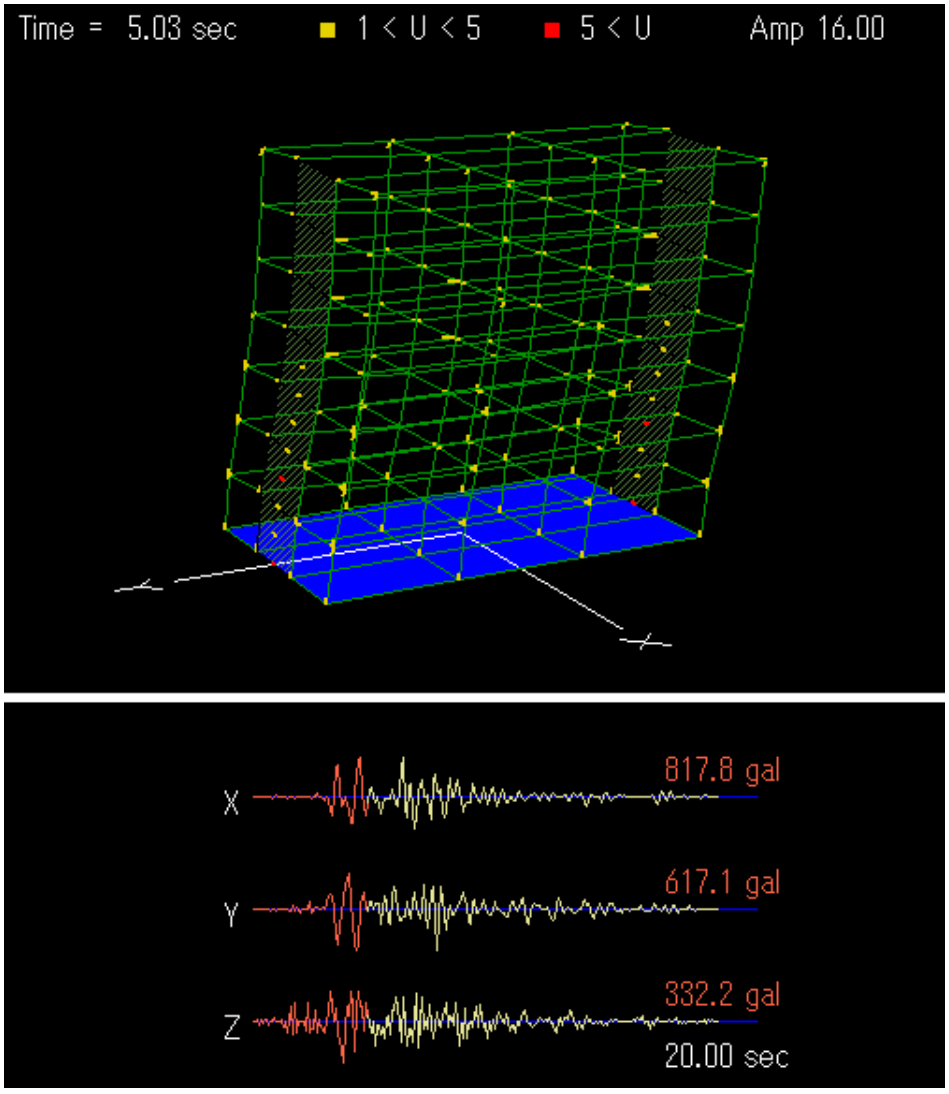
STERA 3D ver.5.5

STructural Earthquake Response Analysis 3D



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Preface

This software is developed for the following analyses of reinforced concrete (RC) buildings:

1) Linear modal analysis,
2) Nonlinear static push-over analysis,
3) Nonlinear earthquake response analysis.

This software is distributed for free for the use of research and educational purpose.

Since this software is still under development, the author can not take any responsibility for the results of this software. It is greatly appreciated to have any opinions for future improvement.

12 September, 2005

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Update history

2006/06/25 STERA_3D Ver.2.7 is uploaded.

- To save response data to output files, you can select a folder to store output files. Also, the program, "response.exe", to save response output is automatically executed from STERA_3D.

2006/07/05 STERA_3D Ver.2.8 is uploaded.

- "Error in Shell Command" is fixed.
- Program bug for the base spring is fixed.

2006/07/10 STERA_3D Ver.2.9 is uploaded.

- Program bug of freezing window in playing a movie is fixed.

2006/07/31 STERA_3D Ver.3.0 is uploaded.

- Program bug of unable to change damping factor is fixed.
- 230 N/mm^2 is added to the list of steel strength of members. (Because of this change, you must modify the previous building data.)
- UBC (Uniform Building Code, USA) distribution for vertical seismic load in nonlinear static analysis is added.
- The graph of top drift (top displacement / building height) and base shear coefficient is added in the view list of earthquake response analysis.
- The button to change the color of 3D view to white and black is added.

2006/09/15 STERA_3D Ver.3.1 is uploaded.

- Static cyclic loading is possible in nonlinear static analysis.

2007/02/26 STERA_3D Ver.3.2 is uploaded.

- "Error message" appears in case of wall data without side columns.
- Zero floor mass is accepted.
- The graph of story drift includes base isolation story.

2007/04/03 STERA_3D Ver.3.3 is uploaded.

- Ground movement is shown in 3D View.
- Static Loading using dominant mode shape is added.
- In the option view of dynamic analysis, the mode number for circular frequency is designated for proportional damping.
- Different steel strengths for vertical reinforcement and shear reinforcement are possible.
- Different Yong modulus for each member is possible.
- Eccentricity ratio is calculated.

- In Option Menu, you can select 2-Dimension Analysis.

2007/05/10 STERA_3D Ver.3.4 is uploaded.

- Black and White buttons are added in both Views.
- Ratio of response amplification is displayed in 3D View.
- Pause button is added.
- Rotation angle at the center of mass is saved in an output file.

2007/07/17 STERA_3D Ver.3.5 is uploaded.

- Nonstructural wall is added in the list of elements and the color of element is changed.
- In Option Menu, you can input restrained freedom numbers.

2007/10/01 STERA_3D Ver.3.6 is uploaded.

- You can get the time-history response of the designated member.

2007/10/18 STERA_3D Ver.3.7 is uploaded.

- You can select the numerical integration method.
- Output data is added more.

2007/10/31 STERA_3D Ver.3.8 is uploaded.

- Program bugs in transformation matrix are fixed.

2008/05/20 STERA_3D Ver.3.9 is uploaded.

- You can set isolation devices in the middle story.

2008/07/10 STERA_3D Ver.4.2 is uploaded.

- You can directly input material strength (steel and concrete).
- Masonry element is added.
- In Masonry and Damper Edit Views, you can set the upper beam types.
- The maximum number of element type is increased to be 30.

2009/01/12 STERA_3D Ver.4.3 is uploaded.

- You can change the default values for Column, Beam and Wall elements by Option Button in the Edit View.
- You can select NRB or LRB for the Isolator element.
- You can select Hysteresis Damper or Viscous Damper for the Damper element.

2009/10/22 STERA_3D Ver.4.4 is uploaded.

- You can get the energy response in the time-history analysis.
- You can set more detail dimension for Beam and Column elements.

2010/03/30 STERA_3D Ver.4.5 is uploaded.

- Formulation of P-D effect is changed.
- Slight change of output format.

2010/05/06 STERA_3D Ver.4.6 is uploaded.

- You can select 100 member types.
- You can select 20 members for output of time-history response.

2010/08/16 STERA_3D Ver.4.7 is uploaded.

- You can set “default values” for member type.
- You can keep previous member settings after changing floor and span numbers.
- You can select response output for floors, nodes, and members from Option Menu.
- You can select 100 members for output of time-history response.

2010/09/02 STERA_3D Ver.4.8 is uploaded.

- You can get the response of side columns of wall element.
- When you select the folder of output files, the previous path of the folder will be displayed.

2010/10/25 STERA_3D Ver.4.9 is uploaded.

- Shear deformation at the beam-column connection is included.
- For beam elements, the shape of hysteresis model for nonlinear bending springs can be controlled by option parameters.
- For column elements, you can input X and Y direction shear reinforcements respectively.

2010/11/07 STERA_3D Ver.5.0 is uploaded.

- The bug was fixed in case several walls are connected.

2010/12/01 STERA_3D Ver.5.1 is uploaded.

- The bug was fixed for yield rotation of nonlinear spring.

2011/01/17 STERA_3D Ver.5.4 is uploaded.

- You can neglect nonlinear shear spring by option menu.
- You can set the value to amplify the original earthquake directly.
- The maximum spans are 30 in X spans and 20 in Y spans.

2011/03/07 STERA_3D Ver.5.5 is uploaded.

- The bug for Ai-distribution is fixed.
- The definition of mass distribution is improved.
- You can analyze L-shape wall or sequence walls.

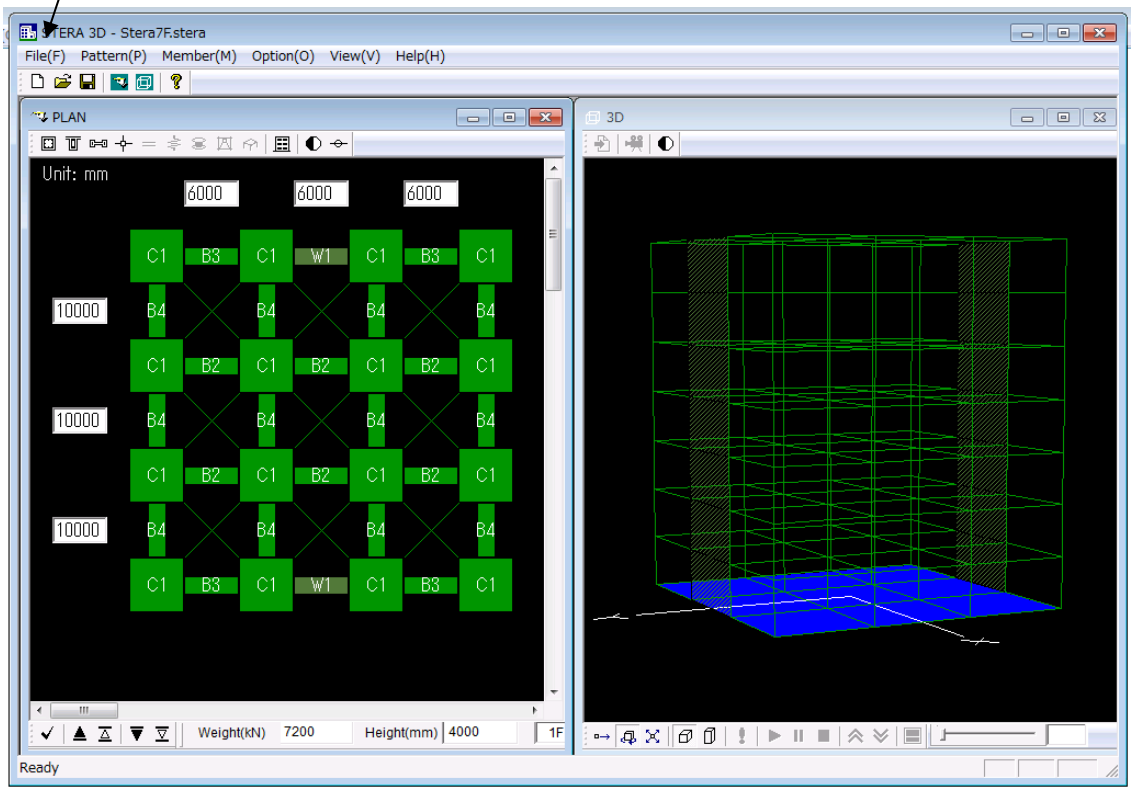
Quick User Manual

READ BUILDING DATA

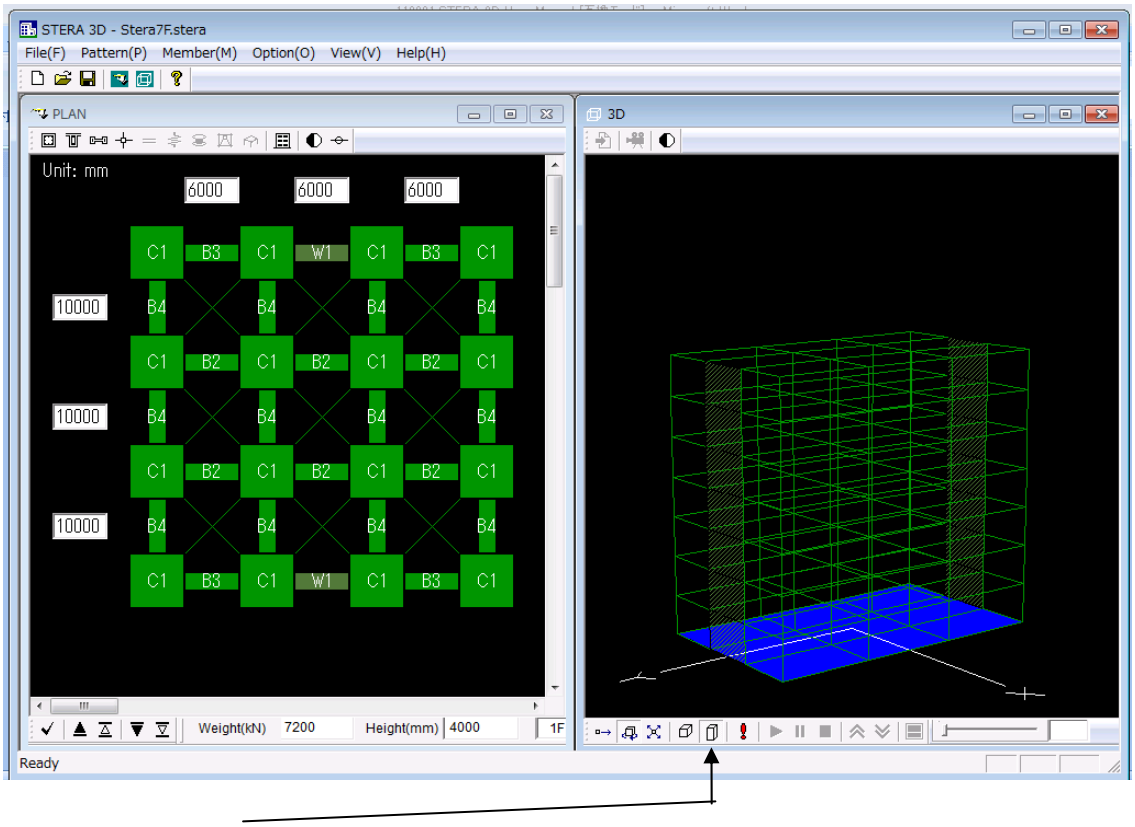
① Double Click 

② “File” → “Open”

Select an example building “Structure7F.stera”



MOVE THE BUILDING

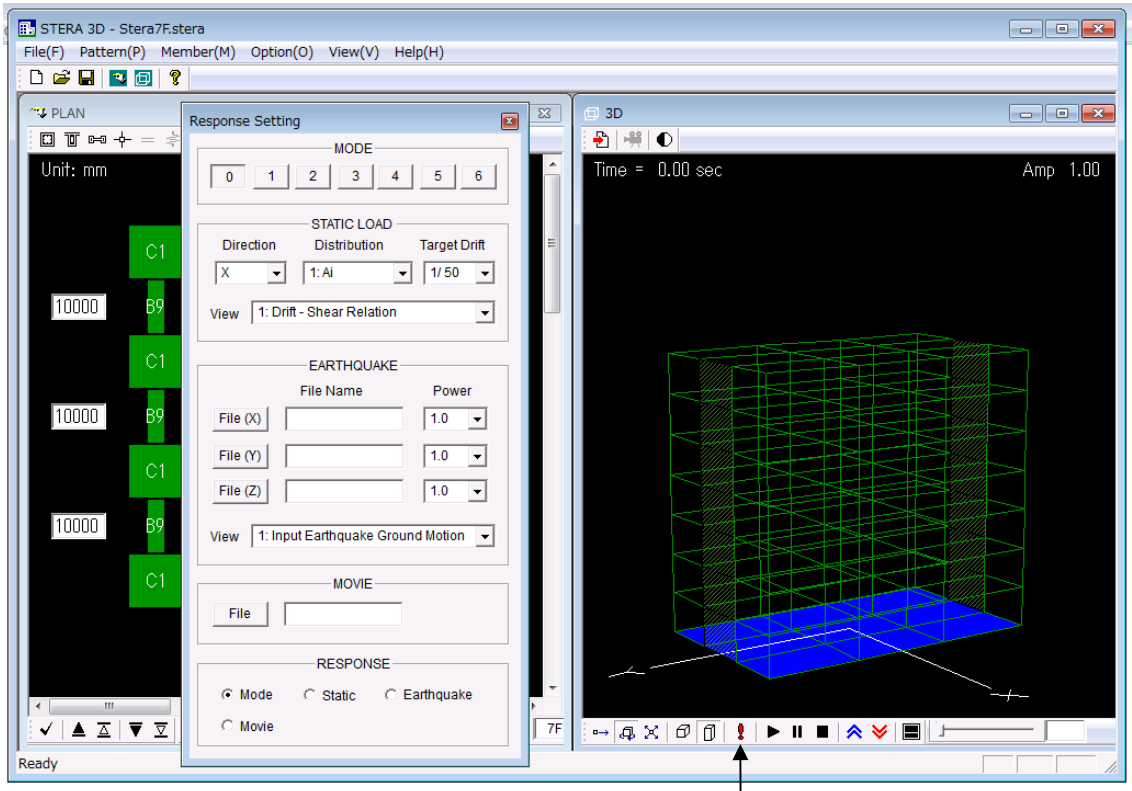


① Click  to be actual size.

② Drag the right mouse on the image to rotate the building.

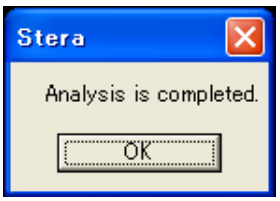
③ Drag the left mouse on the image to enlarge and reduce.

EARTHQUAKE RESPONSE

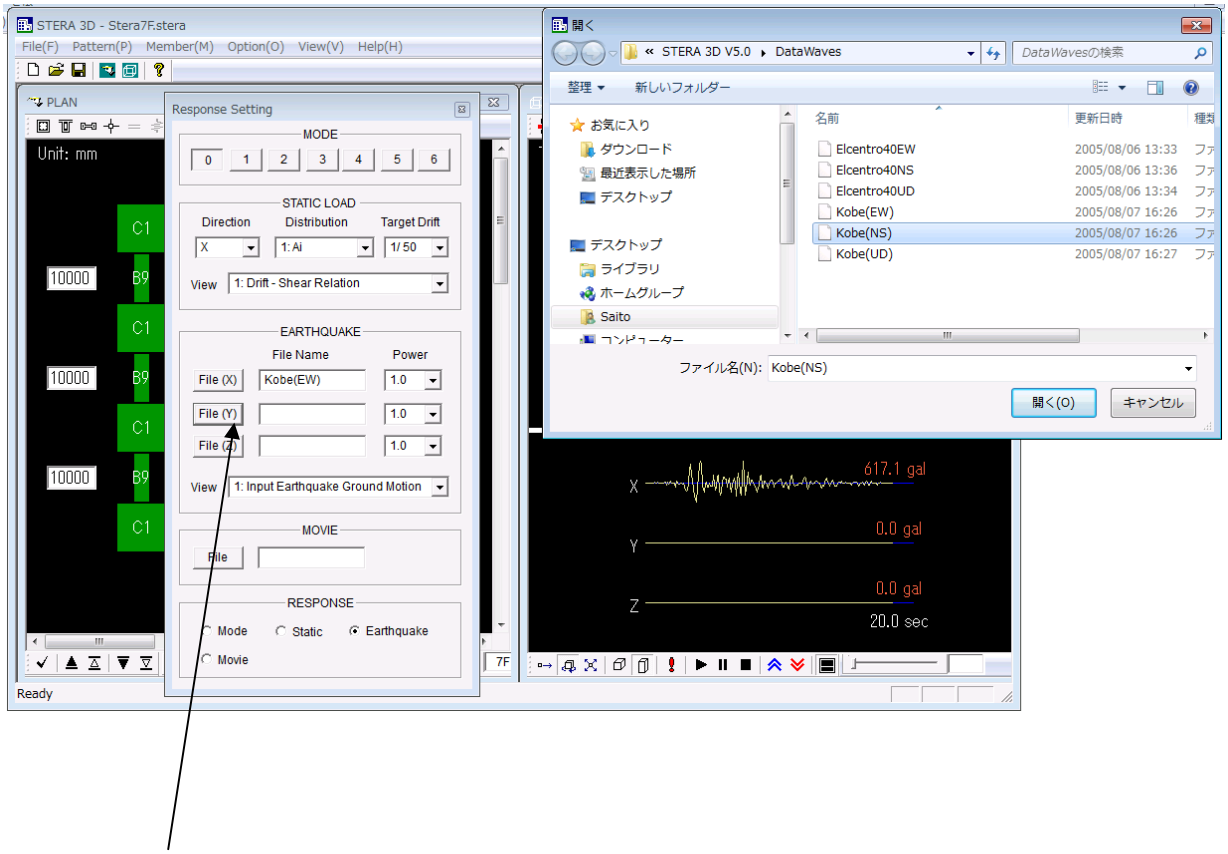


① Click  to analyze the building.

② After the message,



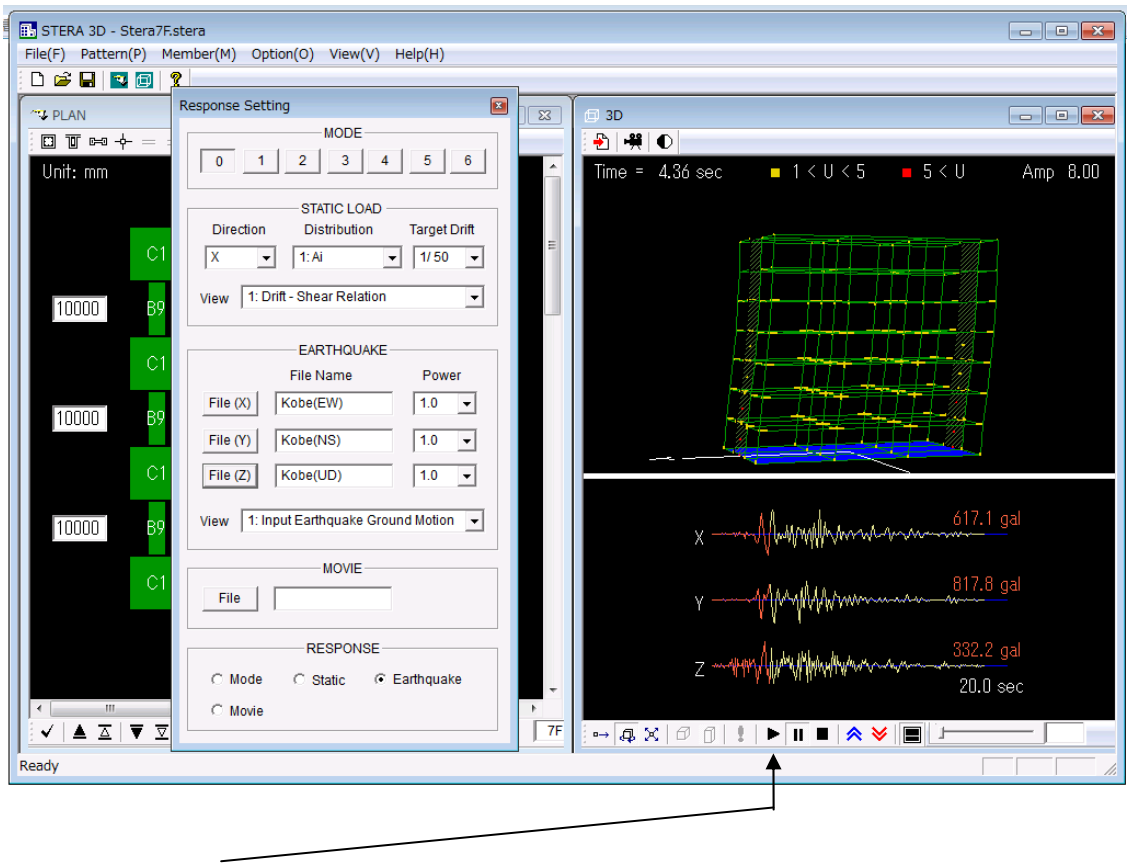
"Response Setting Dialog" will appear.



③ File (X) : Select X-direction earthquake data file.
For example, “Kobe(EW)”.

④ File (Y) : Select Y-direction earthquake data file.
For example, “Kobe(NS)”.

⑤ File (Z) : Select Z-direction earthquake data file.
For example, “Kobe(UD)”.



