Table 7.3.2 Description of the input variables to the program **FEM1D**

• **Data Card 1**	
TITLE	Title of the problem being solved (80 characters)
• **Data Card 2**	
MODEL	Model equation being solved (see below)
NTYPE	Type of problem solved (see below)
	MODEL = 1, NTYPE = 0: A problem of MODEL EQUATION (3.2.1)
	MODEL = 1, NTYPE = 1: A circular DISK (PLANE STRESS)
	MODEL = 1, NTYPE > 1: A circular DISK (PLANE STRAIN)
	MODEL = 2, NTYPE = 0: A Timoshenko BEAM (RIE) problem
	MODEL = 2, NTYPE = 1: A Timoshenko PLATE (RIE) problem
	MODEL = 2, NTYPE = 2: A Timoshenko BEAM (CIE†) problem
	MODEL = 2, NTYPE > 2: A Timoshenko PLATE (CIE) problem
	MODEL = 3, NTYPE = 0: A Euler–Bernoulli BEAM problem
	MODEL = 3, NTYPE > 0: A Euler–Bernoulli circular plate
	MODEL = 4, NTYPE = 0: A plane TRUSS problem
	MODEL = 4, NTYPE = 1: A Euler–Bernoulli FRAME problem
	MODEL = 4, NTYPE = 2: A Timoshenko (CIE) FRAME problem
ITEM	Indicator for transient analysis
	ITEM = 0, Steady-state solution
	ITEM = 1, Transient analysis of PARABOLIC equations
	ITEM = 2, Transient analysis of HYPERBOLIC equations
	ITEM = 3, Eigenvalue analysis
• **Data Card 3**	
IELEM	Type of finite element
	IELEM = 0, Hermite cubic finite element
	IELEM = 1, Linear Lagrange finite element
	IELEM = 2, Quadratic Lagrange finite element
NEM	Number of elements in the mesh
• **Data Card 4**	
ICONT	Indicator for continuity of data for the problem
	ICONT = 1, Data (AX,BX,CX,FX and mesh) is continuous
	ICONT = 0, Data is element dependent
NPRNT	Indicator for printing of element/global matrices
	NPRNT = 0, Not to print element or global matrices but postprocess the solution and print
	NPRNT = 1, Print Element 1 coefficient matrices only but postprocess the solution and print
	NPRNT = 2, Print Element 1 and global matrices but NOT postprocess the solution
	NPRNT > 2, Not to print element or global matrices and NOT postprocess the solution

Skip Cards 5–15 for TRUSS/FRAME problems (MODEL=4), and read Cards 5–15 only if MODEL $\neq$ 4. SKIP cards 5−9 if data is discontinuous (ICONT = 0).

• **Data Card 5**	
DX(I)	Array of element lengths. DX(1) denotes the global coordinate of Node 1 of the mesh; DX(I) (I = 2, NEM1) denotes the length of the (I - 1)st element, where NEM1 = NEM + 1, and NEM denotes the number of elements in the mesh.

Cards 6–9 define the coefficients in the model equations. All coefficients are expressed in terms of GLOBAL coordinate x. See Table 7.2.1 for the meaning of the coefficients.

(**Table 7.3.2** continued)

- **Data Card 6**

AX0	Constant term of the coefficient $[a(x) =]$ AX
AX1	Linear term of AX

- **Data Card 7**

BX0	Constant term of the coefficient $[b(x) =]$ BX
BX1	Linear term of the coefficient BX

- **Data Card 8**

CX0	Constant term of the coefficient $[c(x) =]$ CX
CX1	Linear term of the coefficient CX

SKIP Card 9 for eigenvalue problems (i.e., when ITEM = 3)

- **Data Card 9**

FX0	Constant term of the source $[f(x) =]$ FX
FX1	Linear term of FX
FX2	Quadratic term of FX

SKIP Cards 10–15 if data is continuous (ICONT $\neq$ 0). Cards 10–15 are read for each element (i.e., NEM times). All coefficients are with respect to the LOCAL coordinate $\bar{x}$.

- **Data Card 10**

NNM	Number of global nodes in the mesh

- **Data Card 11**

NOD	Connectivity of the element: NOD(N,I) = Global node number corresponding to the Ith node of Element N (I=1, NPE) where NPE denotes the Number of nodes Per Element
GLX(I)	Length of the Ith element

- **Data Card 12**

DCAX	Constant and linear terms of the coefficient AX

- **Data Card 13**

DCBX	Constant and linear terms of the coefficient BX

- **Data Card 14**

DCCX	Constant and linear terms of the coefficient CX

- **Data Card 15**

DCFX	Constant, linear and quadratic terms of FX

READ Cards 16–23 only for TRUSS/FRAME problems (MODEL = 4); otherwise SKIP.

- **Data Card 16**

NNM	Number of nodes in the finite element mesh

SKIP Cards 17–19 for TRUSS problems (NTYPE = 0)

- **Data Card 17 (Read for each element)**

PR	Poisson's ratio of the material (not used in EBT)
SE	Young's modulus of the material
SL	Length of the element
SA	Cross-sectional area of the element
SI	Moment of inertia of the element
CS	Cosine of the angle of orientation of the element
SN	Sine of the angle of orientation of the element; the angle is measured clockwise from the global x axis

- **Data Card 18 (Read for each element)**

HF	Intensity of the horizontal distributed force
VF	Intensity of the transversely distributed force
PF	Point load on the element
XB	Distance from node 1, along the length of the element to the point of load application, PF
CNT	Cosine of the angle of orientation of the load PF
SNT	Sine of the angle of orientation of the load PF; the angle is measured clockwise from the element x axis.

