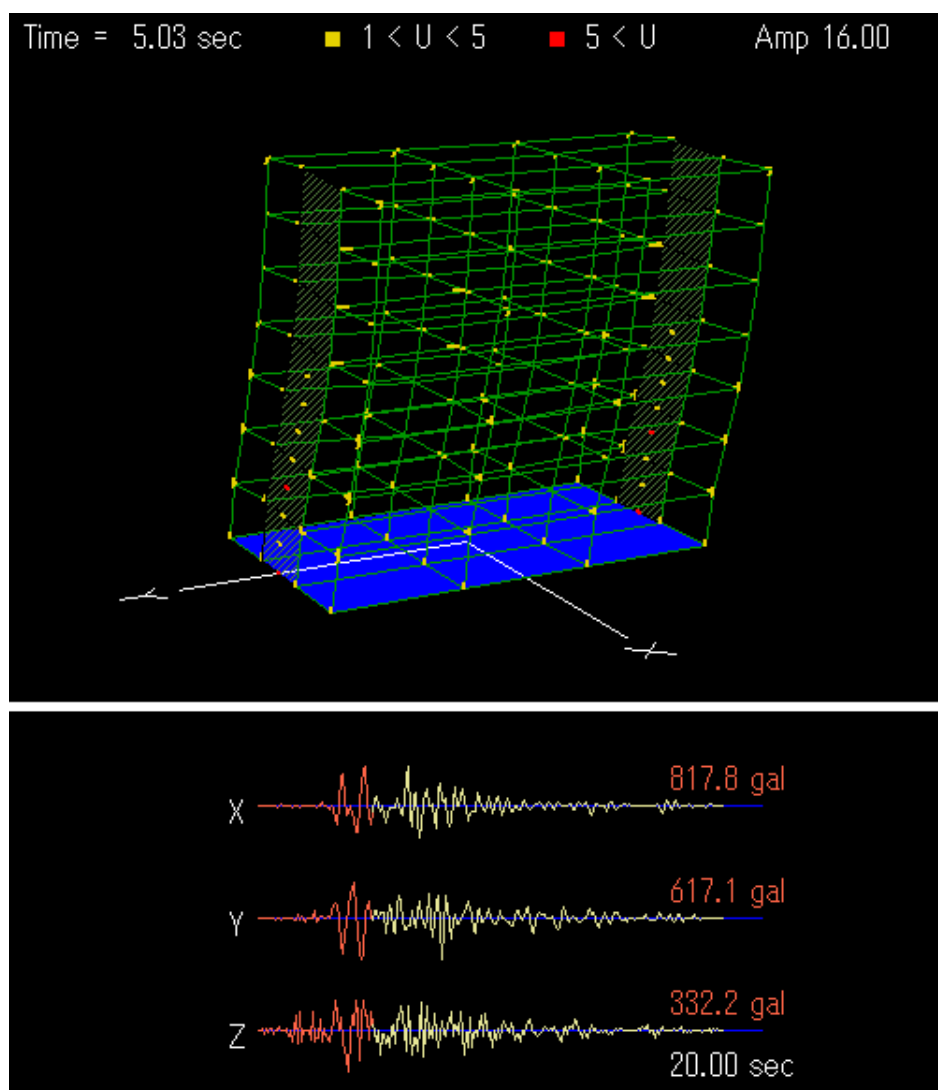


STERA 3D ver.6.1

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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Professor
Toyohashi University of Technology,
Japan

Update history

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.
- 2011/09/26 STERA_3D Ver.5.6 is uploaded.
- The equation of shear capacity of wall is modified.
 - The number of input earthquake data is increased.
 - You can get the axial deformation and force of base isolators.
- 2011/11/15 STERA_3D Ver.5.7 is uploaded.
- Unbalance force correction is newly added.
- 2012/02/27 STERA_3D Ver.5.8 is uploaded.
- The bug in Masonry element is fixed.
 - The bug in Flexible floor is fixed.
- 2013/07/01 STERA_3D Ver.5.9 is uploaded.
- Modified bi-linear model is added for Isolator Element.
- 2014/04/03 STERA_3D Ver.6.0 is uploaded.
- The list of the space of shear reinforcement was modified.
- 2014/06/16 STERA_3D Ver.6.1 is uploaded.
- The definition of effective slab width is modified.
 - Operator Splitting method is used instead of Force correction method for numerical integration.

Quick User Manual

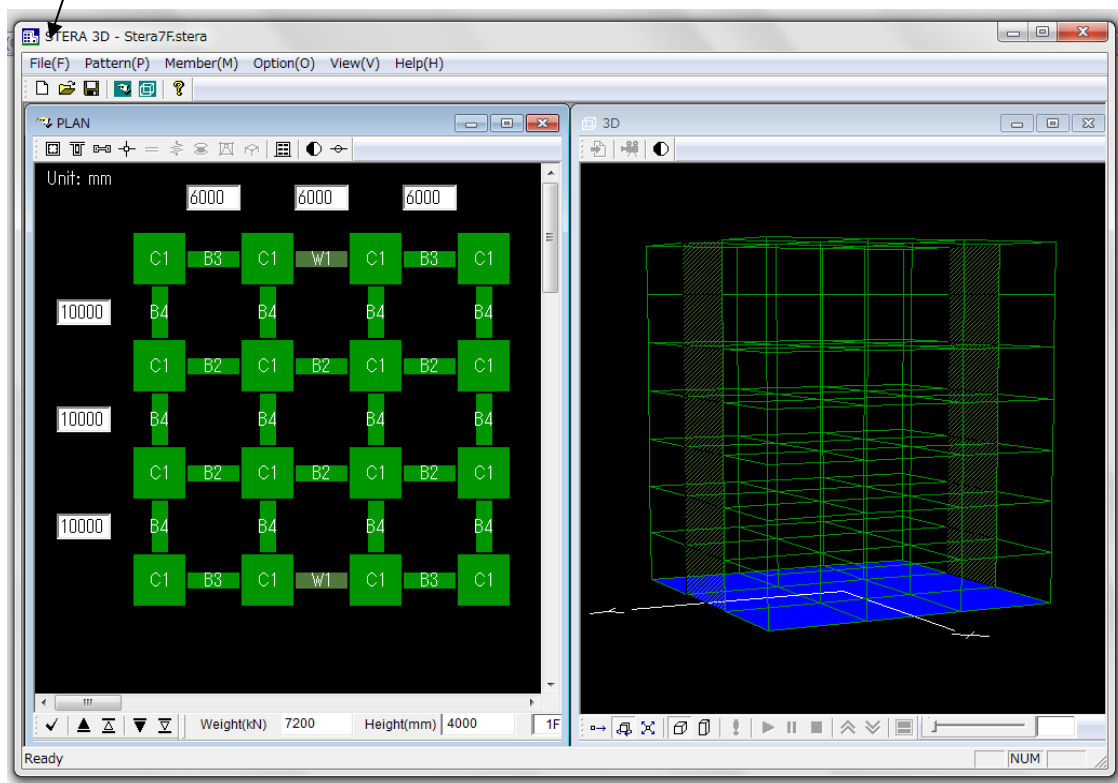
READ BUILDING DATA

- ① Double Click

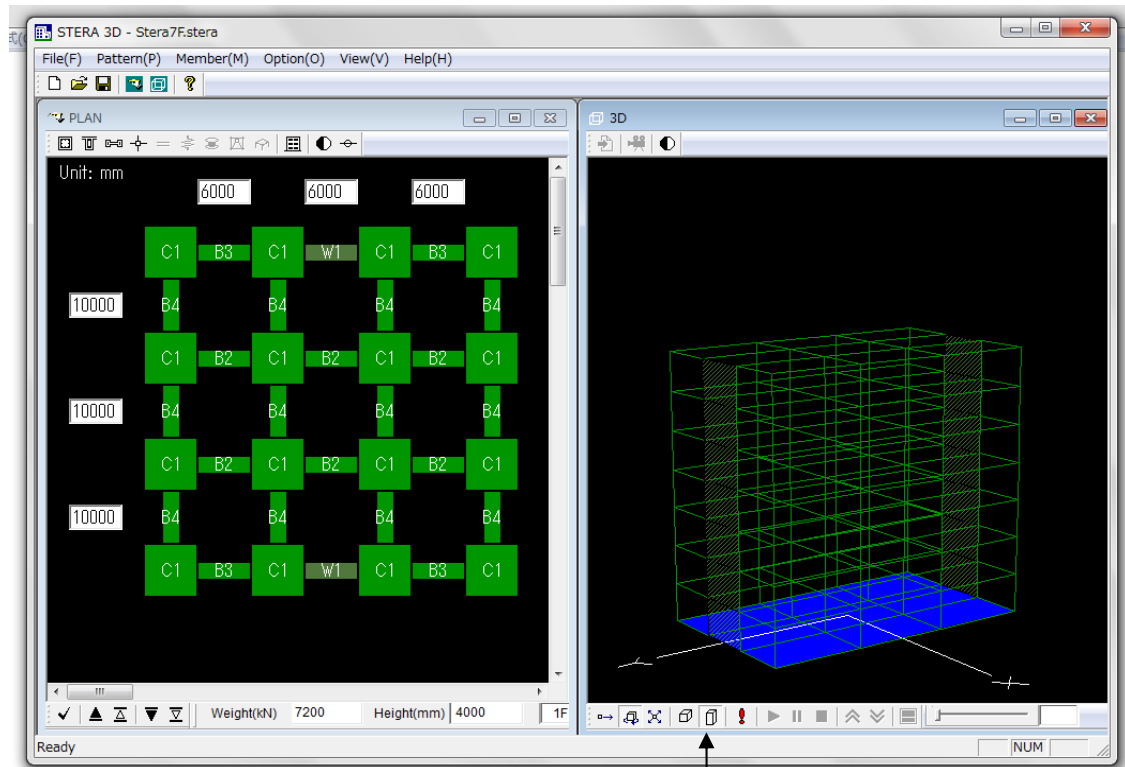


- ② “File” → “Open”