⑥ ▶ : Start the response

■ : Stop the response

: Amplify the response

: Reduce the response

:: Change the view from double screen to single screen

User Manual

Basic Assumptions

1) In a default setting, the displacement freedom of a floor diaphragm is considered to be rigid for in-plane displacement and free for out-of-plane displacement. Elastic deformation of a floor diaphragm in-plane can be considered by the option menu.

2) All structural elements are modeled by line-elements with nonlinear springs except floor diaphragms which are modeled by FEM models.

3) Beam element is represented by a model with nonlinear flexural springs at the both ends and a nonlinear shear spring in the middle of the element,

4) Column element is represented by a MS (multi spring) model with nonlinear axial springs in the sections of the both ends and two directional nonlinear shear springs in the middle of the element,

5) Wall element is represented by a MS (multi spring) model with nonlinear axial springs in the sections of the both ends and nonlinear shear springs in the middle of the wall panel as well as in the two side columns,

6) Nonlinear springs are introduced for base-isolation elements or vertical elements at the basement. Base-isolation element is represented by the MSS (multi shear spring) model with nonlinear shear springs in X-Y plane,

7) Hysteresis damper and nonstructural element are introduced as nonlinear shear models,

8) The shear deformation of connection panel between beam and column is considered to be rigid or elastic..

9) In a default setting, structural damping is proportional damping to initial stiffness. It can be changed to be proportional damping to instantaneous stiffness by the option menu.

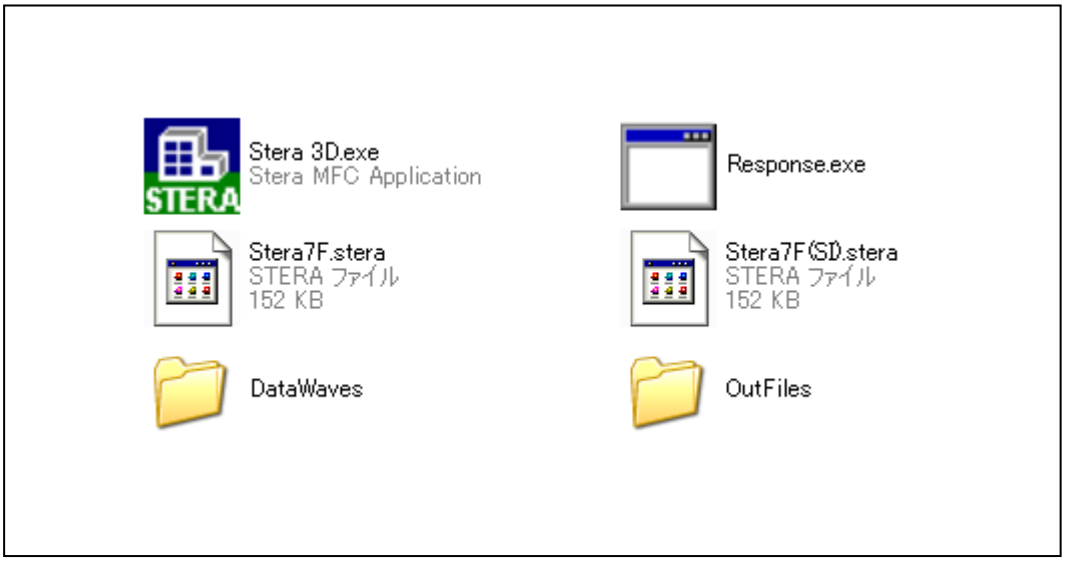
Other assumptions will be written in the technical manual which is under preparation.

1. File Arrangement

Please check if you have the following files and folders in the folder “STERA 3D V*.*”:

Stera 3D.exe	… Main program
response.exe	… Sub-program for response output
Stera7F.stera	… Sample building
Stera7F(SI).stera	… Sample building with seismic isolation
DataWaves	… Folder of earthquake files
OutFiles	… Folder of output files (empty)

If you change the places of these files, please put save two executable files; “Stera 3D.exe” and “response.exe” in a same folder.

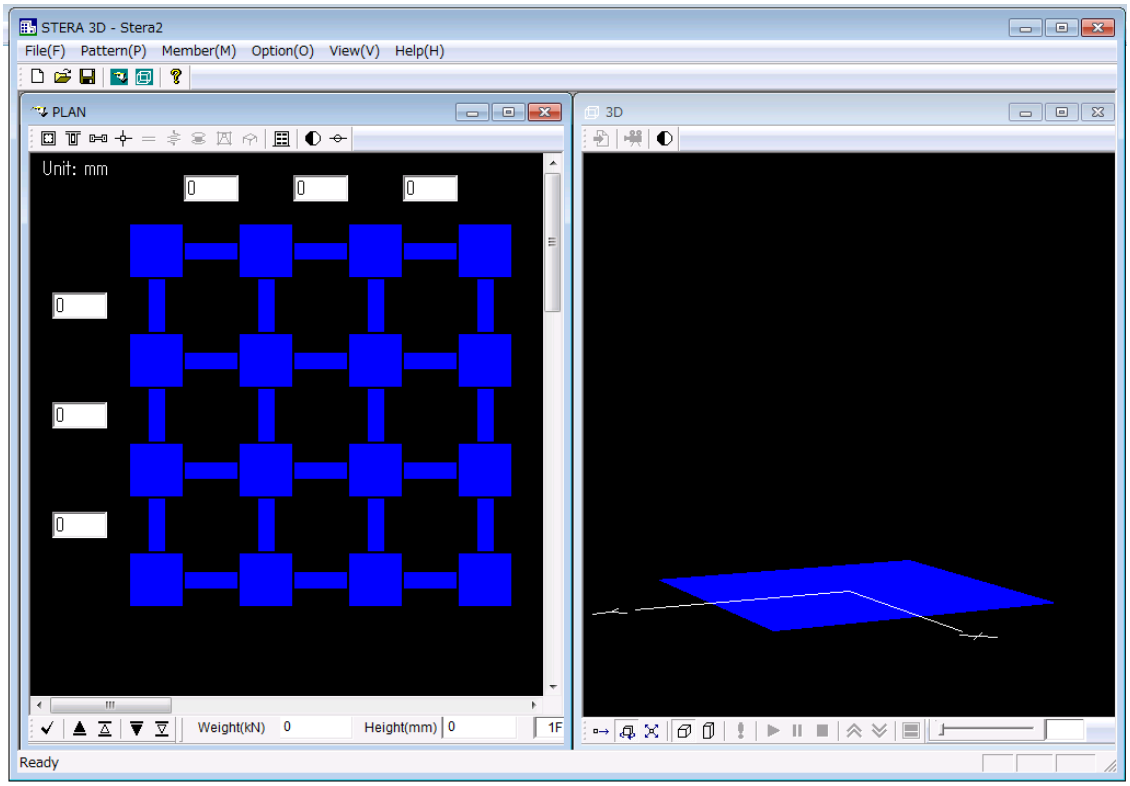


2. Initial View

Please double crick “Stera 3D.exe”

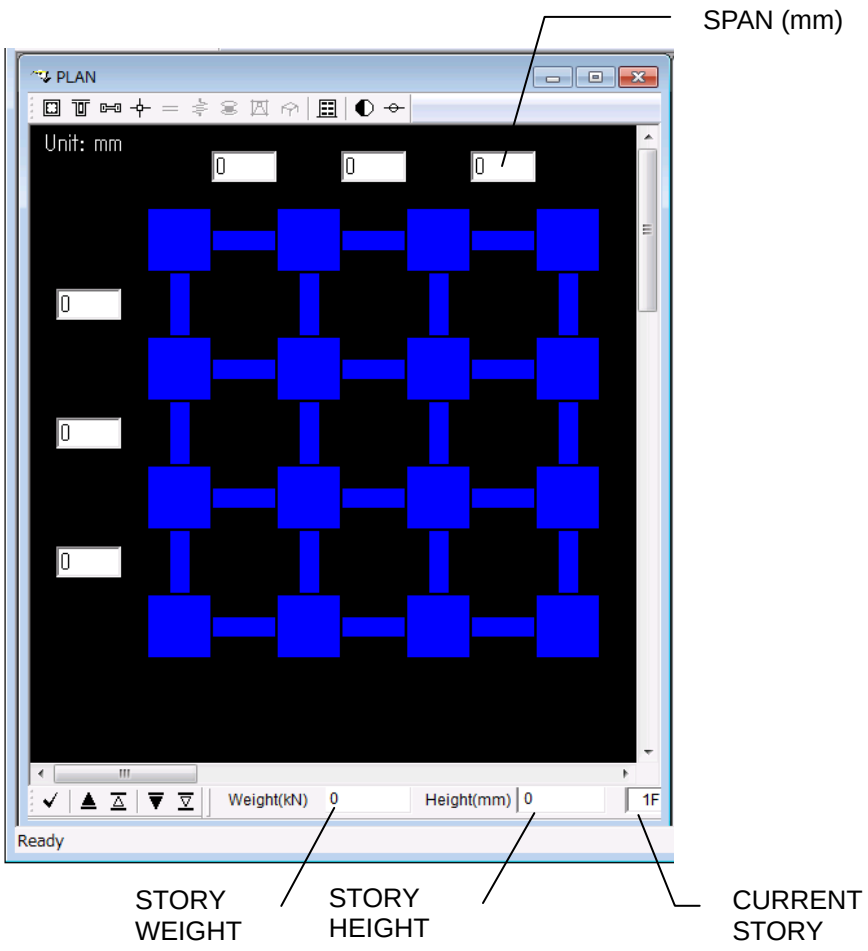
The left view is “PLAN EDIT VIEW” where you input building plan data, and the right view is “3D VIEW” where you can see the building shape and its response after the analysis..

To open the building data already saved, [File]→ [Open], and select the file.



PLAN EDIT VIEW 3D VIEW

3. Setting Element Pattern



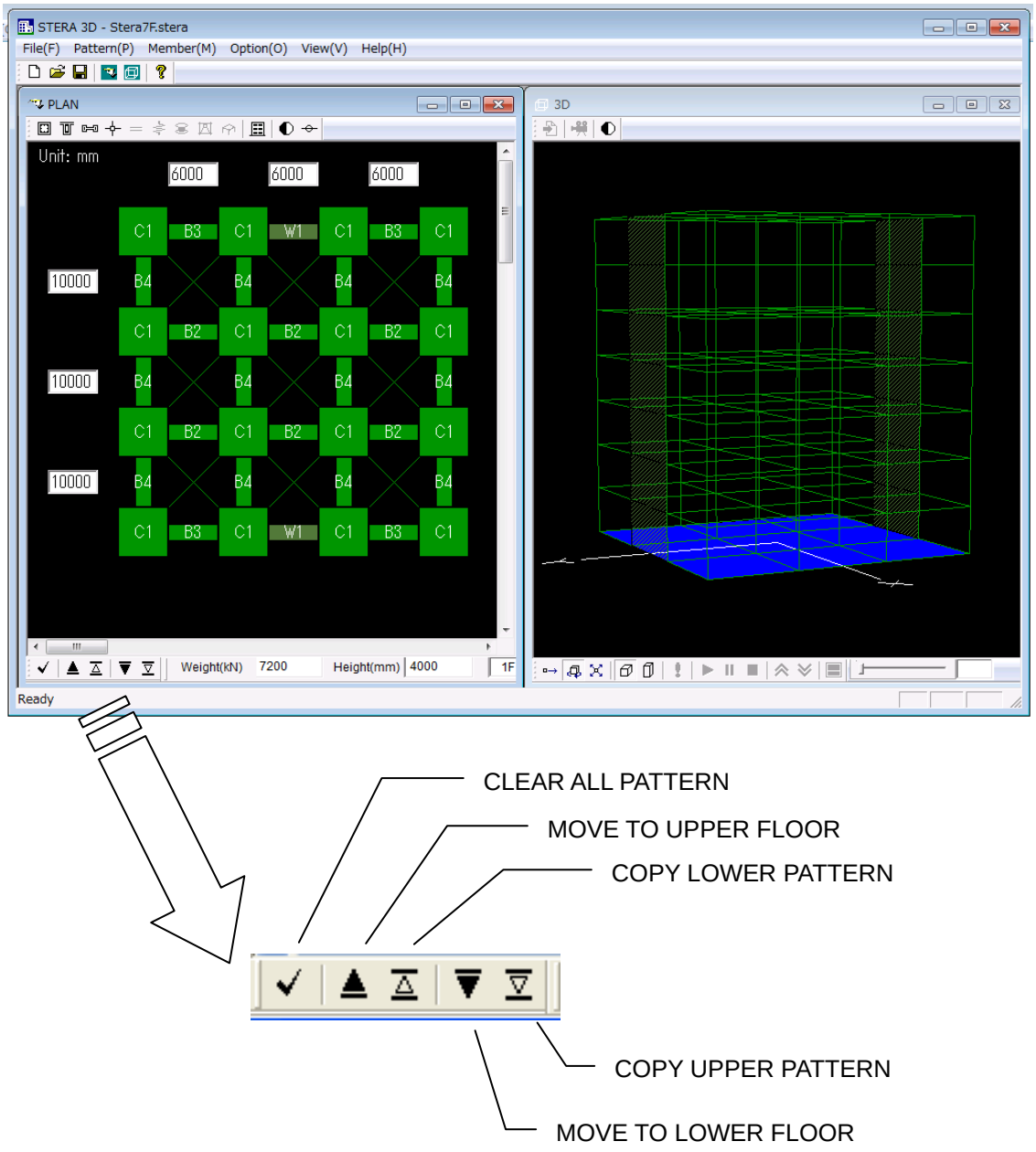
"PLAN EDIT VIEW" starts from 1st floor (1F) of a building.

- Please click the place you want to set.
- Please click again to change the element. It will be changed in the following order:
    - ✧ Column (green) -- > Empty -- > Column(green)
    - ✧ Beam (green) -- > Wall (dark green) -- > Empty -- > Beam (green)

  But, in case of the basement floor (BF), the order is changed as:
    - ✧ Base Spring (brown) -- >Empty -- > Base Spring (brown)

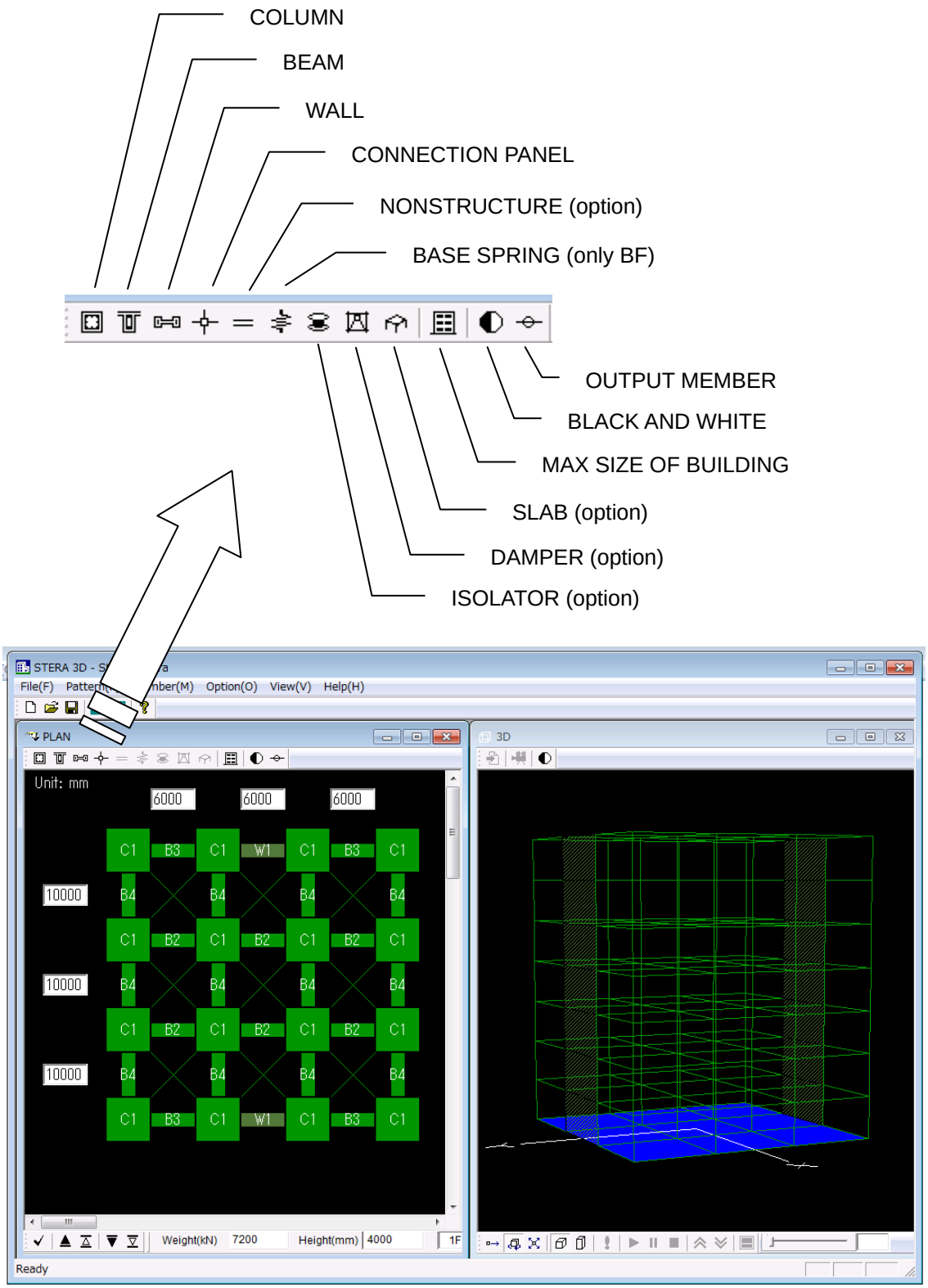
  If you select Masonry element, Damper element and Isolator element,
    - ✧ Column (green) -- > Isolator (brown) -- > Empty -- > Column(green)
    - ✧ Beam (green) -- > Damper (brown) -- > Masonry (brown) -- > Wall (dark green) -- > Empty -- > Beam (green)
- By dragging your mouse in a region, you can set all the elements in the region at once.
- By clicking the right button of your mouse, you can change the element type number for column (C1-C100), for beam (B1-B100), and for wall (W1-W100) etc.

- To move to another floor and copy or clear the member patterns, you can use the following buttons arranged at the bottom of the PLAN EDIT VIEW:



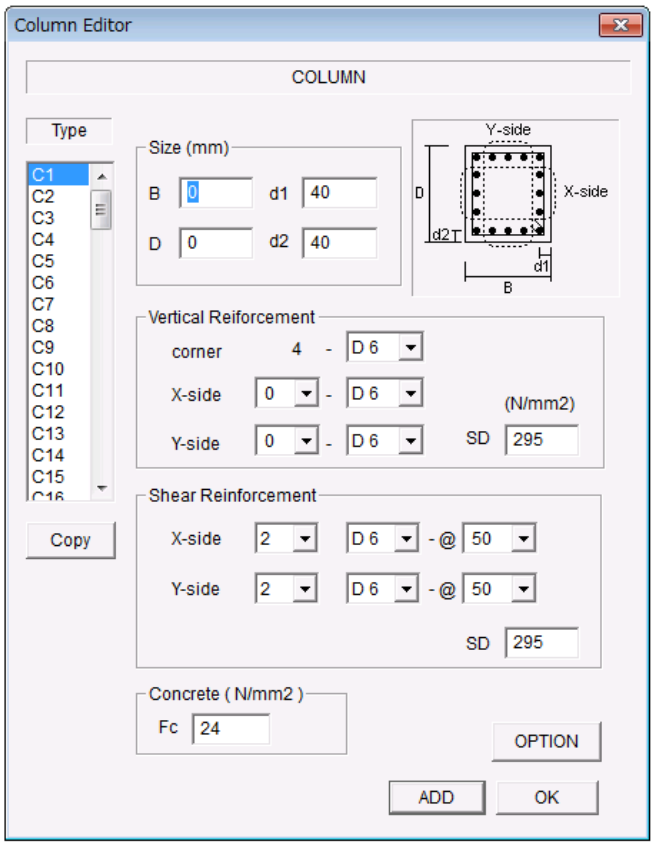
You can check the arrangement of members on the “3D VIEW”.

4. Input Building and Element Information

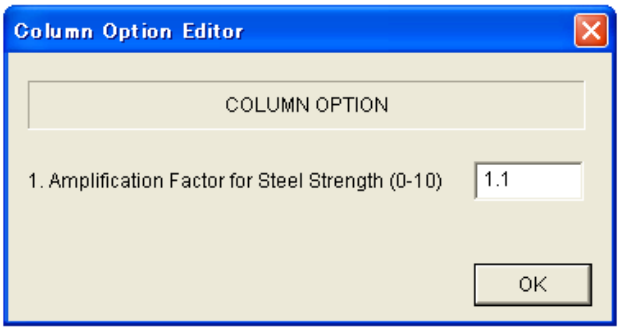


4-1. Input Element Information

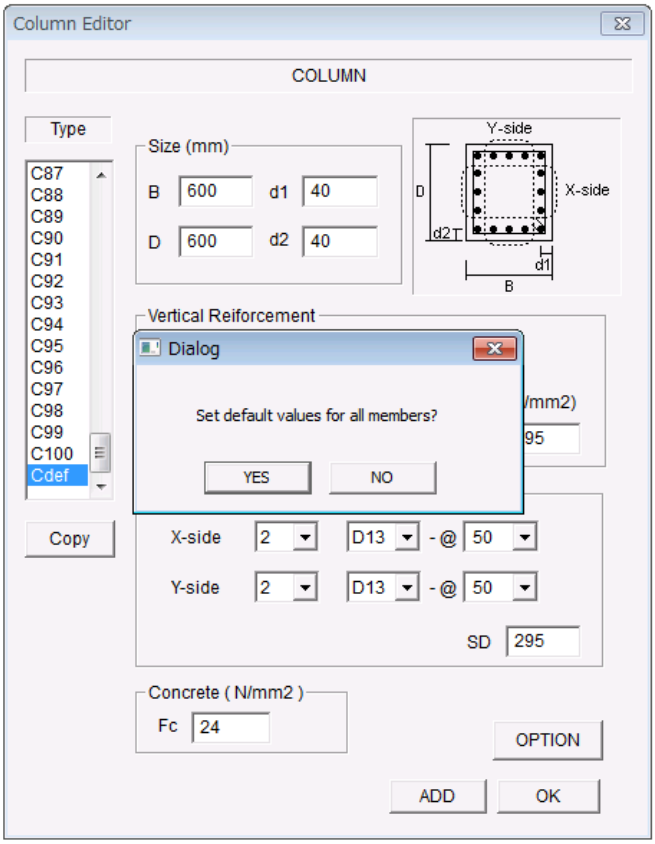
COLUMN ( )



- Please input the section size where d1 and d2 are the distances of X-rebars and Y-rebars respectively. If rebars are arranged in two layers, the distance is determined as the center of rebar area.
- For the number of reinforcement bars and their size, please select the values from the popup windows.
- For the material strength, SD and Fc, you can input values by changing the default values.
- To move to the next element type, please click [ADD] button.
- You can copy the previous element by [COPY] button.
- Please click [OK] to finish.

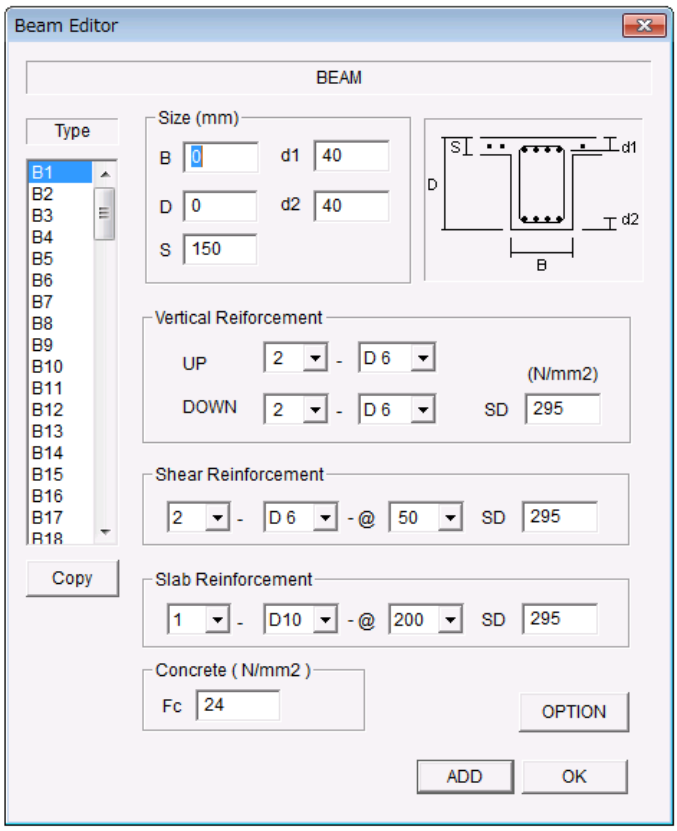


- The default steel strength used for the analysis is assumed to be 1.1 times larger than the nominal strength. You can change the ratio in [OPTION] menu.

