c\, A_g$$

iii. Joints

The allowable panel zone shear stress is evaluated as follows

for confined joints

$$2.4\, \varphi_c \sqrt{f'_c} \qquad \text{(CAN 21.6.4.1a)}$$

for unconfined joints

$$1.8\, \varphi_c \sqrt{f'_c} \qquad \text{(CAN 21.6.4.1b)}$$

5. Intermediate Moment Resisting Frames (frames requiring nominal ductility)

Same as ACI318-89 except that special load combinations requiring factored shear forces with twice the earthquake loads are not checked.

Type of Check/Design	Ordinary Moment Resisting Frames (non-Seismic)	Intermediate Moment Resisting Frames (Seismic)	Special Moment Resisting Frames (Seismic)
Column Check (Interaction)	NLD Combinations	NLD Combinations	NLD Combinations
Column Design (Interaction)	NLD Combinations $1\% < \rho < 8\%$	NLD Combinations $1\% < \rho < 8\%$	NLD Combinations 6/5‡ Beam Capacity $\alpha = 1.0$ $1\% < \rho < 6\%$
Column Shears	NLD Combinations	Modified NLD Combinations (earthquake loads doubled)‡ Column Capacity $\varphi = 1.0$ and $\alpha = 1.0$	NLD Combinations and Beam Capacity $\varphi = 1.0$ and $\alpha = 1.25$
Beam Design Flexure	NLD Combinations	NLD Combinations	NLD Combinations $\rho_{max} \leq 0.025$
Beam Min. Moment Override Check	No Requirement	$M^+_{u_{END}} \geq \frac{1}{3} M^-_{u_{END}}$ $M^+_{u_{SPAN}} \geq \frac{1}{5} M^+_{u_{END}}$ $M^-_{u_{SPAN}} \geq \frac{1}{5} M^-_{u_{END}}$	$M^+_{u_{END}} \geq \frac{1}{2} M^-_{u_{END}}$ $M^+_{u_{SPAN}} \geq \frac{1}{4} M^+_{u_{END}}$ $M^-_{u_{SPAN}} \geq \frac{1}{4} M^-_{u_{END}}$
Beam Design Shear	NLD Combinations	Modified NLD Combinations (earthquake loads doubled)‡ Beam Capacity Shear (V_p) with $\alpha = 1.0$ and $\varphi = 1.0$ plus V_{D+L}	Beam Capacity Shear (V_p) with $\alpha = 1.25$ and $\varphi = 1.0$ plus V_{D+L}
Joint Design	No Requirement	No Requirement	Beam Capacity with $\alpha = 1.25$ and $\varphi = 1.0$
Beam/Column Ratios	No Requirement	No Requirement	Beam Capacity $\alpha = 1.0$ Column Capacity based on Uniaxial Capacity under Axial Loads from NLD Combinations

‡ The values are different for Canadian Code CAN-A23.3-M84. See Section F for differences.

Design Criteria Table
Figure III-16

Chapter IV

CONKER Input Data File

In order to execute the CONKER program, an ETABS post processing file and a CONKER input data file are required. However, if the program defaults are acceptable, the CONKER input data file is optional. The program defaults to the UBC94 code and special moment resisting frames.

The ETABS post processing file contains information pertaining to the structural geometry and loading and the analytical results from the corresponding ETABS analysis. This file forms the interface between ETABS and the CONKER post processor. Only those elements with material properties of C (concrete frame) will be processed by CONKER.

The user must read and understand the contents of Chapter III before proceeding with the data preparation described in this section.

The user should also be thoroughly familiar with the CONKER control variables described below, and with the main control variables of ETABS. Repeated references are made to these variables throughout this chapter.

The user is reminded of the following items which must be considered in preparing the ETABS input when it will be post processed by CONKER.

- For the built in loading combinations when using any code the CONKER program assumes that dead load is specified in ETABS Load Condition I, live load is specified in Load Condition II and the lateral loads are in Load Condition A, B, C, D1, and D2. The user must account for this when preparing the ETABS data. All scaling of loads (for example, dynamic response spectrum loads) should be done in the ETABS eight basic load conditions.

- The design algorithms for column design in CONKER assume that a P-Delta analysis has been made in ETABS. That is, the bending moments causing sidesway do not have to be further amplified by moment magnification factors. The ETABS program uses the specified story masses to calculate the vertical load, P to account for the P-Delta effects. A factor is provided to increase this effect to account for factored vertical loads and for inelastic displacements. The user should use this factor to account for factored dead and live loads due to which P-Delta effect should be accounted for in concrete design. The CONKER program also assumes that the ETABS Load Conditions I, II and III are used for gravity loads which do not cause significant sidesway and the remaining load conditions are used for lateral loads. If the above assumptions of the program are not correct for a particular problem, the user must provide over-riding moment magnification factors in the CONKER data.

- To automatically determine the real ends of a beam, which is needed to determine required shear strength from flexural capacity in seismic designs, the program differentiates between real and dummy columns. It is necessary that dummy column locations not have real property numbers even if the section properties themselves are specified as zeros.

- All input data for ETABS and CONKER must be prepared using the same set of consistent units. Either English (Kip-inch) or MKS metric (Kilogramforce-meter) or SI metric (KiloNewton-meter) units are possible. The type of units is specified in the ETABS input data. This is irrespective of the fact that all the numerical techniques described in Chapter III are presented in inch-pound-second units or millimeter-Newton-second units.

All input data for CONKER is prepared in free format form similar to the ETABS input data. The formatting rules described for the preparation of the ETABS input data (Chapter V of the ETABS User's Manual) also apply to the CONKER input data.

Data Block	When Needed
1. Main Control Data	Always
2. Load Combination Data	Only if **NLC** > 0
3. Material Property Redefinition Data	Only if **NRMP** > 0
4. Section Property Redefinition Data	
i. Column Properties	Only if **NRCP** > 0
ii. Beam Properties	Only if **NRBP** > 0
5. Frame Design Activation Data	
i. Frame Control Data	Only if **NFR** > 0
ii. Element Reassignment Data	
a. Column	Only if **IRCP** > 0
b. Beam	Only if **IRBP** > 0

Typical Data Setup for CONKER
Figure IV-1

There are basically five data sections associated with the CONKER input. A summary of the data setup is shown in Figure IV-1. The sequence of data lines described herein will establish the data file required by CONKER.

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

First, the format giving 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 tabular description in the form:

Variable **Field** **Note** **Entry**

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

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 at the end of the 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.

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

1. Main Control Data

Prepare the following data as defined in Sections a, b, c and d below. This data is always needed. A total of 5 data lines are required.

Format

a. Program Name and Version

Prepare one line of data to give the program name and version as follows:

CONKER 6.1

b. Heading Data

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

c. Execution Control Data

Prepare one line of data to define the program execution options in the following form:

ICODE NFR NLC LDC LLC NRMP NRCP NRBP NCRV NPTS IPRI IPHI

d. Output Control Data

Prepare one line of data to define the program map output options in the following form:

MBB MBV MCI MCV MJV MJR

If no CONKER input file is provided, the **Heading Data** defaults to the **Heading Data** of ETABS; the **ICODE** parameter defaults to 1 (i.e. the UBC94 code for concrete); **NFR** defaults to designing all frames; **NLC** defaults to using the loading combination defaults given in Section 2 later; **LDC** defaults to 1; **LLC** defaults to 2; **NRMP**, **NRCP**, and **NRBP** all default to zero; **NCRV** defaults to 5; **NPTS** defaults to 11; **IPRI** and **IPHI** default to zero.

Description

Variable	Field	Note	Entry
c. Execution Control Data			
ICODE	1	(1)	Code identifier: = 1 UBC94 = 2 ACI 318-89 = 3 CAN3-A23.2-M84
NFR	2	(2)	Number of frames to be designed.
NLC	3	(3)	Number of design loading combinations.
LDC	4	(4)	ETABS load condition number that corresponds to dead load: = 1 Vertical load condition I = 2 Vertical load condition II = 3 Vertical load condition III
LLC	5	(5)	ETABS load condition number that corresponds to live load: = 1 Vertical load condition I = 2 Vertical load condition II = 3 Vertical load condition III
NRMP	6	(6,7)	Number of redefined (or new) material property types.
NRCP	7	(6,8)	Number of redefined (or new) column section property types.
NRBP	8	(6,9)	Number of redefined (or new) beam section property types.
NCRV	9	(10)	Number of curves to be generated to define each column interaction volume diagram.
NPTS	10	(11)	Number of points on each curve.

Variable	Field	Note	Entry
IPRI	11	(12)	Interaction diagram print code: = 0 Suppress printing of curves = 1 Tabulate interaction curves
IPHI	12	(13)	Strength reduction factor φ overwrite code: = 0 use code values = 1 overwrite all φ's to 1.0

d. Output Control Data

MBB	1	(14)	Flag for map of beam bending reinforcement.
MBV	2		Flag for map of beam shear reinforcement.
MCI	3		Flag for map of column longitudinal reinforcement and/or interaction stress ratios.
MCV	4		Flag for map of column shear reinforcement.
MJV	5		Flag for map of joint shear stress ratios.
MJR	6		Flag for map of joint beam/column capacity ratios.

Notes

1. The CONKER program has options to check or design the concrete frame with respect to several different codes. This option allows the user to choose the code to be used. Refer to Chapter III for details of the checks used for the different codes.

   It is reiterated here that only the design checks listed in Chapter III are performed by the CONKER program. Other significant aspects of concrete frame design, for example detailing, minimum thickness, aspect ratios of sections, minimum reinforcement, confinement, development lengths, torsion design, etc., are not addressed by the program and should be separately addressed by the user.

2. This variable controls the number of frame design activation data sets to be provided in Section 5 below. If this number is zero, no data is expected or read in Section 5, but all frames are designed with default values.

3. This variable defines the number of design load combinations and controls the number of data lines to be read in Section 2 below. If this number is zero, no data is expected or read in Section 2, but the default values of loading combinations given in Section 2 are used.

4. This entry defines the vertical load condition of ETABS that corresponds to dead load. This information is required in the calculation of β_d used in computing moment magnification factors.

5. This entry defines the vertical load condition of ETABS that corresponds to the live load. The live load reduction factors are then applied to the member forces associated with this load condition, before they are summed into the combinations.

6. It is possible to redefine or add new material properties or section properties in the material and section property tables that the user originally defined in the ETABS data.

   Via this option, the user can modify the concrete frame and make design iteration runs with CONKER without rerunning the analysis runs of ETABS. After the design is satisfactory, the user must then incorporate the changes into the ETABS data and rerun analysis and design runs to final convergence.

7. The entry **NRMP** defines the number of material property sets that are defined in Section 3 below.

8. The entry **NRCP** defines the number of column section property sets that are defined in Section 4.i. below.

9. The entry **NRBP** defines the number of beam section property sets that are defined in Section 4.ii. below.

10. The column biaxial interaction volumes are defined by a series of three-dimensional interaction curves. The entry **NCRV** specifies the number of curves that will be used to define the volume. The larger the number of curves, the more accurate the definition of the failure surface. The default value for **NCRV** is 5. The maximum allowed value is 51. The value for **NCRV** must be odd. The first curve corresponds to major direction bending, with no minor direction bending and the **NCRV**-th curve corresponds to minor direction bending with no major direction bending.

11. Each interaction curve is defined by a series of points connected by straight lines. The entry **NPTS** specifies the number of points that will be generated on each curve. The default value for **NPTS** is 11. The maximum allowed value is 51. The value for **NPTS** must be odd.

12. The tabulation of each interaction volume diagram requires one page of output per curve. Therefore, if **NCRV** is set to 7, each concrete section tabulation will consume seven pages.

13. This option is useful if checks have to be made with respect to the ultimate capacities of the material.

14. If this entry is 0, the program will not produce display maps associated with this parameter. If this entry is 1, display maps will be created and will exist in the .MAP output file as described in Chapter V. If no CONKER input file is provided, these entries default to 1.

2. Load Combination Data

Load combinations to convert the ETABS analysis load conditions to factored ultimate load levels with load factors are specified in this section as summations of the eight basic load conditions, namely:

- The vertical static load conditions, I, II and III.
- The lateral static load conditions, A B and C.
- The lateral dynamic load conditions, D1 and D2.

The data provided in this data section is completely independent of the load case data that is provided in the corresponding ETABS analysis run.

Format

Provide one data line to define each of the **NLC** load combinations in the following form:

L LTYP XI XII XIII XA XB XC XD1 XD2

Description

Variable	Field	Note	Entry
L	1	(1)	Load combination 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 D1 and D2 load conditions, combine linearly with others
XI	3	(3)	Load factor for vertical Load Condition I.
XII	4		Load factor for vertical load condition II.
XIII	5		Load factor for vertical load condition III.
XA	6		Load factor for lateral static load condition A.
XB	7		Load factor for lateral static load condition B.
XC	8		Load factor for lateral static load condition C.
XD1	9		Load factor for dynamic load condition D1.
XD2	10		Load factor for dynamic load condition D2.