Select an example building “Structure7F.stera”

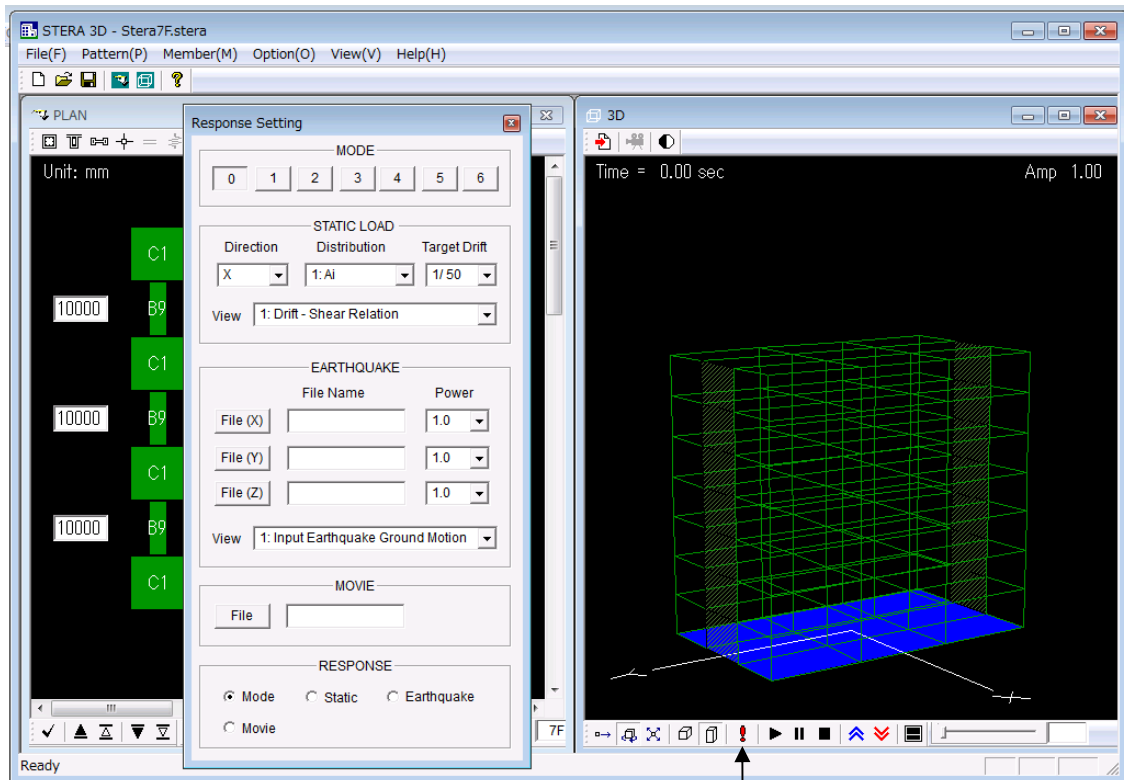


MOVE THE BUILDING



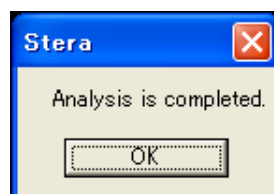
- ① Click  to be actual size.
- ② Drag the right mouse on the image to rotate the building.
- ③ Drag the left mouse on the image to enlarge and reduce.

EARTHQUAKE RESPONSE

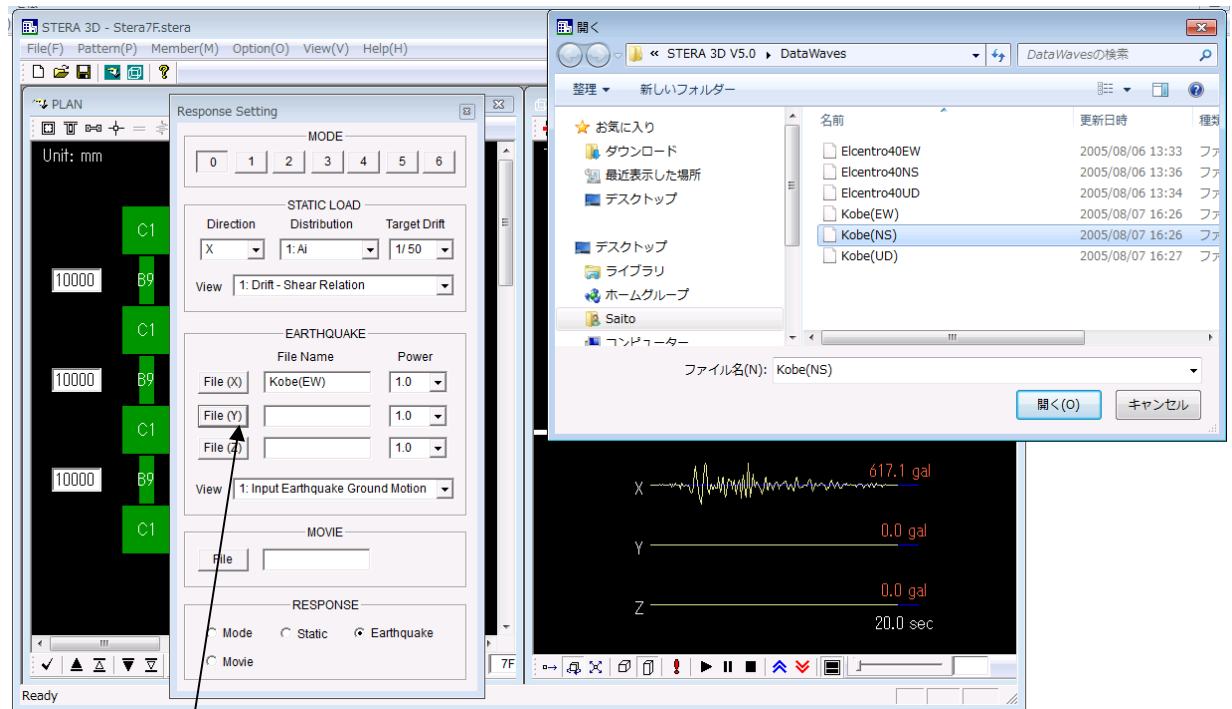


① Click  to analyze the building.

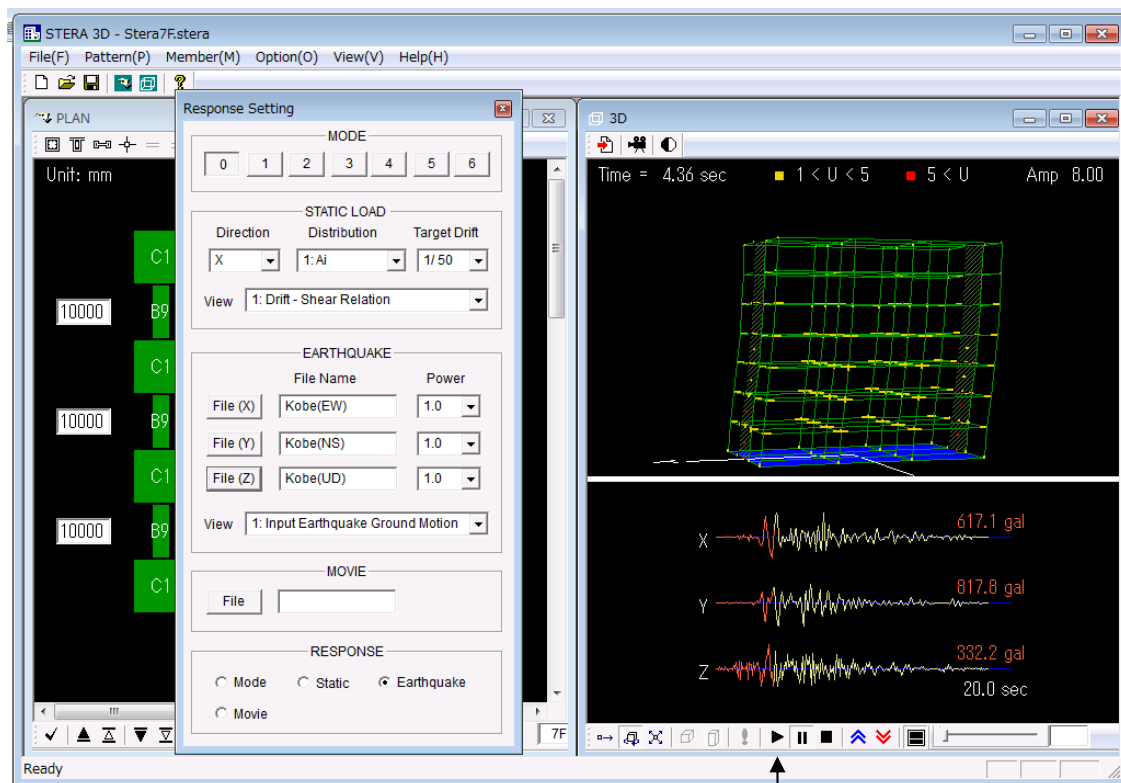
② After the message,



“Response Setting Dialog” will appear.