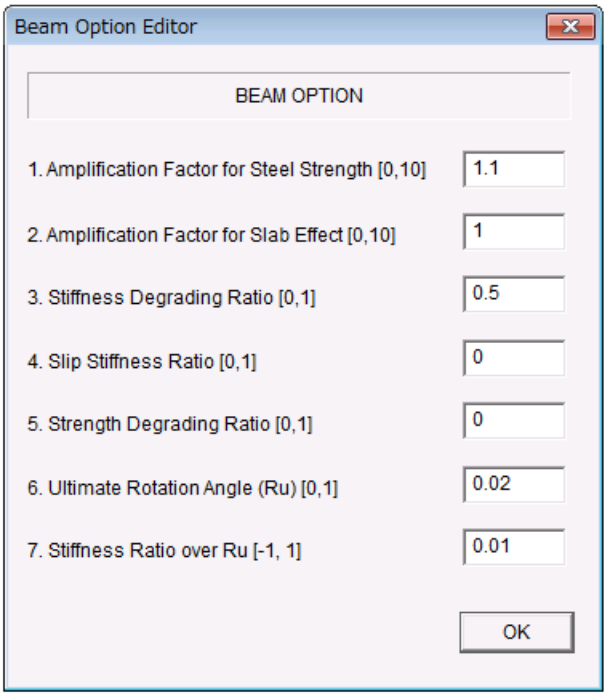


- You can set default values for all members by selecting the last member type “Cdef”.

BEAM ()

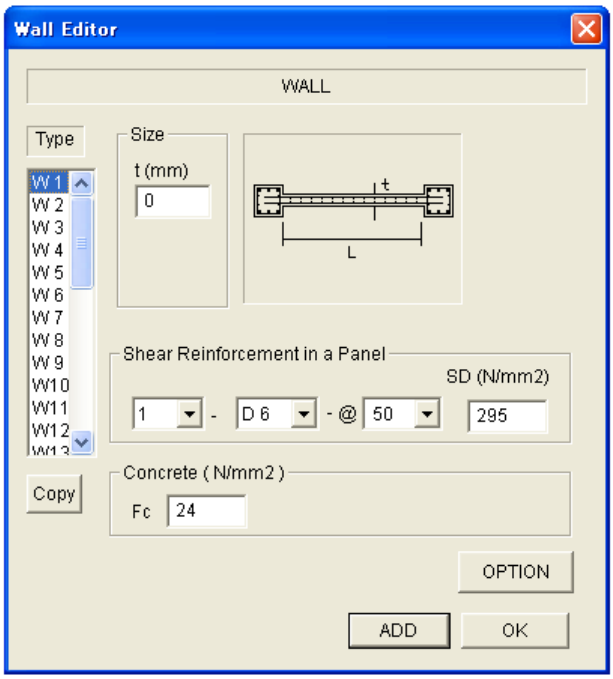


- Please input the section size where d1 and d2 are the distances of upper rebars and bottom rebars respectively. If rebars are arranged in two layers, the distance should be the center of rebar area.
- For the number of reinforcement bars and their size, please select the values from the popup windows.
- For the material strength, SD and Fc, you can input values by changing the default values.
- To move to the next element type, please click [ADD] button.
- You can copy the previous element by [COPY] button.
- You can set default values for all members by selecting the last member type “Bdef”.
- Please click [OK] to finish.

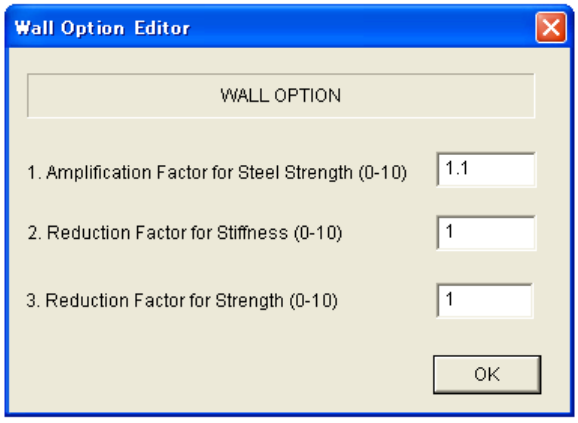


- The default steel strength used for the analysis is assumed to be 1.1 times larger than the nominal strength.
- The moment of inertia of the beam with slab is assumed to be 1.2 times larger than the rectangular beam.
- The parameters to control the shape of hysteresis model are as follows:
- The default value of stiffness degrading ratio in the trilinear hysteresis is 0.5. (0: no degradation)
- The default value of slip stiffness ratio in the trilinear hysteresis is 0.0 (0: no slip).
- The default value of strength degrading ratio in the trilinear hysteresis is 0.0.
- The default value of Ultimate rotation angle Ru is 1/50 (=0.02)
- The default value of stiffness ratio over Ru is 0.01 (could be negative)

WALL ()

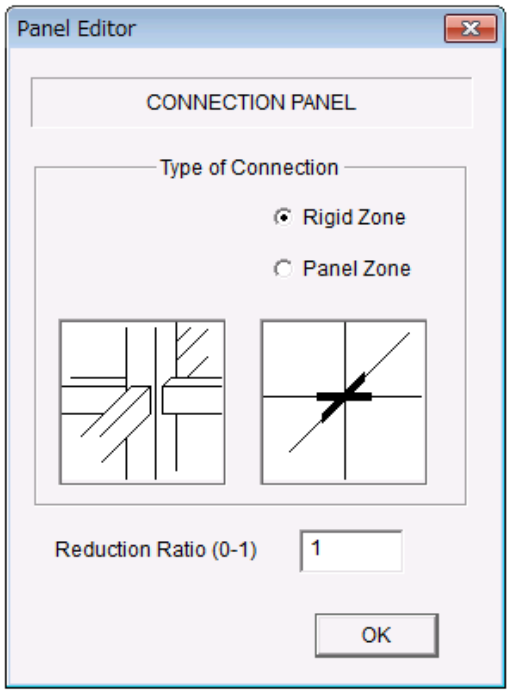


- Please input the section size.
- For the number of reinforcement bars and their size, please select the values from the popup windows.
- For the material strength, SD and Fc, you can input values by changing the default values.
- To move to the next element type, please click [ADD] button.
- You can copy the previous element by [COPY] button.
- You can set default values for all members by selecting the last member type “Wdef”.
- Please click [OK] to finish.

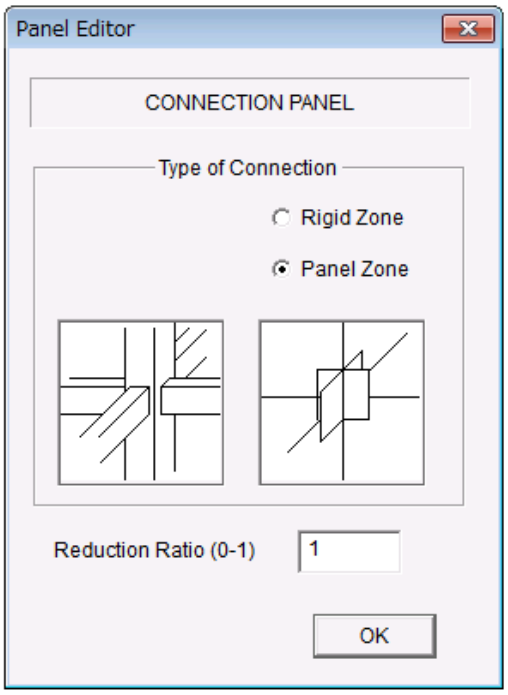


- The default steel strength used for the analysis is assumed to be 1.1 times larger than the nominal strength. You can change the ratio in [OPTION] menu.
- If there is an opening in wall element, you can reduce the stiffness and shear strength by multiplying reduction factors in [OPTION] menu. The default values are 1.0

CONNECTION PANEL ( )



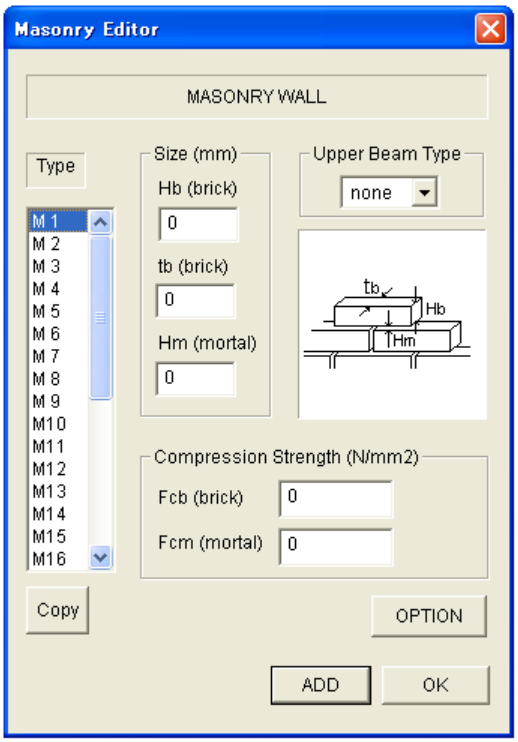
Rigid Zone



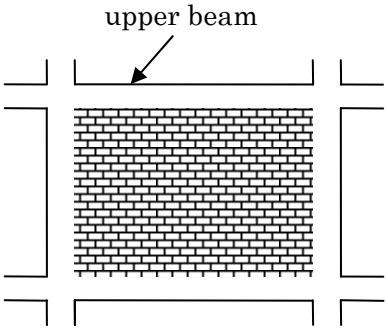
Panel Zone

You can set the ratio of the length of rigid zone or panel zone inside connection area. The default value is 1.0 (to the member face).

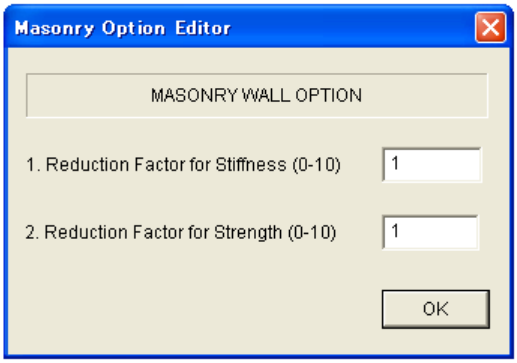
NONSTRUCTURE ( ) (NOTE: only available when you select in Option menu)



- Please input the size of brick unit and thickness of mortal and compression strength of these materials.
- If there is a reinforcement concrete beam upper of Masonry Wall as shown below, please select the beam type number from the pop-up menu.



- You can set default values for all members by selecting the last member type “Mdef”.

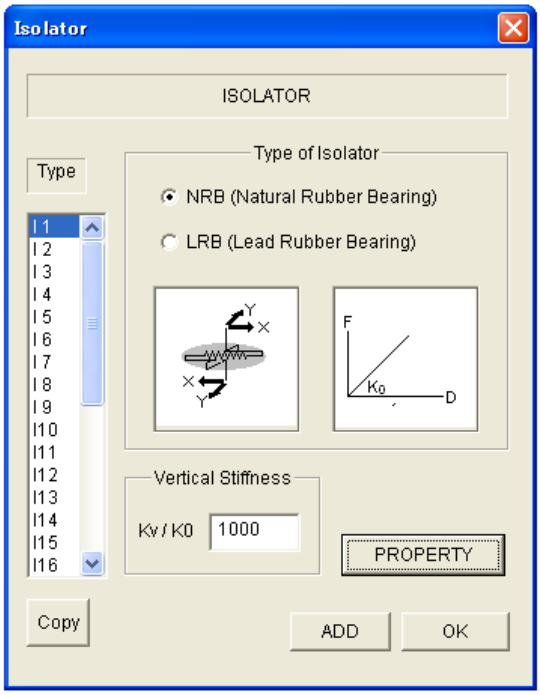


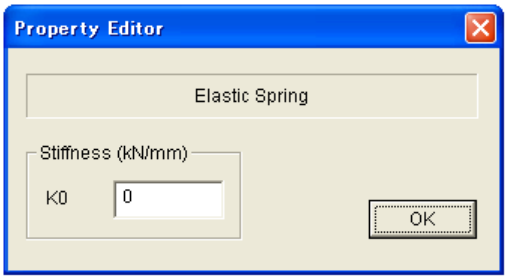
- If there is an opening in wall element, you can reduce the stiffness and shear strength by multiplying reduction factors in [OPTION] menu. The default values are 1.0

ISOLATOR ( ) (NOTE: only available when you select in Option menu)

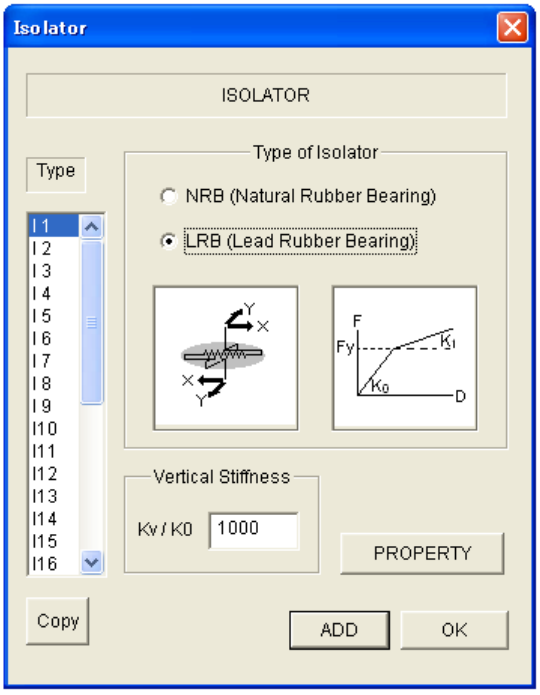
- You can select NRB (Natural Rubber Bearing) or LRB (Lead Rubber Bearing) for Isolator element.
- You can input the properties of isolator by [PROPERTY] view.
- The default value of the ratio between vertical stiffness, Kv, and the horizontal stiffness, K0, is 1000.
- You can set default values for all members by selecting the last member type “Idef”.

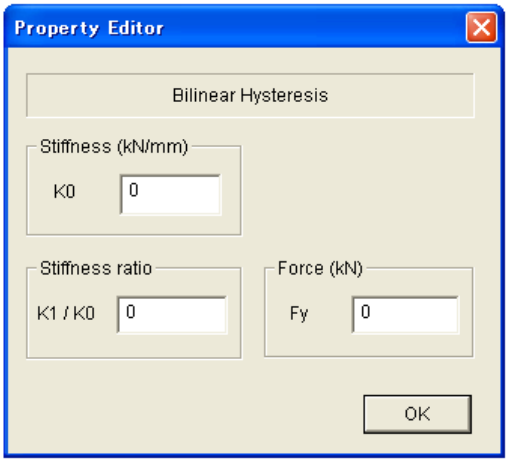
for NRB Isolator



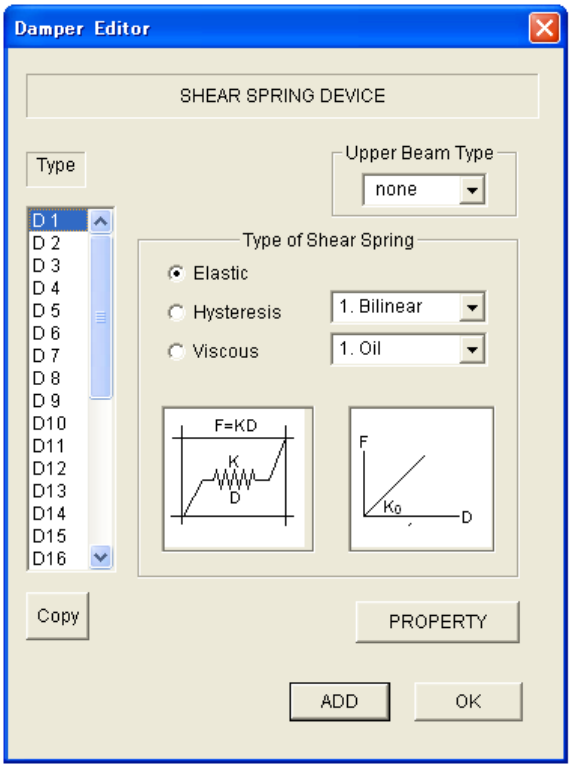


for LRB Isolator





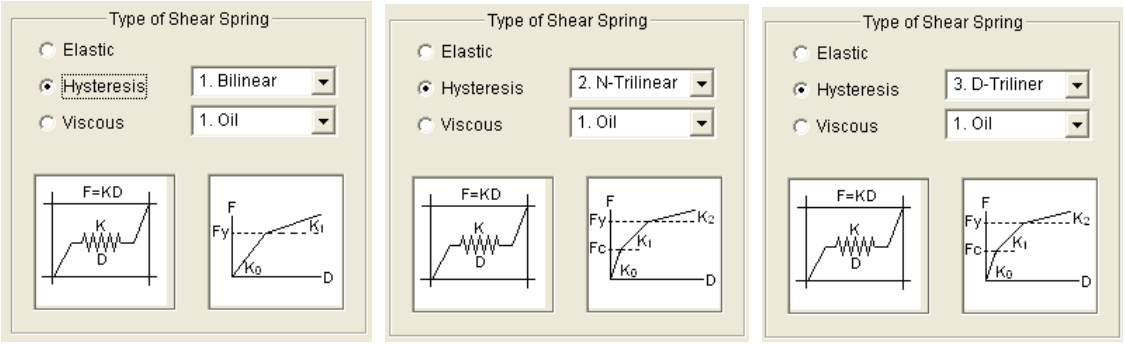
DAMPER DEVICE ( ) (NOTE: only available when you select in Option menu)



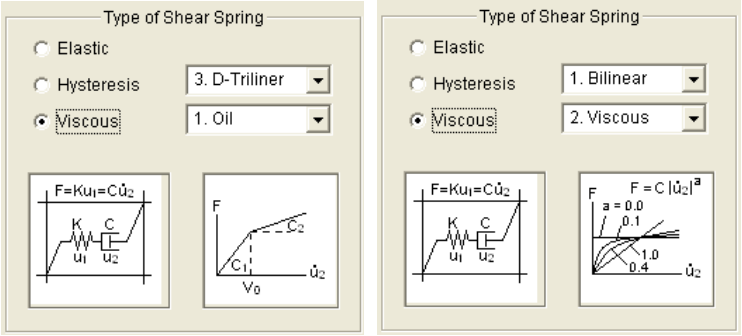
- Please select damper type from Elastic, Hystersis and Viscous and its detail characteristics from the pull down menu.
- If there is a reinforcement concrete beam upper of Damper, please select the beam type number from the pop-up menu.
- You can set default values for all members by selecting the last member type “Ddef”.

- You can input the detail characteristic of the Damper in [PROPERTY] view.

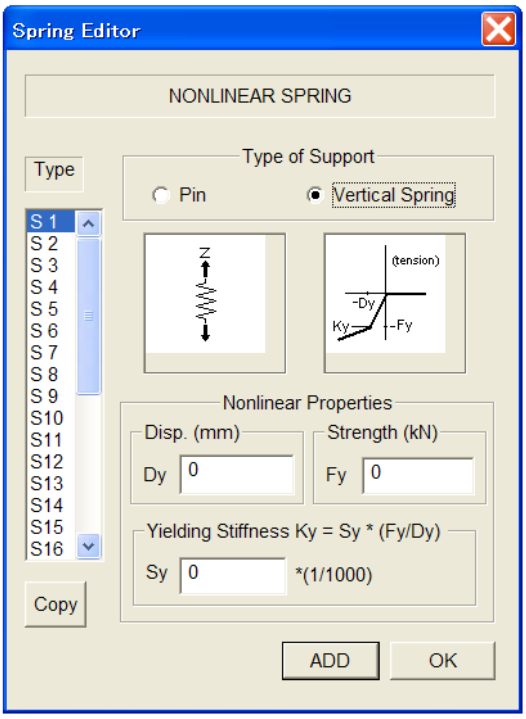
For Hysteresis Damper



For Viscous Damper



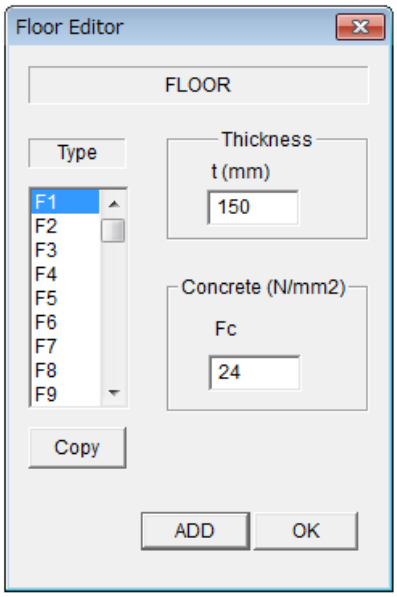
BASE SPRING ( ) (NOTE: only available at the Basement Floor, Default is PIN)



VERTICAL SPRING

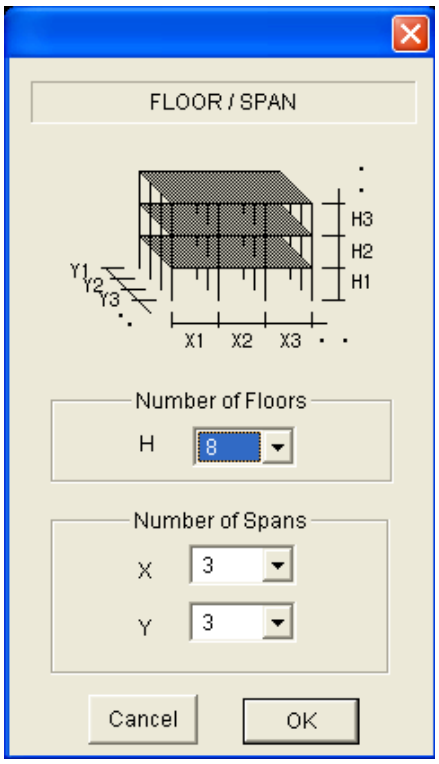
- You can set default values for all members by selecting the last member type “Sdef”.

SLAB ( ) (NOTE: only available when you select in Option menu.)



- In a default setting, the slab is assumed to be rigid in plane. You can consider elastic deformation in the option menu.
- You can set default values for all members by selecting the last member type “Fdef”.

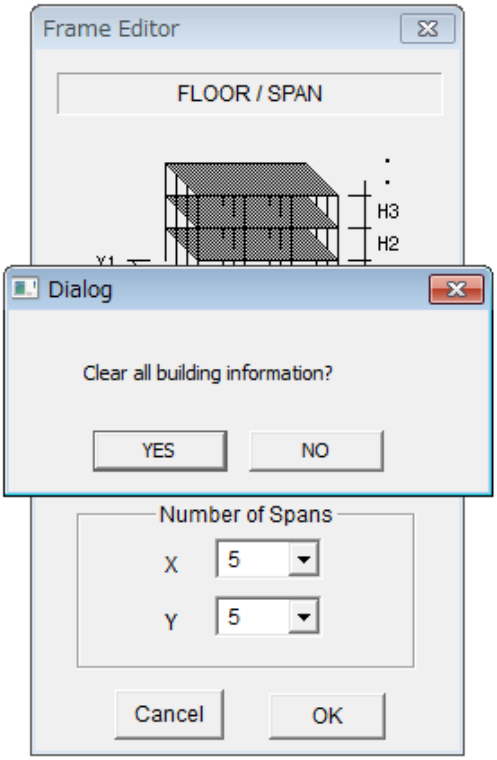
MAX. SIZE OF BUILDING ( )



You use this button to change the maximum number of spans and stories of the building.