Notes

1. This number must be in ascending consecutive numerical 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. This type of combination is not recommended for CONKER. It has been kept here for consistency with ETABS.

   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 for considering orthogonal effects of seismic excitations.

   If this entry is 3, a SRSS combination of the Load Conditions D1 and D2 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. Each member is designed (or checked) for each of the specified loading combinations. The design (or stress ratio) from the controlling loading combination is reported.

   Typically, building structures are subjected to vertical loads due to dead and live loads which usually act downwards. In addition to the vertical loads, the building is usually subjected to lateral loads, resulting from wind or seismic forces, which act along different directions (usually assumed to be in two mutually orthogonal directions), and the directions are reversible.

   If the structure is subjected to dead load (DL) and live load (LL) only, the user need only specify one loading combination, namely, 1.4 DL + 1.7 LL as dead load and live load are not reversible.

   However, if in addition to the dead load (DL) and the live load (LL) the structure is subjected to wind forces from two mutually perpendicular reversible directions (WX, WY), the user needs to specify the following loading combinations. See Reference [1].

1. 1.4 DL + 1.7 LL
2. 0.75 (1.4 DL + 1.7 LL + 1.7 WX)
3. 0.75 (1.4 DL + 1.7 LL + 1.7 WY)
4. 0.75 (1.4 DL + 1.7 LL - 1.7 WX)
5. 0.75 (1.4 DL + 1.7 LL - 1.7 WY)
6. (0.9 DL + 1.3 WX)
7. (0.9 DL + 1.3 WY)
8. (0.9 DL - 1.3 WX)
9. (0.9 DL - 1.3 WY)

These are the program defaults whenever the ACI318-89 code is requested, assuming DL is gravity load condition I , LL is gravity load condition II, WX is static lateral load condition A and WY is static lateral load condition B. The user should specify other combinations if seismic loads are present.

When using UBC94 (Reference [2]) under seismic loads, the required loading combinations would be:

1. $1.4\,DL + 1.7\,LL$
2. $1.4\,DL + 1.4\,LL + 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} + EQT)$
3. $1.4\,DL + 1.4\,LL + 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} - EQT)$
4. $1.4\,DL + 1.4\,LL - 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} + EQT)$
5. $1.4\,DL + 1.4\,LL - 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} - EQT)$
6. $0.9\,DL + 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} + EQT)$
7. $0.9\,DL + 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} - EQT)$
8. $0.9\,DL - 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} + EQT)$
9. $0.9\,DL - 1.4\,(\sqrt{(EQX)^2 + (EQY)^2} - EQT)$

These are the program defaults whenever the UBC94 code is requested, assuming DL is gravity load condition I , LL is gravity load condition II, EQX is static lateral load condition A, EQY is static lateral load condition B and EQT is static lateral load condition C due to accidental torsion.

When using the CAN3-A23.2-M84 the load combinations for wind loads would be and the program defaults are:

1.	1.25 DL		
2.	1.25 DL +	1.5 LL	
3.	1.25 DL +	1.05 LL	+ 1.05 WX
4.	1.25 DL +	1.05 LL	- 1.05 WX
5.	1.25 DL +	1.05 LL	+ 1.05 WY
6.	1.25 DL +	1.05 LL	- 1.05 WY
7.	1.25 DL		+ 1.5 WX
8.	1.25 DL		- 1.5 WX
9.	1.25 DL		+ 1.5 WY
10.	1.25 DL		- 1.5 WY
11.	0.85 DL		+ 1.5 WX
12.	0.85 DL		- 1.5 WX
13.	0.85 DL		+ 1.5 WY
14.	0.85 DL		- 1.5 WY

3. Material Property Redefinition Data

This data section is only needed if the material property table that has been previously defined in the ETABS data is to be modified (or expanded).

If **NRMP** is 0, this data section is not needed and must be skipped. In this case, the values of the material properties used by CONKER will retain the values that were assigned in the ETABS data. However, if for any C material type the values for **FY, FC** or **FYS** have not been defined, they will be set to the default values defined herein (Notes 4, 5 and 6 below) irrespective of whether any material properties are being redefined.

If **NRMP** is not 0, provide **NRMP** data lines to redefine material property types that were previously defined in the ETABS data, or to define additional material property types.

Format

Prepare one line of data in the following form:

MID MTYPE E U W M ALPHA FY FC FYS FCS

Description

Variable	Field	Note	Entry
MID	1	(1)	Material identification number.
MTYPE	2	(2)	Material type: = S Steel = C Concrete (frames) = W Concrete (walls) = M Masonry (walls) = O Other
E	3		Modulus of elasticity.
U	4		Poisson's ratio.
W	5	(3)	Weight density (weight/volume).
M	6	(3)	Mass density (mass/volume).
ALPHA	7	(3)	Coefficient of thermal expansion.
FY	8	(4)	Yield stress of reinforcing steel
FC	9	(5)	Ultimate strength of concrete
FYS	10	(6)	Yield stress of shear reinforcing steel
FCS	11	(7)	Equivalent ultimate strength of concrete for shear strength evaluation.

Notes

1. The material property sets may be entered in any order; however, the identification numbers must lie between 1 and **NMAT+ NRMP**.

   If the identification number is less than or equal to **NMAT**, this property set will replace the corresponding material property set that was previously defined in the ETABS data. If the identification number is greater than **NMAT**, the material property table is expanded, and a new material property set corresponding to this identification number is created.

2. A series of design/stress check post processors operating off the ETABS post processing data base are available. The material type designation is basically an indicator for the post processors. The concrete frame design post processor CONKER, will only design those members that have a material type C. Material types S, W, M, and O are ignored by the CONKER program.

3. These values are not used by program CONKER, However, they are input here in the same order as in the ETABS input data for consistency with it.

4. If the yield stress has not been specified, it is assumed to be 60 ksi or the MKS or SI equivalent.

5. If the concrete strength has not been specified, it is assumed to be 4 ksi or the MKS or SI equivalent.

6. If the yield stress of the shear reinforcing has not been specified, it is assumed to be 40 ksi or the MKS or SI equivalent.

7. A non zero value for this parameter causes the program to use this equivalent value of f'_c in evaluating the value of $\sqrt{f'_c}$ for use in calculating the concrete shear strength, V_c. This option is useful for lightweight-aggregate concrete where an equivalent value of $\sqrt{f'_c}$ must be used in the shear design (ACI89 11.2.1 and 21.5.3.2). When using the Canadian code this option can similarly be used to account for the λ factor (CAN 11.2.3).

   A zero value for this parameter defaults to the value for **FC**.

4. Section Property Redefinition Data

This data section is only needed if the column or beam property tables that have been previously defined in ETABS are to be modified (or expanded) or reinforced concrete specific data is to be added to them.

Prepare one (or up to two) of the following data sections, 4.i. through 4.ii. below, to redefine the section property tables of the column and beam elements that make up the frames in the structure.

4.i. Column Property Redefinition Data

If **NRCP** is 0, skip this data section. Otherwise, provide **NRCP** data lines to redefine, add to or assign reinforced concrete specific data to the ETABS column property table.

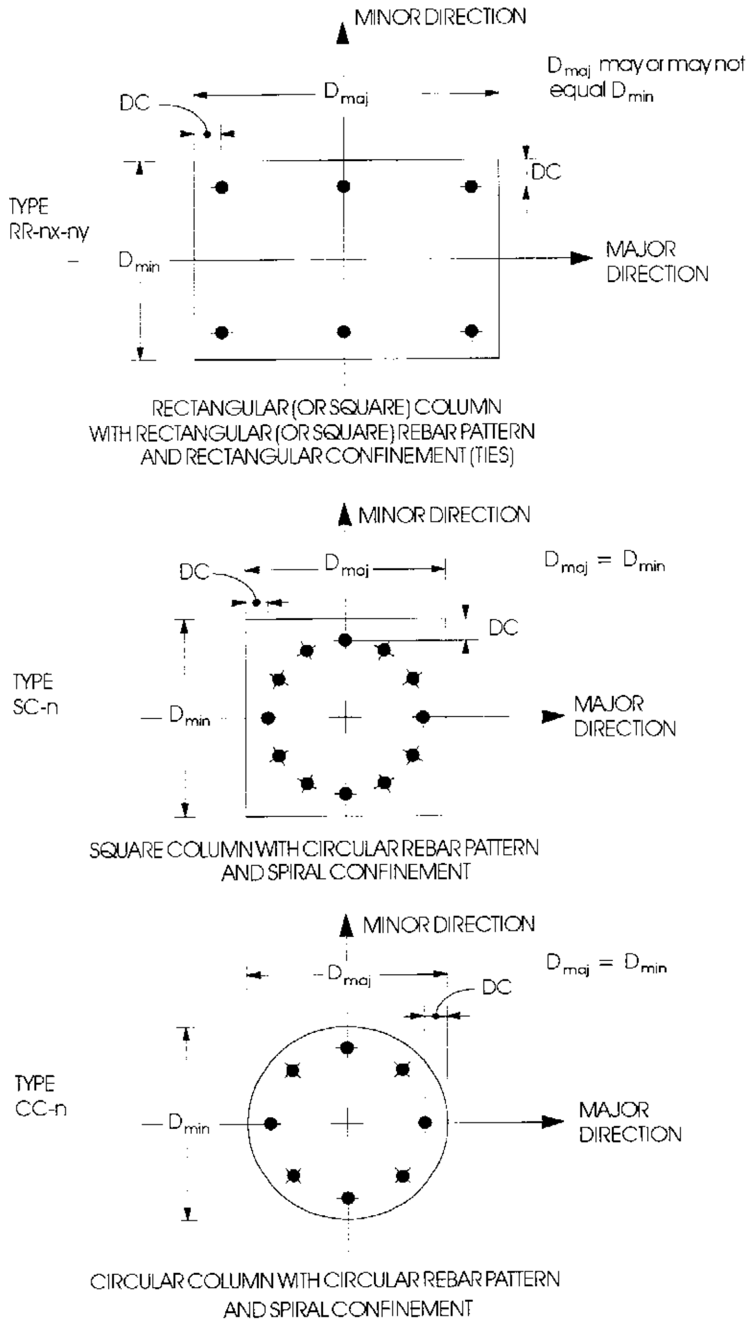
Format

Prepare one line of data in the following form:

ID ITYPE IMAT DMAJ DMIN DC ABAR1 ABAR2

Description

Variable	Field	Note	Entry
ID	1	(1)	Identification number of column section property set.
ITYPE	2	(2)	Section type: = RR-nx-ny = SC-n = CC-n
IMAT	3	(3)	Material identification number for this section property.
DMAJ	4	(4)	Section dimension in major direction.
DMIN	5		Section dimension in minor direction.
DC	6	(5)	Concrete cover to **center** of reinforcing bar.
ABAR1	7	(6)	Area of reinforcing bar at each corner for section type RR. Area of one of the reinforcing bars for SC and CC section types.
ABAR2	8	(7)	Area of one of the reinforcing bars except those at corners for section type RR.



Valid Column Sections and Rebar Configurations
Figure IV-2

Notes

1. The column property sets may be entered in any order; however, the identification numbers must be between 1 and **NCP + NRCP.**

   If the identification number is less than or equal to **NCP**, this property set will replace the corresponding column property set that was previously defined in the ETABS data. If the identification number is greater than **NCP**, the column property table is expanded and a new column property set corresponding to this identification number is created.

2. See Figures IV-2 and IV-3. Section type RR is a rectangular (or square) section with a rectangular (or square) reinforcing arrangement, consisting of nx layers of bars in the major direction of the column and ny layers of bars in the minor direction of the column. Neither nx or ny may be less than 2. The section is assumed tied.

   Section type SC is a square section with a circular reinforcing arrangement, consisting of n bars. The value of n must be even and must not be less than 4. The section is assumed spirally confined.