- ③  : Select X-direction earthquake data file.
For example, “Kobe(EW)”.
- ④  : Select Y-direction earthquake data file.
For example, “Kobe(NS)”.
- ⑤  : 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.

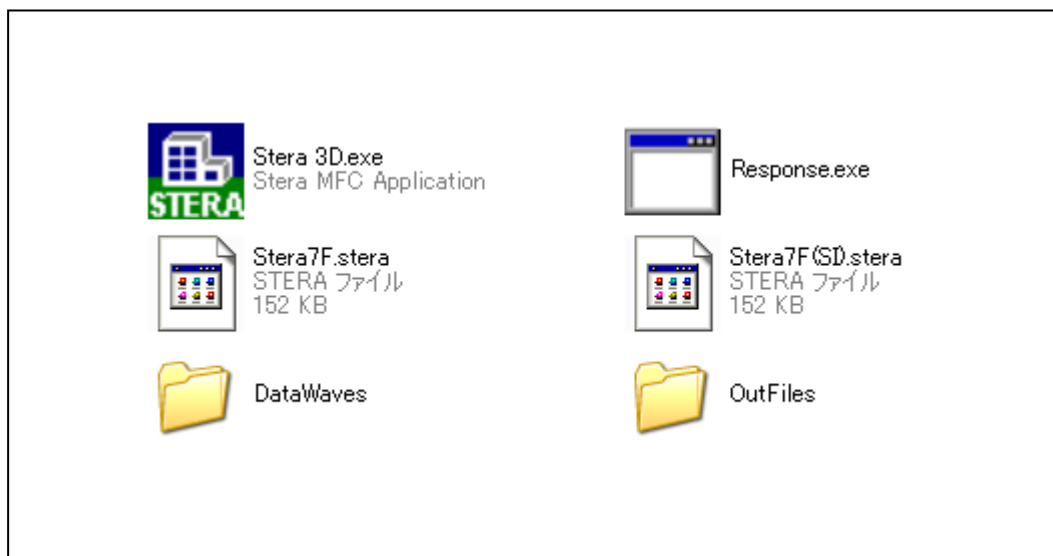
Other assumptions and details are written in “Technical Manual”.

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.



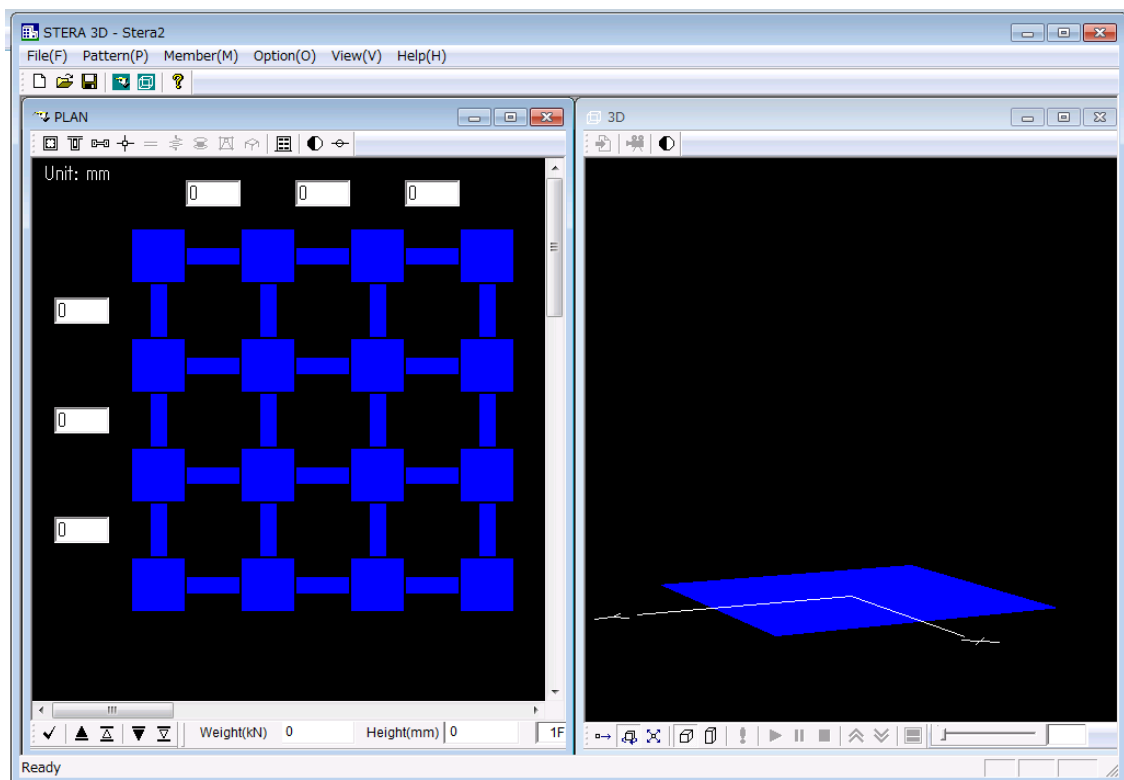
2. Initial View

Please double click “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..

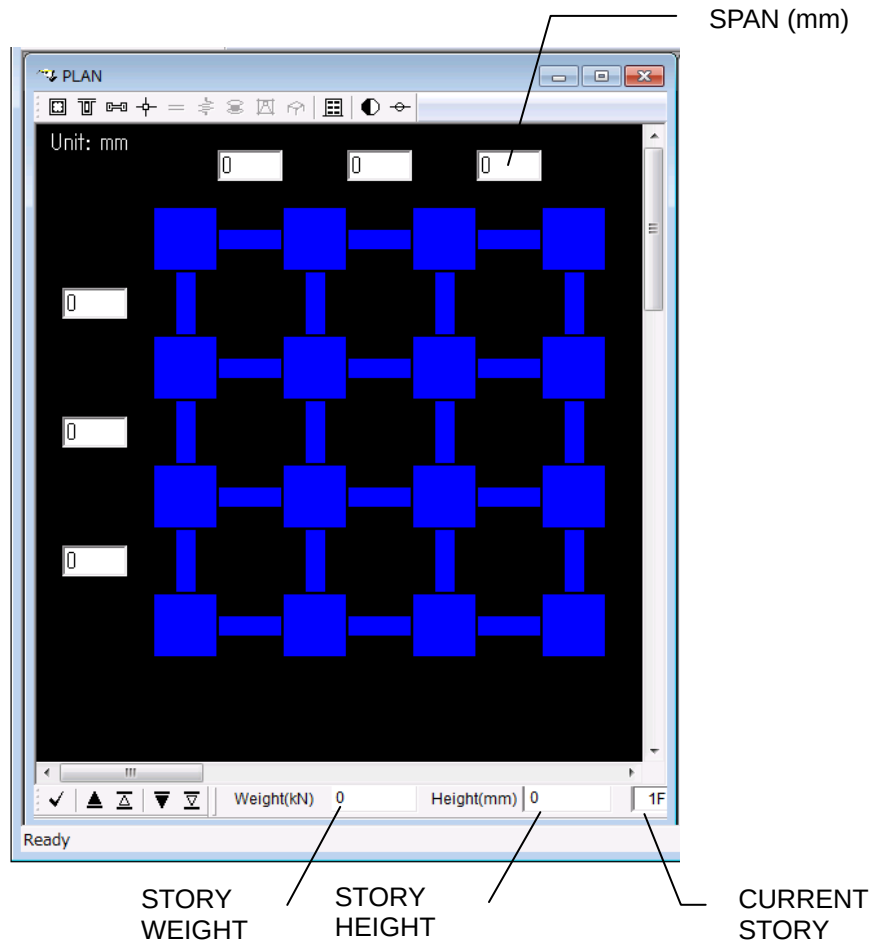
To open the building data already saved, [File]→ [Open], and select the file.



