Beam-Column Analysis Program - BMCOL51
Version 5.2

INPUT GUIDE

HEADER CARDS (three cards per run)

```
   PSF                        Hwy    PD/    Control-   Coded    Date              Units
   No.        County          No.    IPE    Sec-Job     by                     (Comment)
 |_____|_____|_____|_____|_____|_____|_____|_____|
 1    5  8                    20 23     28 31-34 37          47 50-52 55           66 69        80

Structure Name or other descriptive run information (do not leave blank)
|_____|
1         10        20        30        40        50        60        70        80

Prob
 No.              Description of problem (one card for each problem)
|_____|_____|
1    5    11        20        30        40        50        60        70        80
```

TABLE 1. CONTROL DATA (one card for each problem)

Envelopes or data may be kept from the prior problem.
Plot options are plotting envelopes for deflections, moments, shears and reactions.

```
          Enter 1 to keep prior data from  |<- Number of cards added ->|<-Enter 1 to plot->|
          Envelopes|<--       Table     -->|         for Table         |   envelopes for   |
                    2    3    4    5    6 | 2    3    4    5       6 |Defl. Mom Shr React|
|_____|___|___|___|___|___|___|___|___|___|___|____|____|___|_____|___|___|___|__|
1         10   15        20        25        30        35        40        45 48-50 53-55    60        65        70        75        80
```

TABLE 2. CONSTANTS AND MOVABLE LOAD DATA
(one card, none if Table 2 from proceeding problem is held)

The maximum number of beam-column increments is 999.

The number of increments in the moving load pattern may not exceed those in the beam-column. Negative start stations are permissible if after one step a load is on the beam-column. The stop station may be any station on the beam-column or no more than one step past the right end.

The step size is limited to a minimum of 1 for fifty (50) or fewer increments; 2 from fifty-one (51) to seven-hundred (700) increments; and 3 for over seven-hundred (700) increments.
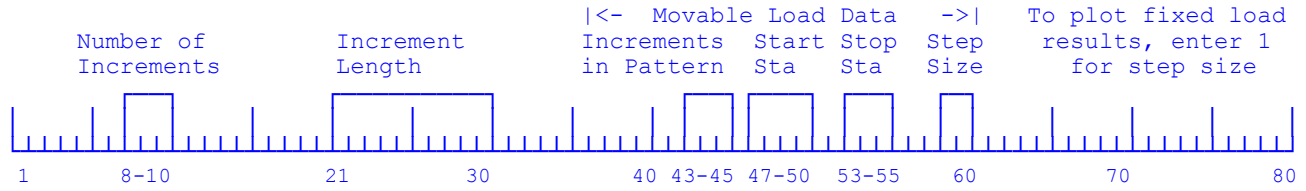
```
                                    |<-  Movable Load Data   ->|  To plot fixed load
        Number of        Increment  Increments  Start Stop Step   results, enter 1
        Increments        Length    in Pattern   Sta  Sta  Size     for step size
   |‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾|‾‾‾‾|‾‾‾‾|‾‾|‾‾‾‾|‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|
   1      8-10          21        30          40 43-45 47-50 53-55   60          70          80
```

TABLE 3. SPECIFIED DEFLECTIONS AND SLOPES
(number of cards per Table 1, 20 max, none if kept)

A fixed-end support may be simulated by the specification of zero deflection and zero slope at the same station. Specified deflections may be non-zero.