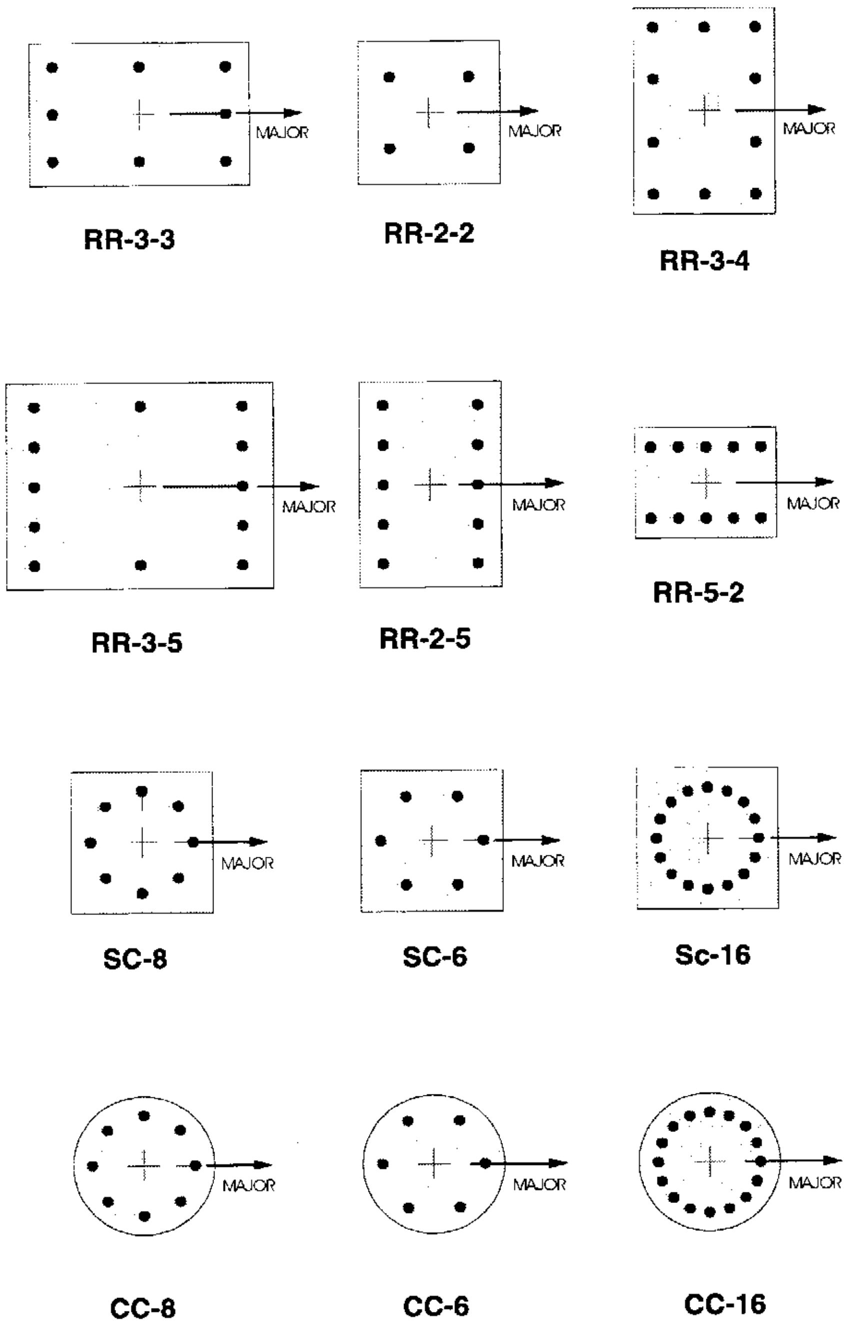
   Section type CC is a circular section with a circular reinforcing arrangement consisting of n bars. The value of n must be even and must not be less than 4. The section is assumed spirally confined.

   Note that all sections are doubly symmetric.

   If a column section is **not** redefined in this data section, the program assumes RR type reinforcement for rectangular (or square) sections and CC type reinforcement for circular sections. **The bar distribution is assumed uniform around the perimeter, with a cover to center of reinforcing as specified by DC.**

3. This entry references the material property types that were previously defined in the ETABS data or subsequently redefined in Section 3 above. This entry must not be less than 1 and must not be greater than the maximum number of material types which exist in the material property table.

4. **DMAJ** and **DMIN** define the dimensions of the column. For SC and CC type columns, **DMAJ** must be equal to **DMIN**. If not defined, the program defaults them to values specified in the ETABS data.



Examples of Valid Column Sections
Figure IV-3

5. The concrete cover is the same in the major or minor directions of the column. See Figure IV-2. If not defined, the program defaults it to the smaller of 10% of **DMAJ** and 10% of **DMIN**.

6. For SC or CC section types all bars in any one section must be of the same size. For RR section types the corner bars may be different in size from the other bars in the section.

7. A zero value for **ABAR2** defaults to the value for **ABAR1**. If **ABAR1** and **ABAR2** are both zero, the program will design the column longitudinal reinforcement.

4.ii. Beam Property Redefinition Data

If **NRBP** is 0, skip this data section. Otherwise, provide **NRBP** data lines to redefine, add to or assign reinforced concrete specific data to the ETABS beam property table.

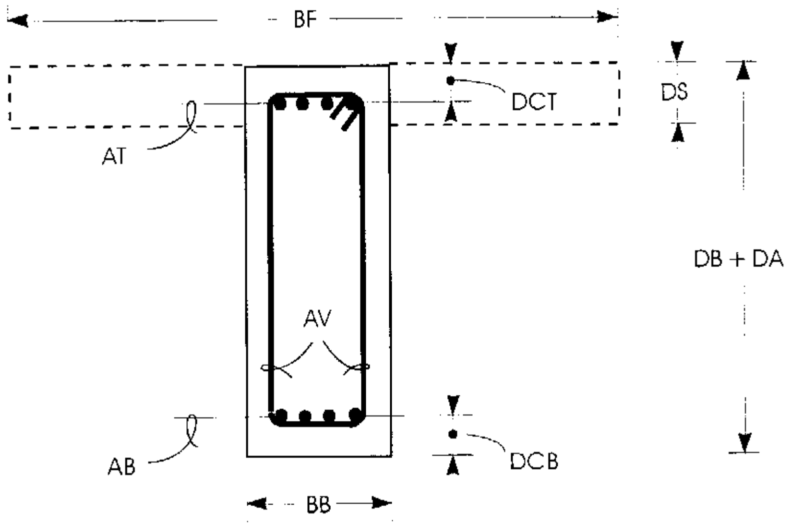
Format

Prepare one line of data in the following form:

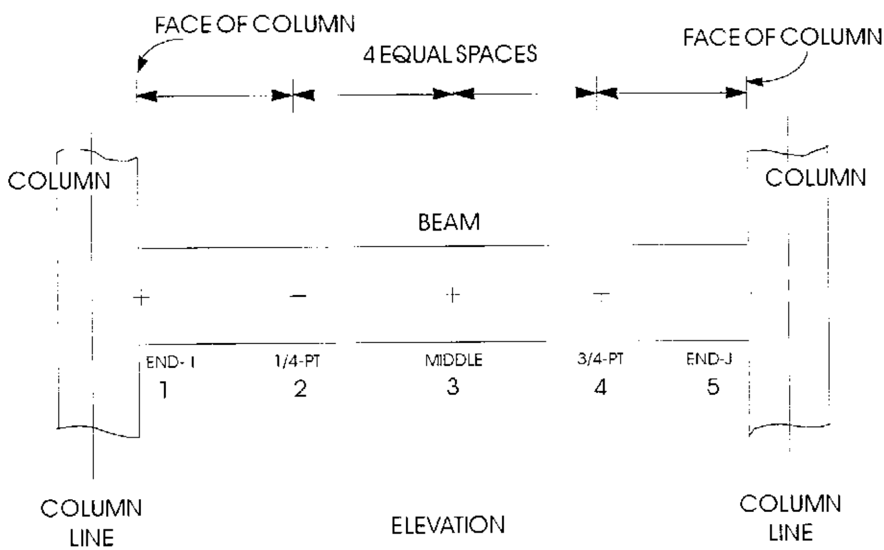
ID ITYPE IMAT DB DA BB DS BF DCT DCB ATI ABI ATJ ABJ

Description

Variable	Field	Note	Entry
ID	1	(1)	Identification number of beam section property set.
ITYPE	2	(2)	Section type = RCB
IMAT	3	(3)	Material identification number for this section property.
DB	4	(4,5)	Depth of beam below diaphragm.
DA	5	(4,5)	Depth of beam above diaphragm.
BB	6	(4)	Width of beam.
DS	7	(4,6)	Thickness of slab for T-Beam sections (enter 0.0 for rectangular sections).
BF	8	(4,6)	Effective width of slab for T-Beam sections (enter 0.0 for rectangular sections).
DCT	9	(4)	Concrete cover to center of top reinforcing steel.
DCB	10	(4)	Concrete cover to center of bottom reinforcing steel.
ATI	11	(7)	Actual top flexural area of steel at END I.
ABI	12	(7)	Actual bottom flexural area of steel at END I.
ATJ	13	(7)	Actual top flexural area of steel at END J.
ABJ	14	(7)	Actual bottom flexural area of steel at END J.



TYPICAL CONCRETE BEAM SECTION



TYPICAL CONCRETE BEAM DESIGN STATIONS

Beam Design Section and Stations
Figure IV-4

Notes

1. The beam property sets may be defined in any order, however, the identification numbers must be between 1 and **NBP + NRBP** .

   If the identification number is less than or equal to **NBP**, this property set will replace the corresponding beam property set that was previously defined in the ETABS data. If the identification number is greater than **NBP**, the beam property table is expanded and a new beam property set corresponding to this identification number is created.

2. The only valid reinforced concrete beam section type is RCB. Enter the three letters RCB for **ITYPE**.

3. This entry references the material property types that were previously defined in the ETABS data or subsequently redefined in Section 3 above. This entry must not be less than 1 and must not be greater than the maximum number of material types which exist in the material property table.

4. See Figure IV-4 for an illustration of this variable. If not defined, the program defaults **DCT** and **DCB** to 10% of (**DB** + **DA**).

5. For beam design the beam depth is assumed as **DB** + **DA**. The split between beam depth below and above diaphragm is used only in calculating clear lengths of columns. If not defined, the program defaults them to values specified in the ETABS data.

6. The entries **DS** and **BF** are for introducing T-Beam effects into the beam design algorithm.

   The depth **DS** is always assumed to be at the top of the beam and the T-Beam effect is only introduced when the moment condition indicates compression at the top of the beam.

   If **DS** = 0 or **BF** = 0 the section defaults to a rectangular section of dimensions **BB** times (**DB** + **DA**).

   The T-Beam section definition is purely for the design of the beam bottom steel. Any other section properties that are required in the design process are based upon the properties of the rectangular section **BB** times (**DB** + **DA**).

7. The program calculates top and bottom flexural areas of steel for all beams in the design process, and reports the required areas of steel.

   The area of steel that is actually provided could end up being more than what is required due to the round off in converting the area of steel to numbers of reinforcing bars. For the design of special moment resisting frames, the beam flexural capacities required for the shear design of the beam, the column and the beam-column joint need to be based upon the area of steel that is actually provided.

   The four values **ATI**, **ABI**, **ATJ** and **ABJ** are the areas of steel that are actually provided in the beam. See Figure IV-4. These values are only required for the special moment resisting frame design option. If these values are not input, the program will use the calculated areas of steel for implementing the design. If these values are input, the program will use the maximum of the provided and the calculated steel values.

   Obviously, these values are not known in the first design iteration runs, but as the design is finalized, these values are known and they must be introduced in the final runs to get the correct design.

   Correct beam/column moment capacity ratios are also dependent upon the actual steel values being input.

5. Frame Design Activation Data Sets

Provide **NFR** data sets, one for each of the ETABS frames that are to be designed/stress checked. Each set consists of one line of Frame Design Control Data and as many lines as needed of Element Reassignment Data as described in the following sections.

5.i. Frame Design Control Data

One line of control data is required.

Format

Prepare the data in the following form:

I ITYP IRCP IRBP ALPHA

Description

Variable	Field	Note	Entry
I	1	(1)	Frame sequence number that uniquely identifies this frame among the **NTF** total frames.
ITYP	2	(2)	Frame design type: = 1 Special moment resisting frame = 2 Intermediate moment resisting frame = 3 Ordinary moment resisting frame
IRCP	3	(3)	Column reassignment flag: = 0 No column reassignment provided = 1 Column reassignment provided
IRBP	4	(3)	Beam reassignment flag: = 0 No beam reassignment provided = 1 Beam reassignment provided
ALPHA	5	(4)	Reinforcing steel overstrength factor.

Notes

1. This is a positive non zero number, not greater than **NTF**. This sequence number refers to the sequence in which the frames are entered in the ETABS Frame Location Data. In this data section the frame that is entered first has a sequence number of 1, and the frame that is entered last has a sequence number of **NTF**.

   The frames may be designed in any sequence.

2. This flag determines whether the special seismic requirements of the codes are to be used. If **ITYP** is 1, the seismic requirements for special moment resisting frames (high seismic risk areas) are used. If **ITYP** is 2, the seismic requirements for intermediate moment resisting frames (moderate seismic risk areas) is used. If **ITYP** is 3, the seismic requirements are not used. The default value of **ITYP** is 1 (special moment resisting frames).

3. Irrespective of any section (or material) property redefinition in the column section (or material) property data above, it is possible to reassign section properties and/or live load reduction factors and/or moment magnification factors on a column-by-column basis by redefining the column assignment data. If **IRCP** is 1, the program will expect column reassignment data as defined in Section 5.ii.a. below.

   Similarly, **IRBP** applies to beam reassignment data.

4. In special moment resisting frame design this overstrength factor is used to obtain the probable reinforcing steel yield stress in calculating beam ultimate moment capacities. These moment capacities are used in calculating required beam and joint shear strength and column flexural and shear strength. If a zero value for this entry is specified it defaults to a value of 1.25.

   This entry is used only if **ITYP** is 1, i.e. special moment resisting frames.