For the moment, the maximum numbers you can select are:

Story : up to 61
Span : up to 30 in X-direction
up to 20 in X-direction



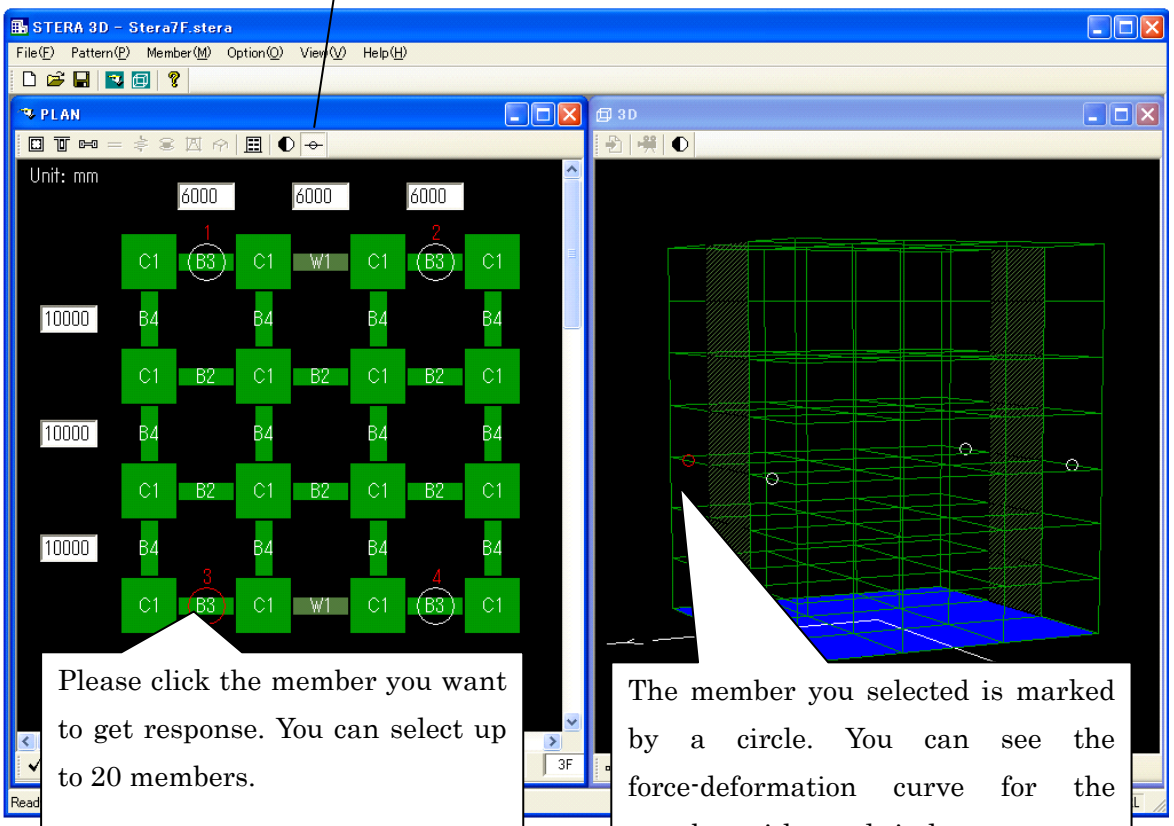
You can clear all building information by answering "YES" or you can keep the same building information after changing floor and span numbers by answering "NO".

4-2. Output Member

You can obtain Force-Displacement relationship of the designated member.

OUTPUT MEMBER ( )

If you click this bottom, you can designate the output member. By one more click, you can cancel it.



Please click the member you want to get response. You can select up to 20 members.

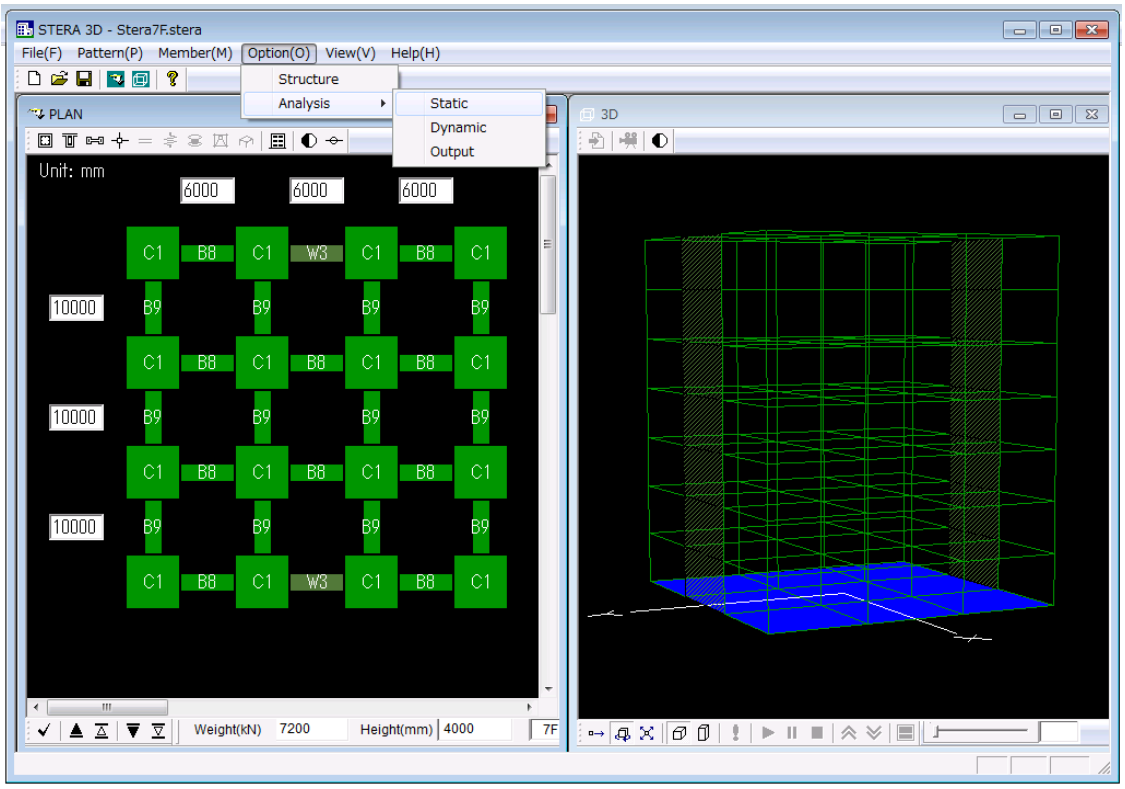
By one more click, the color of the circle will change to be red and its force-deformation curve will be displayed in 3D view.

By the right click, you can cancel the selection.

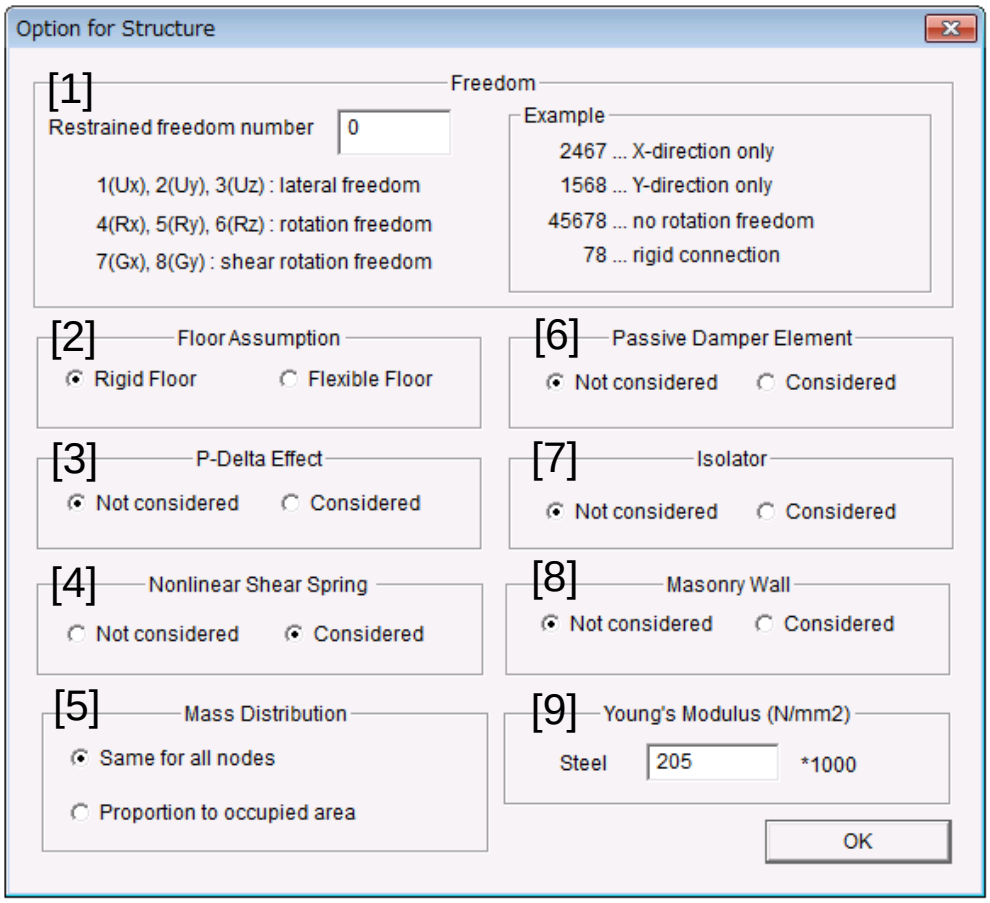
The member you selected is marked by a circle. You can see the force-deformation curve for the member with a red circle.

4-3. Option Menu

You can change default values in the option menu. [Option (O)]



OPTION → STRUCTURE



[1]. Restrained freedom number

Please indicate the freedom numbers to restrain the freedoms.

[2]. Floor Assumption

Flexible Floor → slab is modeled as a FEM model to consider in-plane elastic deformation.

[3]. P-Delta Effect

Considered → P-Delta effect is considered in element stiffness matrix of column and wall.

[4]. Nonlinear Shear Spring

If it is not considered, shear spring is elastic.

[5] Mass distribution at nodes in a floor

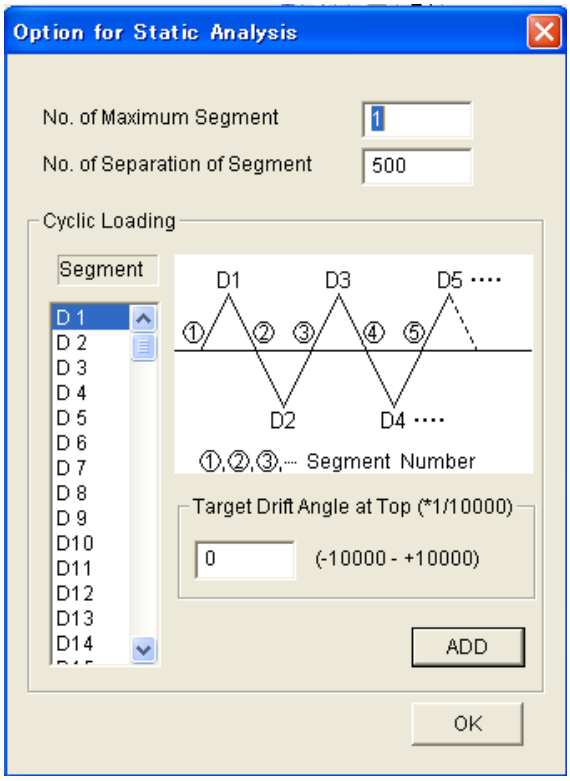
[6]. Passive Damper Device

[7]. Isolator

[8]. Masonry Wall

[9]. Young's Modulus of Steel

OPTION → ANALYSIS → STATIC



Cyclic loading is possible controlling with the drift of the top of a building.

1. No. of Maximum Segment

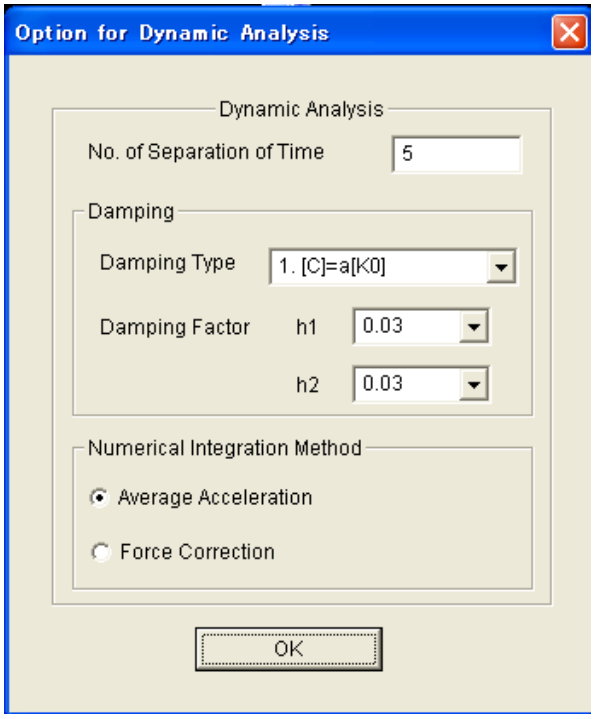
The total number of segments in cyclic loading,

2. No. of Separation of Segment

Number of calculation steps in one segment for static analysis to increase the accuracy of nonlinear analysis,

Loading program is defined by the target drift angle, D1, D2 … D150, at the top of a building in each loading segment. To move to the next angle, please click [ADD] button.

OPTION → ANALYSIS → DYNAMIC



1. No. of Separation of Time

Separating the original time interval of input earthquake into a smaller time interval will increase accuracy and stability in numerical integration, however, it also increase calculation time. For example, if the original time interval is 0.02sec and "No. of Separation of Time" = 5, then, the time interval of numerical integration will be 0.004 sec (= 0.02 sec / 5).

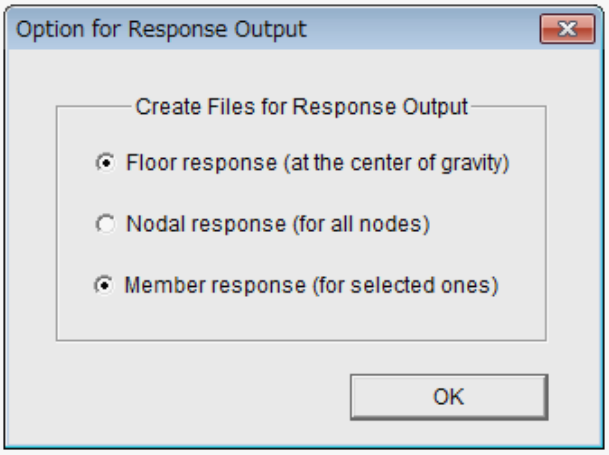
2. Damping

Three types of damping matrix are available:
1) [C] = a[K0] : proportional to [K0]
2) [C] = a[Kp] : proportional to [Kp]
3) [C] = a[K0]+b[M] : Rayleigh damping
The first mode damping factor, h1, is used for type 1) and 2). The second mode damping factor, h2, is used for type 3).

3. Numerical Integration Method

You can select the method from the Average Acceleration Method and the Force Correction Method.

OPTION → ANALYSIS → OUTPUT



You can select response output to create files to save data.

1. Floor response
Output of story displacement and shear force at the center of gravity in each floor will be saved.
It is marked as a default setting.

2. Nodal response
Output of deformation and external force at all nodes will be saved.
Note that the file size will be quite large.
It is not marked as a default setting.

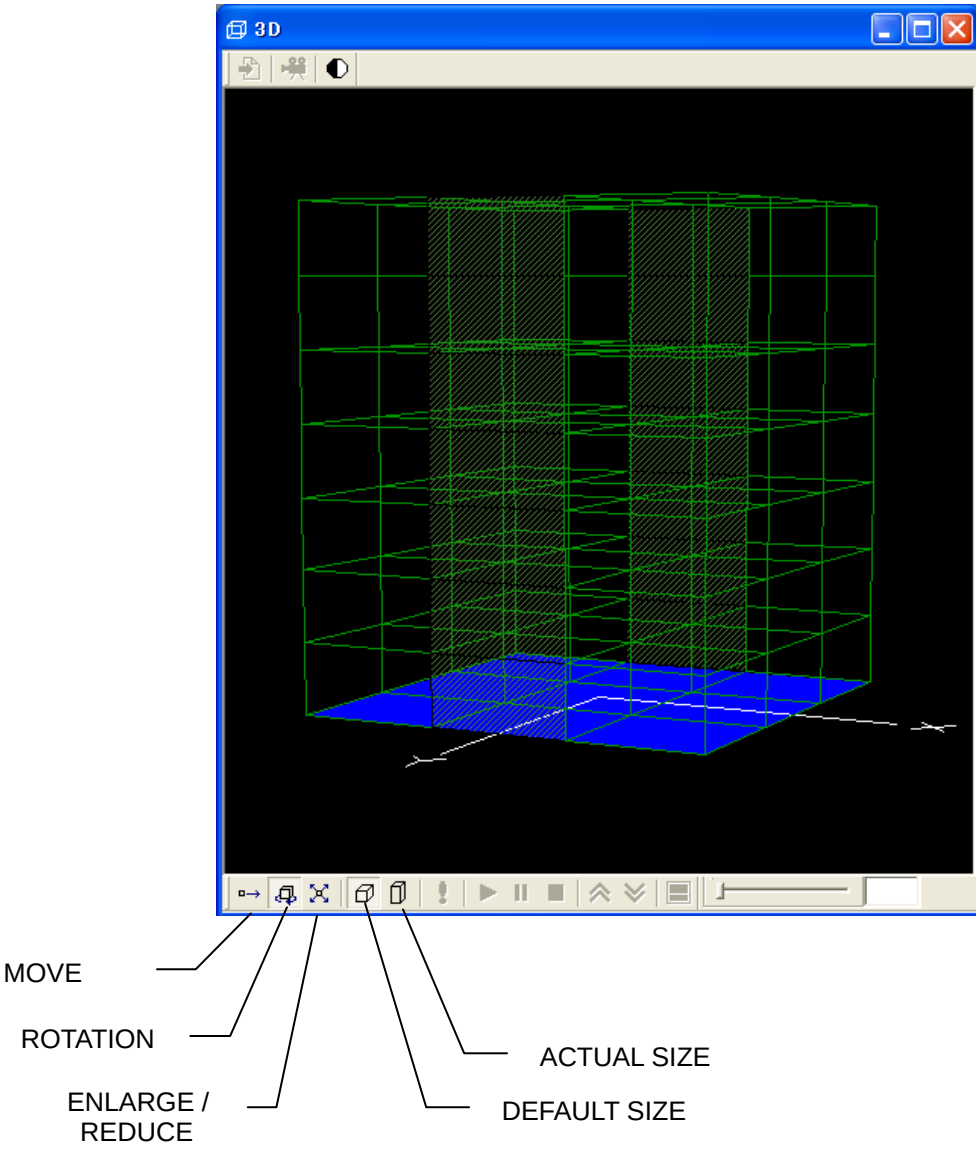
3. Member response
Response of the members marked by circles will be saved.
It is marked as a default setting.

5. 3D View of Building

5-1. 3D View of Building

[1] [Default] ( ) set the ratio between span and story height as 1 and 0.5.

[2] [Actual] ( ) use the actual ratio between span and story height using input data.

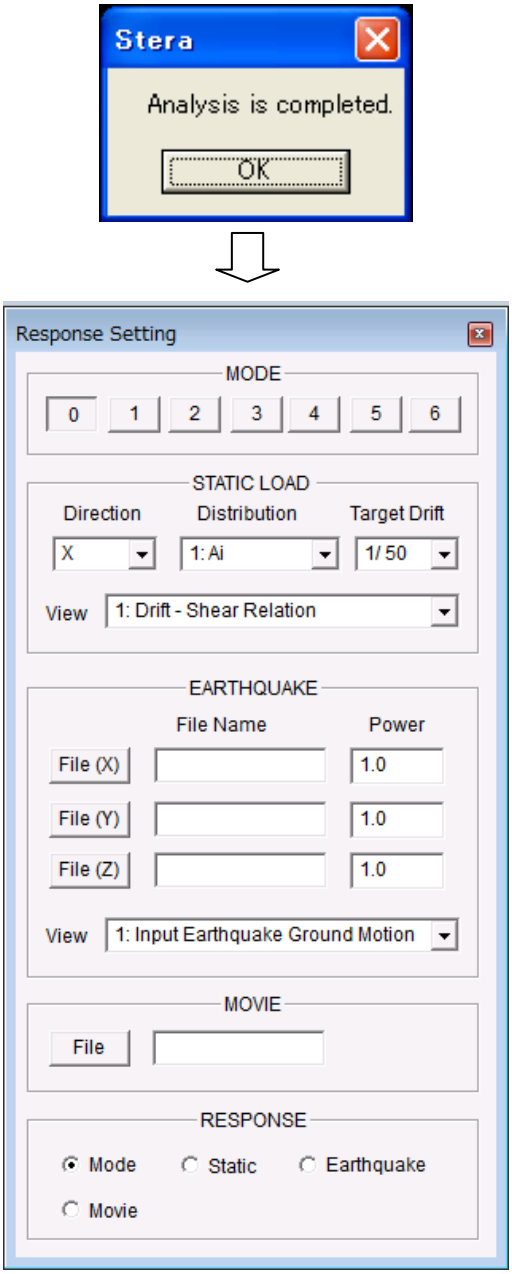


[3] You can change the view by moving the mouse as follows:

- Rotation: Left-click and dragging
- Enlargement and Reduction: Right click and dragging

[4] If the [Analyze] ( ) is activated, by clicking the button, you can make an initial analysis for getting natural periods and mode shapes.

[5] If the analysis is successfully done, the following message will appear on the screen. By click [OK] button, RESPONSE SETTING DIALOG will also appear.



RESPONSE SETTING DIALOG

5-2. Modal Analysis

[1] On the RESPONSE SETTING DIALOG, please click the MODE number from [0] to [6] to see the view of mode shape and the value of natural period.

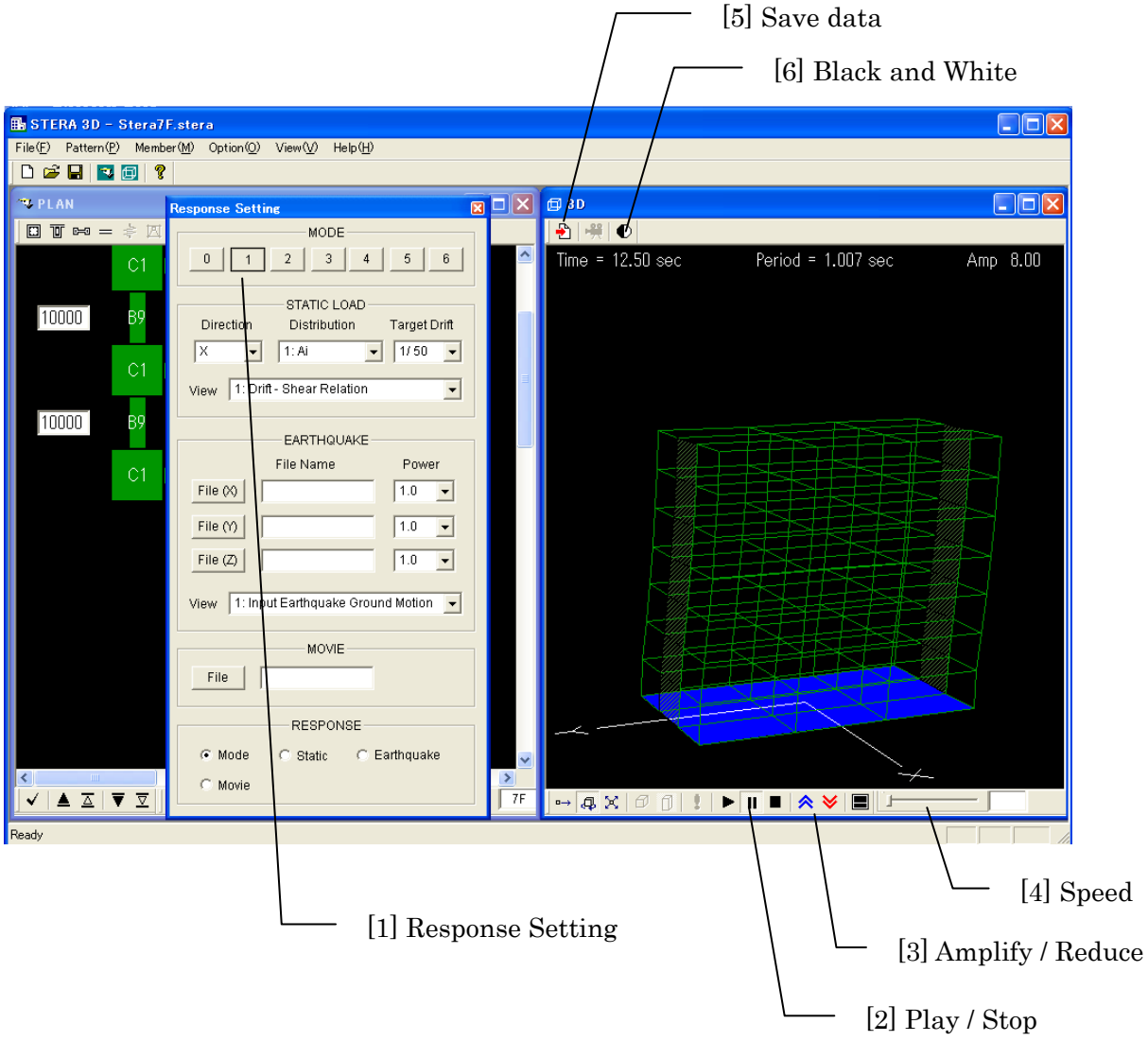
[2] On the 3D VIEW, ( ) starts the vibration of each mode, ( ) stops the vibration and ( ) pauses the vibration.

[3] ( ) amplifies the response. ( ) reduces the response.

[4] Slider ( ) changes the speed of vibration.

[5] ( ) will save the results into text files.