A slope may not be specified closer than 3 increments from another specified slope. A deflection may not be specified closer than 2 increments from a specified slope unless at the same station.

```
                      *Case
        Station        ↓ Deflection   Slope

        |‾‾|           |‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|          *Case: 1 for deflection only
                                                             2 for slope only
        |‾‾|           |‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|                  3 for both

        |‾‾|           |‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|

        |‾‾|           |‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|

        |‾‾|           |‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|

        |‾‾|           |‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|
   |‾‾‾‾|‾‾|‾‾‾‾|‾‾‾‾|‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|‾‾‾‾|
   1      8-10         20 21       30          40        50        60        70        80
```
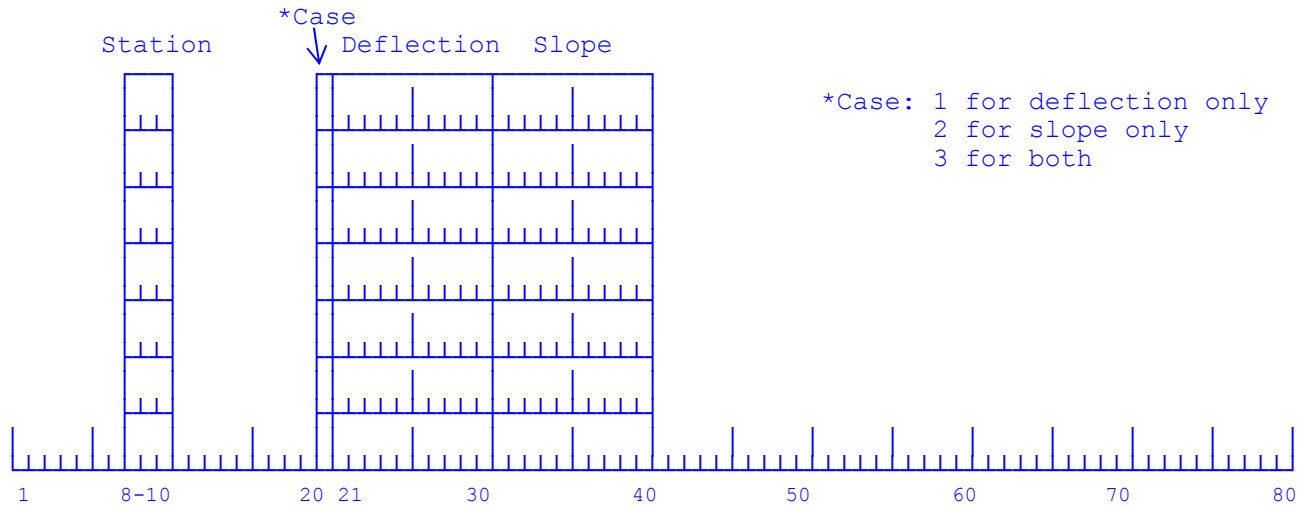
TABLE 4. FIXED LOADS AND RESTRAINTS (number of cards per Table 1, 150 max)

Data added to storage as lumped quantities per increment length, linearly interpolated between values input at indicated end stations, with 1/2-values at each end station.

Concentrated effects are established as full values at single stations by setting final station equal to initial station.
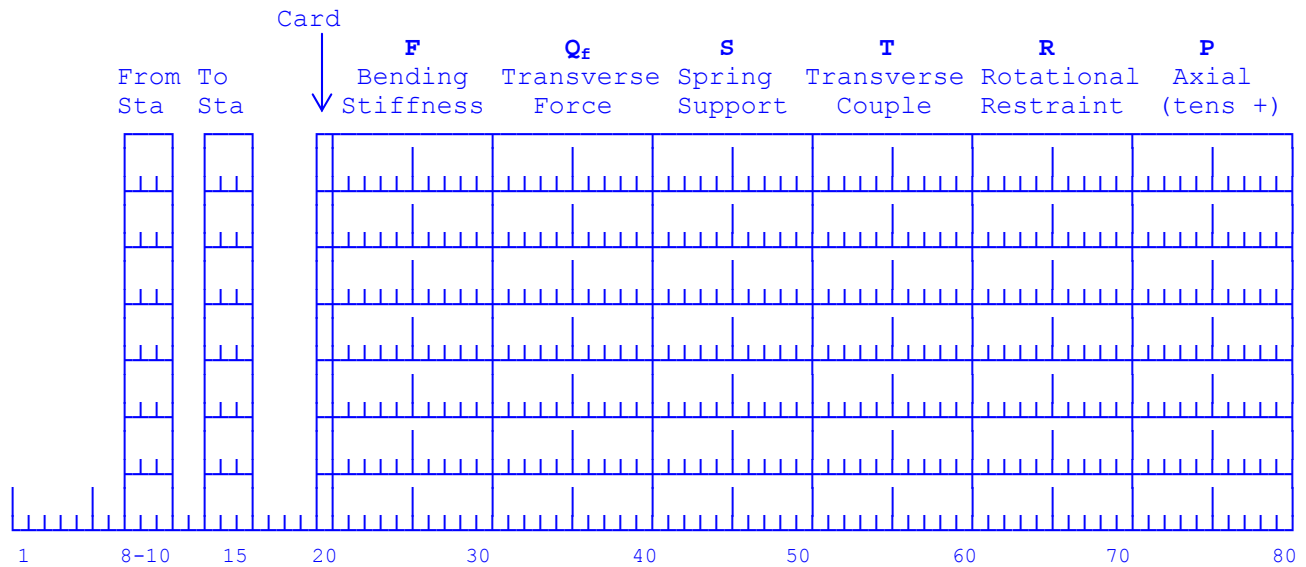
```
        Enter 1 if
      Cont'd on Next
```