5.ii. Element Reassignment Data

This data section is only needed if the column or beam element section property identifications, live load reduction factors or column moment magnification factors are to be modified or overridden.

Prepare one (or both) of the following data Sections a and b below, as required.

5.ii.a. Column Reassignment Data

If **IRCP** is 0, none of the column element parameters are to be reassigned, therefore, skip this data section (including the blank termination line defined below).

Otherwise, provide as many data lines as needed to define the required parameters. The order of input is immaterial, and parameter assignments for any column element at any level may be repeated. The last values read (or generated) will be used. **End this data section with a blank line.**

Format

Prepare the data in the following form:

NT NC1 NC2 NSAME SD1 SD2 P1 P2 P3 P4

Description

Variable	Field	Note	Entry
NT	1	(1)	Data line type: = I Property type = R Live load factor = D Moment magnification factors
NC1	2	(2,6)	Column line number of first column line being reassigned.
NC2	3		Column line number of last column line being reassigned.
NSAME	4	(3)	Column line number, the properties of which are to be repeated at column lines **NC1** through **NC2**.
SD1	5	(4,5)	Identification of the first story level associated with the column being reassigned.
SD2	6		Identification of the last story level associated with the column being reassigned.
P1	7	(6)	Parameter 1: = Column property ID (**NT** = I) = Live load factor (**NT** = R) = Major moment magnification factor (sidesway moments) (**NT** = D)
P2	8		Parameter 2: = Minor moment magnification factor (sidesway moments) (**NT** = D)
P3	9		Parameter 3: = Major moment magnification factor non-sidesway moment) (**NT** = D)
P4	10		Parameter 4: = Minor moment magnification factor (non-sidesway moment) (**NT** = D)

Notes

1. This entry identifies the type of data that is being defined by this data line. For example, if **NT** = R, the parameter **P1** on this data line is the live load reduction factor for the element.

2. This entry is a column line number. The number must not be greater than **NC**.

3. If **NSAME** is non zero, it is a column line number, the properties of which are already defined by default or by user specifications in preceding data lines of this data section. The non zero entry for **NSAME** puts the program into a duplication mode. In this mode, the member properties (as identified by the **NT** entry) for the column elements at all levels on column lines **NC1** through **NC2** are set identical to that of column line **NSAME** as it stands defined at the time of this entry.

   Subsequent reassignment of properties on column line **NSAME** in later data lines will not result in automatic corresponding reassignment of the properties on column lines **NC1** through **NC2**, or vice versa.

   In this duplication mode (i.e. when **NSAME** is non zero), the entries for **SD1**,**SD2**, **P1**, **P2**, **P3**, and **P4** are meaningless and must not be entered. These entries are only needed if **NSAME** is 0.

4. This entry is an alphanumeric story identifier that must correspond to one of the story level identifiers previously defined in the ETABS data. The story level associated with a column element is the story level at the top of the column.

5. All column elements existing on column lines **NC1** through **NC2** associated with levels **SD1** through **SD2** will be assigned the properties identified by the entries **NT**, **P1**, **P2**, **P3** and **P4** on this data line.

6. If **NT** = I, the data line is for reassigning member property identifications and the parameter **P1** is an integer entry referring to the section property tables originally defined in the ETABS data or redefined in Section 4 above. If **NT** = I, **P2**,**P3** and **P4** are not used. The default values for the section properties are as originally defined in the ETABS data.

   If **NT** = R, the data line is for defining live load reduction factors. The entry **P1** is the live load reduction factor for the element.

   Thus, for instance, if the axial force in a column at a particular level for load condition **LLC** is 50k, and the entry for **P1** is 0.7, then the axial force in load condition **LLC** (that will further be scaled by the design load combinations) will be taken as

$$0.7 \text{ x } 50^{k} = 35^{k}$$

The program does not have any algorithm based upon tributary area to calculate the live load reduction factor automatically. The default value for the live load reduction factor is 1.0.

If **NT** = R, **P2**, **P3** and **P4** are not used.

If **NT** = D, the data line is for defining column element moment magnification factors. The entries **P1** and **P2** are the moment magnification factors for sidesway moments (from Load Condition A, B, C, D1 and D2) in the major and minor directions, respectively. The default values for these is 1.0 as the program assumes a P-Delta analysis has been made. The entries **P3** and **P4** are moment magnification factors for non-sidesway moments (from Load Conditions I, II and III) in the major and minor directions respectively. The default values for these are as calculated in the algorithms defined in Chapter III.

5.ii.b. Beam Reassignment Data

If **IRBP** is 0, none of the beam element parameters are to be reassigned, therefore, skip this data section (including the blank termination line defined below). Also, if **NB** is 0 there are no bays defined in this frame. Therefore, skip this data section completely (including the blank termination line defined below).

Otherwise, provide as many data lines as needed to define the required parameters. The order of input is immaterial, and parameter assignments for any beam element at any level may be repeated. The last values read (or generated) will be used. **End this data section with a blank line.**

Format

Prepare the data in the following form:

NT NB1 NB2 NSAME SD1 SD2 P

Description

Variable	Field	Note	Entry
NT	1	(1)	Data line type: = I Property type = R Live load factor
NB1	2	(2,5)	Bay number of first bay being reassigned.
NB2	3		Bay number of last bay being reassigned.
NSAME	4	(3)	Bay number, the properties of which are to be repeated at bays **NB1** through **NB2**
SD1	5	(4,5)	Identification of the first story level associated with the beam being reassigned.
SD2	6		Identification of the last story level associated with the beam being reassigned.
P	7	(6)	Parameter: = Beam property ID (NT = I) = Live load factor (NT = R)

Notes

1. This entry identifies the type of data that is being defined by this data line. For example, if **NT** = R, the parameter **P** on this data line is the live load reduction factor for the element.

2. This entry is a bay number. The number must be positive and not greater than **NB**.

3. If **NSAME** is non zero, it is a bay number, the properties of which are already defined by default or by user specification in preceding data lines of this data section. The non zero entry for **NSAME** puts the program into a duplication mode. In this mode, the member properties (as identified by the **NT** entry) for the beam elements at all levels in bays **NB1** through **NB2** are set identical to that of bay **NSAME** as it stands defined at the time of this entry.

   Subsequent reassignment of properties to bay **NSAME** in later data lines will not result in automatic corresponding reassignment of the properties in bays **NB1** through **NB2**, or vice versa.

   In the duplication mode (i.e. when **NSAME** is non zero), the entries for **SD1**, **SD2** and **P** are meaningless and must not be entered. These entries are only used if **NSAME** is 0.

4. This entry is an alphanumeric story identifier that must correspond to one of the story level identifiers previously defined in the ETABS data.

5. All beam elements existing in bays **NB1** through **NB2** between levels **SD1** through **SD2** will be assigned the properties identified by the entries **NT** and **P** on this data line.

6. If **NT** = I, the data line is for reassigning member property identifications and the parameter **P** is an integer entry referring to the section property tables originally defined in the ETABS data or redefined in Section 4 above. The default values for the section properties are as originally defined in the ETABS data.

   If **NT** = R, the data line is for reassigning live load reduction factors. The entry **P** is the live load reduction factor for the beam.

   Thus, for instance, if the shear force in a particular beam at a particular level for load condition **LLC** is 50k, and the entry for **P** is 0.7, then the shear force in load condition **LLC** (that will further be scaled by the design load combinations) will be taken as

$$0.7 \text{ x } 50^k = 35^k$$

The program does not have any algorithm based upon tributary area of the beam to calculate a live load reduction factor. The default value for the live load reduction factor is 1.0.

Chapter V

Program Output

A. Description of Output Files

If the name of the ETABS analysis data file is EXCON, the ETABS analysis will produce a post processing file called EXCON.PST.

If the name of the CONKER input data file is DESCON, there will be three output files produced by CONKER, namely DESCON.CNK, DESCON.COL and DESCON.MAP. However, if the program defaults are acceptable and the CONKER input data file is not provided, the three output files produced by CONKER are EXCON.CNK, EXCON.COL and EXCON.MAP.

Sample output is presented in the last section of this manual. For English units, all output is in kip-inch units except for the shear reinforcing steel, which is in square inches/foot. For MKS units, **all** tabulations associated with the **echoing of the input data** are in MKS units. However, **all calculated** forces and moments are in meter-ton-second units. **All calculated** reinforcing steel is output in square centimeters and all shear steel is tabulated in square centimeters/meter. For SI units, all output is in meter-kiloNewton units except calculated reinforcing steel is output in square centimeters and all shear reinforcing steel is tabulated in square centimeters/meter.

In addition to the echo of all of the CONKER input data and control information recovered from the ETABS post processing file, the file DESCON.CNK contains the following:

1. For each concrete beam, the file will contain the controlling positive and negative bending moments and shear forces at each of the five beam stations, along with the controlling load combination numbers and required top and bottom flexural reinforcing and shear reinforcing. See Figure V-2 for details of the output format.

2. In the design mode for each concrete column, the file will contain the required longitudinal reinforcement at the top and bottom of the column with associated controlling design load combination numbers and the critical axial force and biaxial moments. However, for columns in the check mode, the controlling moment interaction capacity ratios are reported instead of the longitudinal reinforcement. The required shear reinforcing in the major and minor direction of the column, along with the controlling load combination number of the critical shear force is also tabulated. See Figure V-2 for details of the output format.

3. For each beam/column joint, the file will contain the controlling joint shear force in the major and minor direction of the column that corresponds to the joint, effective joint area, joint shear stress, allowable shear stress and shear stress ratio.

   Also, for special moment resisting concrete frames, the file will contain beam/column moment capacity ratios in the major and minor directions of the column that corresponds to the joint. See Figure V-2 for details of the output format.

The file DESCON.COL contains additional back-up information pertaining to the design or checking of each column. The file contains the following:

1. A tabulation of the concrete column moment interaction curves. Each concrete section property type will have a moment interaction volume generated that is defined by a series of **NCRV** curves. See Figure III-2. The first curve lies in the P-M_x plane with M_y being zero, the **NCRV**-th curve lies in the P-M_y plane with M_x being zero. All other curves are in a general three-dimensional space having P, M_x and M_y components. The interaction diagrams are tabulated both with the strength reduction factor and without it. The P_{max} limit is included in both tables. The printing of these tables is optional.

2. At top and bottom of each concrete column, the file will contain information on the moment magnification factors for non-sidesway moments, δ_b, in the major and minor direction and the coordinates of the failure surface point, namely point C in Figure III-9. The moment magnification factors for sidesway moments are assumed to be 1.0 (because of P-delta analysis), unless overridden by the user in which case the specified values are echoed in the .CNK file. See Figure V-3 for details of the output format.

The design output for a particular frame is in the following sequence:

1. Starting from the top of the frame, the design of all of the beams at a particular level, followed by the design of all of the beams at the next level below, and so on.

2. Starting from the top of the frame, the design of all of the columns at a particular level, followed by the design of all of the columns at the next level below, and so on. Also columns to be designed are printed separately from and before columns to be checked.

3. Starting from the top of the frame, the design of all of the joints at a particular level, followed by the design of all of the joints at the next level below, and so on.

The file DESCON.MAP contains numerical maps of design parameters. Maps are printed for beam bending and shear reinforcement; column longitudinal reinforcement (or stress ratios) and shear reinforcement; and joint shear stress ratios and beam/column capacity ratios. These maps display the parameters in a spatial manner that corresponds to an elevation view of the frame being designed.

B. Design Overstress and Failure Conditions

In the design or capacity check process, the program will produce diagnostic messages if overstress or failure conditions are encountered.

The diagnostics are in the form of check numbers, namely CHK#1, CHK#2, etc.

A description of the design diagnostic checks are presented in Figure V-1.

C. Details of Output Information

The following notes detail the information that is presented in the output files produced by the program. The notes correspond to the numbers shown in Figures V-2 and V-3.

1. This is the bay number of the beam.

2. This is the size of the beam being used. For a T-Beam section, these are the dimensions of the beam web.

3. This is the station identification where the stress ratio is being evaluated.

4. This is the maximum factored negative moment value (negative sign suppressed) at the station from all the loading combinations along with the number of the controlling load combination. In ductile concrete design, if minimum moment capacity requirements govern (ACI 21.3.2.2), the controlling load combination is given as zero.

5. This is the maximum factored positive moment value at the station from all the loading combinations along with the number of the controlling load combination. In ductile concrete design, if minimum moment capacity requirements govern (ACI 21.3.2.2), the controlling load combination is given as zero.

6. This is the maximum factored design shear force at the station from all the loading combinations along with number of the controlling load combination.

7. This is the required top reinforcing at the station corresponding to the factored negative design moment. These values are subject to a minimum (ACI 10.5.1 and ACI 21.3.2.1).

8. This is the required bottom reinforcing at the station corresponding to the factored positive design moment. These values are subject to a minimum (ACI 10.5.1 and ACI 21.3.2.1).