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:

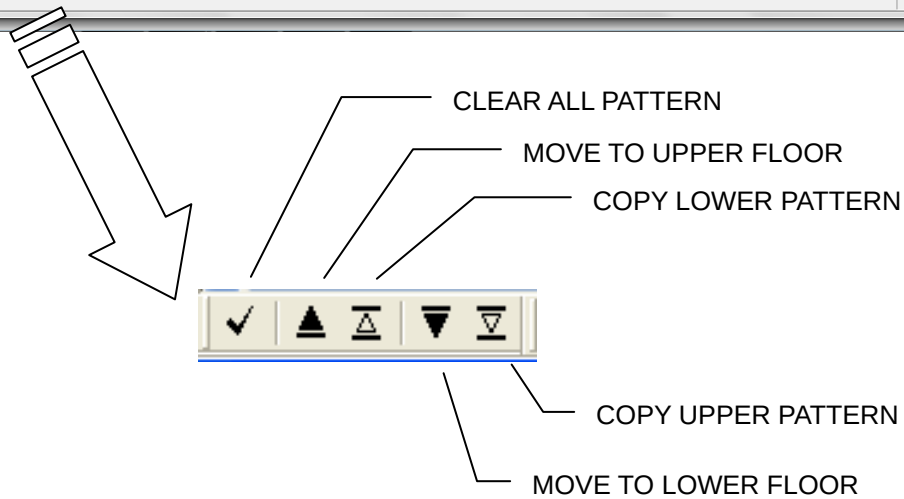
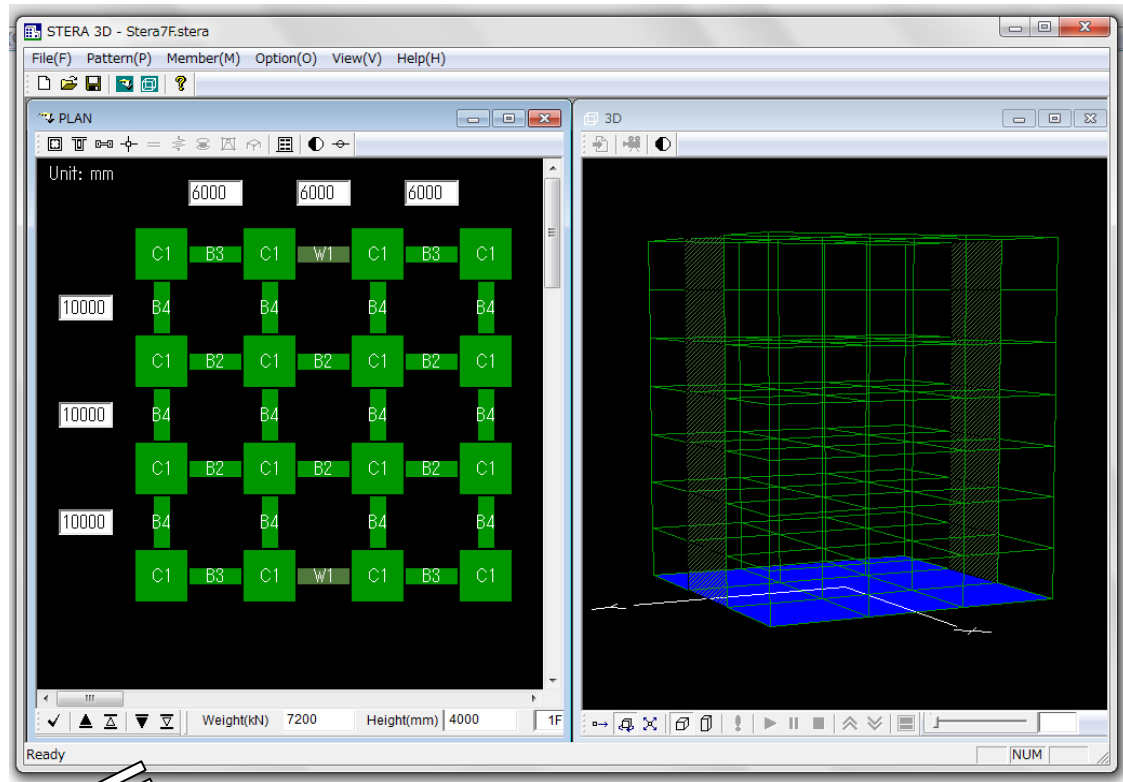
- ✧ Base Spring (brown) -- > Empty -- > Base Spring (brown)

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.

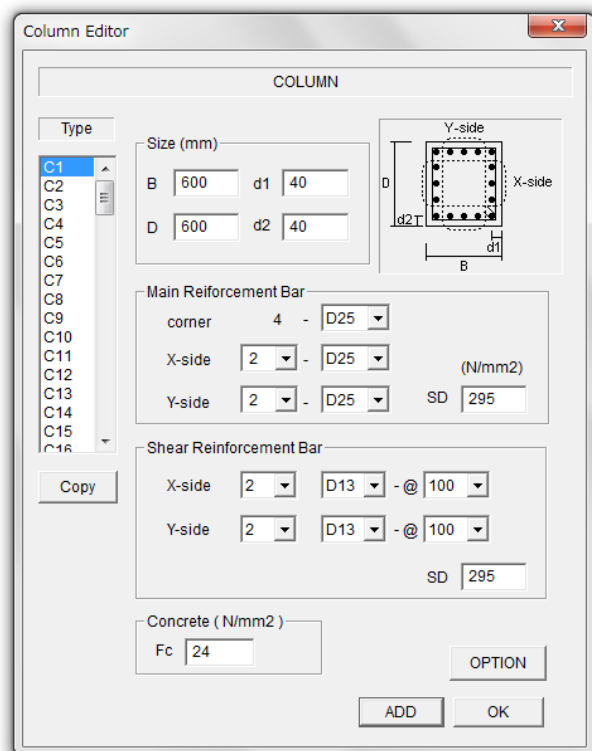
- To move to another floor and copy or clear the member patterns, you can use the following buttons arranged at the bottom of the PLAN EDIT VIEW:



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



4-1. Input Element Information

COLUMN ()


Column Editor

COLUMN

Type: C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16

Size (mm): B 600, d1 40, D 600, d2 40

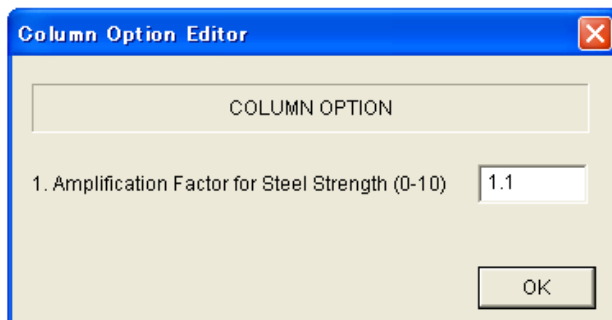
Main Reinforcement Bar: corner 4 - D25, X-side 2 - D25, Y-side 2 - D25, SD 295 (N/mm2)

Shear Reinforcement Bar: X-side 2 - D13 - @ 100, Y-side 2 - D13 - @ 100, SD 295

Concrete (N/mm2): Fc 24

Buttons: Copy, ADD, OK, OPTION

- 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.



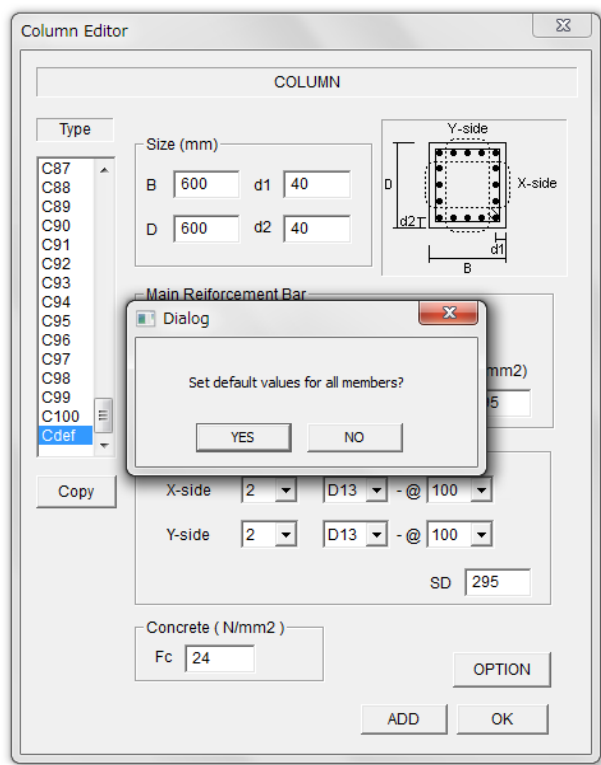
Column Option Editor

COLUMN OPTION

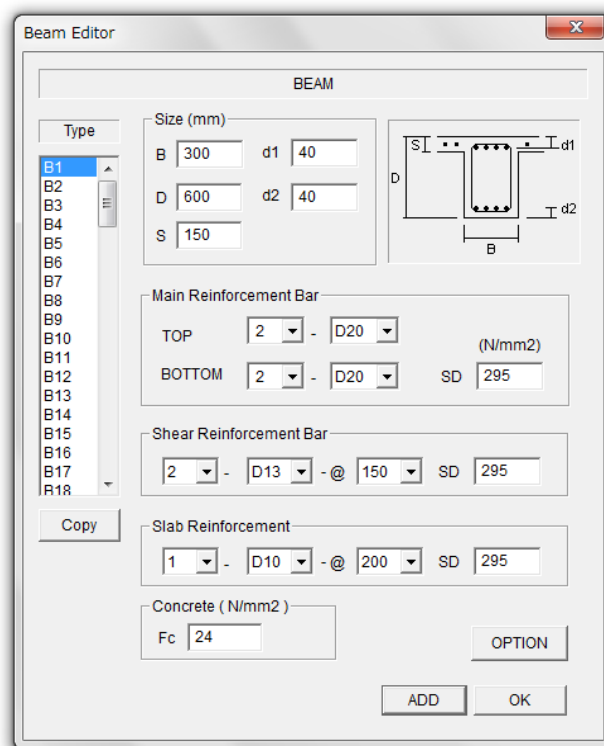
1. Amplification Factor for Steel Strength (0-10) 1.1