[6] ( ) changes the color of the view to be black and white.



5-3. Nonlinear Static Push-Over Analysis

[1] Please set loading conditions for the STATIC LOAD:

"Direction": please select loading direction from the menu.

1. X 2. –X (opposite to X) 3. Y 4. -Y (opposite to Y)

"Distribution": please select a loading distribution along the height of the building. The load is applied at the center of gravity in each floor.

1. Ai 2. Triangular 3. Uniform 4. UBC 5. Mode

"Target Drift": please set the target drift ratio which is defined by the ratio between the top displacement and the height of the building.

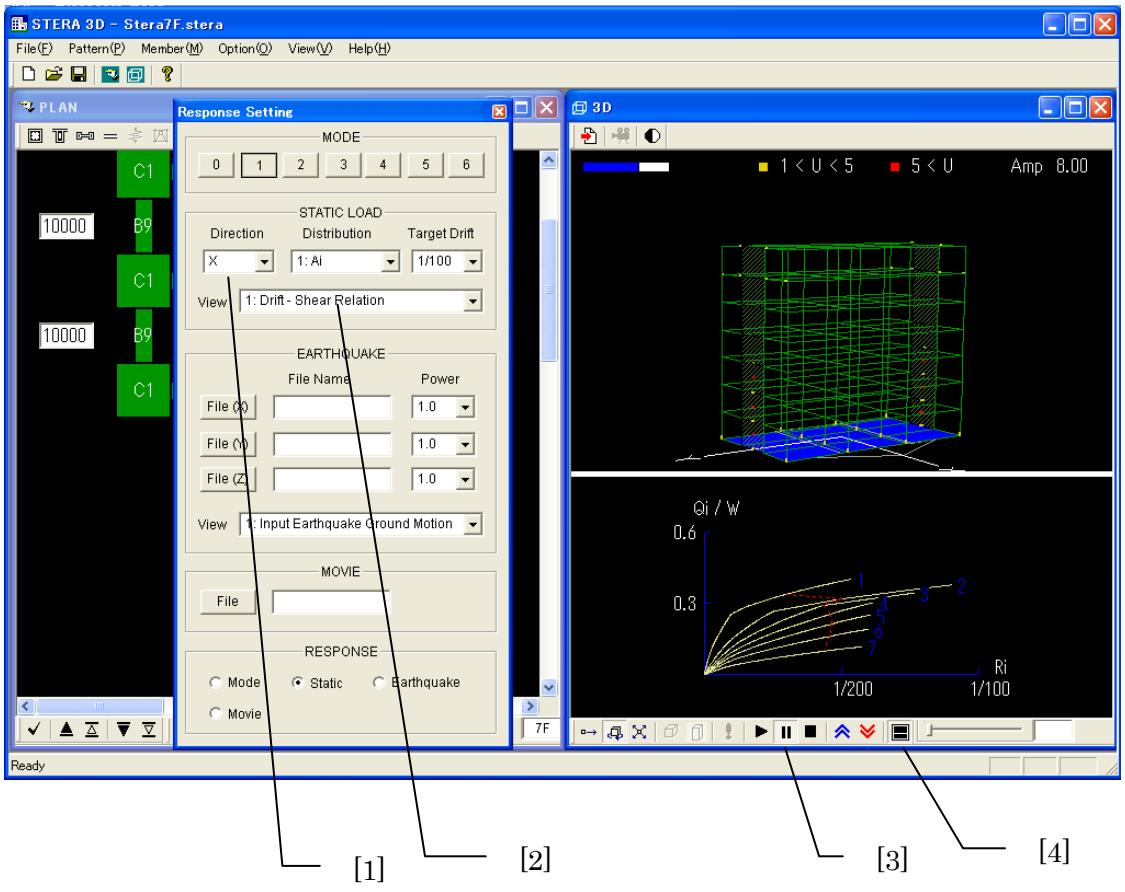
1. 1/50 2. 1/100 3. 1/200 4. Cyclic

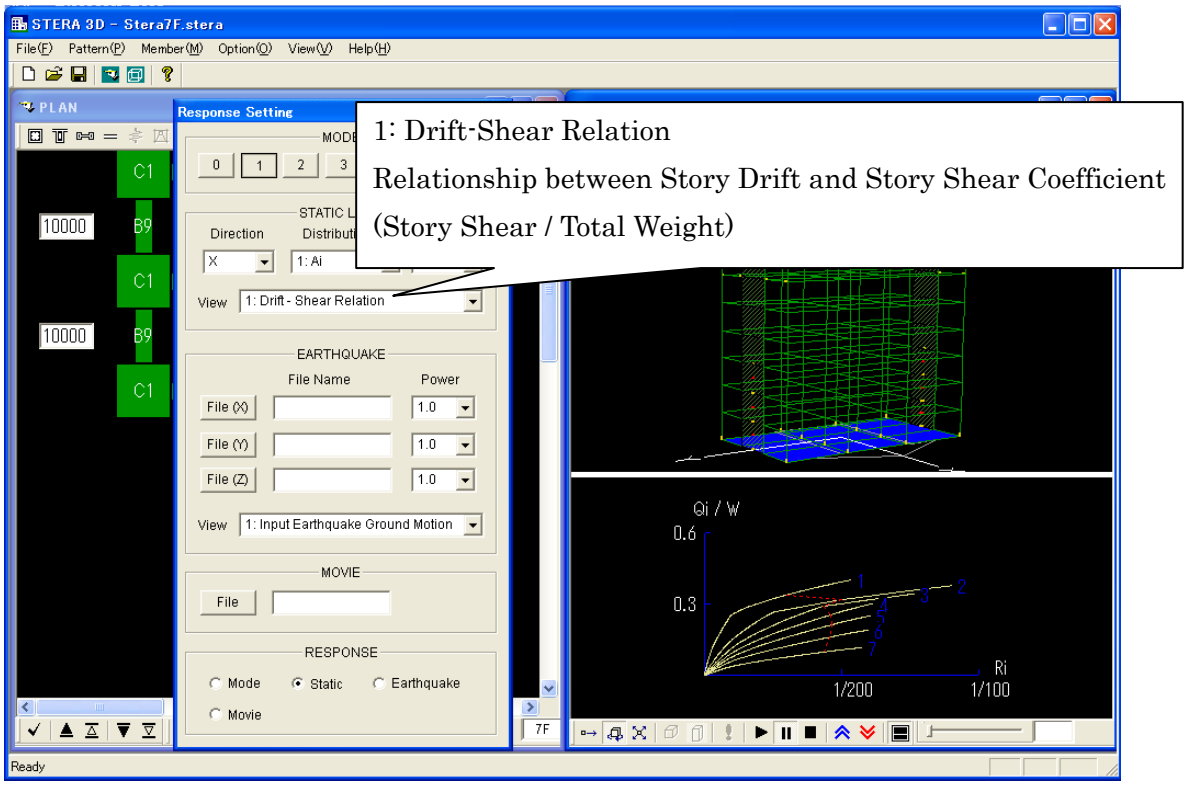
[2] Please select the response for the lower view window.

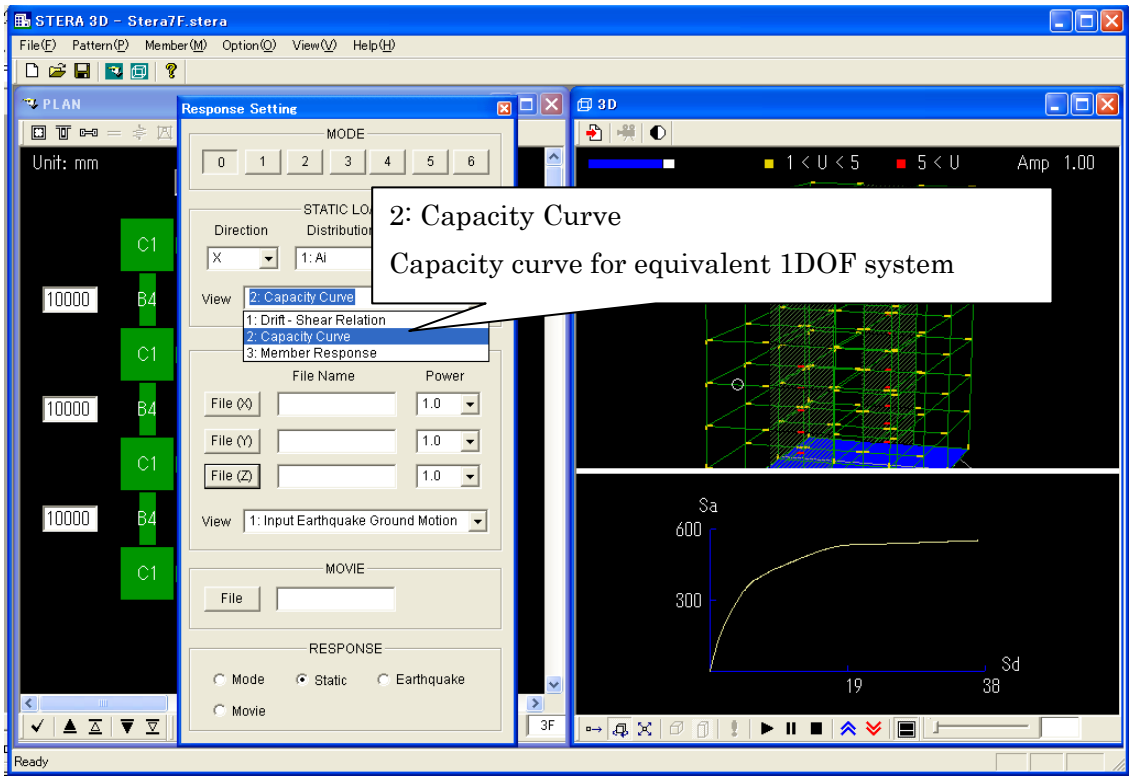
[3] On the 3D VIEW, (▶) starts, (⏸) pauses and (■) stops the response.

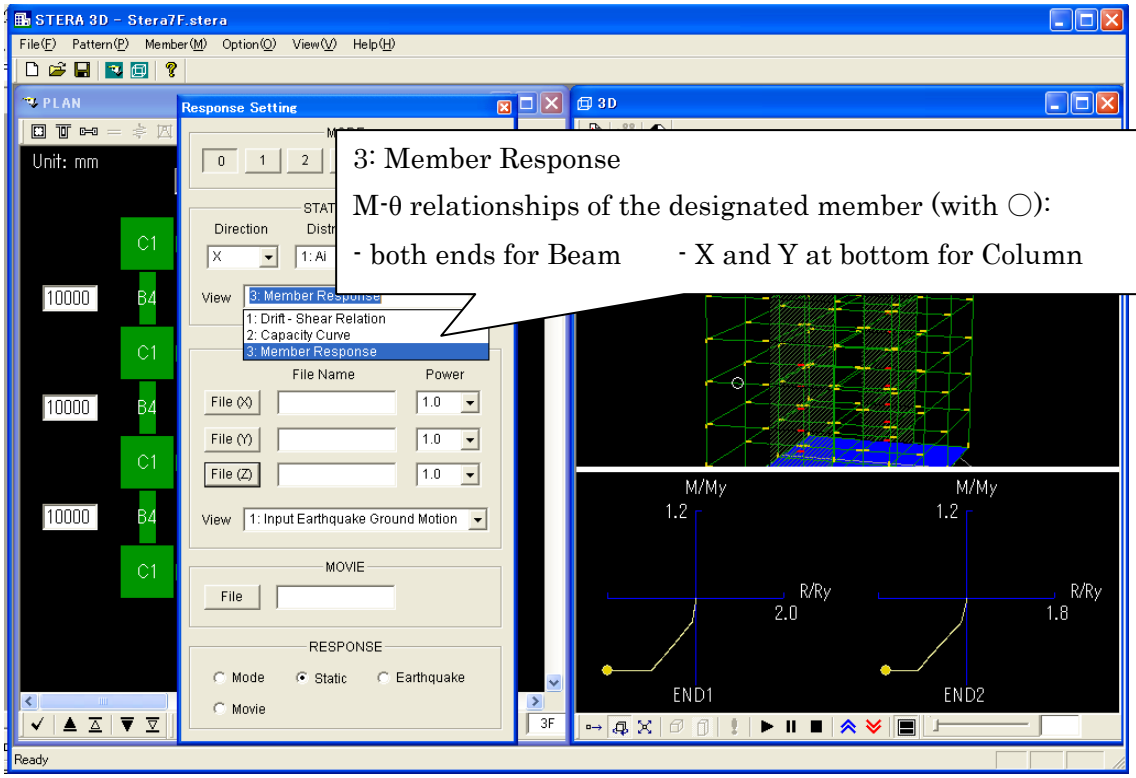
In the upper view, you can see an arrow under the building to indicate the loading direction, also a progressing bar, and colors of ductility factors (U).

[4] (▬) will change the view from 2-screens to 1-screen and vise versa.




STERA 3D – Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Response Setting
MODE
0 1 2 3
STATIC L
Direction
Distributi
X
1: Ai
View
1: Drift - Shear Relation
EARTHQUAKE
File Name
Power
File (X)
File (Y)
File (Z)
1.0
View
1: Input Earthquake Ground Motion
MOVIE
File
RESPONSE
Mode
Static
Earthquake
Movie
C1
B9
10000
7F
Qi / W
0.6
0.3
1/200
Ri
1/100
Ready
1: Drift-Shear Relation
Relationship between Story Drift and Story Shear Coefficient
(Story Shear / Total Weight)


STERA 3D – Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Response Setting
3D
Unit: mm
MODE
0 1 2 3 4 5 6
Direction
Distributio
X
1: Ai
View
2: Capacity Curve
1: Drift - Shear Relation
2: Capacity Curve
3: Member Response
File Name
Power
File (X)
File (Y)
File (Z)
1.0
View
1: Input Earthquake Ground Motion
MOVIE
File
RESPONSE
Mode
Static
Earthquake
Movie
C1
B4
10000
3F
1 < U < 5
5 < U
Amp 1.00
Sa
600
300
19
38
Sd
Ready
2: Capacity Curve
Capacity curve for equivalent 1DOF system


STERA 3D – Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Unit: mm
C1
B4
10000
Response Setting
Direction
View
1: Drift - Shear Relation
2: Capacity Curve
3: Member Response
File Name
Power
File (X)
File (Y)
File (Z)
1.0
View
1: Input Earthquake Ground Motion
MOVIE
File
RESPONSE
Mode
Static
Earthquake
Movie
3F
3D
3: Member Response
M-θ relationships of the designated member (with ○):
- both ends for Beam
- X and Y at bottom for Column
M/My
1.2
R/Ry
2.0
END1
1.8
END2
Ready

5-4. Nonlinear Earthquake Response Analysis

[1] On the RESPONSE SETTING DIALOG, please set earthquake data:

"File(X)": Please select earthquake input file for X-direction.

"File(Y)": Please select earthquake input file for Y-direction.

"File(Z)": Please select earthquake input file for Z-direction (up-down).

"Power": Set the value to amplify the original earthquake

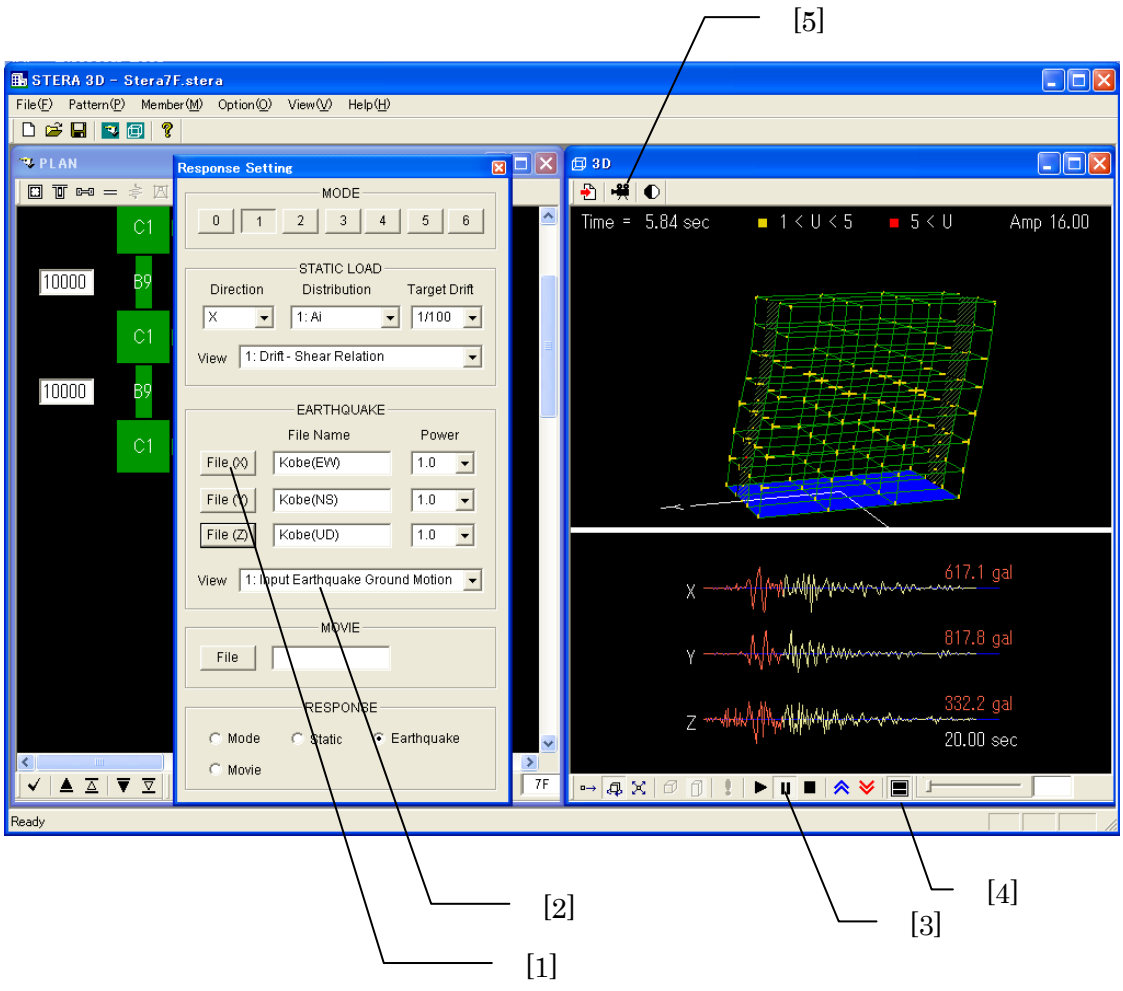
[2] Please select the response for the lower view window.

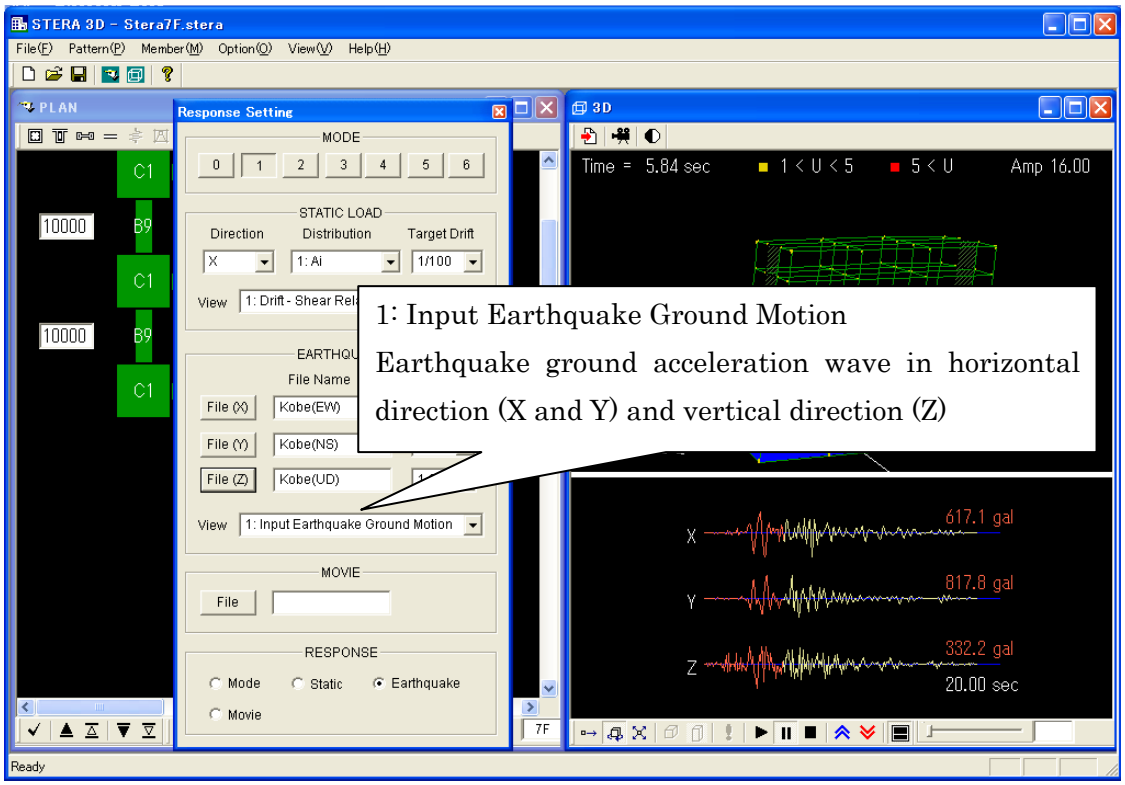
[3] On the 3D VIEW, (▶) starts, (⏸) pauses and (■) stops the response.

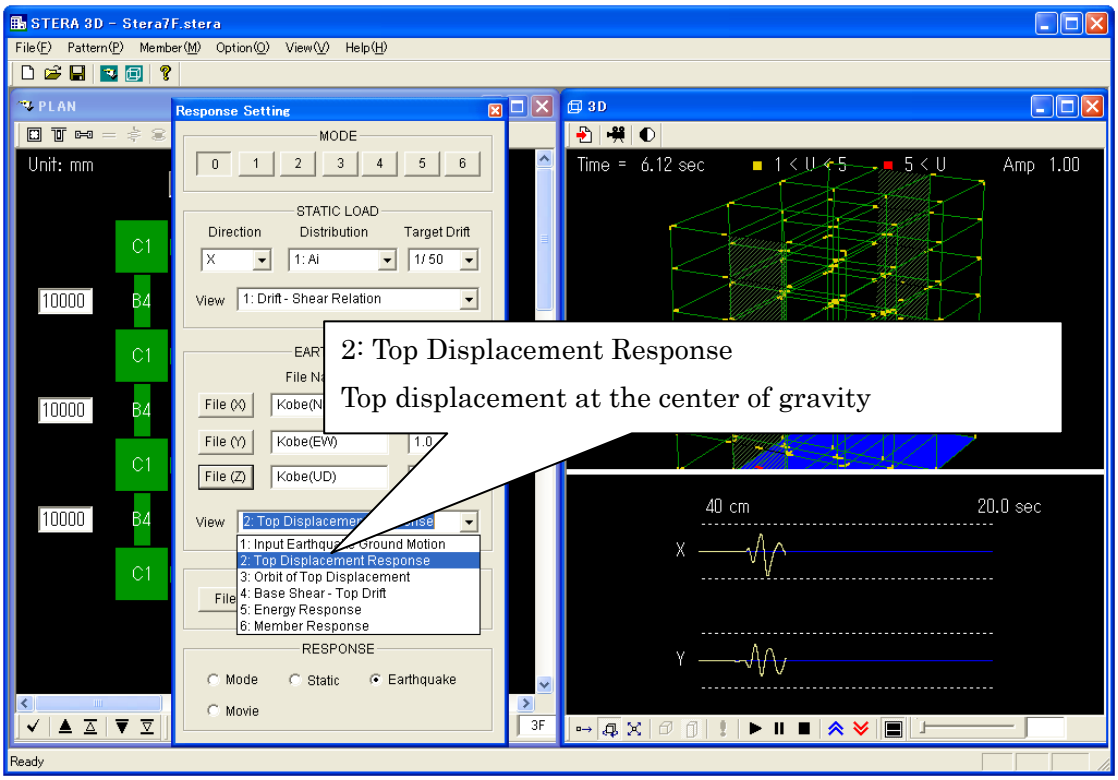
In the lower view, you can see the input earthquake wave and present status.