9. This is the required shear reinforcing in square inches/foot (or square centimeters/ meter), namely vertical stirrups, averaging an area equal to this reported value for every foot of beam length to be provided. For example, if the reported steel is 0.60, and the shear reinforcing is of the type shown in the beam section in Figure IV-4, a #5 stirrup (area = 0.31 square inches) placed at 12 inches center to center will be adequate, giving a total of 0.62 square inches/foot. (Note: minimum requirements should be checked separately by the user).

CHECK #	OVERSTRESS CONDITION
CHK #1	Concrete compression failure (depth of compression block exceeds maximum allowed)
CHK #2	Percentage of steel in beam design exceeds maximum allowed
CHK #3	Shear stress exceeds maximum allowed (or shear design cannot be implemented because the calculation of beam flexural capacities is not possible)
CHK #4	Column design moments cannot be calculated because calculation of beam flexural capacity is not possible
CHK #5	Moment magnification factor cannot be calculated because $P_u \geq \varphi P_c$
CHK #6	Percentage of steel in column design exceeds the maximum allowable
CHK #7	Beam/column capacity ratios cannot be calculated due to beam or column flexural overstresses

Design Overstress Checks
Figure V-1

10. This is the column line ID number of the column.

11. This is the size and type of the column being used.

12. This is the station identification where the stress ratio or longitudinal reinforcement is evaluated.

13. This is the controlling axial force and biaxial moment set that produced the controlling stress ratio. A negative axial force indicates tension. The values include the effects of the load factors from the controlling load combination and the moment magnification factors.

14. This is the controlling load combination number that produced the controlling design or the controlling capacity ratio.

15. This is the required longitudinal reinforcement.

16. This is the direction of the design shear force.

17. This is the value of the factored design shear force.

18. This is the controlling load combination number for the shear design.

19. This is the required reinforcing in square inches/foot (or square centimeters/meter). Ties or spirals, averaging an area equal to this reported value for every foot along the length of the column, are to be provided. For example, if the reported steel is 0.60 and the column ties are of the type shown in Figure III-11, a #5 tie (area = 0.31 square inches) placed at 12 inches center to center will be adequate, giving a total of 0.62 square inches per foot. (Note: minimum requirements should be checked separately by the user.)

20. This is the controlling capacity ratio of the column.

21. The joint is located at the top end of the column defined by this column ID and this level ID.

22. The joint analysis is done in the major and minor direction of the column line.

23. This is the controlling joint shear force.

24. This is the effective area of the joint.

25. This is the joint shear stress (Shear Force / Effective Area).

26. This is the allowable shear stress.
27. This is the actual shear stress ratio.
28. For ductile concrete frames, this number should be less than or equal to 0.83.
29. These are the moment magnification factors used to amplify the moments in the column capacity check.
30. This axial force and biaxial moment set corresponds to point C in Figure III-9.

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     8
                                     ETABS_FILE:excon.PST/CONKER_FILE:descon.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF BEAM ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

  BAY     BEAM SIZE STRESS /-FACTORED  LOADS  & COMBOS-//--REQUIRED  REBAR--/
   ID WIDTH X DEPTH  POINT    -MOMENT    +MOMENT     SHEAR M(top) M(bot) V(/ft)
       (in)    (in)           (K-in)     (K-in)        (K) (sqin) (sqin) (sqin)
   1 12.00 X 24.00
   |       |         END I  1816 < 3>  908 < 0>   38 < 5>  1.62   0.88   0.16
   |       |        1/4-PT   653 < 0>  873 < 2>   26 < 2>  0.88   0.88   0.41
   |       |        MIDDLE   653 < 0> 1298 < 1>   16 < 5>  0.88   1.14   0.26
   |       |        3/4-PT   653 < 0>  409 < 2>   29 < 2>  0.88   0.88   0.01
   |       |         END J  2610 < 3> 1305 < 0>   42 < 5>  2.39   1.14   0.22
                       |       |         |          |      |      |       |
  (1)     (2)         (3)     (4)       (5)        (6)    (7)    (8)     (9)
   |       |           |       |         |          |      |      |       |
   ----------------------Note Reference Number----------------------------
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE    11
                                     ETABS_FILE:excon.PST/CONKER_FILE:descon.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

 COL   COLUMN SIZE STR /------MOMENT INTERACTION------/ /----SHEAR DESIGN----/
  ID MAJOR X MINOR  PT      PU   MMAJ   MMIN COMBO REBAR  DIRN    VU COMBO A(/ft)
      (in)    (in)          (K) (K-in) (K-in)      (sqin)         (K)      (sqin)
   1 18.00 X 18.00                                        MAJOR   32 < 0>   0.71
   |  RR-3-3                                              MINOR    7 < 0>   0.15
   |      |        Top      15   2180     0    <0>  5.63    |      |    |     |
   |      |        Bot      35   1448   170    <3>  3.25    |      |    |     |
   |      |         |        |     |      |      |     |     |      |    |     |
  (10)  (11)       (12)    (13)  (13)   (13)   (14)  (15)  (16)   (17) (18)  (19)
   |      |         |        |     |      |      |     |     |      |    |     |
   -------------------------Note Number Reference----------------------------
```

Output From File ***DESCON.CNK***

Figure V-2

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   12
                                    ETABS_FILE:excon.PST/CONKER_FILE:descon.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 STRESS CHECK OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... FLOOR

 COL   COLUMN SIZE STR /------MOMENT INTERACTION------/ /----SHEAR DESIGN----/
  ID MAJOR X MINOR  PT     PU   MMAJ   MMIN COMBO RATIO  DIRN    VU COMBO A{/ft}
     {in}    {in}         {K} {K-in} {K-in}                     {K}       {sqin}
   1 18.00 X 18.00                                     MAJOR    23 < 0>   0.51
   |  RR-3-3                                           MINOR     6 < 4>   0.13
   |     |         TOP     92    740    211  < 2>  0.25  |       |    |      |
   |     |         BOT     72    952    561  < 3>  0.39  |       |    |      |
   |     |          |       |     |      |     |     |   |       |    |      |
  (10)  (11)      (12)    (13)  (13)   (13)  (14)  (20) (16)    (17) (18)  (19)
   |     |          |       |     |      |     |     |   |       |    |      |
    -------------------------Note Number Reference-------------------------
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   13
                                    ETABS_FILE:excon.PST/CONKER_FILE:descon.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 BEAM-COLUMN JOINT ANALYSIS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

  COL     JOINT     SHEAR  EFFECTV    SHEAR    ALLOW   STRESS       BEAM/COLUMN
   ID      DIRN     FORCE     AREA   STRESS   STRESS    RATIO   STRENGTH RATIO
                      {K}   {sqin}    {Ksi}    {Ksi}

    1     MAJOR    121.21   324.00    0.374    0.645    0.580             0.834
          MINOR     42.00   324.00    0.130    0.645    0.201             0.189
    |       |         |       |         |        |        |                 |
  (21)    (22)      (23)    (24)      (25)     (26)     (27)              (28)
    |       |         |       |         |        |        |                 |
    -----------------------Note Number Reference-------------------------
```

Output from File ***DESCON.CNK***
Figure V-2 (continued)

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   46
                                    ETABS_FILE:excon.PST/CONKER_FILE:descon.COL
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

 COL STRESS       /DELTA(B)-FACTOR//----FAILURE SURFACE POINT---/
  ID  POINT           MAJOR  MINOR        PCA     MCMAJ     MCMIN
                                          (K)     (K-in)    (K-in)
   1
   |     TOP           1.00   1.00         15      2180         0
   |     BOT           1.00   1.00         35      1448       170
   |      |             |      |            |        |          |
 (10)   (12)          (29)   (29)         (30)     (30)      (30)
   |      |             |      |            |        |          |
   ---------------------Note Number Reference-------------------
```

Output From File ***DESCON.COL***
Figure V-3

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5. American Concrete Institute, Journal of

Failure Surfaces for Members in Compression and Bending, by F.N. Pannell, January 1963.

6. American Concrete Institute, Journal of

Ultimate Strength of Columns with Biaxial Eccentric Loads, by John L. Meek, August 1963.

7. American Concrete Institute, Journal of

Capacity of Rectangular Columns, by Alfred L. Parme, Jose M. Nieves and Albert Gouwens, September 1966.

8. University of California, Berkeley

Ultimate Analysis and Design of L-Shaped Reinforced Concrete Column Sections under Biaxial Loading, by F.E. Peterson, December 1963.

9. Portland Cement Association

Notes on ACI 318-89, Building Code Requirements for Reinforced Concrete, with Design Applications, Skokie, Illinois, 1990.

10. American Concrete Institute

Recommendations for Design of Beam-Column Joints in Monolithic Reinforced Concrete Structures, (ACI 352R-76) (Reaffirmed 1981), ACI-ASCE Committee 352, Detroit, Michigan, 1976.

11. White, D. W. and Hajjar, J. F.

Application of Second-Order Elastic Analysis in LRFD: Research to Practice, Engineering Journal, American Institute of Steel Construction, Inc., Volume 28, No.4, 1991.

Sample Example

The following is an example to illustrate the typical input and output associated with a CONKER run. The CONKER input data file, DESCON, and the corresponding ETABS input data file EXCON, along with ETABS post processing file EXCON.PST, all exist on the CONKER disk, which comes with the complete CONKER package.

The two-story special moment resisting frame designed as per the UBC94 code has a partial floor diaphragm and a full roof diaphragm. There are a total of eight column lines and eight bays in the model.

Other structural data is as follows:

Typical Column @ Roof	18" x 18", rebar not specified 2" cover to center of steel
Typical Column @ 1st Floor	18" x 18" Fixed Base w/8- #9 bars (RR-3-3) and 2" cover to center of steel
Beams in Bays 1 through 4	12" x 24"
Beams in Bays 5 through 8	12" x 16"

Loading on Bays 1 through 4, Both Levels

1.0 K/ft	DL
0.5 K/ft	LL

Material Properties

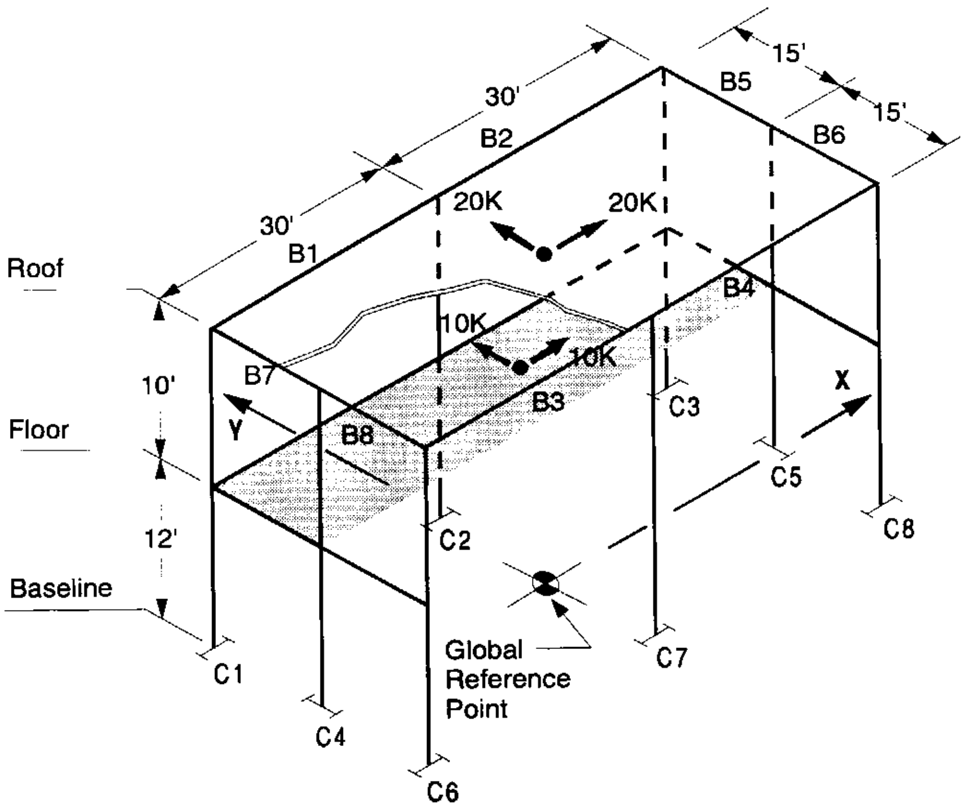
f'_c = 4.0 ksi
f_y = 60.0 ksi
f_{ys} = 40.0 ksi
E_c = 3600 ksi

For analysis in ETABS the value of the moment of inertia of the sections was modified to account for cracking. A multiplier of 0.4 was used for columns assuming about 2% steel and a multiplier of 0.5 was used for the beams. See ACI 318-89, Section R.10.10.1.

For P-Delta analysis in ETABS

Story mass specified	100 psf
Story dead load (assumed)	100 psf
Story live load (assumed)	50 psf
P-Delta factor used in ETABS	3

(calculated as [(1.4*100 + 1.4*50)/100]/0.7)



Special Moment Resisting Concrete Frame
Sample Example