Button: OK

- 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 ()


Beam Editor

BEAM

Type: B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17, B18

Size (mm): B 300, d1 40, D 600, d2 40, S 150

Main Reinforcement Bar: TOP 2 - D20 (N/mm2), BOTTOM 2 - D20, SD 295

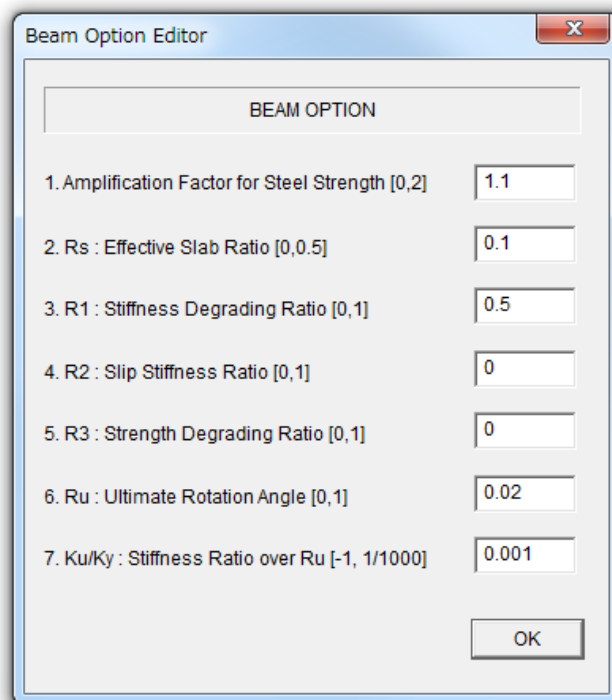
Shear Reinforcement Bar: 2 - D13 - @ 150, SD 295

Slab Reinforcement: 1 - D10 - @ 200, SD 295

Concrete (N/mm2): Fc 24

OPTION, ADD, OK

- 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.



Beam Option Editor

BEAM OPTION

1. Amplification Factor for Steel Strength [0,2] 1.1

2. Rs : Effective Slab Ratio [0,0.5] 0.1

3. R1 : Stiffness Degrading Ratio [0,1] 0.5

4. R2 : Slip Stiffness Ratio [0,1] 0

5. R3 : Strength Degrading Ratio [0,1] 0

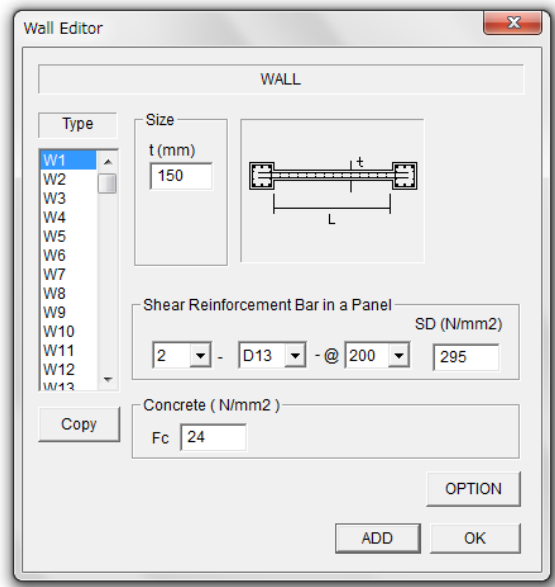
6. Ru : Ultimate Rotation Angle [0,1] 0.02

7. Ku/Ky : Stiffness Ratio over Ru [-1, 1/1000] 0.001

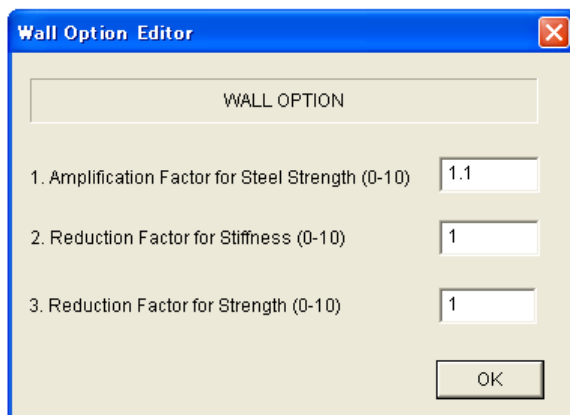
OK

- The default steel strength used for the analysis is assumed to be 1.1 times larger than the nominal strength.
 - The effective slab width to contribute flexural behavior of beam is assumed to be 0.1 times beam length.
- The parameters to control the shape of hysteresis model are defined 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 0.001 (could be negative)

WALL

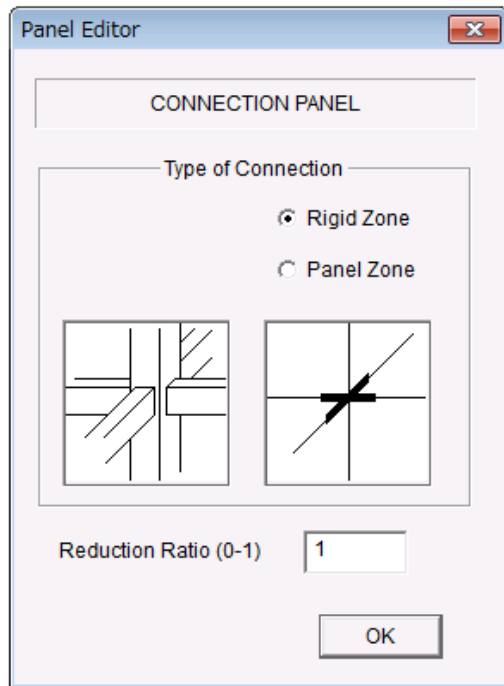


- Please input the section size.
- For the number of reinforcement bars and their size, please select the values from the popup windows.
- For the material strength, SD and Fc, you can input values by changing the default values.
- To move to the next element type, please click [ADD] button.
- You can 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.

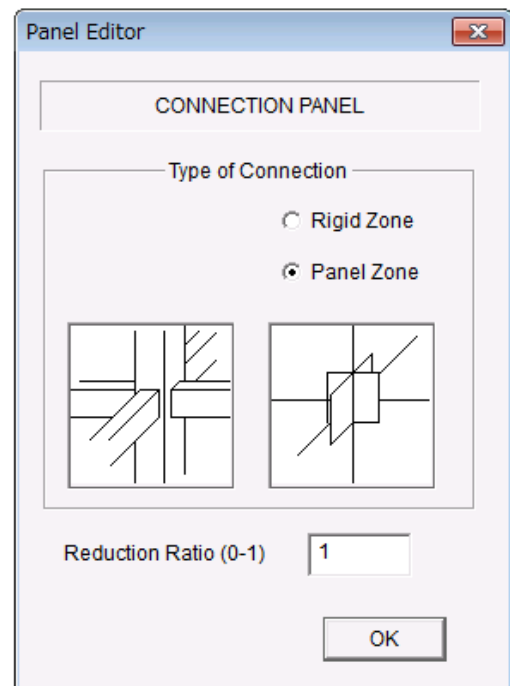


- The default steel strength used for the analysis is assumed to be 1.1 times larger than the nominal strength. You can change the ratio in [OPTION] menu.
- If there is an opening in wall element, you can reduce the stiffness and shear strength by multiplying reduction factors in [OPTION] menu. The default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

CONNECTION PANEL ()



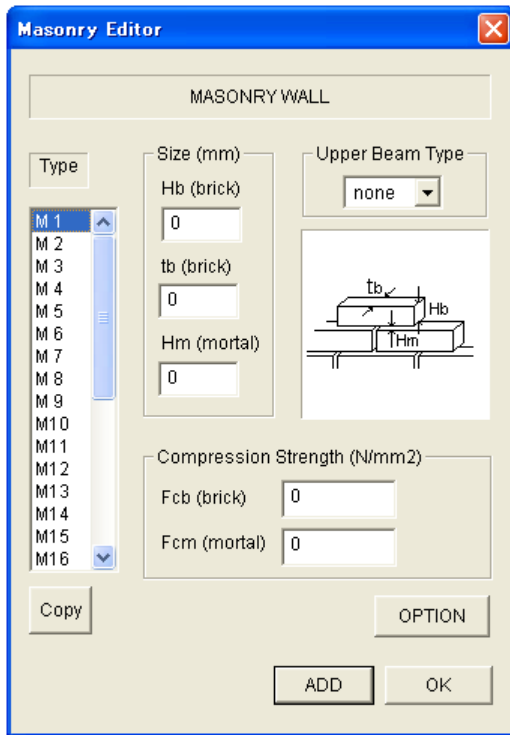
Rigid Zone



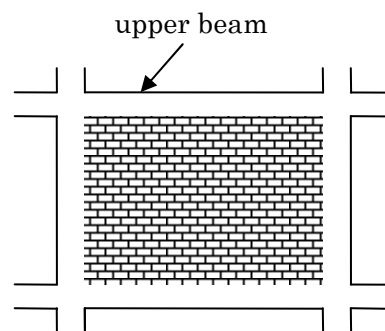
Panel Zone

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).