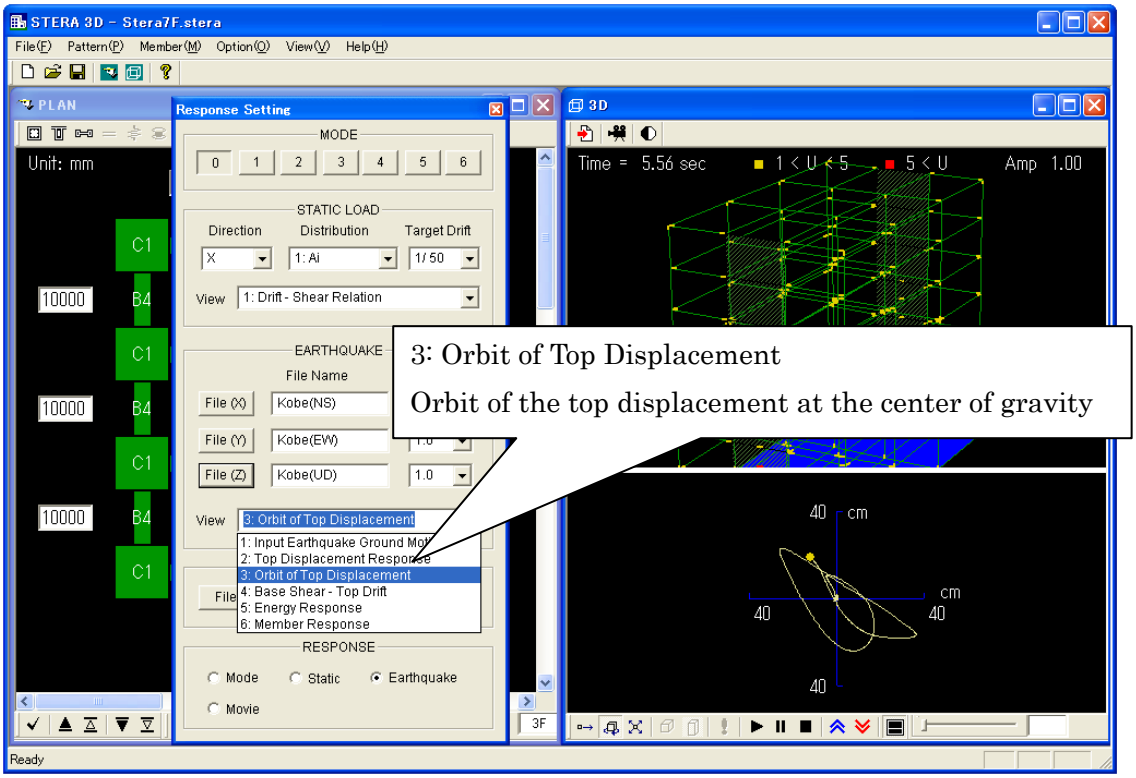
[4] (▣) will change the view from 2-screen to 1-screen and vise versa.

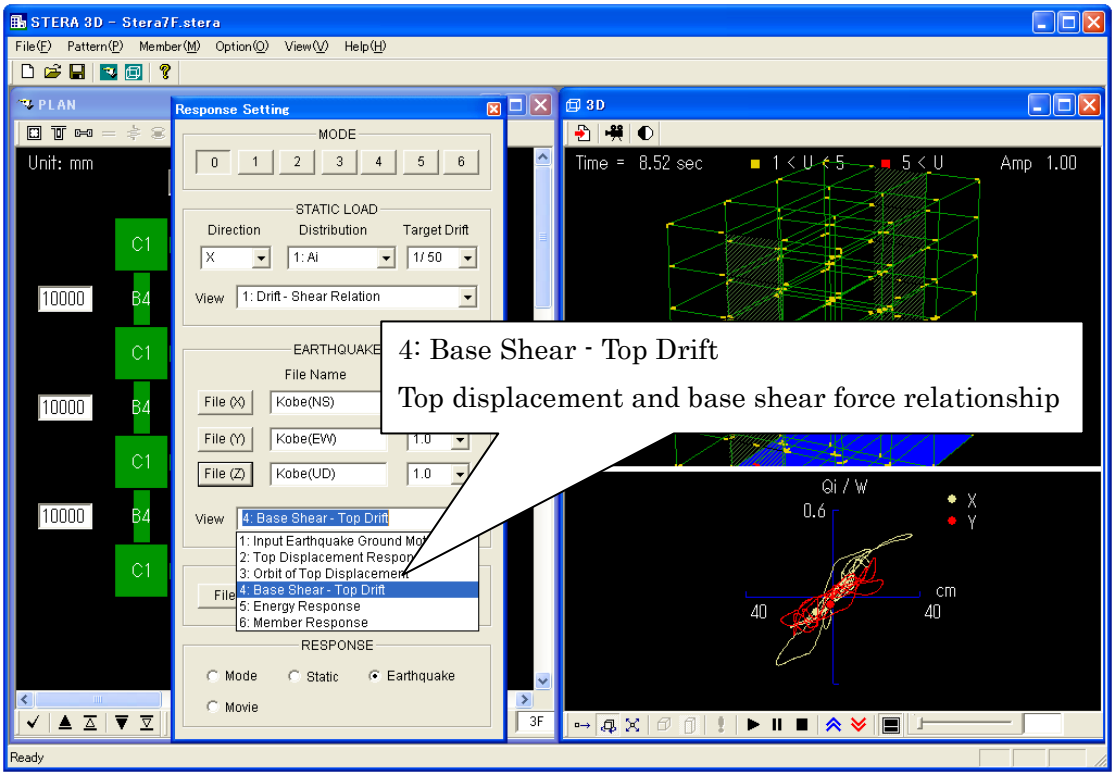
[5] (🎥) will save the response animation as a movie file (see 5-5).

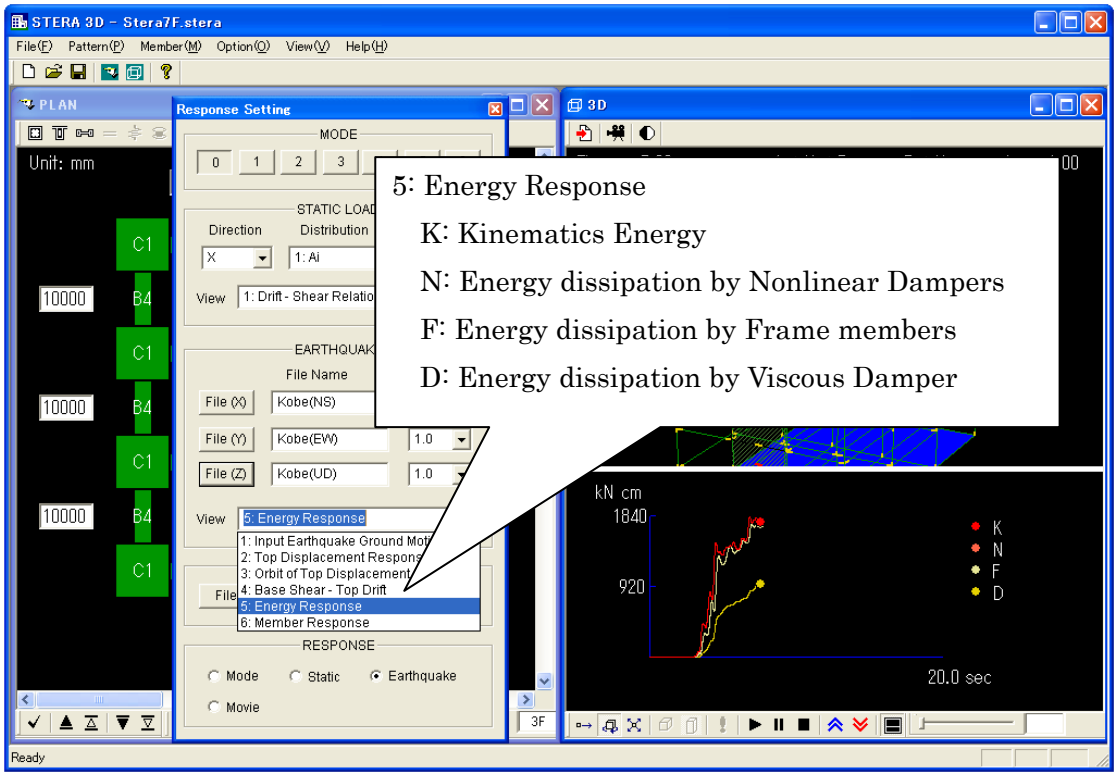


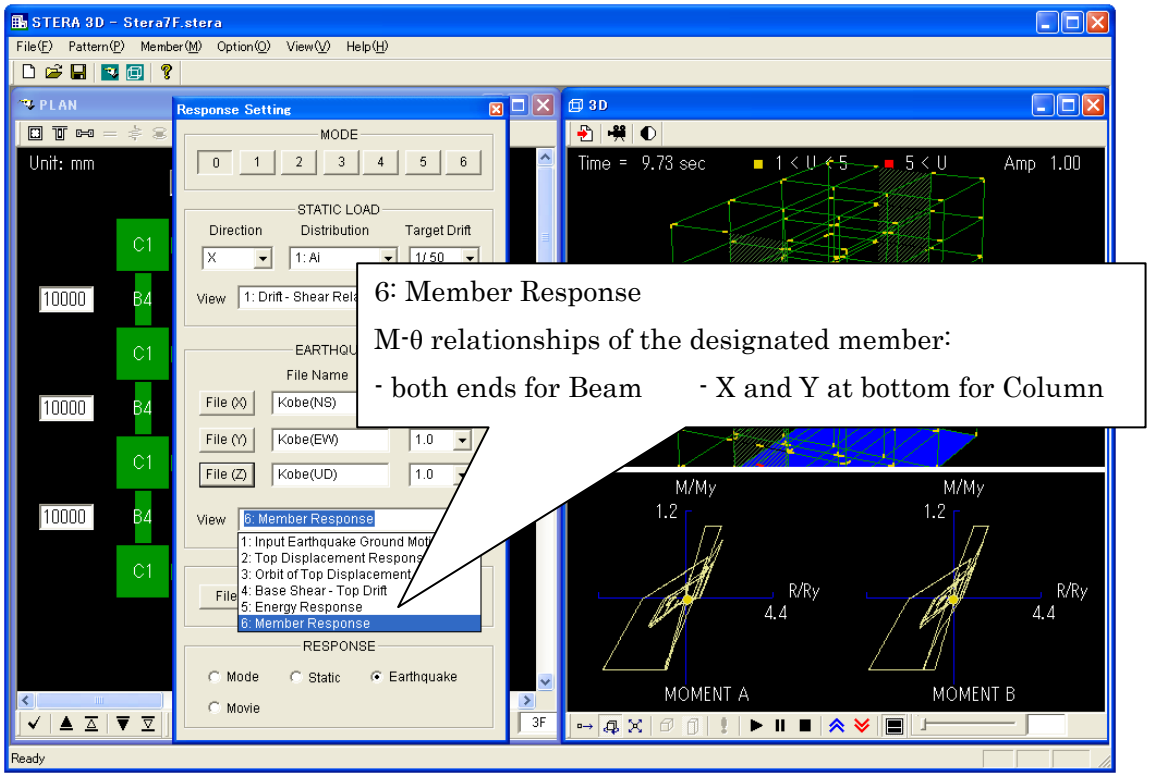

STERA 3D - Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Response Setting
MODE
0 1 2 3 4 5 6
STATIC LOAD
Direction Distribution Target Drift
X 1: Ai 1/100
View 1: Drift - Shear Rel
EARTHQU
File Name
File (X) Kobe(EW)
File (Y) Kobe(NS)
File (Z) Kobe(UD)
View 1: Input Earthquake Ground Motion
MOVIE
File
RESPONSE
Mode Static Earthquake
Movie
3D
Time = 5.84 sec 1 < U < 5 5 < U Amp 16.00
617.1 gal
817.8 gal
332.2 gal
20.00 sec
Ready
1: Input Earthquake Ground Motion
Earthquake ground acceleration wave in horizontal direction (X and Y) and vertical direction (Z)


STERA 3D - Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Response Setting
Unit: mm
MODE
0 1 2 3 4 5 6
STATIC LOAD
Direction Distribution Target Drift
X 1: Ai 1/50
View 1: Drift - Shear Relation
File (X) Kobe(N
File (Y) Kobe(EW)
File (Z) Kobe(UD)
View 2: Top Displacemen
1: Input Earthquake Ground Motion
2: Top Displacement Response
3: Orbit of Top Displacement
4: Base Shear - Top Drift
5: Energy Response
6: Member Response
RESPONSE
Mode Static Earthquake
Movie
3D
Time = 6.12 sec 1 < U < 5 5 < U Amp 1.00
40 cm
20.0 sec
Ready
2: Top Displacement Response
Top displacement at the center of gravity


STERA 3D - Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Unit: mm
Response Setting
MODE
0 1 2 3 4 5 6
STATIC LOAD
Direction Distribution Target Drift
X 1: Ai 1/50
View 1: Drift - Shear Relation
EARTHQUAKE
File Name
File (X) Kobe(NS)
File (Y) Kobe(EW)
File (Z) Kobe(UD) 1.0
View 3: Orbit of Top Displacement
1: Input Earthquake Ground Mot
2: Top Displacement Response
3: Orbit of Top Displacement
4: Base Shear - Top Drift
5: Energy Response
6: Member Response
RESPONSE
Mode Static Earthquake
Movie
3D
Time = 5.56 sec 1 < U < 5 5 < U Amp 1.00
40 cm
40 cm
40
3F
Ready
3: Orbit of Top Displacement
Orbit of the top displacement at the center of gravity


STERA 3D - Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Unit: mm
Response Setting
MODE
0 1 2 3 4 5 6
STATIC LOAD
Direction Distribution Target Drift
X 1: Ai 1/50
View 1: Drift - Shear Relation
EARTHQUAKE
File Name
File (X) Kobe(NS)
File (Y) Kobe(EW)
File (Z) Kobe(UD) 1.0
View 4: Base Shear - Top Drift
1: Input Earthquake Ground Mot
2: Top Displacement Respon
3: Orbit of Top Displacement
4: Base Shear - Top Drift
5: Energy Response
6: Member Response
RESPONSE
Mode Static Earthquake
Movie
3D
Time = 8.52 sec 1 < U < 5 5 < U Amp 1.00
Qi / W
0.6
X
Y
40 cm
40
3F
Ready
4: Base Shear - Top Drift
Top displacement and base shear force relationship


STERA 3D - Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Unit: mm
Response Setting
MODE
0 1 2 3
STATIC LOAD
Direction
Distribution
X
1: Ai
View
1: Drift - Shear Relatio
EARTHQUAK
File Name
File (X)
Kobe(NS)
File (Y)
Kobe(EW)
1.0
File (Z)
Kobe(UD)
1.0
View
5: Energy Response
1: Input Earthquake Ground Moti
2: Top Displacement Respons
3: Orbit of Top Displacement
4: Base Shear - Top Drift
5: Energy Response
6: Member Response
RESPONSE
Mode
Static
Earthquake
Movie
10000
C1
B4
3F
3D
kN cm
1840
920
K
N
F
D
20.0 sec
Ready
5: Energy Response
K: Kinematics Energy
N: Energy dissipation by Nonlinear Dampers
F: Energy dissipation by Frame members
D: Energy dissipation by Viscous Damper


STERA 3D - Stera7F.stera
File(F) Pattern(P) Member(M) Option(O) View(V) Help(H)
PLAN
Unit: mm
Response Setting
MODE
0 1 2 3 4 5 6
STATIC LOAD
Direction
Distribution
Target Drift
X
1: Ai
1/ 50
View
1: Drift - Shear Rela
EARTHQU
File Name
File (X)
Kobe(NS)
File (Y)
Kobe(EW)
1.0
File (Z)
Kobe(UD)
1.0
View
6: Member Response
1: Input Earthquake Ground Moti
2: Top Displacement Respons
3: Orbit of Top Displacement
4: Base Shear - Top Drift
5: Energy Response
6: Member Response
RESPONSE
Mode
Static
Earthquake
Movie
10000
C1
B4
3F
3D
Time = 9.73 sec
1 < U <= 5
5 < U
Amp 1.00
M/My
1.2
R/Ry
4.4
MOMENT A
MOMENT B
Ready
6: Member Response
M-θ relationships of the designated member:
- both ends for Beam
- X and Y at bottom for Column

Format of input earthquake data file

When you prepare an input earthquake file by yourself, please arrange the data format as follows:

Order	Type	Information	Comments
1st data (ID)	INT	0 or 1	0: Earthquake ground acceleration data only 1: Earthquake ground acceleration data and ground displacement data
2nd data (NDATA)	INT	Number of data	If ID=1, the number of data for acceleration must be the same as that for displacement. The maximum value of NDATA accepted is 20,000.
3rd data (DT)	REAL	Time interval	(sec)
4th data and later	REAL	Acceleration	1, 2, …, NDATA (cm/sec^2)
		Displacement	1, 2, …, NDATA (cm)

Example)

```
0
750
0.020
    -1.40    -10.80    -10.10     -8.80     -9.50    -12.00    -14.20
   -12.80    -11.00     -8.50     -8.50    -13.10    -17.60    -19.40
   -16.20    -14.40    -10.80     -8.20     -4.20     -6.60    -13.10
   -19.00    -19.60     -6.60      3.00      14.10     -4.90    -12.80
   -14.40    -20.30    -26.00    -32.50    -30.60    -17.20    -19.70
```

5-5. Save Nonlinear Earthquake Response as a Movie File

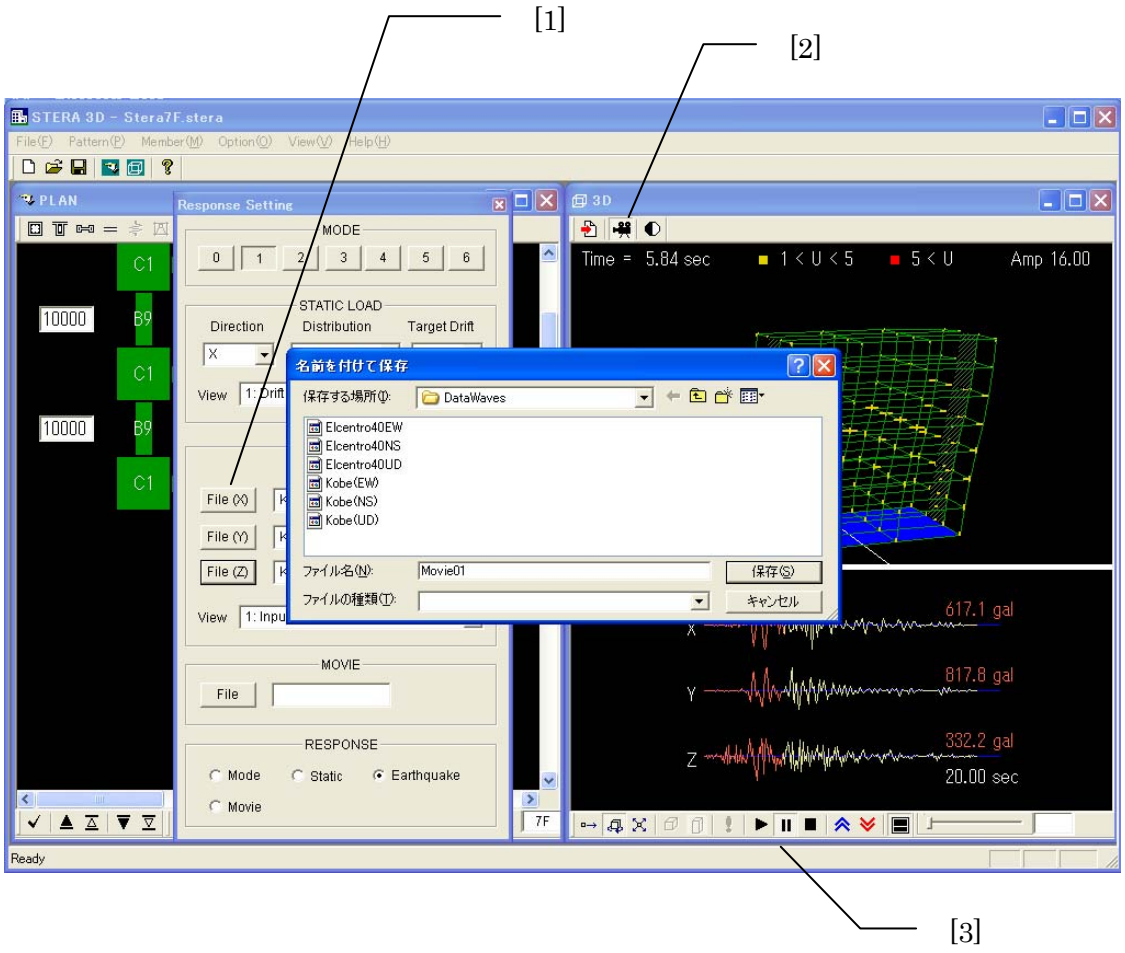
Generally, it takes long time to calculate earthquake response of a building. You can save the response of the building in a movie file and later you can open the movie to see the response quickly.

1) Record movie

[1] On the RESPONSE SETTING DIALOG, please select earthquake input files in the menu “EARTHQUAKE”.

[2] Please push the movie button ( ) and write the file name such as “Movie.txt”.

[3] ( ) displays the response. ( ) stops the response.

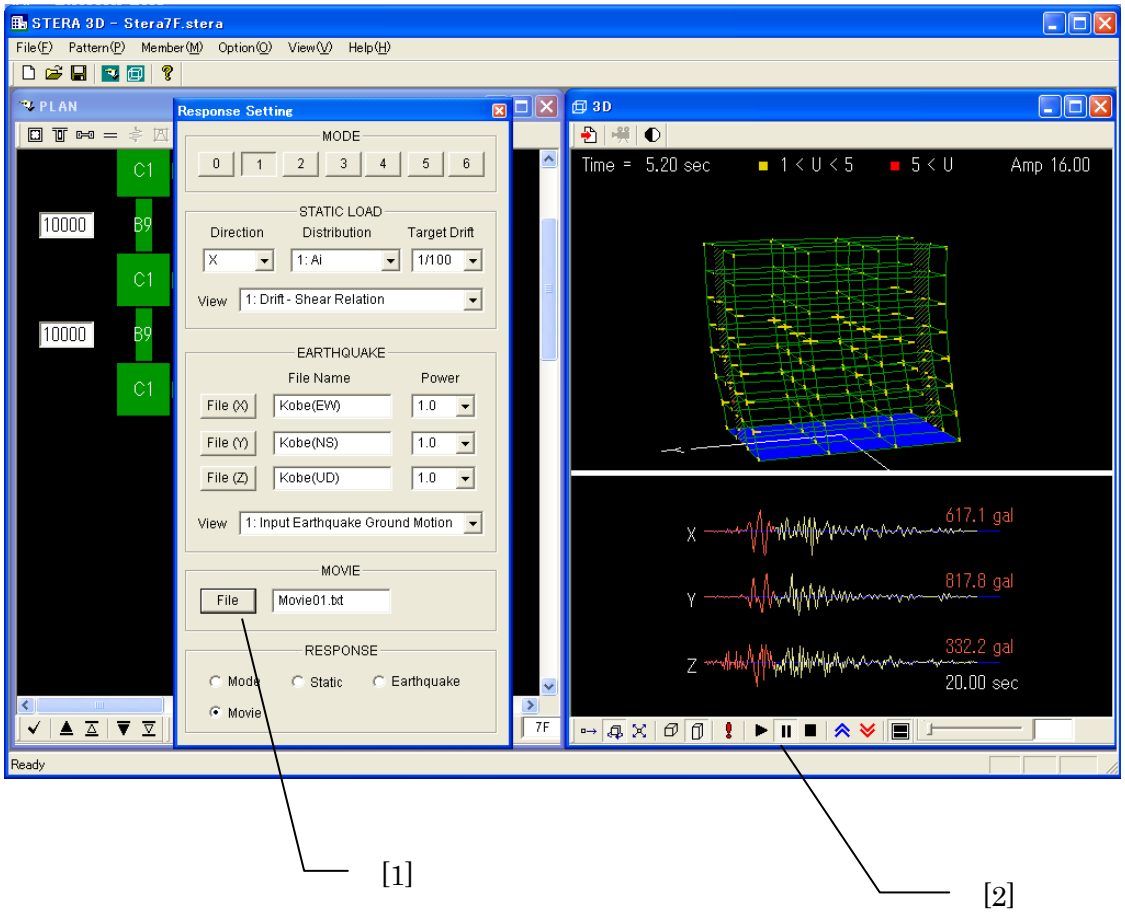


2) Play movie

[1] On the RESPONSE SETTING DIALOG, please push 

in the “MOVIE” menu to select a movie file.