From Sta	To Sta	**F** Bending Stiffness	**Q_f** Transverse Force	**S** Spring Support	**T** Transverse Couple	**R** Rotational Restraint	**P** Axial (tens +)

```
         Card
                F         Qf        S         T         R         P
From To       Bending  Transverse Spring  Transverse Rotational  Axial
Sta  Sta      Stiffness  Force    Support   Couple   Restraint  (tens +)

1    8-10  15   20        30        40        50        60        70        80
```

TABLE 5. MOVABLE LOADS (number of cards per Table 1, 150 max)

Enter stations and Q_m only. Data added to storage (accumulated) just as in Table 4.

```
                   Enter 1 If
                   Cont'd on        Qm
From  To            Next         Transverse
Sta   Sta                          Force

1    8-10  15     20        31        40        50        60        70        80
```
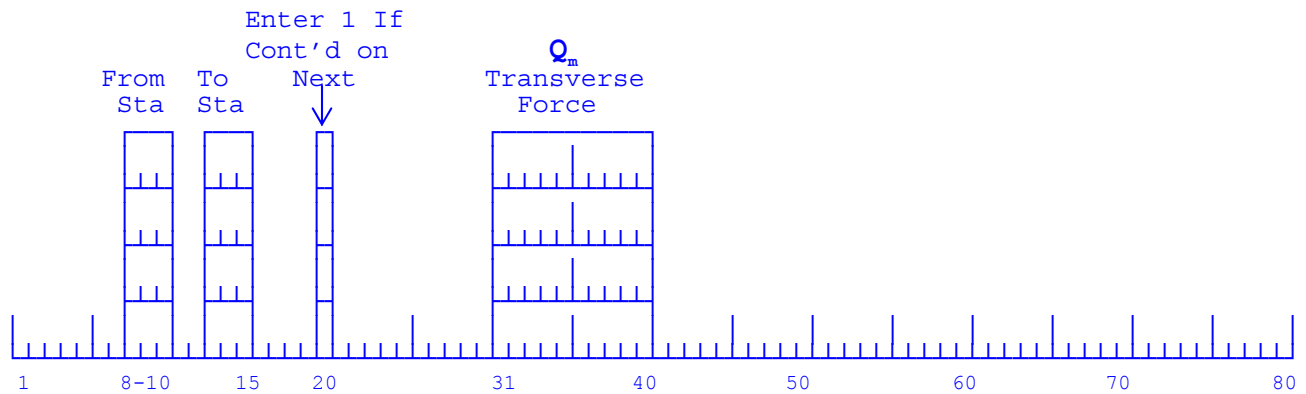
TABLE 6. SPECIFIED STATIONS FOR INFLUENCE DIAGRAMS (4 cards or none)

```
                                              *1 = Plotted Output
Num of    Type of    Specified Stations        2 = Tabulated Output
Diagrams  Output*   (max = 5 per variable)     3 = Plotted and Tabulated

                                              Deflection

                                              Moment

                                              Shear

                                              Reaction

1        10    15   20   25    30    35   40        50        60        70        80
```
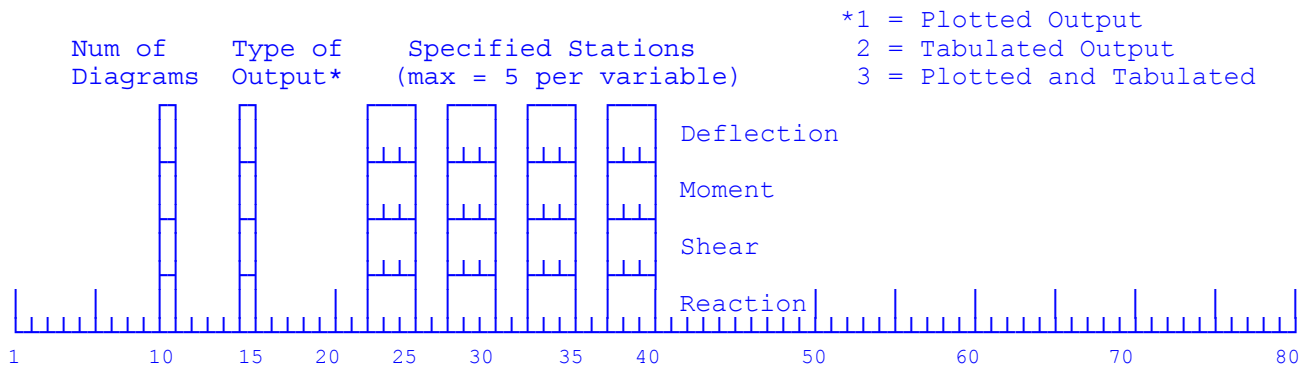
MOVABLE LOAD ANALYSIS OF BEAM COLUMNS – BMCOL51
Input Data Instructions