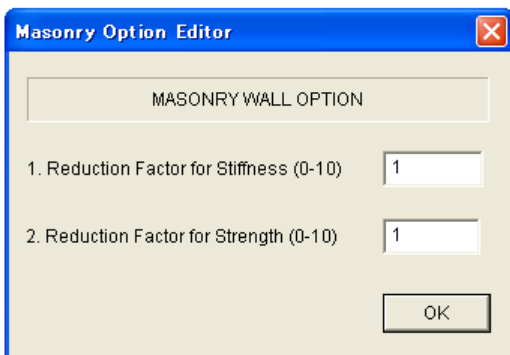
NONSTRUCTURE (=) (NOTE: only available when you select in Option menu)



- 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.

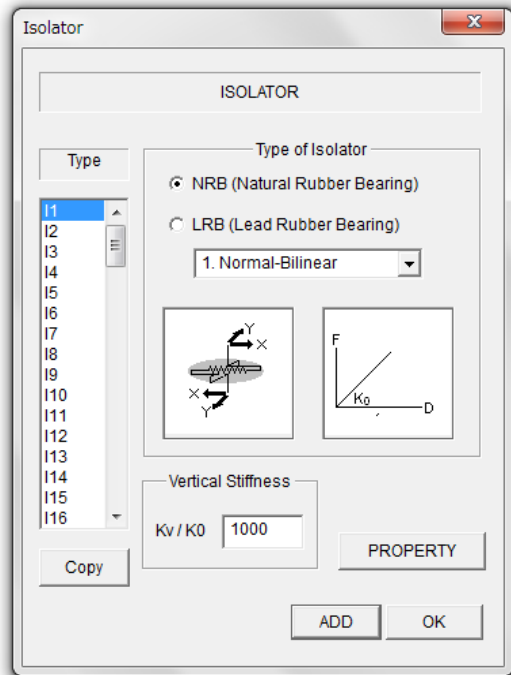


- You can set default values for all members by selecting the last member type "Mdef".
- If there is an opening in wall element, you can reduce the stiffness and shear strength by multiplying reduction factors in [OPTION] menu. The default values are 1.0

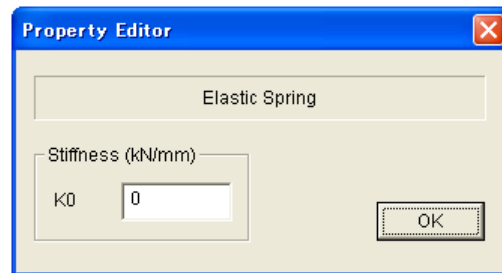


ISOLATOR () (NOTE: only available when you select in Option menu)

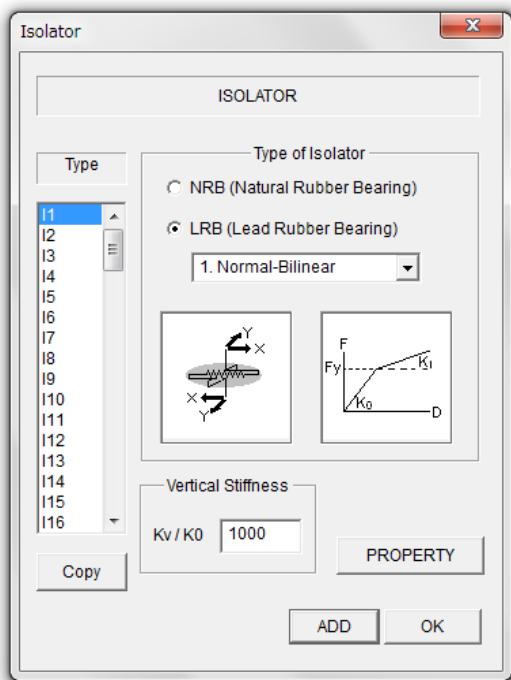
for NRB Isolator



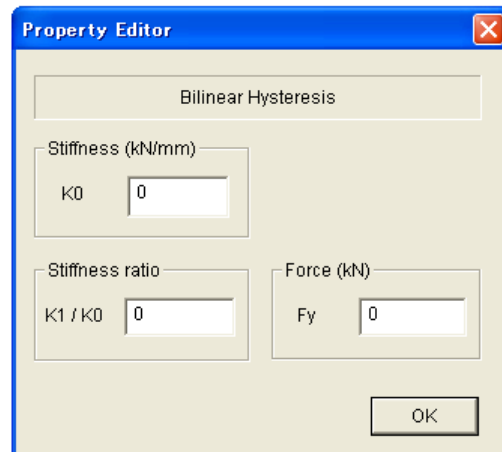
- You can select NRB (Natural Rubber Bearing) or LRB (Lead Rubber Bearing) for Isolator element.
- You can input the properties of isolator by [PROPERTY] view.
- The default value of the ratio between vertical stiffness, K_v , and the horizontal stiffness, K_0 , is 1000.
- You can set default values for all members by selecting the last member type "Idef".



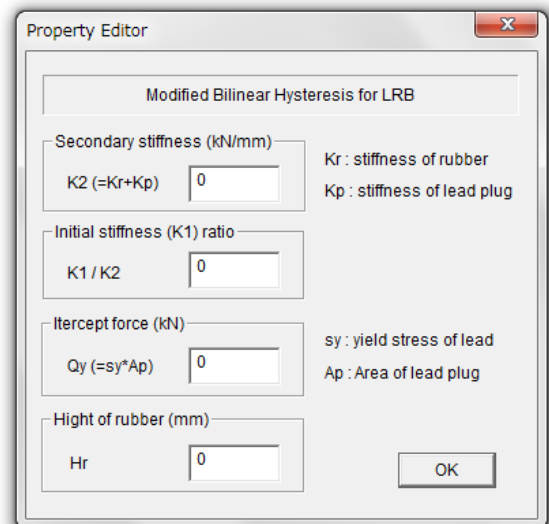
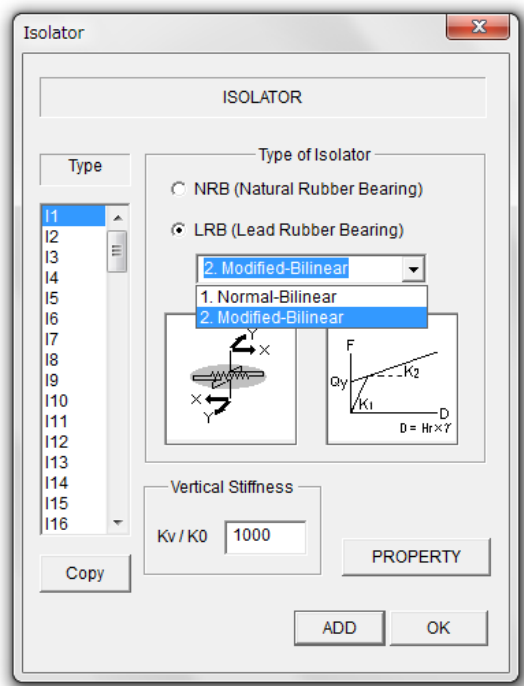
for LRB Isolator



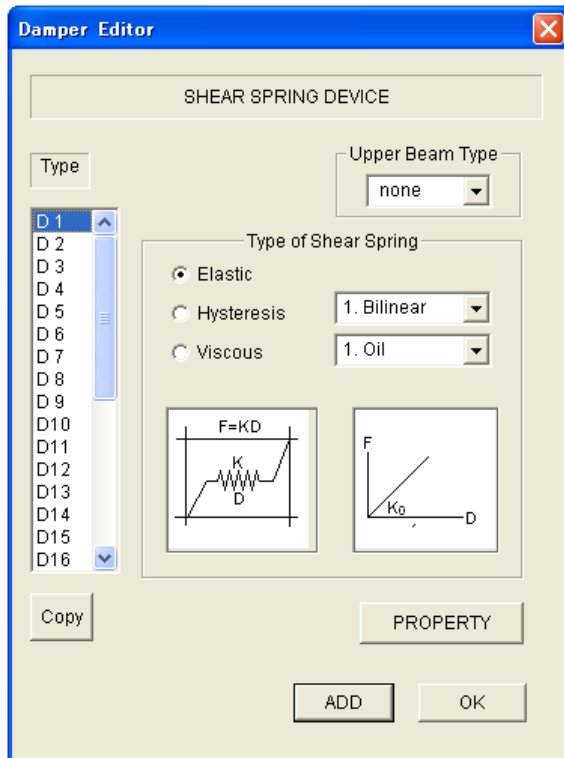
- For LRB, there are two types of hysteresis model; one is Normal Bilinear model and another one is Modified Bilinear model.



