



FIGURE 2.9 Model of Problem 2.1.

```

% to be used by all the functions (M-files) constituting
% the program
%
global nnd nel nne nodof eldof n global geom connec prop nf load
%
format short e
%
%%%%%%%%%%%%%% Beginning of data input %%%%%%%%%%%%%%%
%
nnd = 9; % Number of nodes:
nel = 15; % Number of elements:
nne = 2; % Number of nodes per element:
nodof = 2; % Number of degrees of freedom per node
eldof = nne*nodof; % Number of degrees of freedom
                % per element
%
% Nodes coordinates X and Y
geom=zeros(nnd,2);
geom = [0.    0.; ... % X and Y coord. node 1
        2.    2.; ... % X and Y coord. node 2
        2.    0.; ... % X and Y coord. node 3
        4.    2.; ... % X and Y coord. node 4
        4.    0.; ... % X and Y coord. node 5
        6.    2.; ... % X and Y coord. node 6
        6.    0.; ... % X and Y coord. node 7
        8.    2.; ... % X and Y coord. node 8
        8.    0.]; % X and Y coord. node 9
%
% Element connectivity
%
connec=zeros(nel,2);
connec = [1  2; ... % 1st and 2nd node of element 1
          1  3; ... % 1st and 2nd node of element 2
          2  3; ... % 1st and 2nd node of element 3
          2  4; ... % 1st and 2nd node of element 4
          3  4; ... % 1st and 2nd node of element 5
          3  5; ... % 1st and 2nd node of element 6
          4  5; ... % 1st and 2nd node of element 7
          4  6; ... % 1st and 2nd node of element 8

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5 6 ; ... % 1st and 2nd node of element 9
5 7 ; ... % 1st and 2nd node of element 10
6 7 ; ... % 1st and 2nd node of element 11
6 8 ; ... % 1st and 2nd node of element 12
7 8 ; ... % 1st and 2nd node of element 13
7 9 ; ... % 1st and 2nd node of element 14
8 9 ] ; % 1st and 2nd node of element 15
%
% Geometrical properties
%
% prop(1,1) = E; prop(1,2)= A
%
prop=zeros(nel,2);
prop = [30.e6      0.02 ; ... % E and A of element 1
        30.e6      0.045 ; ... % E and A of element 2
        30.e6      0.02 ; ... % E and A of element 3
        30.e6      0.045 ; ... % E and A of element 4
        30.e6      0.02 ; ... % E and A of element 5
        30.e6      0.045 ; ... % E and A of element 6
        30.e6      0.02 ; ... % E and A of element 7
        30.e6      0.045 ; ... % E and A of element 8
        30.e6      0.02 ; ... % E and A of element 9
        30.e6      0.045 ; ... % E and A of element 10
        30.e6      0.02 ; ... % E and A of element 11
        30.e6      0.045 ; ... % E and A of element 12
        30.e6      0.02 ; ... % E and A of element 13
        30.e6      0.045 ; ... % E and A of element 14
        30.e6      0.02 ]; % E and A of element 15
%
% Boundary conditions
%
nf = ones(nnd, nodof); % Initialize the matrix nf to 1
nf(1,1) = 0; nf(1,2) = 0 ; % Prescribed nodal freedom of node 1
nf(9,2) = 0 ; % Prescribed nodal freedom of node 3
%
% Counting of the free degrees of freedom
%
n=0; for i=1:nnd
    for j=1:nodof
        if nf(i,j) ~= 0
            n=n+1;
            nf(i,j)=n;
        end
    end
end
%
% loading
%
load = zeros(nnd, 2);
load(2,:)=[15.  0.]; %forces in X and Y directions at node 2
load(3,:)=[0.  -5.]; %forces in X and Y directions at node 3
load(4,:)=[0.  -7.]; %forces in X and Y directions at node 4
load(7,:)=[0.  -10.]; %forces in X and Y directions at node 7
%
%***** End of input *****

```

## Results file

\*\*\*\*\* PRINTING MODEL DATA \*\*\*\*\*

```

-----
Number of nodes:                9
Number of elements:             15
Number of nodes per element:    2

```

Number of degrees of freedom per node: 2  
 Number of degrees of freedom per element: 4

```
-----
Node      X      Y
1,      0000.00,  0000.00
2,      0001.00,  0002.00
3,      0002.00,  0000.00
4,      0003.00,  0002.00
5,      0004.00,  0000.00
6,      0005.00,  0002.00
7,      0006.00,  0000.00
8,      0007.00,  0002.00
9,      0008.00,  0000.00
```

```
-----
Element   Node_1  Node_2
1,        1,      2
2,        1,      3
3,        2,      3
4,        2,      4
5,        3,      4
6,        3,      5
7,        4,      5
8,        4,      6
9,        5,      6
10,       5,      7
11,       6,      7
12,       6,      8
13,       7,      8
14,       7,      9
15,       8,      9
```

```
-----
Element   E      A
1,      3e+007,  0.02
2,      3e+007,  0.045
3,      3e+007,  0.02
4,      3e+007,  0.045
5,      3e+007,  0.02
6,      3e+007,  0.045
7,      3e+007,  0.02
8,      3e+007,  0.045
9,      3e+007,  0.02
10,     3e+007,  0.045
11,     3e+007,  0.02
12,     3e+007,  0.045
13,     3e+007,  0.02
14,     3e+007,  0.045
15,     3e+007,  0.02
```

```
-----
Node      disp_U  disp_V
1,        0,      0
2,        1,      2
3,        3,      4
4,        5,      6
5,        7,      8
6,        9,     10
7,       11,     12
8,       13,     14
9,       15,      0
```

```
-----
Node      load_X  load_Y
1,      0000.00,  0000.00
2,      0015.00,  0000.00
```

```

3,    0000.00,    -005.00
4,    0000.00,    -007.00
5,    0000.00,    0000.00
6,    0000.00,    0000.00
7,    0000.00,    -010.00
8,    0000.00,    0000.00
9,    0000.00,    0000.00

```

-----  
Total number of active degrees of freedom, n = 15  
-----

\*\*\*\*\* PRINTING ANALYSIS RESULTS \*\*\*\*\*

-----  
Global force vector F

```

15
0
0
-5
0
-7
0
0
0
0
0
-10
0
0
0

```

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-----  
Displacement solution vector: delta

```

0.00014
-0.00010
0.00003
-0.00019
0.00010
-0.00023
0.00006
-0.00023
0.00007
-0.00021
0.00009
-0.00018
0.00005
-0.00009
0.00010

```

-----  
Nodal displacements

Node	disp_X	disp_Y
1,	0.00000,	0.00000
2,	0.00014,	-0.00010
3,	0.00003,	-0.00019
4,	0.00010,	-0.00023
5,	0.00006,	-0.00023
6,	0.00007,	-0.00021
7,	0.00009,	-0.00018
8,	0.00005,	-0.00009
9,	0.00010,	0.00000

-----

Members actions

element	force	action
1,	-7.69,	Compression
2,	18.44,	Tension
3,	7.69,	Tension
4,	-21.87,	Compression
5,	-2.10,	Compression
6,	22.81,	Tension
7,	-5.73,	Compression
8,	-20.25,	Compression
9,	5.73,	Tension
10,	17.69,	Tension
11,	-5.73,	Compression
12,	-15.12,	Compression
13,	16.91,	Tension
14,	7.56,	Tension
15,	-16.91,	Compression