These notes may be used as a quick reference guide for input to the BMCOL51 program. More detailed instructions may be found in the Movable Load Analysis of Beam Columns of the original research report. [1].

GENERAL NOTES

A consistent system of units must be used for all input data, for example, kips and feet, lbs and inches, or kN and meter.

All data of 5 spaces or less must be whole integers and must be right justified.

All data of 10 spaces must be entered as decimal numbers with or without a right justified exponent. A decimal point must be entered. Blank spaces are interpreted as zeros.

The data cards must be stacked in proper order for the program to run successfully.

HEADER CARDS

The first two cards contain run identification information. The data on these two cards will be displayed at the top of the output, just below the page header. The input form indicates recommended data that may be included to identify the run; however, the entire 80 columns of the card can contain any descriptive data that the user wishes to be displayed at the top of each page of output.

If the first card is left blank or if all the text entered thereon is confined to the labeled fields, the labeled heading of all the recommended fields, except for the Units (Comment), will be printed and the current date, if not already entered, displayed in the date field. The header of each page of output contains the current date (the run date). If a date is entered on the header card, whether confined to the date field or not, it will remain fixed. The USER may find it helpful to record this date and associate it with data file creation. The second card includes the structure name or other descriptive information. It should not be left blank. The field labeled "PSF No." is a legacy from the days when physical punch cards were used. Back then the Problem Series File No. (PSF No.) was used for data filing purposes and is not needed any more. Nevertheless, the USER may utilize this field to indentify the input files in any way that might be helpful.

Check to ensure that each run has the two header cards or two blank lines. If the cards are left blank, the previously mentioned heading will be printed, though the output will not otherwise be affected. Each problem in the run (which may encompass a series of problems) must also have one Problem No. card, the first of which must be the third card/line of the input. Each individual problem in the run may have any convenient descriptive Problem No., such as LDG 5.

TABLE 1. CONTROL DATA (one card for each problem)

For each of Tables 2, 3, and 6, a choice must be made between holding all of the data from the preceding problem or entering entirely new data. If the hold option for any of these tables is desired, a 1 must be entered in the appropriate column and the number of cards 'added' for the corresponding table must be entered as zero. Envelopes may also held if desired.