- Parameters for Modified Bilinear model are determined from material characteristics and the size of LRB. For the detail, please refer to “STERA3D_technical_manual”.

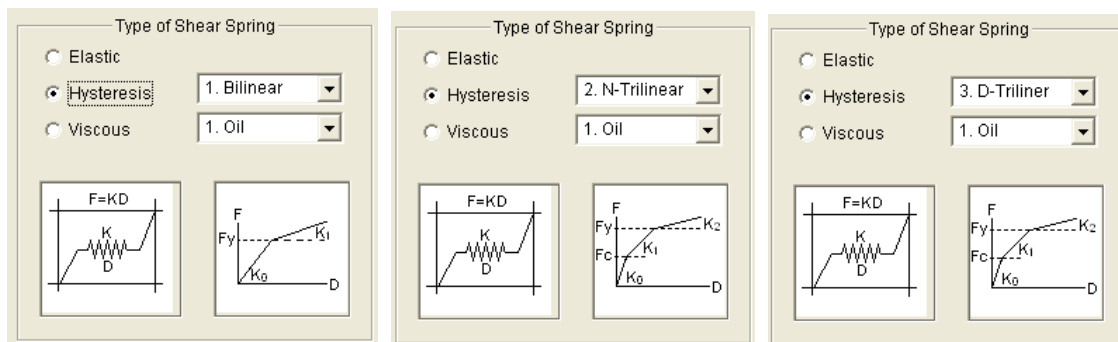


DAMPER DEVICE () (NOTE: only available when you select in Option menu)

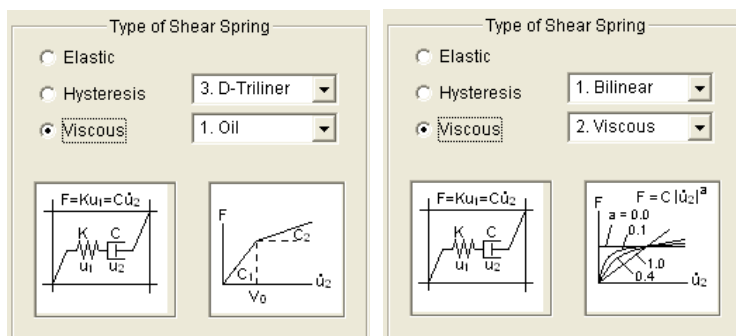


- Please select damper type from Elastic, Hysteresis and Viscous and its detail characteristics from the pull down menu.
- If there is a reinforcement concrete beam upper of Damper, please select the beam type number from the pop-up menu.
- You can set default values for all members by selecting the last member type "Ddef".
- You can input the detail characteristic of the Damper in [PROPERTY] view.

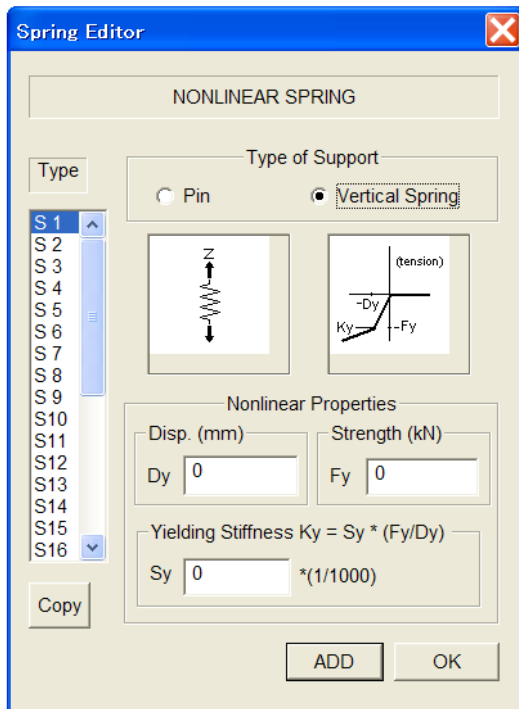
For Hysteresis Damper



For Viscous Damper



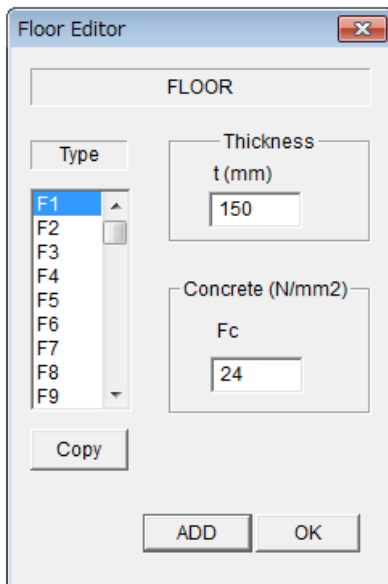
BASE SPRING () (NOTE: only available at the Basement Floor, Default is PIN)



VERTICAL SPRING

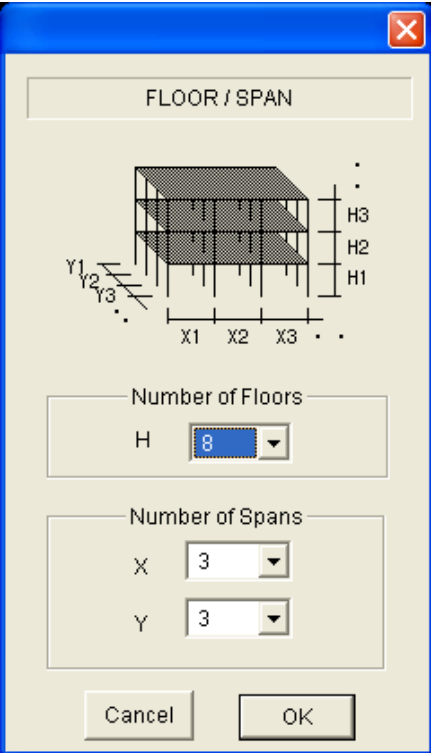
- You can set default values for all members by selecting the last member type "Sdef".

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".

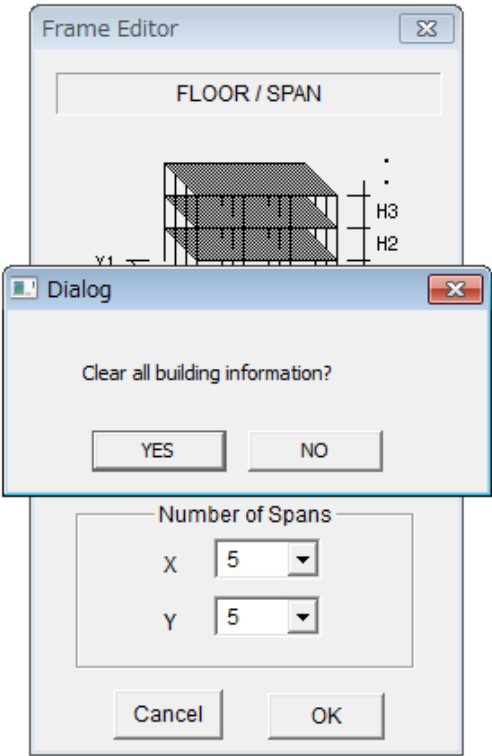
MAX. SIZE OF BUILDING ()



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 Y-direction



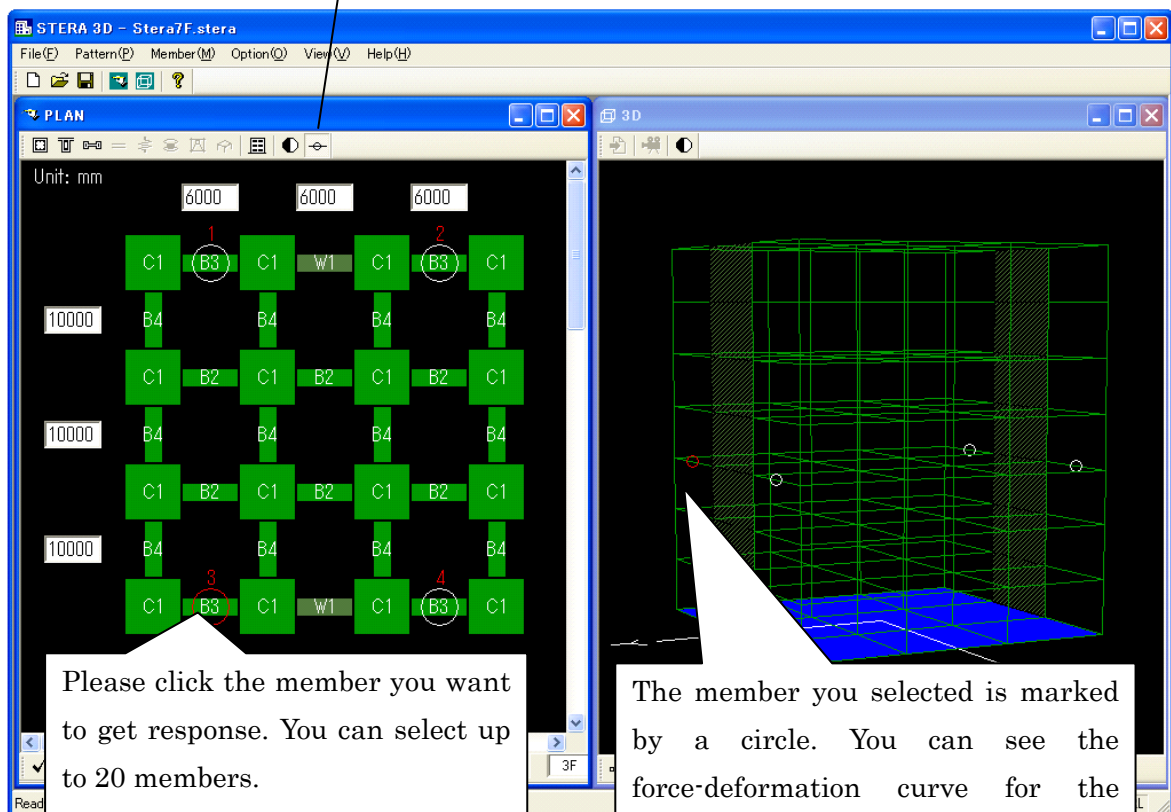
You can clear all building information by answering “YES” or you can keep the same building information after changing floor and span numbers by answering “NO”.