```
$ --------------------------------HEADING
ETABS 6.1
EXAMPLE EXCON :  SAMPLE EXAMPLE FOR STEELER MANUAL UNITS: KIP-INCH-SEC
SPECIAL MOMENT RESISTING STEEL FRAME: USER DEFINED STATIC LATERAL LOAD
$ --------------------------------CONTROL DATA
 2 1 1 1 2 4 0 1 1 2 0 0 0 0 1 0 0 1 2 1 1
 386.4  0  0  3
$ --------------------------------MASS DATA
 1  1  1/386.4
 RECT .1/144  0       0  30*12   60*12
 2  1  1/386.4
 RECT .1/144  0  7.5*12  15*12   60*12
$ --------------------------------STORY DATA
 ROOF  120 1
 1 1
 FLOOR 144 1
 1 2
$ --------------------------------MATERIAL PROPERTY DATA
 1  C  3600  .15 .150/1728  0  0  60  4   40   4
$ --------------------------------COLUMN SECTION PROPERTIES
 1  RECT  1   18      18   0  0 .4   .4  .4
$ --------------------------------BEAM SECTION PROPERTIES
 1  RECT  1   24  0   12   0  0 .5   .5  .5
 2  RECT  1   16  0   12   0  0 .5   .5  .5
$ --------------------------------FRAME DATA
 /MAIN FRAME
 1 8 8 0 0 2 0 1
$ --------------------------------COLUMN LINE LOCATIONS
 1  -360  180
 2     0  180
 3   360  180
 4  -360    0 90
 5   360    0 90
 6  -360 -180
 7     0 -180
 8   360 -180
$ --------------------------------BAY CONNECTIVITY
 1  1  2
 2  2  3
 3  6  7
 4  7  8
 5  3  5
 6  5  8
 7  1  4
 8  4  6
$ --------------------------------BEAM SPAN VERTICAL LOADING PATTERNS
 1 0 1/12
 2 0 .5/12
$ --------------------------------JOINT ASSIGNMENTS
 6 8 0 FLOOR FLOOR 0

$ --------------------------------COLUMN ASSIGNMENTS
 1 8 0 ROOF FLOOR 1

$ --------------------------------BEAM ASSIGNMENTS
 1 2 0 ROOF FLOOR 1
 3 4 0 ROOF ROOF  1
 5 8 0 ROOF FLOOR 2
```

ETABS Input Data File : ***EXCON***

```
$ -------------------------------ASSIGNMENT OF BEAM SPAN LOADINGS
 1 4 0 ROOF FLOOR 1 2

$ -------------------------------FRAME LOCATION DATA
 1 0 0 0 /MAIN FRAME
$ -------------------------------USER-DEFINED LATERAL STATIC LOAD
 ROOF  1 A 20
 ROOF  1 B  0 20
 FLOOR 1 A 10 0  0 7.5*12
 FLOOR 1 B  0 10

$ -------------------------------LOAD CASE DEFINITION DATA
 1 0 1
 2 0 0 1
 3 0 0 0 0 1
 4 0 0 0 0 0 1
$ -------------------------------END OF INPUT DATA
```

*ETABS Input Data File : **EXCON** (continued)*

```
$ ------------------------------------------HEADING DATA
 CONKER 6.1
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND
$
$ ----------------------------------------- CONTROL DATA
$ ICODE  NFR  NLC  LDC  LLC  NRMP  NRCP  NRBP  NCRV  NPTS  IPRI IPHI
      1    1    5    1    2     0     2     2     0     0     1   0
$ MBB  MBV  MCI  MCV  MJV  MJR
    1    1    1    1    1    1
$
$ ----------------------------------------- LOAD COMBINATION DEFINITION DATA
$L   LTYP    XI     XII  XIII    XA     XB    XC    XD1    XD2
 1     0   1.4    1.7   1.4
 2     2   1.4    1.4   1.4   1.4   1.4
 3     2   1.4    1.4   1.4  -1.4   1.4
 4     2   0.9    0.0   0.9   1.4   1.4
 5     2   0.9    0.0   0.9  -1.4   1.4
$
$ ----------------------------------------- MATERIAL PROPERTY REDEFINITION DATA
$MID  MTYPE    E     U        W      M  ALPHA   FY  FC  FYS   FCS
$
$ ----------------------------------------- COLUMN PROPERTY REDEFINITION DATA
$ID        ITYPE  IMAT  DMAJ  DMIN  DC  ABAR1  ABAR2
  1       RR-3-3    1    18    18   2      1      1
  2       RR-3-3    1    18    18   2
$
$ ----------------------------------------- BEAM PROPERTY REDEFINITION DATA
$ID  ITYPE IMAT     DB  DA  BB  DS  BF  DCT  DCB  ATI  ABI  ATJ ABJ
  1    RCB    1     24   0  12   0   0    2    2
  2    RCB    1     16   0  12   0   0    2    2
$
$ ----------------------------------------- FRAME DESIGN ACTIVATION DATA
$ I ITYP IRCP IRBP  ALPHA
  1    1    1    0   1.25
$ ----------------------------------------- COLUMN ELEMENT REASSIGNMENT DATA
$NT   NC1  NC2   NSAME  SD1   SD2   P1  P2  P3  P4
  I     1    8       0 ROOF  ROOF    2
```

CONKER Input Data File : ***DESCON***

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    1
                                   ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


DESIGN CODE TYPE---------------------------      1 (UBC 1994 CONCRETE)

NUMBER OF FRAMES TO BE DESIGNED/CHECKED----      1
NUMBER OF LOAD COMBINATIONS----------------      5

ETABS DEAD LOAD CONDITION NUMBER-----------      1
ETABS LIVE LOAD CONDITION NUMBER-----------      2

NUMBER OF REDEFINED MATERIAL PROPERTIES----      0
NUMBER OF COLUMN DESIGN PROPERTY SETS------      2
NUMBER OF BEAM DESIGN PROPERTY SETS--------      2

NUMBER OF CURVES PER INTERACTION VOLUME----      5
NUMBER OF POINTS PER INTERACTION CURVE-----     11
CODE FOR PRINTING INTERACTION CURVES-------      1

CODE FOR UNITY PHI FACTOR OVER RIDE--------      0

TYPE OF UNITS (ENGLISH, MKS OR SI)---------      E

EXECUTION MODE-----------------------------      0
FLAG FOR MAP OF BEAM FLEXURAL STEEL--------      1
FLAG FOR MAP OF BEAM SHEAR STEEL-----------      1
FLAG FOR MAP OF COLUMN DESIGN/CHECK--------      1
FLAG FOR MAP OF COLUMN SHEAR STEEL---------      1
FLAG FOR MAP OF JOINT SHEAR STRESS RATIOS--      1
FLAG FOR MAP OF B/C MOMENT CAPACITY RATIOS-      1
```

Sample Output from ***CONKER***

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE    2
                                       ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 DESIGN LOADING COMBINATION DATA

 LOAD TYPE       I       II      III        A        B        C       D1      D2
    1    0   1.400   1.700   1.400    0.000    0.000    0.000    0.000   0.000
    2    2   1.400   1.400   1.400    1.400    1.400    0.000    0.000   0.000
    3    2   1.400   1.400   1.400   -1.400    1.400    0.000    0.000   0.000
    4    2   0.900   0.000   0.900    1.400    1.400    0.000    0.000   0.000
    5    2   0.900   0.000   0.900   -1.400    1.400    0.000    0.000   0.000



CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE    3
                                       ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 MATERIAL PROPERTIES

  ID TYPE      ELASTIC     POISSONS        UNIT         UNIT    COEFF OF
               MODULUS        RATIO      WEIGHT         MASS   EXPANSION
                 (Ksi)                  (K/cuin)

   1    C  0.3600E+04       0.1500  0.8681E-04   0.0000E+00 0.0000E+00

 MATERIAL PROPERTIES FOR DESIGN

                 YIELD    STRENGTH        YIELD   STRENGTH        ALLOWABLES
  ID TYPE           FY      FC(FM)          FYS    FCS(FMS)       FBMAJ      FBMIN
                 (Ksi)       (Ksi)        (Ksi)       (Ksi)       (Ksi)      (Ksi)

   1    C  0.600E+02  0.400E+01  0.400E+02  0.400E+01



CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE    4
                                       ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 SECTION PROPERTIES FOR COLUMNS

 SECT SECTION   MAT         MAJOR    MINOR CONCRETE  AREA OF  AREA OF
   ID TYPE       ID           DIM      DIM    COVER  BARS  1  BARS 2
                             (in)     (in)     (in)   (sqin)  (sqin)

    1 RR-3-3     1        18.0000  18.0000  2.00000  1.00000 1.00000
    2 RR-3-3     1        18.0000  18.0000  2.00000  0.00000 0.00000
```

Sample Output from ***CONKER*** *(continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     5
                                      ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 SECTION PROPERTIES FOR BEAMS

 SECT SECT    MAT     DEPTH     DEPTH      BEAM      SLAB      SLAB      TOP    BOTTOM
   ID TYPE     ID     BELOW     ABOVE     WIDTH     THICK     WIDTH    COVER     COVER
                       (in)      (in)      (in)      (in)      (in)     (in)      (in)

    1 RCB       1   24.0000    0.0000   12.0000    0.0000    0.0000 2.00000   2.00000
    2 RCB       1   16.0000    0.0000   12.0000    0.0000    0.0000 2.00000   2.00000


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     6
                                      ETABS FILE:EXCON.PST/CONKER FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 SECTION PROPERTIES FOR BEAMS

 SECT      TOP STEEL    BOT STEEL    TOP STEEL    BOT STEEL
   ID          END-I        END-I        END-J        END-J
              (sqin)       (sqin)       (sqin)       (sqin)

    1     0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
    2     0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    7
                                   ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 FRAME NUMBER-------------------------------      1

 FRAMING TYPE-------------------------------      1 (SEISMIC)

 COLUMN PROPERTY REASSIGNMENT FLAG----------      1
 BEAM PROPERTY REASSIGNMENT FLAG------------      0

 YIELD OVERSTRENGTH FACTOR------------------   1.25



 FRAME ID NUMBER----------------------------      1
 NUMBER OF STORY LEVELS---------------------      2
 NUMBER OF COLUMN LINES---------------------      8
 NUMBER OF BAYS-----------------------------      8
 NUMBER OF BRACING ELEMENTS-----------------      0
 NUMBER OF PANEL ELEMENTS-------------------      0
 NUMBER OF COLUMN LATERAL LOAD PATTERNS-----      0
 NUMBER OF BEAM SPAN LOAD PATTERNS----------      2
 MAXIMUM NUMBER OF LOADS PER BEAM SPAN------      4

 REASSIGNED COLUMN PROPERTY ID*S

 LEVEL         1   2   3   4   5   6   7   8

 ROOF          2   2   2   2   2   2   2   2
 FLOOR         1   1   1   1   1   1   1   1

 SPECIFIED COLUMN LIVE LOAD REDUCTION FACTORS

 ALL ELEMENTS HAVE THIS OPTION SPECIFIED AS      1.000


 SPECIFIED COLUMN MAJOR MM-FACTOR (SIDESWAY)

 ALL ELEMENTS HAVE THIS OPTION SPECIFIED AS      0.000


 SPECIFIED COLUMN MINOR MM-FACTOR (SIDESWAY)

 ALL ELEMENTS HAVE THIS OPTION SPECIFIED AS      0.000


 SPECIFIED COLUMN MAJOR MM-FACTOR (NO-SIDESWAY)

 ALL ELEMENTS HAVE THIS OPTION SPECIFIED AS      0.000


 SPECIFIED COLUMN MINOR MM-FACTOR (NO-SIDESWAY)

 ALL ELEMENTS HAVE THIS OPTION SPECIFIED AS      0.000
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     8
                                         ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON   SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME   UNITS : KIP-INCH-SECOND

 DESIGN OF BEAM ELEMENTS    (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

  BAY      BEAM SIZE STRESS /-FACTORED  LOADS  & COMBOS-//--REQUIRED  REBAR--/
   ID WIDTH X DEPTH  POINT     -MOMENT    +MOMENT       SHEAR M(top) M(bot) V(/ft)
       (in)     (in)            (K-in)     (K-in)          (K) (sqin) (sqin) (sqin)
    1 12.00 X 24.00
                     END I  1816 < 3>  908 < 0>   38 < 5>  1.62    0.88    0.16
                    1/4-PT   653 < 0>  873 < 2>   26 < 2>  0.88    0.88    0.41
                    MIDDLE   653 < 0> 1298 < 1>   16 < 5>  0.88    1.14    0.26
                    3/4-PT   653 < 0>  409 < 2>   29 < 2>  0.88    0.88    0.01
                     END J  2610 < 3> 1305 < 0>   42 < 5>  2.39    1.14    0.22
    2 12.00 X 24.00
                     END I  2610 < 3> 1305 < 0>   42 < 5>  2.39    1.14    0.22
                    1/4-PT   653 < 0>  409 < 2>   29 < 2>  0.88    0.88    0.01
                    MIDDLE   653 < 0> 1298 < 1>   16 < 5>  0.88    1.14    0.26
                    3/4-PT   653 < 0>  873 < 2>   26 < 2>  0.88    0.88    0.41
                     END J  1816 < 3>  908 < 0>   38 < 5>  1.62    0.88    0.16
    3 12.00 X 24.00
                     END I  1178 < 3>  589 < 0>   37 < 5>  1.03    0.88    0.14
                    1/4-PT   707 < 0> 1257 < 2>   24 < 5>  0.88    1.10    0.39
                    MIDDLE   707 < 0> 1459 < 1>   19 < 5>  0.88    1.28    0.30
                    3/4-PT   707 < 0>  353 < 0>   32 < 5>  0.88    0.88    0.05
                     END J  2827 < 3> 1414 < 0>   45 < 5>  2.61    1.24    0.26
    4 12.00 X 24.00
                     END I  2827 < 3> 1414 < 0>   45 < 5>  2.61    1.24    0.26
                    1/4-PT   707 < 0>  353 < 0>   32 < 5>  0.88    0.88    0.05
                    MIDDLE   707 < 0> 1459 < 1>   19 < 5>  0.88    1.28    0.30
                    3/4-PT   707 < 0> 1257 < 2>   24 < 5>  0.88    1.10    0.39
                     END J  1178 < 3>  589 < 0>   37 < 5>  1.03    0.88    0.14
    5 12.00 X 16.00
                     END I   288 < 3>  244 < 4>    8 < 5>  0.56    0.56    0.21
                    1/4-PT   124 < 5>  159 < 2>    7 < 2>  0.56    0.56    0.19
                    MIDDLE    76 < 0>   61 < 0>    7 < 2>  0.56    0.56    0.18
                    3/4-PT   111 < 3>  115 < 4>    8 < 5>  0.56    0.56    0.20
                     END J   303 < 3>  197 < 4>    9 < 2>  0.56    0.56    0.21
    6 12.00 X 16.00
                     END I   305 < 3>  200 < 4>    9 < 2>  0.56    0.56    0.21
                    1/4-PT   111 < 3>  115 < 4>    8 < 5>  0.56    0.56    0.20
                    MIDDLE    76 < 0>   62 < 0>    7 < 2>  0.56    0.56    0.18
                    3/4-PT   128 < 5>  162 < 2>    7 < 2>  0.56    0.56    0.19
                     END J   294 < 3>  249 < 4>    8 < 5>  0.56    0.56    0.21
    7 12.00 X 16.00
                     END I   288 < 3>  244 < 4>    8 < 5>  0.56    0.56    0.21
                    1/4-PT   124 < 5>  159 < 2>    7 < 2>  0.56    0.56    0.19
                    MIDDLE    76 < 0>   61 < 0>    7 < 2>  0.56    0.56    0.18
                    3/4-PT   111 < 3>  115 < 4>    8 < 5>  0.56    0.56    0.20
                     END J   303 < 3>  197 < 4>    9 < 2>  0.56    0.56    0.21
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    9
                                    ETABS FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF BEAM ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

  BAY     BEAM SIZE STRESS /-FACTORED  LOADS  & COMBOS-//--REQUIRED  REBAR--/
   ID WIDTH X DEPTH  POINT    -MOMENT   +MOMENT      SHEAR M(top) M(bot) V(/ft)
       (in)    (in)           (K-in)    (K-in)         (K) (sqin) (sqin) (sqin)
    8 12.00 X 16.00
                     END I   305 < 3>  200 < 4>    9 < 2>  0.56   0.56   0.21
                    1/4-PT   111 < 3>  115 < 4>    8 < 5>  0.56   0.56   0.20
                    MIDDLE    76 < 0>   62 < 0>    7 < 2>  0.56   0.56   0.18
                    3/4-PT   128 < 5>  162 < 2>    7 < 2>  0.56   0.56   0.19
                     END J   294 < 3>  249 < 4>    8 < 5>  0.56   0.56   0.21
```