(**Table 7.3.2** continued)

- **Data Card 19**

NOD	Connectivity of the element: NOD(N,I) = global node number corresponding to the Ith node of element N (I = 1,NPE)

READ Cards 20 and 21 only for TRUSS problems (NTYPE = 0).

- **Data Card 20 (Read for each element)**

SE	Young's modulus of the material
SL	Length of the element
SA	Cross-sectional area of the element
CS	Cosine of the angle of orientation of the element
SN	Sine of the angle of orientation of the element Angle is measured counterclockwise from x axis
HF	Intensity of the horizontal distributed force

- **Data Card 21**

NOD(N,I)	Connectivity of the element: NOD(N,I) = global node number corresponding to the Ith node of element N (I = 1,NPE)

- **Data Card 22**

NCON	Number of inclined support conditions

SKIP Card 23 if no inclined support conditions are specified (NCON=0).

- **Data Card 23 (I = 1 to NCON)**

ICON(I)	Global node number of the support
VCON(I)	Angle (in degrees) between the normal and the global x-axis

- **Data Card 24**

NSPV	Number of specified PRIMARY degrees of freedom

SKIP Card 25 if no primary variables is specified (NSPV=0).

- **Data Card 25 (I = 1 to NSPV)**

ISPV(I,1)	Node number at which the PV is specified
ISPV(I,2)	Specified local primary degree of freedom (DOF) at the node
VSPV(I)	Specified value of the primary variable (PV) (will not read for eigenvalue problems)

SKIP Card 26 for eigenvalue problems (i.e., when ITEM = 3).

- **Data Card 26**

NSSV	Number of specified (nonzero) SECONDARY variables

SKIP Card 27 if no secondary variables is specified (NSSV=0); repeat Card 27 NSSV times.

- **Data Card 27 (I = 1 to NSSV)**

ISSV(I,1)	Node number at which the SV is specified
ISSV(I,2)	Specified local secondary DOF at the node
VSSV(I)	Specified value of the secondary variable (SV)

- **Data Card 28**

NNBC	Number of the Newton (mixed) boundary conditions

SKIP Card 29 if no mixed boundary condition is specified (NNBC = 0). The mixed boundary condition is assumed to be of the form:

SV+VNBC *(PV − UREF) = 0. Repeat Card 29 NNBC times.

- **Data Card 29 (I = 1 to NNBC)**

INBC(I,1)	Node number at which the mixed B.C. is specified
INBC(I,2)	Local DOF of the PV and SV at the node
VNBC(I)	Value of the coefficient of the PV in the B.C.
UREF(I)	Reference value of the PV

(**Table 7.3.2** continued)

• **Data Card 30**

NMPC	Number of multipoint constraints (solid mechanics)

SKIP Card 31 if no multipoint conditions are specified (NMPC = 0). The multipoint condition is assumed to be of the form:
VMPC(.,1)*PV1+VMPC(.,2)*PV2=VMPC(.,3). Repeat Card 31 NMPC times.

• **Data Card 31 (I = 1 to NMPC)**

IMC1(I,1)	Node number associated with PV1
IMC1(I,2)	Local DOF of PV1
IMC2(I,1)	Node number associated with PV2
IMC2(I,2)	Local DOF of PV2
VMPC(I)	Values of the coefficients of the constraint equation
VMPC(4)	Value of the force applied at the node of PV1 or PV2

Skip Card 32 if ITEM = 0 (read only for time-dependent or eigenvalue problems).

• **Data Card 32**

CT0	Constant part of CT = CT0 + CT1*X
CT1	Linear part of CT = CT0 + CT1*X

Skip remaining cards if steady-state or eigenvalue analysis is to be performed (ITEM = 0 or ITEM = 3).

• **Data Card 33**

DT	Time increment (uniform)
ALFA	Parameter in the time approximation scheme
GAMA	Parameter in the time approximation scheme*
	GAMA (not used when ITEM = 1: parabolic equation).

Give GAMA= 10^{-6} when centered difference is used (formulation in Problem 6.23 is the correct way to implement the centered difference scheme).

• **Data Card 34**

INCOND	Indicator for initial conditions
	INCOND = 0, Homogeneous (zero) initial conditions
	INCOND > 0, Nonhomogeneous initial conditions
NTIME	Number of time steps for which solution is sought
INTVL	Time step intervals at which solution is to be printed

Skip Cards 35 and 36 if initial conditions are zero (INCOND = 0).

• **Data Card 35**

GUO	Array of initial values of the primary variables

Skip Card 36 for parabolic equations (ITEM = 1).

• **Data Card 36**

GUI	Array of initial values of the first time derivatives of the primary variables.

format" used here, variables of each "data card" (we shall use this terminology to imply an input sequence in a single instruction) are read from the same line; if the values are not found on the same line, the computer will look for them on the next line(s). However, data required by different data cards cannot be put on single line; each data card must start with a new line. The space available after typing required data on a given line may be used to include any comments. For example, we may list the variable names on that line for ready reference but only after all of the required data are listed. The text included thereafter is *not* read by the computer (except to echo the input file).