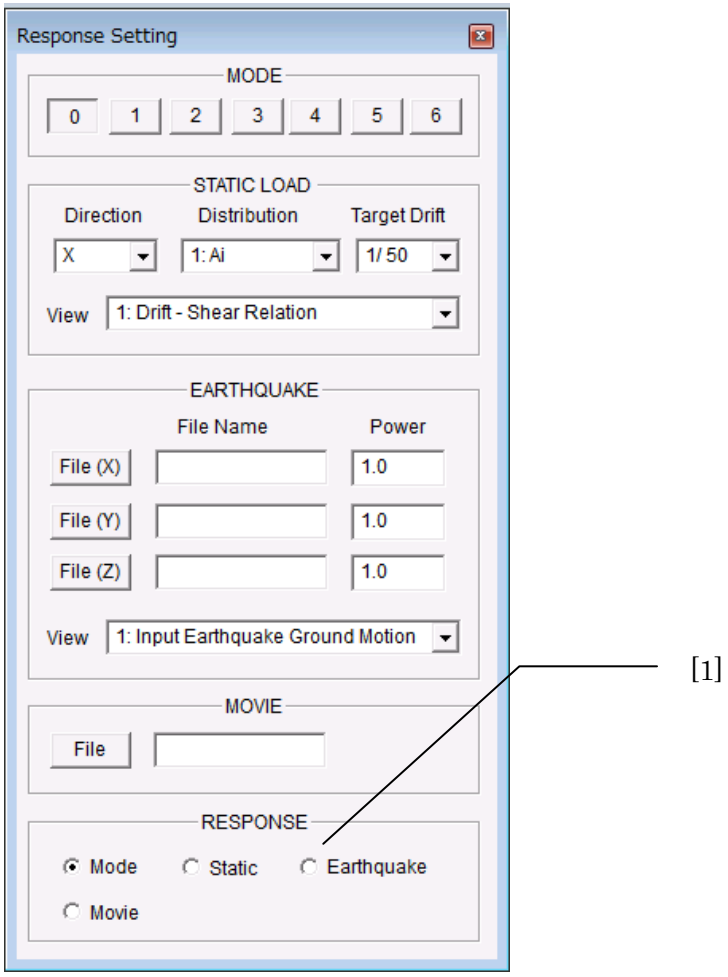
[2] () displays, () pauses and () stops the response.



5-6. Change Analysis

[1] On the RESPONSE SETTING DIALOG, you can change the analysis:

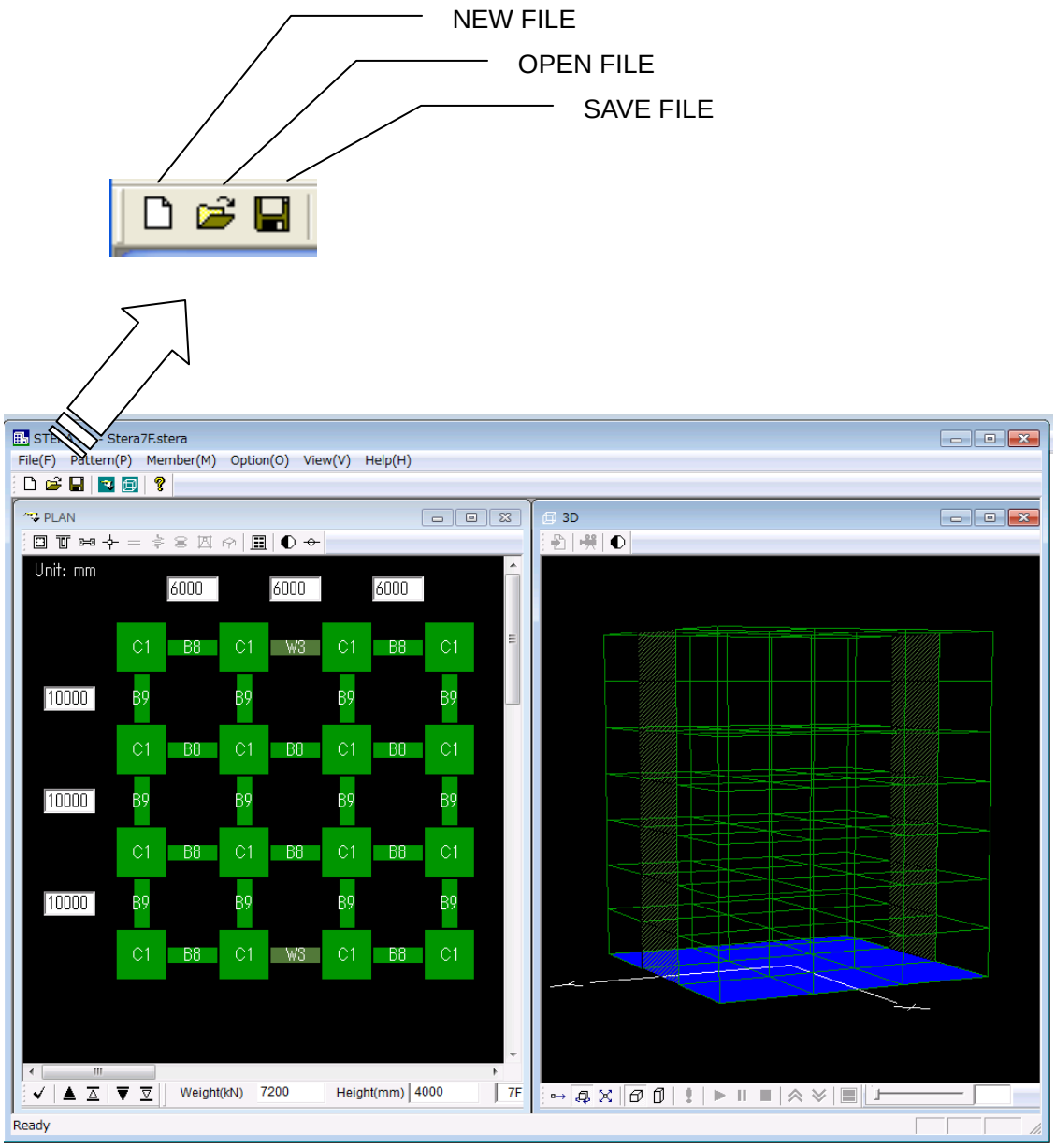
Mode:	Modal Analysis
Static:	Nonlinear Static Push-Over Analysis
Earthquake:	Nonlinear Earthquake Response Analysis
Movie:	Movie for Nonlinear Earthquake Response Analysis



6. Save and Open Files

6-1. Save Building Data

You can save the building data in a file and open it later. The file has an extension ".stera".



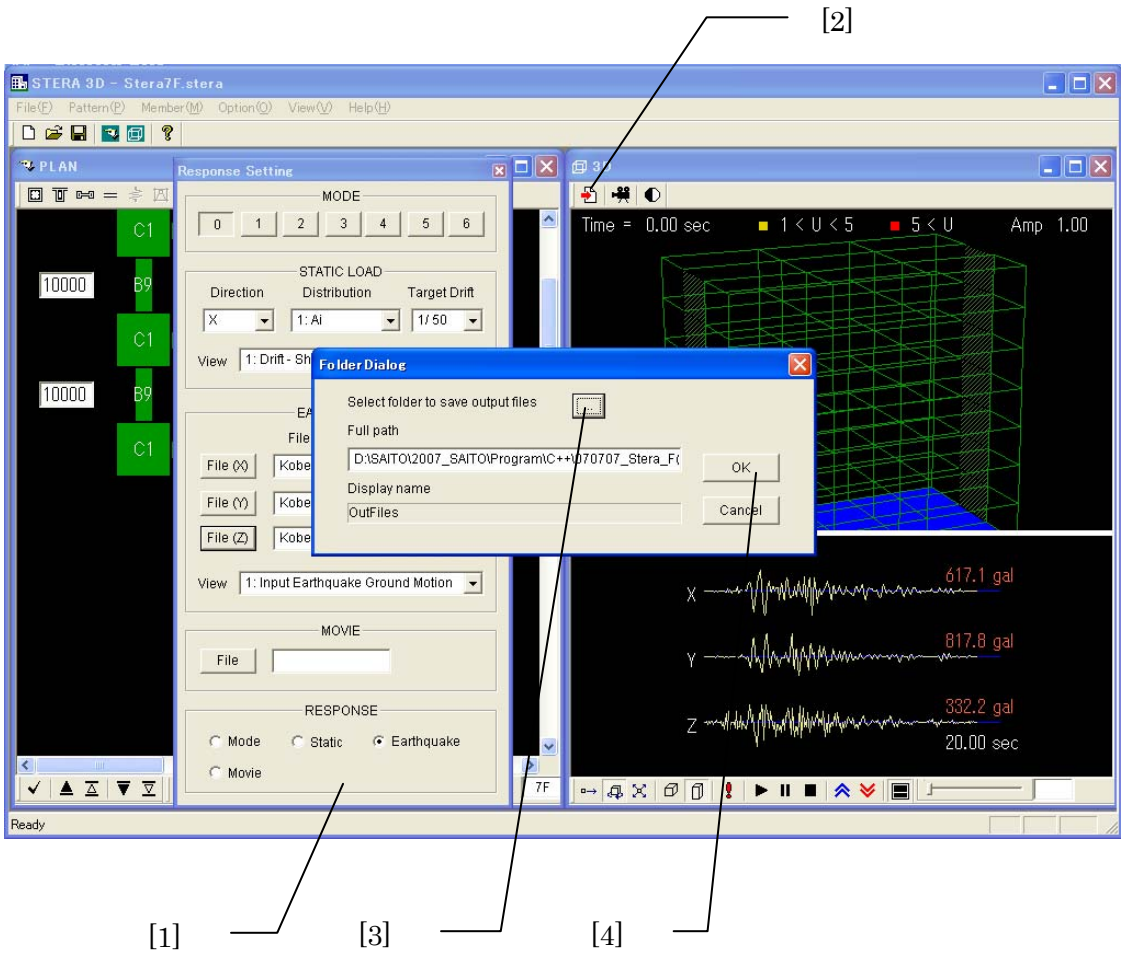
6-2. Save Results of Analysis into Text Files

To save the results of analysis in text files, you must run another program.

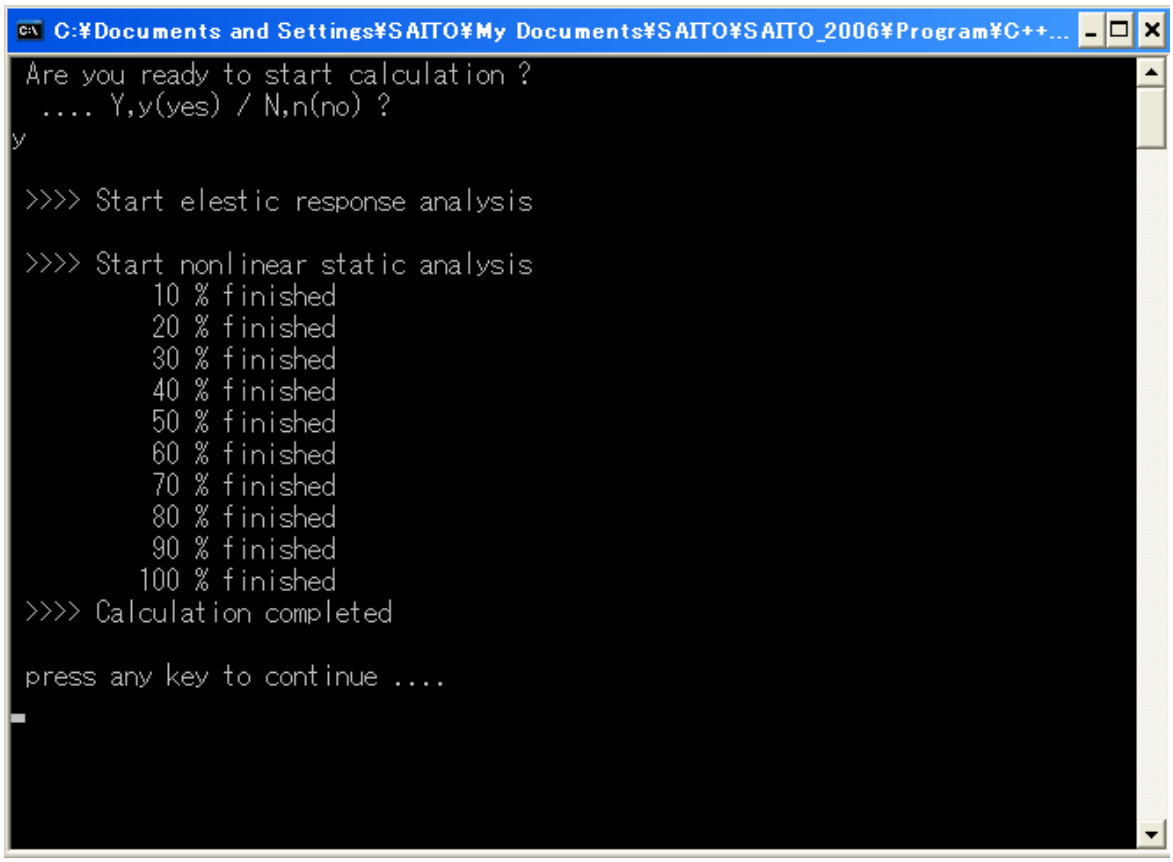
[1] On the RESPONSE SETTING DIALOG, please set the condition of analysis.

[2] Please push the “Save Data” button ( ).

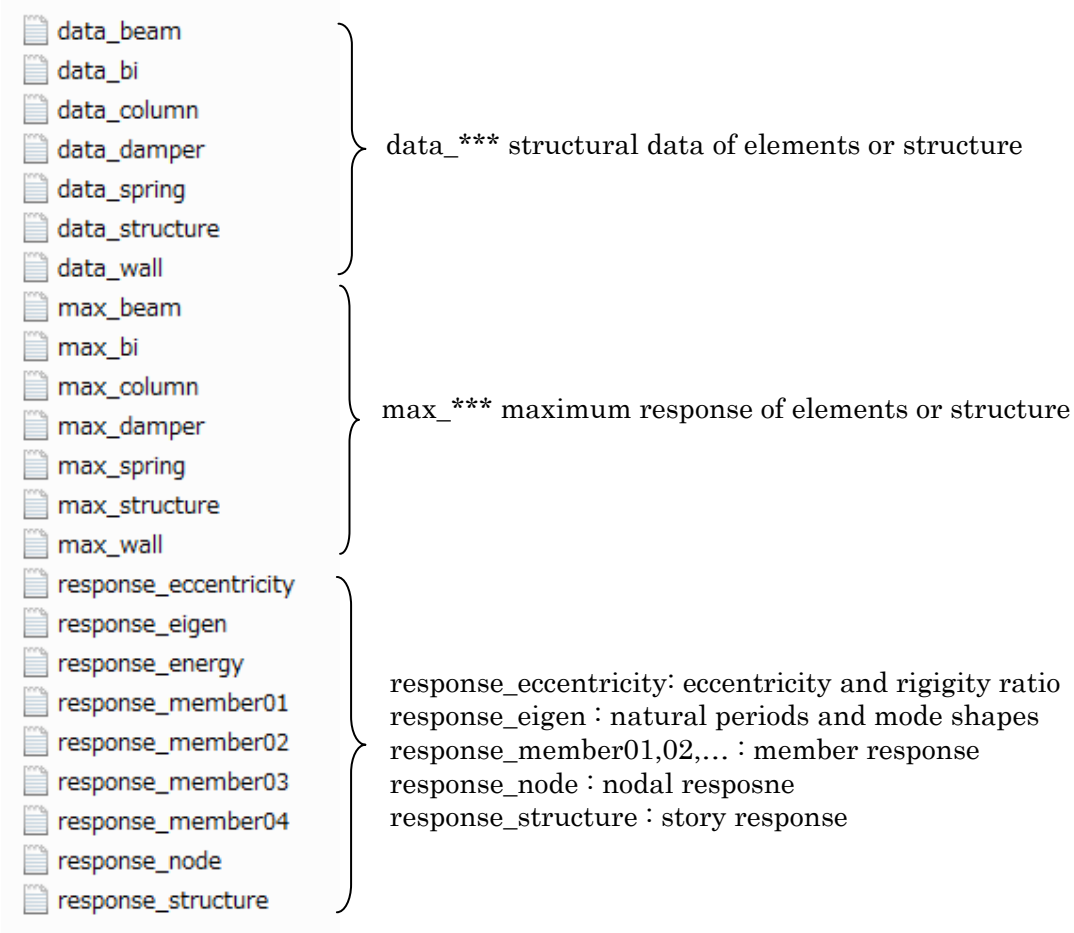
[3] Please select folder to save output files.



[4] When you push “OK”, a window appears to start calculation and save output data to the designated folder.



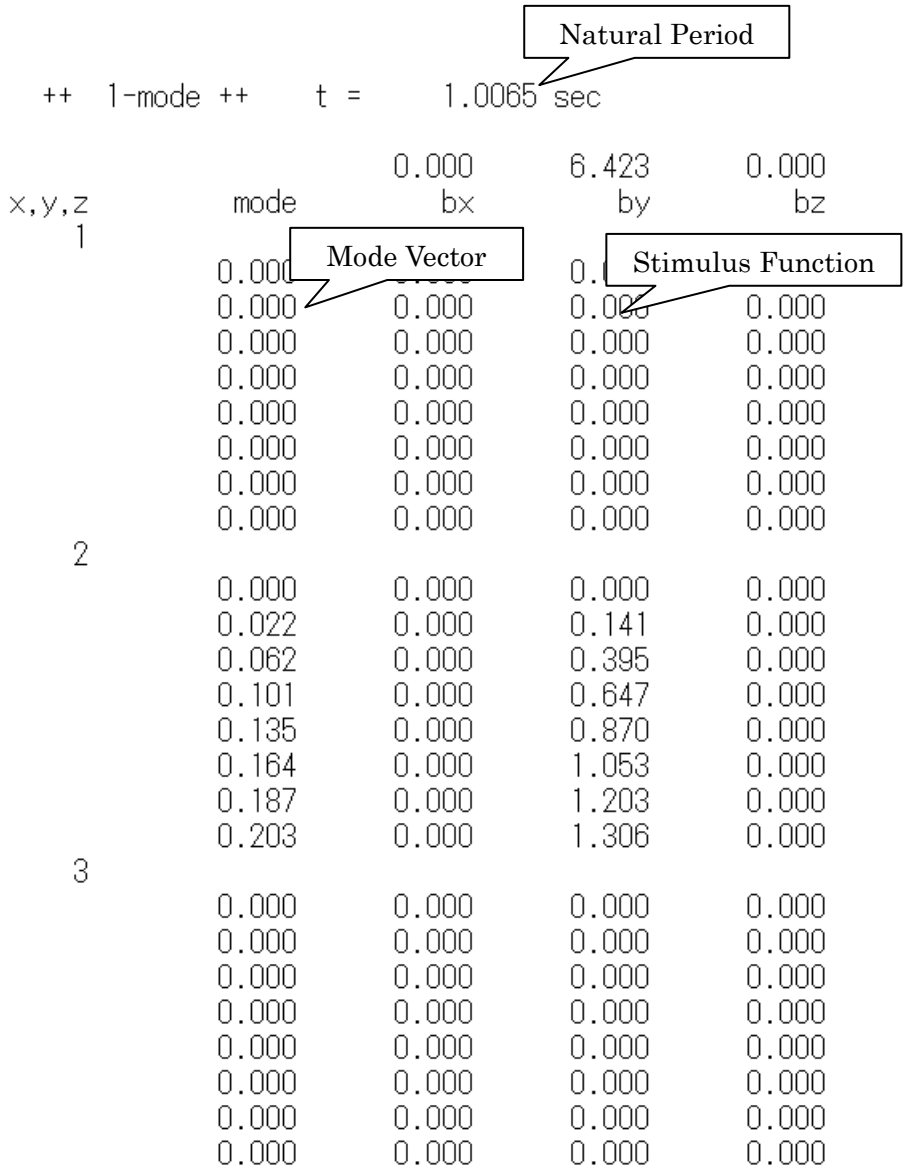
In the designated folder, the following files are automatically created:



beam : Beam
column : Column
wall : Wall
damper : Damper and Nonstructural wall
spring : Vertical spring
bi : Base Isolator
structure : Building

1) “response_eigen.txt”

In this file, the results of modal analysis including natural periods, mode vectors, stimulus functions are saved.



2) “response_structure.txt”

[1] In case of nonlinear static analysis, the following data are saved for each story.

kstep	sd	sa	max drift	F	sdx	sdy	ssx	ssy	sfx	sfy	dx	dy	rz	F
0	0.0000E+00	0.0000E+00	0.00000	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.5561E-12	-0.1368E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
1	0.7990E-01	0.1667E+02	0.00005	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.6131E+03	-0.5684E-13	0.0000E+00	0.0000E+00	0.0000E+00	1
2	0.1598E+00	0.3329E+02	0.00010	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.1224E+04	-0.1084E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
3	0.2398E+00	0.4990E+02	0.00015	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.1835E+04	-0.2363E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
4	0.3191E+00	0.6283E+02	0.00020	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.2304E+04	-0.1936E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
5	0.3986E+00	0.6976E+02	0.00024	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.2555E+04	-0.4974E-13	0.0000E+00	0.0000E+00	0.0000E+00	1
6	0.4781E+00	0.8760E+02	0.00029	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.3207E+04	-0.9770E-13	0.0000E+00	0.0000E+00	0.0000E+00	1
7	0.5577E+00	0.1040E+03	0.00034	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.3809E+04	-0.1421E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
8	0.6373E+00	0.1164E+03	0.00039	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.4263E+04	-0.2132E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
9	0.7167E+00	0.1278E+03	0.00044	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.4674E+04	-0.1510E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
10	0.7959E+00	0.1296E+03	0.00049	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.4732E+04	-0.2851E-12	0.0000E+00	0.0000E+00	0.0000E+00	1
11	0.8752E+00	0.1397E+03	0.00054	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.5098E+04	-0.1412E-12	0.0000E+00	0.0000E+00	0.0000E+00	1

kstep calculation step in static analysis

< Equivalent 1DOF system>
- sd displacement (cm)
- sa acceleration (gal)

<Relative story displacement>
- F story number
- sdx story drift in X-direction (cm)
- sdy story drift in Y-direction (cm)
- srz rotational angle around Z-direction (torsion angle)

＜Story shear force>
- sfx story shear force in X-direction (kN)
- sfy story shear force in Y-direction (kN)

<Displacement from the ground at the center of gravity in each floor>
- dx displacement in X-direction (cm)
- dy displacement in Y-direction (cm)
- rz rotational angle around Z-direction

[2] In case of earthquake response analysis, the following data are saved for each story:

kstep	t	F	sdx	sdy	ssx	ssy	sfx	sfy	dx	dy	rz	ax	ay	F
0	0.0000	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.5561E-12	-0.1368E-12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
5	0.0200	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.4253E-13	0.7851E-12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
10	0.0400	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.1093E-10	-0.9877E-12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
15	0.0600	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.1451E-10	0.1215E-11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
20	0.0800	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.7334E-11	0.6395E-13	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
25	0.1000	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.1252E-10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
30	0.1200	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.7099E-11	-0.1483E-12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
35	0.1400	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.5970E-11	0.2149E-12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1
40	0.1600	0	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-0.5672E-11	-0.1634E-12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1

t time step in dynamic analysis

<Relative story displacement>
- F story number
- sdx story drift in X-direction (cm)
- sdy story drift in Y-direction (cm)
- srz rotational angle around Z-direction (torsion angle)

＜Story shear force>
- sfx story shear force in X-direction (kN)
- sfy story shear force in Y-direction (kN)

<Displacement from the ground at the center of gravity in each floor>
- dx displacement in X-direction (cm)
- dy displacement in Y-direction (cm)
- rz rotational angle around Z-direction

3) “response_eccentricity.txt”

This file includes the output of eccentricity ratio and rigidity ratio based on Japanese standards.

```
 == Output for rigidity ratio ==
<X-direction>
   NF         Rx
    1  0.220E+01
    2  0.105E+01
    3  0.813E+00
    4  0.725E+00
    5  0.709E+00
    6  0.723E+00
    7  0.781E+00
<Y-direction>
   NF         Ry
    1  0.143E+01
    2  0.747E+00
    3  0.743E+00
    4  0.811E+00
    5  0.924E+00
    6  0.103E+01
    7  0.131E+01

 == Output for eccentricity ratio ==
< 0 F>
< 1 F>
 Center of rigitity (cm)
     Cx =    900.00
     Cy =   1517.95
 Center of gravity (cm)
     Gx =    900.000
     Gy =   1500.000
 Eccentricity distance (cm)
     Ex =      0.000
     Ey =     17.948
 Radius of gyration (cm)
     rx =   1455.956
     ry =   3034.104
 Eccentricity ratio
     Rx =      0.012
     Ry =      0.000
< 2 F>
```

0 F : basement floor

4) “response_member.txt”