Sample Output from ***CONKER*** *(continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   10
                                         ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF BEAM ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... FLOOR

  BAY     BEAM SIZE STRESS /-FACTORED  LOADS  & COMBOS-//--REQUIRED  REBAR--/
   ID WIDTH X DEPTH  POINT     -MOMENT    +MOMENT      SHEAR M(top) M(bot) V(/ft)
       (in)    (in)             (K-in)     (K-in)        (K) (sqin) (sqin) (sqin)
    1 12.00 X 24.00
                    END I  2225 < 3> 1112 < 0>   40 < 5>  2.01    0.97    0.18
                   1/4-PT   678 < 0>  864 < 2>   27 < 2>  0.88    0.88    0.43
                   MIDDLE   678 < 0> 1245 < 1>   16 < 5>  0.88    1.09    0.26
                   3/4-PT   678 < 0>  524 < 2>   29 < 2>  0.88    0.88    0.47
                    END J  2713 < 3> 1356 < 0>   42 < 2>  2.49    1.19    0.22
    2 12.00 X 24.00
                    END I  2713 < 3> 1356 < 0>   42 < 2>  2.49    1.19    0.22
                   1/4-PT   678 < 0>  524 < 2>   29 < 2>  0.88    0.88    0.47
                   MIDDLE   678 < 0> 1245 < 1>   16 < 5>  0.88    1.09    0.26
                   3/4-PT   678 < 0>  864 < 2>   27 < 2>  0.88    0.88    0.43
                    END J  2225 < 3> 1112 < 0>   40 < 5>  2.01    0.97    0.18
    5 12.00 X 16.00
                    END I   425 < 3>  370 < 4>    8 < 5>  0.58    0.56    0.21
                   1/4-PT   193 < 5>  221 < 2>    8 < 2>  0.56    0.56    0.19
                   MIDDLE   106 < 0>   92 < 0>    7 < 5>  0.56    0.56    0.18
                   3/4-PT   170 < 5>  178 < 2>    8 < 2>  0.56    0.56    0.20
                    END J   423 < 3>  326 < 4>    9 < 2>  0.58    0.56    0.22
    6 12.00 X 16.00
                    END I   421 < 3>  325 < 4>    9 < 5>  0.57    0.56    0.22
                   1/4-PT   170 < 5>  178 < 2>    8 < 2>  0.56    0.56    0.20
                   MIDDLE   106 < 0>   92 < 0>    7 < 5>  0.56    0.56    0.18
                   3/4-PT   192 < 5>  220 < 2>    8 < 5>  0.56    0.56    0.19
                    END J   424 < 3>  367 < 4>    8 < 2>  0.58    0.56    0.21
    7 12.00 X 16.00
                    END I   425 < 3>  370 < 4>    8 < 5>  0.58    0.56    0.21
                   1/4-PT   193 < 5>  221 < 2>    8 < 2>  0.56    0.56    0.19
                   MIDDLE   106 < 0>   92 < 0>    7 < 5>  0.56    0.56    0.18
                   3/4-PT   170 < 5>  178 < 2>    8 < 2>  0.56    0.56    0.20
                    END J   423 < 3>  326 < 4>    9 < 2>  0.58    0.56    0.22
    8 12.00 X 16.00
                    END I   421 < 3>  325 < 4>    9 < 5>  0.57    0.56    0.22
                   1/4-PT   170 < 5>  178 < 2>    8 < 2>  0.56    0.56    0.20
                   MIDDLE   106 < 0>   92 < 0>    7 < 5>  0.56    0.56    0.18
                   3/4-PT   192 < 5>  220 < 2>    8 < 5>  0.56    0.56    0.19
                    END J   424 < 3>  367 < 4>    8 < 2>  0.58    0.56    0.21
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   11
                                    ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

 COL   COLUMN SIZE STR /------MOMENT INTERACTION------/ /----SHEAR DESIGN----/
  ID MAJOR X MINOR  PT     PU   MMAJ   MMIN COMBO REBAR  DIRN    VU COMBO A(/ft)
     (in)    (in)         (K) (K-in) (K-in)       (sqin)         (K)       (sqin)
   1 18.00 X 18.00                                       MAJOR   32 < 0>   0.71
      RR-3-3                                             MINOR    7 < 0>   0.15
                   TOP     15   2180      0  < 0>  5.63
                   BOT     35   1448    170  < 3>  3.25
   2 18.00 X 18.00                                       MAJOR   66 < 0>   1.45
      RR-3-3                                             MINOR    1 < 4>   0.02
                   TOP     87   4699      0  < 0> 13.58
                   BOT     38   2219      0  < 0>  5.49
   3 18.00 X 18.00                                       MAJOR   32 < 0>   0.71
      RR-3-3                                             MINOR    7 < 0>   0.15
                   TOP     15   2180      0  < 0>  5.63
                   BOT     35   1448    170  < 3>  3.25
   4 18.00 X 18.00                                       MAJOR   14 < 0>   0.30
      RR-3-3                                             MINOR    2 < 2>   0.05
                   TOP      4    413     75  < 5>  3.24
                   BOT      4    367    142  < 5>  3.24
   5 18.00 X 18.00                                       MAJOR   14 < 0>   0.30
      RR-3-3                                             MINOR    2 < 3>   0.05
                   TOP      4    413     75  < 5>  3.24
                   BOT      4    367    142  < 5>  3.24
   6 18.00 X 18.00                                       MAJOR   12 < 0>   0.27
      RR-3-3                                             MINOR    7 < 0>   0.15
                   TOP     14   1414      0  < 0>  3.44
                   BOT     14    128    161  < 5>  3.24
   7 18.00 X 18.00                                       MAJOR   44 < 0>   0.97
      RR-3-3                                             MINOR    1 < 5>   0.02
                   TOP     93   5089      0  < 0> 14.90
                   BOT     41     56     91  < 5>  3.24
   8 18.00 X 18.00                                       MAJOR   12 < 0>   0.27
      RR-3-3                                             MINOR    7 < 0>   0.15
                   TOP     14   1414      0  < 0>  3.44
                   BOT     14    128    161  < 5>  3.24
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   12
                                  ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 STRESS CHECK OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... FLOOR

 COL   COLUMN SIZE STR /------MOMENT INTERACTION------/ /----SHEAR DESIGN----/
  ID MAJOR X MINOR  PT      PU   MMAJ   MMIN COMBO RATIO  DIRN   VU COMBO A{/ft}
     {in}    {in}          {K} {K-in} {K-in}                     {K}       {sqin}
   1 18.00 X 18.00                                        MAJOR   23 < 0>   0.51
      RR-3-3                                              MINOR    6 < 4>   0.13
                    TOP     92    740    211  < 2>  0.25
                    BOT     72    952    561  < 3>  0.39
   2 18.00 X 18.00                                        MAJOR   42 < 0>   0.16
      RR-3-3                                              MINOR    4 < 2>   0.00
                    TOP    166    406    189  < 2>  0.22
                    BOT    166    736    466  < 2>  0.33
   3 18.00 X 18.00                                        MAJOR   23 < 0>   0.51
      RR-3-3                                              MINOR    6 < 4>   0.13
                    TOP     92    740    211  < 2>  0.25
                    BOT     72    952    561  < 3>  0.39
   4 18.00 X 18.00                                        MAJOR    9 < 0>   0.19
      RR-3-3                                              MINOR    5 < 3>   0.10
                    TOP     16    324    156  < 2>  0.13
                    BOT     16    626    526  < 2>  0.30
   5 18.00 X 18.00                                        MAJOR    9 < 0>   0.19
      RR-3-3                                              MINOR    5 < 2>   0.10
                    TOP     16    324    156  < 2>  0.13
                    BOT     16    626    526  < 2>  0.30
   6 18.00 X 18.00                                        MAJOR   12 < 0>   0.27
      RR-3-3                                              MINOR    6 < 3>   0.13
                    TOP     51    312    216  < 2>  0.13
                    BOT     51    935    559  < 2>  0.39
   7 18.00 X 18.00                                        MAJOR   44 < 0>   0.97
      RR-3-3                                              MINOR    1 < 5>   0.02
                    TOP     98    125    129  < 1>  0.12
                    BOT     93    532    249  < 2>  0.21
   8 18.00 X 18.00                                        MAJOR   12 < 0>   0.27
      RR-3-3                                              MINOR    6 < 3>   0.13
                    TOP     51    312    216  < 2>  0.13
                    BOT     51    935    559  < 2>  0.39
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   13
                                   ETABS_FILE:EXCON.PST/CONKER FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 BEAM-COLUMN JOINT ANALYSIS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF
```

COL ID	JOINT DIRN	SHEAR FORCE (K)	EFFECTV AREA (sqin)	SHEAR STRESS (Ksi)	ALLOW STRESS (Ksi)	STRESS RATIO	BEAM/COLUMN STRENGTH RATIO
1	MAJOR	121.21	324.00	0.374	0.645	0.580	0.834
	MINOR	42.00	324.00	0.130	0.645	0.201	0.189
2	MAJOR	264.77	324.00	0.817	0.806	CHK#3	0.831
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
3	MAJOR	121.21	324.00	0.374	0.645	0.580	0.834
	MINOR	42.00	324.00	0.130	0.645	0.201	0.189
4	MAJOR	84.00	324.00	0.259	0.806	0.322	0.633
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
5	MAJOR	84.00	324.00	0.259	0.806	0.322	0.633
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
6	MAJOR	77.01	324.00	0.238	0.645	0.368	0.833
	MINOR	42.00	324.00	0.130	0.645	0.201	0.291
7	MAJOR	288.66	324.00	0.891	0.806	CHK#3	0.833
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
8	MAJOR	77.01	324.00	0.238	0.645	0.368	0.833
	MINOR	42.00	324.00	0.130	0.645	0.201	0.291

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   14
                                     ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.CNK
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 BEAM-COLUMN JOINT ANALYSIS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... FLOOR
```