For Tables 4 and 5, the data are accumulated into storage by adding algebraically to any previously stored values, including data which may be held from the preceding problem. Thus any number of new cards may be input regardless of the hold option, however, the cumulative total of cards can not exceed 150.

Card counts in Table 1 should be rechecked carefully after the coding of input data for each problem is completed.

The plot option for each of the envelopes of maximums is independent of the others. No plots are drawn for those options that are blank or zero. Only envelopes of maximums are plotted. Fixed loads can be plotted indirectly as discussed in Table 2 below.

TABLE 2. CONSTANTS (one card - none if Table 2 is kept)

The maximum number of increments into which the beam-column may be divided is 999. Typical units for the value of increment length are feet or inches.

The number of increments in the movable-load pattern may not exceed the number of increments in the beam-column.

The start station is the first station on the beam-column where the zero station of the movable load is to be placed. The stop station is the last station on the beam-column where the zero station of movable load is to be placed.

Any positive start station for the movable load is permissible. A negative start station is permissible if one step of the load pattern will place some portion of the load pattern on the beam-column.

Any stop station on the beam is allowed. A stop station of no more than one step of movement past the right end of the beam-column is permissible.

The movable-load pattern may be moved across the beam in steps of as many increments as desired.

To plot envelopes of maximums for fixed-load solutions, enter zero increment of pattern length, zero start and stop stations, and 1 for step size. No Table 5 is necessary.

TABLE 3. SPECIFIED DEFLECTIONS AND SLOPES
(number of cards per Table 1 - none if Table 3 is kept)

The maximum number of stations at which deflections and slopes may be specified is 20.

_____

A slope may not be specified closer than 3 increments from another specified slope.

A deflection may not be specified closer than 2 increments from a specified slope, except that both a deflection and a slope may be specified at the same station.

TABLE 4. FIXED-LOAD AND RESTRAINT
(number of cards per Table 1, 150 max – kept data accumulated)

			Spring		Rotational	
Typical units:	Stiffness, EI	Shear	Constant	Torque	Restraint	Axial
Variables:	**F**	**Q**	**S**	**T**	**R**	**P**
Values per station:	lb x in^2	lb	lb / in	in x lb	in x lb / rad	lb
Or:	K x ft^2	K	K/ft	ft x K	ft x K/rad	K

Although unit pairs pound – inch and kip – feet are shown above any system of length and force units may be used as long as the same units are used throughout the input file.

Axial tension or compression values P must be stated at each station in the same manner as any other distributed data; there is no mechanism in the program to automatically distribute the internal effects of an externally applied axial load.

Data should not be entered in this table (nor held from the preceding problem) which would express effects at fictitious stations beyond the ends of the real beam-column.

The left end of the beam-column must be located at Station 0.

For the interpolation and distribution process, there are four variations in the station numbering and the referencing for continuation to succeeding cards. These variations are explained and illustrated on the page of this *Guide* headed **Fixed-position Data**.

There are no restrictions on the order of cards in Table 4, except that within a distribution sequence the stations must be in regular order.

TABLE 5. MOVABLE-LOAD (number of cards per Table 1, 150 max - kept data accumulated)

The input data in Table 5 is governed by the same rules as in Table 4.

TABLE 6. SPECIFIED STATIONS FOR INFLUENCE DIAGRAMS (number of cards is 4 or 0)

A maximum of 5 stations may be specified for each of the four variables: deflection, bending moment, shear and support reaction.

The data cards must be stacked in the order of the listed variables.

_____

If no influence lines are desired for one variable, a blank card must be inserted for that variable.

Shear is computed one-half increment to the left of designated station.