[1] In case of Beam

BE No. 47

	Rya	Mya	Uya	Rpa	Mpa	Upa	Ryb	Myb	Uyb
0.000	-0.7202E-04	-0.5209E+04	-0.013	-0.4177E-04	-0.5209E+04	-0.011	-0.8340E-04	-0.5492E+04	-0.015
1.000	-0.1200E-03	-0.8533E+04	-0.021	-0.6844E-04	-0.8533E+04	-0.017	-0.1324E-03	-0.8843E+04	-0.023
2.000	-0.1679E-03	-0.1186E+05	-0.029	-0.9510E-04	-0.1186E+05	-0.024	-0.1814E-03	-0.1219E+05	-0.032
3.000	-0.2159E-03	-0.1518E+05	-0.038	-0.1218E-03	-0.1518E+05	-0.031	-0.2304E-03	-0.1554E+05	-0.040
4.000	-0.2650E-03	-0.1859E+05	-0.046	-0.1491E-03	-0.1859E+05	-0.038	-0.2805E-03	-0.1897E+05	-0.049
5.000	-0.3118E-03	-0.2125E+05	-0.055	-0.1757E-03	-0.2125E+05	-0.044	-0.3317E-03	-0.2151E+05	-0.058
6.000	-0.3706E-03	-0.2243E+05	-0.065	-0.2329E-03	-0.2243E+05	-0.059	-0.3861E-03	-0.2316E+05	-0.068
7.000	-0.4313E-03	-0.2364E+05	-0.076	-0.2921E-03	-0.2364E+05	-0.074	-0.4425E-03	-0.2488E+05	-0.078
8.000	-0.4927E-03	-0.2487E+05	-0.086	-0.3520E-03	-0.2487E+05	-0.089	-0.4999E-03	-0.2662E+05	-0.088
9.000	-0.5511E-03	-0.2606E+05	-0.097	-0.4095E-03	-0.2606E+05	-0.104	-0.5569E-03	-0.2833E+05	-0.098
10.000	-0.6092E-03	-0.2724E+05	-0.107	-0.4668E-03	-0.2724E+05	-0.118	-0.6137E-03	-0.3005E+05	-0.108

< Moment >

Disp.	Force.	Ductility Factor	
Rya	Mya	Uya	End A
Rpa	Mpa	Upa	End B
Ryb	Myb	Uyb	Nonlinear Rotational Spring at End A
Rpb	Mpb	Upb	Nonlinear Rotational Spring at End B

< Shear Force >

Disp.	Force.	Ductility Factor	
Rsx	Qsx	Usx	Nonlinear Shear Spring

[2] In case of Column

CO No. 1

	Rya	Mya	Uya	Ryb	Myb	Uyb	Rxa	Mxa	Uxa
0.000	0.9130E-06	0.4332E+03	0.000	0.6594E-05	0.8325E+03	0.000	0.5818E-07	0.2760E+02	0.000
1.000	0.2023E-04	0.2518E+04	0.000	0.2078E-05	0.1242E+04	0.000	0.6740E-07	0.3197E+02	0.000
2.000	0.3949E-04	0.4597E+04	0.000	-0.2424E-05	0.1651E+04	0.000	0.7622E-07	0.3616E+02	0.000
3.000	0.5875E-04	0.6677E+04	0.000	-0.6925E-05	0.2060E+04	0.000	0.8504E-07	0.4035E+02	0.000
4.000	0.7703E-04	0.8663E+04	0.000	-0.1094E-04	0.2480E+04	0.000	0.8545E-07	0.4054E+02	0.000
5.000	0.9534E-04	0.1062E+05	0.000	-0.1562E-04	0.2821E+04	0.000	0.8354E-07	0.3963E+02	0.000
6.000	0.1142E-03	0.1277E+05	0.000	-0.1763E-04	0.3507E+04	0.000	0.8772E-07	0.4162E+02	0.000
7.000	0.1333E-03	0.1496E+05	0.000	-0.1957E-04	0.4216E+04	0.000	0.1075E-06	0.5101E+02	0.000
8.000	0.1522E-03	0.1712E+05	0.000	-0.2143E-04	0.4920E+04	0.000	0.1032E-06	0.4898E+02	0.000
9.000	0.1694E-03	0.1882E+05	0.000	-0.2882E-04	0.4884E+04	0.000	0.1010E-06	0.4791E+02	0.000
10.000	0.1856E-03	0.2035E+05	0.000	-0.3687E-04	0.4717E+04	0.000	0.1037E-06	0.4917E+02	0.000

< Moment >

Disp.	Force.	Ductility Factor			
Rya	Mya	Uya	End A	(Bottom)	Y-direction
Ryb	Myb	Uyb	End B	(Bottom)	Y-direction
Rxa	Mxa	Uxa	End A	(Bottom)	X-direction
Rxb	Mxb	Uxb	End B	(Bottom)	X-direction

< Shear Force >

Disp.	Force.	Ductility Factor		
Rsx	Qsx	Usx	Nonlinear Shear Spring	X-direction
Rsy	Qsy	Usy	Nonlinear Shear Spring	Y-direction

< Multi-spring >

Disp.	Force.	Ductility Factor		
C1D(a)	C1F(a)	C1U(a)	End A	Concrete Spring 1
C2D(a)	C2F(a)	C2U(a)	End A	Concrete Spring 2
C3D(a)	C3F(a)	C3U(a)	End A	Concrete Spring 3
C4D(a)	C4F(a)	C4U(a)	End A	Concrete Spring 4
C5D(a)	C5F(a)	C5U(a)	End A	Concrete Spring 5
S1D(a)	S1F(a)	S1U(a)	End A	Steel Spring 1
S2D(a)	S2F(a)	S2U(a)	End A	Steel Spring 2
S3D(a)	S3F(a)	S3U(a)	End A	Steel Spring 3
S4D(a)	S4F(a)	S4U(a)	End A	Steel Spring 4
S5D(a)	S5F(a)	S5U(a)	End A	Steel Spring 5
C1D(b)	C1F(b)	C1U(b)	End B	Concrete Spring 1
C2D(b)	C2F(b)	C2U(b)	End B	Concrete Spring 2
C3D(b)	C3F(b)	C3U(b)	End B	Concrete Spring 3
C4D(b)	C4F(b)	C4U(b)	End B	Concrete Spring 4
C5D(b)	C5F(b)	C5U(b)	End B	Concrete Spring 5
S1D(b)	S1F(b)	S1U(b)	End B	Steel Spring 1
S2D(b)	S2F(b)	S2U(b)	End B	Steel Spring 2
S3D(b)	S3F(b)	S3U(b)	End B	Steel Spring 3
S4D(b)	S4F(b)	S4U(b)	End B	Steel Spring 4
S5D(b)	S5F(b)	S5U(b)	End B	Steel Spring 5

[3] In case of Wall

WA No. 1

	Rya	Mya	Uya	Ryb	Myb	Uyb	Rsx	Qsx	Usx
0.000	-0.2314E-19	0.1455E-10	0.000	-0.2314E-19	-0.7276E-10	0.000	-0.2224E-19	-0.5183E-12	0.000
1.000	0.2021E-04	0.2835E+06	0.000	0.1978E-05	-0.2139E+06	0.000	0.1066E-04	0.2485E+03	0.018
2.000	0.4037E-04	0.5663E+06	0.000	0.3937E-05	-0.4274E+06	0.000	0.2129E-04	0.4962E+03	0.037
3.000	0.6052E-04	0.8491E+06	0.000	0.5896E-05	-0.6409E+06	0.000	0.3191E-04	0.7438E+03	0.055
4.000	0.7957E-04	0.1107E+07	0.000	0.7364E-05	-0.8484E+06	0.000	0.4177E-04	0.9735E+03	0.072
5.000	0.9870E-04	0.1328E+07	0.000	0.8626E-05	-0.1050E+07	0.000	0.5129E-04	0.1195E+04	0.089
6.000	0.1180E-03	0.1568E+07	0.000	0.9408E-05	-0.1214E+07	0.000	0.6023E-04	0.1404E+04	0.104
7.000	0.1374E-03	0.1808E+07	0.000	0.9606E-05	-0.1386E+07	0.000	0.6880E-04	0.1604E+04	0.119
8.000	0.1565E-03	0.2011E+07	0.000	0.9497E-05	-0.1541E+07	0.000	0.7668E-04	0.1787E+04	0.132
9.000	0.1745E-03	0.2213E+07	0.000	0.8142E-05	-0.1699E+07	0.000	0.8341E-04	0.1944E+04	0.144
10.000	0.1916E-03	0.2356E+07	0.000	0.6466E-05	-0.1847E+07	0.000	0.8958E-04	0.2088E+04	0.155

< Moment >

Disp.	Force.	Ductility Factor			
Rya	Mya	Uya	End A	(Bottom)	Y-direction
Ryb	Myb	Uyb	End B	(Bottom)	Y-direction
Rxa	Mxa	Uxa	End A	(Bottom)	X-direction
Rxb	Mxb	Uxb	End B	(Bottom)	X-direction

< Shear Force >

Disp.	Force.	Ductility Factor		
Rsx	Qsx	Usx	Nonlinear Shear Spring	X-direction

< Multi-spring > (springs 11-15 in a wall panel)

Disp.	Force.	Ductility Factor		
C11D(a)	C11F(a)	C11U(a)	End A	Concrete Spring 11
C12D(a)	C12F(a)	C12U(a)	End A	Concrete Spring 12
C13D(a)	C13F(a)	C13U(a)	End A	Concrete Spring 13
C14D(a)	C14F(a)	C14U(a)	End A	Concrete Spring 14
C15D(a)	C15F(a)	C15U(a)	End A	Concrete Spring 15
S11D(a)	S11F(a)	S11U(a)	End A	Steel Spring 11
S12D(a)	S12F(a)	S12U(a)	End A	Steel Spring 12
S13D(a)	S13F(a)	S13U(a)	End A	Steel Spring 13
S14D(a)	S14F(a)	S14U(a)	End A	Steel Spring 14
S15D(a)	S15F(a)	S15U(a)	End A	Steel Spring 15
C11D(b)	C11F(b)	C11U(b)	End B	Concrete Spring 11
C12D(b)	C12F(b)	C12U(b)	End B	Concrete Spring 12
C13D(b)	C13F(b)	C13U(b)	End B	Concrete Spring 13
C14D(b)	C14F(b)	C14U(b)	End B	Concrete Spring 14
C15D(b)	C15F(b)	C15U(b)	End B	Concrete Spring 15
S11D(b)	S11F(b)	S11U(b)	End B	Steel Spring 11
S12D(b)	S12F(b)	S12U(b)	End B	Steel Spring 12
S13D(b)	S13F(b)	S13U(b)	End B	Steel Spring 13
S14D(b)	S14F(b)	S14U(b)	End B	Steel Spring 14
S15D(b)	S15F(b)	S15U(b)	End B	Steel Spring 15

[4] In case of Vertical Spring

< Axial Force >

Disp.	Force.	Ductility Factor
Dz	Fz	Uz

[5] In case of Base Isolator

< Shear Force >

Disp.	Force.	Ductility Factor	
Dx	Qx	Ux	X-direction
Dy	Qy	Uy	Y-direction

[6] In case of Damper and Nonstructural Wall

< Shear Force >

Disp.	Force.	Ductility Factor	
Dx	Qx	Ux	X-direction

7) “response_node.txt”

```
Node number
  OF
          1    2    3    4
          5    6    7    8
          9   10   11   12
         13   14   15   16
     center of gravity:    17
  1F
         18   19   20   21
         22   23   24   25
         26   27   28   29
         30   31   32   33
```

Node number in each floor

kstep	node	dx	dy	dz	rx	ry	rz	fx	fy	fz
0	1	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	2	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	3	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	13	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	14	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	15	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	16	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	17	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0	18	-0.6370E-17	-0.6150E-18	-0.4916E-01	0.3620E-06	0.5681E-05	0.1790E-20	0.5645E-07	-0.3387E-07	-0.4500E+03
0	19	-0.6370E-17	-0.1689E-17	-0.2643E-01	0.3191E-05	0.0000E+00	0.1790E-20	0.5645E-07	-0.1129E-07	-0.4500E+03
0	20	-0.6370E-17	-0.2763E-17	-0.2643E-01	0.3191E-05	0.0000E+00	0.1790E-20	0.5645E-07	0.1129E-07	-0.4500E+03

	kstep	calculation step in static analysis
	node	node number
< Displacement>		
	dx	displacement in X-direction (cm)
	dy	displacement in Y-direction (cm)
	dz	displacement in Z-direction (cm)
	rx	rotational angle around X-direction
	ry	rotational angle around Y-direction
	rz	rotational angle around Z-direction)
<Force>		
	fx	force in X-direction (kN)
	fy	force in Y-direction (kN)
	fz	force in Z-direction (kN)

6) “max_****.txt”

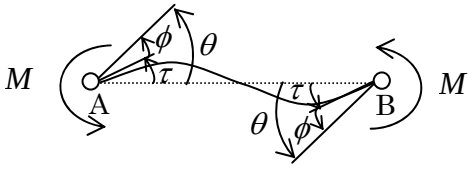
In this file, the maximum stress and displacement of each member and the maximum story responses are saved.

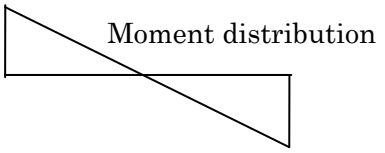
[1] “max_baem.txt” Beam

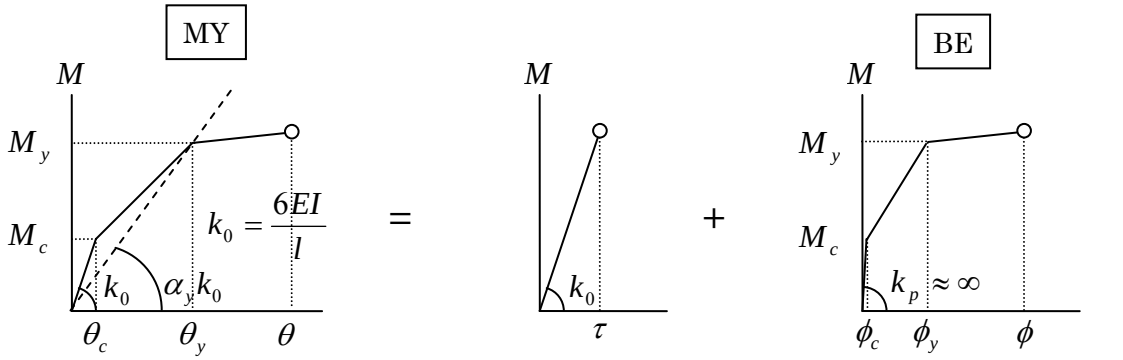
Ductility factor

```
EL.NO.=  31   disp        force       duct
      MY  1 -0.2048E-01 -0.1649E+06  -4.34
      BE  1 -0.1940E-01 -0.1649E+06  -5.68
      MY  2 -0.1900E-01 -0.1576E+06  -4.02
      BE  2 -0.1815E-01 -0.1576E+06  -5.31
      Q   1 -0.1878E-03 -0.6242E+03  -0.05
```

M at the end of flexural part A
M at the nonlinear spring A
M at the end of flexural part B
M at the nonlinear spring B
Q







Elastic element Nonlinear bending spring

[2] “max_column.txt” Column

```
EL.NO.=   1   disp        force       duct
      MY  1  0.1892E-01  0.1102E+06   3.91
       CO 1  0.9352E+00 -0.5956E+03  -7.22 /
       CO 2 -0.6541E-02 -0.8083E+03   0.05 /
       CO 3  0.9370E+00 -0.5952E+03  -7.23 /
       CO 4 -0.6149E-02 -0.7599E+03   0.05 /
       CO 5  0.4656E+00 -0.1498E+03  -3.59 /
      MY  2  0.1627E-02  0.6002E+05   0.34
       CO 1 -0.4900E-02 -0.6055E+03   0.04 /
       CO 2  0.8132E-01 -0.5916E+03  -0.63 /
       CO 3 -0.4907E-02 -0.6064E+03   0.04 /
       CO 4  0.7735E-01 -0.5925E+03  -0.60 /
       CO 5  0.3856E-01 -0.1498E+03  -0.30 /
      Q   1  0.1113E-03  0.5848E+03   0.03
      Q   2  0.1542E-04  0.8097E+02   0.00
      N      0.5191E+00 -0.2963E+04

          disp        force       duct
     MX  1  0.2307E-04  0.6891E+04   0.00
      ST 1  0.9352E+00  0.1243E+04   7.22
      ST 2 -0.6541E-02 -0.1408E+03  -0.05
      ST 3  0.9370E+00  0.1246E+04   7.23
      ST 4 -0.6149E-02 -0.1323E+03  -0.05
      ST 5  0.0000E+00  0.0000E+00   0.00
     MX  2  0.1666E-03  0.1575E+05   0.00
      ST 1 -0.4900E-02 -0.1055E+03  -0.04
      ST 2  0.8132E-01  0.8726E+03   0.63
      ST 3 -0.4907E-02 -0.1056E+03  -0.04
      ST 4  0.7735E-01  0.8431E+03   0.60
      ST 5  0.0000E+00  0.0000E+00   0.00
```

MX: Moment in X-direction
MY: Moment in Y-direction
ST: Steel CO : Concrete
Q : Shear N: Axial force

[3] “max_wall.txt”, Wall

```
EL.NO.=   2   disp        force     duct          disp        force     duct
      MY   1   0.172E-01   0.714E+07 14.58
      MXA  1  -0.525E-05  -0.664E+03 -1.03      MXB  1  -0.525E-05  -0.664E+03  0.04
       CO  1   0.991E+01  -0.182E+03-45.52 /     ST  1   0.991E+01   0.129E+04 45.52
       CO  2   0.881E+01  -0.166E+03-40.49 /     ST  2   0.881E+01   0.128E+04 40.49
       CO  3   0.981E+01  -0.757E+02-45.08 /     ST  3   0.981E+01   0.129E+04 45.08
       CO  4   0.872E+01  -0.525E+02-40.06 /     ST  4   0.872E+01   0.128E+04 40.06
       CO  5   0.931E+01  -0.404E+02-42.79 /     ST  5   0.000E+00   0.000E+00  0.00
       CO  6  -0.150E+00  -0.264E+04  0.69 /     ST  6  -0.150E+00  -0.847E+03 -0.69
       CO  7  -0.124E+01  -0.386E+04  5.71 /     ST  7  -0.124E+01  -0.124E+04 -5.71
       CO  8  -0.144E+00  -0.253E+04  0.66 /     ST  8  -0.144E+00  -0.812E+03 -0.66
       CO  9  -0.124E+01  -0.386E+04  5.68 /     ST  9  -0.124E+01  -0.124E+04 -5.68
       CO 10  -0.693E+00  -0.125E+04  3.19 /     ST 10   0.000E+00   0.000E+00  0.00
       CO 11   0.720E+01  -0.134E+03-33.08 /     ST 11   0.720E+01   0.117E+04 33.08
       CO 12   0.576E+01  -0.146E+03-26.44 /     ST 12   0.576E+01   0.116E+04 26.44
       CO 13   0.431E+01  -0.171E+03-19.80 /     ST 13   0.431E+01   0.115E+04 19.80
       CO 14   0.286E+01  -0.132E+03-13.16 /     ST 14   0.286E+01   0.114E+04 13.16
       CO 15   0.142E+01  -0.155E+03 -6.52 /     ST 15   0.142E+01   0.114E+04  6.52
      MY   2  -0.902E-03  -0.555E+07 -0.76
      MXA  2  -0.881E-02  -0.307E+05 -7.47      MXB  2  -0.379E-04   0.165E+05  0.31
       CO  1   0.140E+00  -0.882E+02 -0.85 /     ST  1   0.140E+00   0.791E+03  0.85
       CO  2   0.837E-01  -0.852E+02 -0.70 /     ST  2   0.837E-01   0.474E+03  0.70
       CO  3   0.682E+00  -0.170E+03 -3.13 /     ST  3   0.682E+00   0.123E+04  3.13
       CO  4   0.625E+00  -0.164E+03 -2.87 /     ST  4   0.625E+00   0.123E+04  2.87
       CO  5   0.383E+00  -0.381E+02 -1.76 /     ST  5   0.000E+00   0.000E+00  0.00
       CO  6  -0.981E-01  -0.173E+04  0.45 /     ST  6  -0.981E-01  -0.555E+03 -0.45
       CO  7  -0.154E+00  -0.272E+04  0.71 /     ST  7  -0.154E+00  -0.873E+03 -0.71
       CO  8  -0.109E+00  -0.192E+04  0.50 /     ST  8  -0.109E+00  -0.616E+03 -0.50
       CO  9  -0.165E+00  -0.291E+04  0.76 /     ST  9  -0.165E+00  -0.934E+03 -0.76
       CO 10  -0.132E+00  -0.755E+03  0.60 /     ST 10   0.000E+00   0.000E+00  0.00
       CO 11   0.274E+00  -0.195E+03 -1.26 /     ST 11   0.274E+00   0.113E+04  1.26
       CO 12   0.200E+00  -0.176E+03 -0.92 /     ST 12   0.200E+00   0.104E+04  0.92
       CO 13   0.126E+00  -0.150E+03 -0.58 /     ST 13   0.126E+00   0.652E+03  0.58
       CO 14   0.512E-01  -0.127E+03 -0.24 /     ST 14   0.512E-01   0.266E+03  0.24
       CO 15  -0.251E-01  -0.843E+03  0.20 /     ST 15  -0.251E-01  -0.120E+03 -0.20
      Q    1   0.225E-03   0.576E+04  0.00
      Q    2  -0.151E-05  -0.870E+01  0.00
      Q    3  -0.151E-05  -0.870E+01  0.00
      N       0.440E+01  -0.716E+04
```

MY: Moment at the wall panel
MXA, MAB: Moment at the side columns A and B
ST: Steel CO : Concrete
Q1 : Shear at the wall panel
Q2, Q3: Shear at the side columns A and B
N: Axial force

[4] “max_structure.txt”　Floor response

F	h	sdx	sdy	ssx	ssy	sfx	sfy	dx	dy	dz	rz
7	0.400E+03	0.730E+01	0.114E-01	0.658E+01	-0.446E+03	0.854E+04	0.765E+02	0.560E+02	0.948E-02	0.000E+00	0.121E-06
6	0.400E+03	0.738E+01	0.146E-01	0.666E+01	-0.377E+03	0.139E+05	0.124E+03	0.487E+02	0.830E-02	0.000E+00	0.000E+00
5	0.400E+03	0.746E+01	0.163E-01	0.676E+01	-0.309E+03	0.183E+05	0.164E+03	0.413E+02	0.711E-02	0.000E+00	0.000E+00
4	0.400E+03	0.813E+01	0.185E-01	0.746E+01	-0.240E+03	0.219E+05	0.197E+03	0.339E+02	0.583E-02	0.000E+00	0.000E+00
3	0.400E+03	0.899E+01	0.202E-01	0.838E+01	-0.171E+03	0.249E+05	0.224E+03	0.257E+02	0.455E-02	0.000E+00	0.000E+00
2	0.400E+03	0.947E+01	0.201E-01	0.896E+01	-0.103E+03	0.272E+05	0.245E+03	0.167E+02	0.309E-02	0.000E+00	0.000E+00
1	0.400E+03	0.726E+01	0.105E-01	0.704E+01	-0.343E+02	0.289E+05	0.262E+03	0.726E+01	0.157E-02	0.000E+00	0.000E+00

F　story number
h　story height (cm)
<Maximum relative story displacement>
sdx　story drift in X-direction (cm)
sdy　story drift in Y-direction (cm)
ssx　story drift in X-direction (cm), shear component
ssy　story drift in Y-direction (cm), shear component
<Maximum story shear force>
sfx　story shear force in X-direction (kN)
sfy　story shear force in Y-direction (kN)
<Maximum displacement from the ground at the center of gravity in each floor>
dx　displacement in X-direction (cm)
dy　displacement in Y-direction (cm)
rz　rotational angle around Z-direction

7) “data_****.txt”

To know the member number and member properties, please refer to “data_***.txt”.

```
Member number for Beam   (total =  178)
  0F
        0    1    0    2    0    3    0
        4    0    5    0    6    0    7
        0    8    0    9    0   10    0
       11    0   12    0   13    0   14
        0   15    0   16    0   17    0
       18    0   19    0   20    0   21
        0   22    0   23    0   24    0
  1F
        0   25    0    0    0   26    0
       27    0   28    0   29    0   30
        0   31    0   32    0   33    0
       34    0   35    0   36    0   37
        0   38    0   39    0   40    0
       41    0   42    0   43    0   44
        0   45    0    0    0   46    0
```

Member number

C---B---C---B---C---
|
B
|
C
|

```
--- inelastic properties   member =  1 ---( type = 1 )
steel reinforcement
  (up)      10- at = 11.400
  (down)    10- at = 11.400
shear reinforcement
   2- at =  5.067 @  5.000
material strength
   Fc =   2.50       Sy =   42.90      Sy(shear) =   42.90
bending-spring No. 1
   Mc = 217142.632   My = 651427.895
   Rc =  0.258E-05   Ry =  0.258E-02
bending-spring No. 2
   Mc = 217142.632   My = 651427.895
   Rc =  0.258E-05   Ry =  0.258E-02
shear-spring No. 1
   Qc =   1984.618   Qy =   3969.236   Qu =   3979.159
   Rc =  0.204E-03   Ry =  0.102E-02   Ru =  0.204E-02
```

Properties