COL ID	JOINT DIRN	SHEAR FORCE (K)	EFFECTV AREA (sqin)	SHEAR STRESS (Ksi)	ALLOW STRESS (Ksi)	STRESS RATIO	BEAM/COLUMN STRENGTH RATIO
1	MAJOR	127.57	324.00	0.394	0.645	0.610	0.500
	MINOR	39.07	324.00	0.121	0.645	0.187	0.095
2	MAJOR	233.96	324.00	0.722	0.806	0.895	0.765
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
3	MAJOR	127.57	324.00	0.394	0.645	0.610	0.500
	MINOR	39.07	324.00	0.121	0.645	0.187	0.095
4	MAJOR	76.53	324.00	0.236	0.806	0.293	0.189
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
5	MAJOR	76.53	324.00	0.236	0.806	0.293	0.189
	MINOR	0.00	324.00	0.000	0.806	0.000	0.000
6	MAJOR	0.00	324.00	0.000	0.645	0.000	0.000
	MINOR	38.97	324.00	0.120	0.645	0.186	0.095
7	MAJOR	0.00	324.00	0.000	0.645	0.000	0.000
	MINOR	0.00	324.00	0.000	0.645	0.000	0.000
8	MAJOR	0.00	324.00	0.000	0.645	0.000	0.000
	MINOR	38.97	324.00	0.120	0.645	0.186	0.095

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    1
                                        ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.COL
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND


 LOAD MOMENT INTERACTION DIAGRAM
 NEUTRAL AXIS INCLINATION NUMBER  1

 SECTION PROPERTY ID----------          1
 SECTION PROPERTY TYPE--------     RR-3-3  ( 8 BARS)
 MAJOR DIMENSION--------------   18.000000      (in)
 MINOR DIMENSION--------------   18.000000      (in)
 CONCRETE COVER---------------    2.000000      (in)
 AREA OF BARS 1---------------    1.000000    (sqin)
 AREA OF BARS 2---------------    1.000000    (sqin)

     /---------PHI INCLUDED---------/ /-----------PHI=1.00-----------/
  PT      AXIAL      MAJOR       MINOR        AXIAL       MAJOR      MINOR
  NO       LOAD     MOMENT      MOMENT         LOAD      MOMENT     MOMENT
            (K)     (K-in)      (K-in)          (K)      (K-in)     (K-in)

   1      870.5        0.0         0.0       1243.5         0.0        0.0
   2      870.5     1372.0         0.0       1243.5      1960.0        0.0
   3      768.4     2039.0         0.0       1097.7      2912.9        0.0
   4      649.9     2537.4         0.0        928.5      3624.9        0.0
   5      508.4     2997.5         0.0        726.2      4282.2        0.0
   6      339.0     3429.7         0.0        484.2      4899.5        0.0  (PB,MB)
   7      245.8     3308.6         0.0        351.2      4726.5        0.0
   8      122.8     3068.4         0.0        172.9      4318.8        0.0
   9        8.9     3108.3         0.0         10.0      3507.1        0.0
  10     -194.5     1768.5         0.0       -216.1      1965.0        0.0
  11     -432.0        0.0         0.0       -480.0         0.0        0.0
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   46
                               ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.COL
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 DESIGN OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... ROOF

 COL STRESS        /DELTA(B)-FACTOR//----FAILURE SURFACE POINT---/
  ID  POINT            MAJOR  MINOR         PCA      MCMAJ      MCMIN
                                            (K)     (K-in)     (K-in)
   1
       TOP             1.00   1.00          15       2180          0
       BOT             1.00   1.00          35       1448        170
   2
       TOP             1.00   1.00          87       4699          0
       BOT             1.00   1.00          38       2219          0
   3
       TOP             1.00   1.00          15       2180          0
       BOT             1.00   1.00          35       1448        170
   4
       TOP             1.00   1.00           4        413         75
       BOT             1.00   1.00           4        367        142
   5
       TOP             1.00   1.00           4        413         75
       BOT             1.00   1.00           4        367        142
   6
       TOP             1.00   1.00          14       1414          0
       BOT             1.02   1.00          14        128        161
   7
       TOP             1.00   1.00          93       5089          0
       BOT             1.06   1.07          41         56         91
   8
       TOP             1.00   1.00          14       1414          0
       BOT             1.02   1.00          14        128        161
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   47
                                    ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.COL
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 STRESS CHECK OF COLUMN ELEMENTS   (UBC 1994 CONCRETE)

 FRAME ID .... /MAIN FRAME
 LEVEL ID .... FLOOR

 COL STRESS        /DELTA(B)-FACTOR//----FAILURE SURFACE POINT---/
  ID  POINT            MAJOR  MINOR         PCA     MCMAJ      MCMIN
                                            (K)     (K-in)     (K-in)
   1
        TOP             1.00   1.00         362      2915        830
        BOT             1.00   1.00         183      2431       1433
   2
        TOP             1.05   1.00         749      1834        854
        BOT             1.05   1.00         507      2252       1425
   3
        TOP             1.00   1.00         362      2915        830
        BOT             1.00   1.00         183      2431       1433
   4
        TOP             1.00   1.00         127      2570       1237
        BOT             1.00   1.00          54      2104       1766
   5
        TOP             1.00   1.00         127      2570       1237
        BOT             1.00   1.00          54      2104       1766
   6
        TOP             1.06   1.02         379      2320       1600
        BOT             1.06   1.02         131      2404       1438
   7
        TOP             1.12   1.15         834      1069       1097
        BOT             1.12   1.15         442      2536       1189
   8
        TOP             1.06   1.02         379      2320       1600
        BOT             1.06   1.02         131      2404       1438
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     1
                                              ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON   SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF BEAM FLEXURAL TOP STEEL (sqin)   (UBC 1994 CONCRETE)

            BEAM       1       2       3       4       5       6       7      8
 LEVEL

 ROOF                2.4     2.4     2.6     2.6     0.6     0.6     0.6    0.6

 FLOOR               2.5     2.5                     0.6     0.6     0.6    0.6

 LEVEL
            BEAM       1       2       3       4       5       6       7      8
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     2
                                              ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON   SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF BEAM FLEXURAL BOTTOM STEEL (sqin)   (UBC 1994 CONCRETE)

            BEAM       1       2       3       4       5       6       7      8
 LEVEL

 ROOF                1.1     1.1     1.3     1.3     0.6     0.6     0.6    0.6

 FLOOR               1.2     1.2                     0.6     0.6     0.6    0.6

 LEVEL
            BEAM       1       2       3       4       5       6       7      8
```

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     3
                                              ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON   SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF BEAM SHEAR STEEL (sqin)(/ft)   (UBC 1994 CONCRETE)

            BEAM       1       2       3       4       5       6       7      8
 LEVEL

 ROOF               0.41    0.41    0.39    0.39    0.21    0.21    0.21   0.21

 FLOOR              0.47    0.47                    0.22    0.22    0.22   0.22

 LEVEL
            BEAM       1       2       3       4       5       6       7      8
```

Sample Output from ***CONKER*** *(continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    4
                                     ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF COLUMN LONGITUDINAL STEEL (sqin)  (UBC 1994 CONCRETE)

         COLUMN       1      2      3      4      5      6      7     8
 LEVEL

 ROOF               5.6   13.6    5.6    3.2    3.2    3.4   14.9   3.4

 FLOOR              N/C    N/C    N/C    N/C    N/C    N/C    N/C   N/C

 LEVEL
         COLUMN       1      2      3      4      5      6      7     8


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    5
                                     ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF COLUMN SHEAR STEEL  (MAJOR) (sqin)(/ft)  (UBC 1994 CONCRETE)

         COLUMN       1      2      3      4      5      6      7     8
 LEVEL

 ROOF              0.71   1.45   0.71   0.30   0.30   0.27   0.97  0.27

 FLOOR              N/C    N/C    N/C    N/C    N/C    N/C    N/C   N/C

 LEVEL
         COLUMN       1      2      3      4      5      6      7     8


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE    6
                                     ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF COLUMN SHEAR STEEL  (MINOR) (sqin)(/ft)  (UBC 1994 CONCRETE)

         COLUMN       1      2      3      4      5      6      7     8
 LEVEL

 ROOF              0.15   0.02   0.15   0.05   0.05   0.15   0.02  0.15

 FLOOR              N/C    N/C    N/C    N/C    N/C    N/C    N/C   N/C

 LEVEL
         COLUMN       1      2      3      4      5      6      7     8
```

*Sample Output from **CONKER** (continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     7
                                        ETABS FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF COLUMN INTERACTION CAPACITY RATIOS  (UBC 1994 CONCRETE)

          COLUMN      1       2       3       4       5       6       7      8
 LEVEL

 ROOF               N/C     N/C     N/C     N/C     N/C     N/C     N/C    N/C

 FLOOR             0.391   0.327   0.391   0.298   0.298   0.389   0.210  0.389

 LEVEL
          COLUMN      1       2       3       4       5       6       7      8


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     8
                                        ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF COLUMN SHEAR STEEL  (MAJOR) (sqin)(/ft)  (UBC 1994 CONCRETE)

          COLUMN      1       2       3       4       5       6       7      8
 LEVEL

 ROOF               N/C     N/C     N/C     N/C     N/C     N/C     N/C    N/C

 FLOOR              0.51    0.16    0.51    0.19    0.19    0.27    0.97   0.27

 LEVEL
          COLUMN      1       2       3       4       5       6       7      8


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE     9
                                        ETABS FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF COLUMN SHEAR STEEL  (MINOR) (sqin)(/ft)  (UBC 1994 CONCRETE)

          COLUMN      1       2       3       4       5       6       7      8
 LEVEL

 ROOF               N/C     N/C     N/C     N/C     N/C     N/C     N/C    N/C

 FLOOR              0.13    0.00    0.13    0.10    0.10    0.13    0.02   0.13

 LEVEL
          COLUMN      1       2       3       4       5       6       7      8
```

Sample Output from ***CONKER*** *(continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   10
                                     ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF JOINT SHEAR STRESS RATIOS  (MAJOR)  (UBC 1994 CONCRETE)

          COLUMN       1       2       3       4       5       6       7      8
 LEVEL

 ROOF                0.58    O/S    0.58    0.32    0.32    0.37    O/S   0.37

 FLOOR               0.61   0.90    0.61    0.29    0.29    0.00   0.00   0.00

 LEVEL
          COLUMN       1       2       3       4       5       6       7      8


CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS  PAGE   11
                                     ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF JOINT SHEAR STRESS RATIOS  (MINOR)  (UBC 1994 CONCRETE)

          COLUMN       1       2       3       4       5       6       7      8
 LEVEL

 ROOF                0.20   0.00    0.20    0.00    0.00    0.20   0.00   0.20

 FLOOR               0.19   0.00    0.19    0.00    0.00    0.19   0.00   0.19

 LEVEL
          COLUMN       1       2       3       4       5       6       7      8
```

Sample Output from ***CONKER*** *(continued)*

```
CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE   12
                                        ETABS FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF B/C MOMENT CAPACITY RATIOS  (MAJOR)  (UBC 1994 CONCRETE)

          COLUMN       1       2       3       4       5       6       7      8
 LEVEL

 ROOF                0.83    0.83    0.83    0.63    0.63    0.83    0.83   0.83

 FLOOR               0.50    0.77    0.50    0.19    0.19    0.00    0.00   0.00

 LEVEL
          COLUMN       1       2       3       4       5       6       7      8

CSI/ETABS - EXTENDED THREE DIMENSIONAL ANALYSIS OF BUILDING SYSTEMS   PAGE   13
                                        ETABS_FILE:EXCON.PST/CONKER_FILE:DESCON.MAP
 FILE : DESCON  SAMPLE EXAMPLE FOR CONKER MANUAL
 SPECIAL MOMENT RESISTING CONCRETE FRAME  UNITS : KIP-INCH-SECOND

 FRAME ID .... /MAIN FRAME

 MAP OF B/C MOMENT CAPACITY RATIOS  (MINOR)  (UBC 1994 CONCRETE)

          COLUMN       1       2       3       4       5       6       7      8
 LEVEL

 ROOF                0.19    0.00    0.19    0.00    0.00    0.29    0.00   0.29

 FLOOR               0.10    0.00    0.10    0.00    0.00    0.10    0.00   0.10

 LEVEL
          COLUMN       1       2       3       4       5       6       7      8
```

Sample Output from ***CONKER*** *(continued)*

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