Type of output: If 1 is specified: Plot
                     If 2 is specified: Table
                     If 3 is specified: Plot and Table

Fixed-position Data

Individual-card Input

	From Sta	To Sta	Cont'd to next card ?	F Bending stiffness	Q Typical load	
Case a.1: Data concentrated at one station	7 → 7		0 = NO		3.0	●
Case a.2: Data uniformly distributed ……	5 → 15		0 = NO	2.0		◓
	15 → 20		0 = NO	4.0	1.0	◓
	10 → 20		0 = NO		2.0	○

Multiple-card Sequence

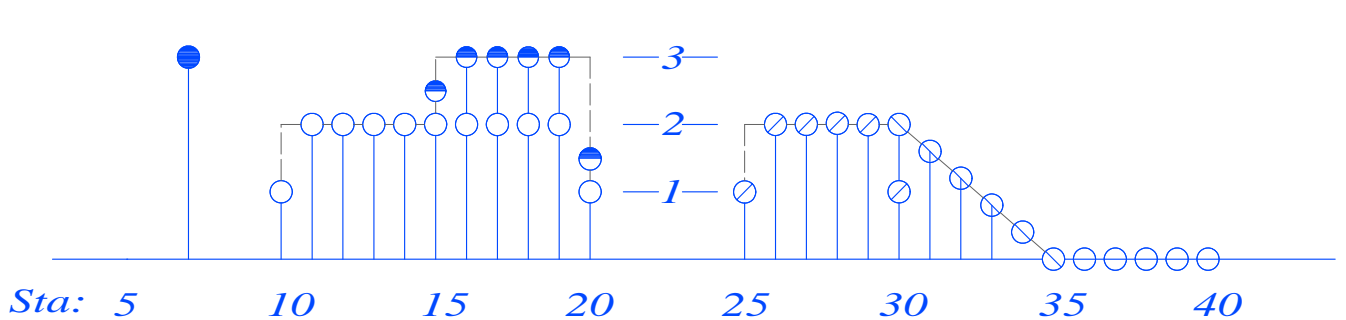|	From Sta	To Sta	Cont'd to next card ?	F Bending stiffness	Q Typical Load	
Case b: First-of-sequence ………………	25		1 = YES	0.0	2.0	
Case c: Interior-of-sequence ……………		30	1 = YES	4.0	2.0	
		35	1 = YES	2.0	0.0	
Case d: End-of-sequence ………………		40	0 = NO	2.0		
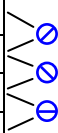
Graphics of Resulting Distribution of Data

Stiffness F (kips x ft^2)
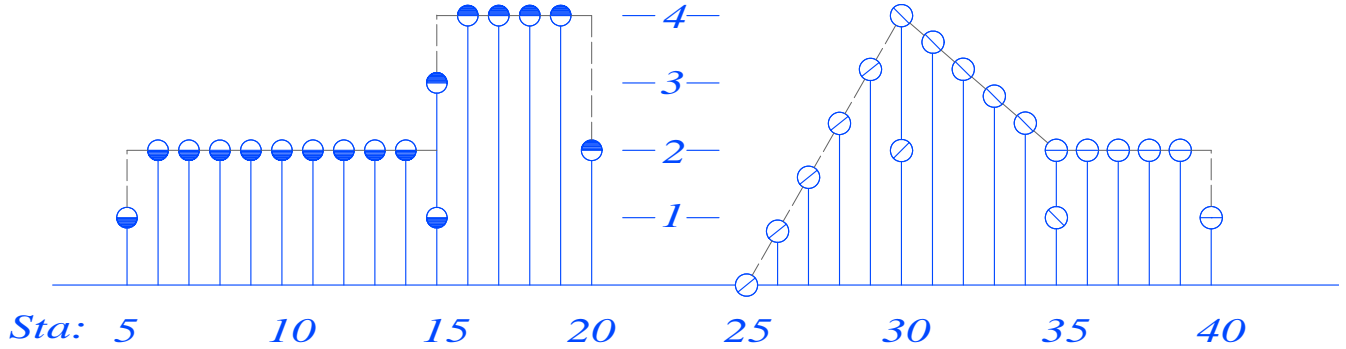
Load Q (kips /sta)

Reference

1. Matlock, Hudson, and Thomas P. Taylor, "A Computer Program to Analyze Beam Columns under Movable Loads", Research Report 56-4, Project 3-5-63-56, issued by the Center for Highway Research, the University of Texas at Austin, June 1968.