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.

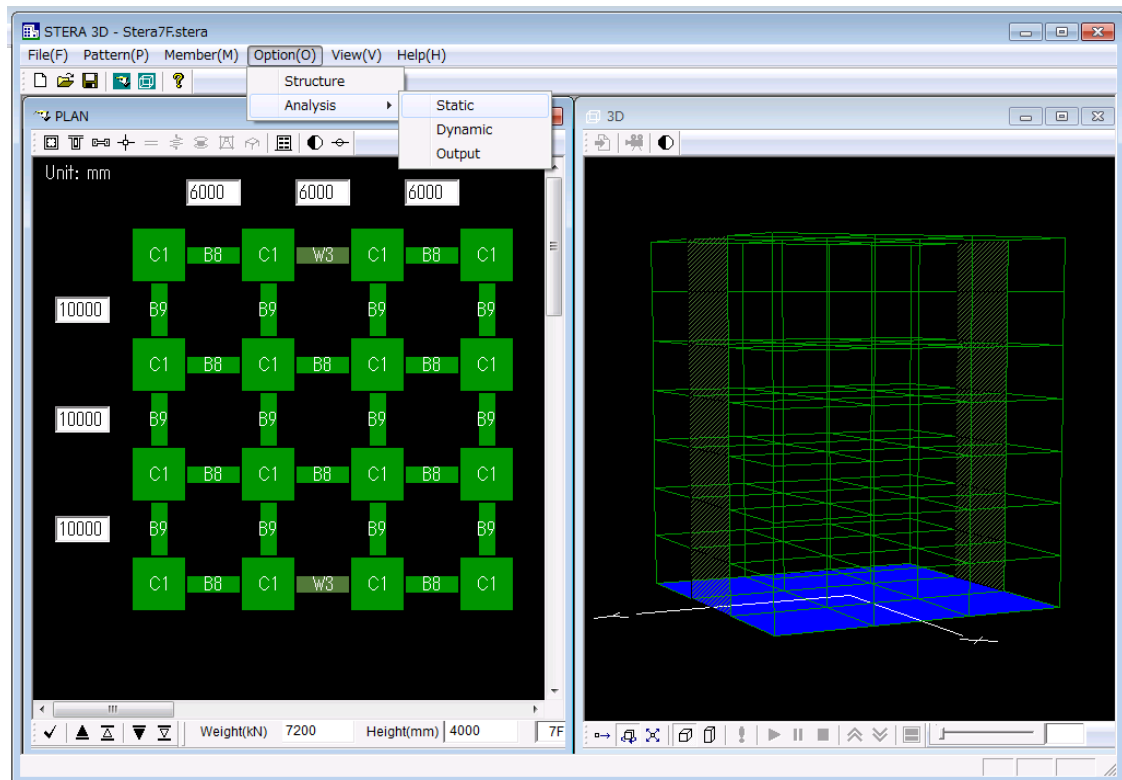
By one more click, the color of the circle will change to be red and its force-deformation curve will be displayed in 3D view.

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] Freedom
 Restrained freedom number
 1(Ux), 2(Uy), 3(Uz) : lateral freedom
 4(Rx), 5(Ry), 6(Rz) : rotation freedom
 7(Gx), 8(Gy) : shear rotation freedom
 Example
 2467 ... X-direction only
 1568 ... Y-direction only
 45678 ... no rotation freedom
 78 ... rigid connection

[2] Floor Assumption
☒ Rigid Floor ☐ Flexible Floor

[3] P-Delta Effect
☒ Not considered ☐ Considered

[4] Nonlinear Shear Spring
☐ Not considered ☒ Considered

[5] Mass Distribution
☒ Same for all nodes
☐ Proportion to occupied area

[6] Passive Damper Element
☒ Not considered ☐ Considered

[7] Isolator
☒ Not considered ☐ Considered

[8] Masonry Wall
☒ Not considered ☐ Considered

[9] Young's Modulus (N/mm2)
 Steel *1000

OK

[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

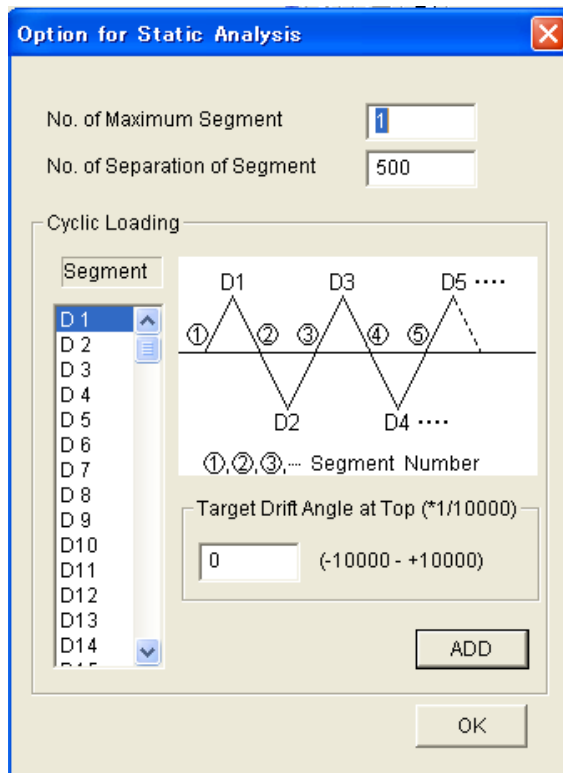
Considered → P-Delta effect is considered in element stiffness matrix of column and wall.

[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

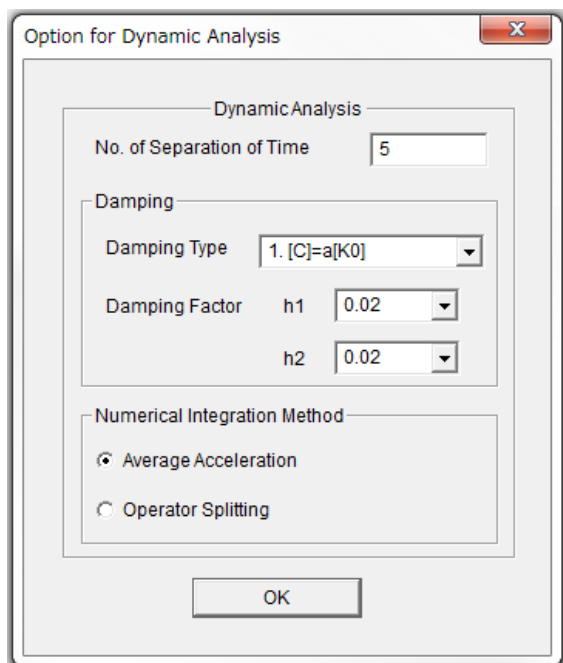
The total number of segments in cyclic loading,

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).

The maximum data size multiplying number of input earthquake and separation number is 60,000.

2. Damping

Three types of damping matrix are available:

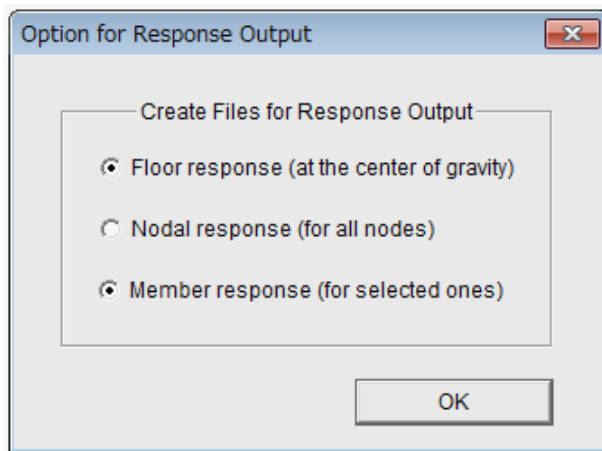
- 1) $[C] = a[K_0]$: proportional to $[K_0]$
- 2) $[C] = a[K_p]$: proportional to $[K_p]$
- 3) $[C] = a[K_0] + b[M]$: Rayleigh damping

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 Operator Splitting 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.

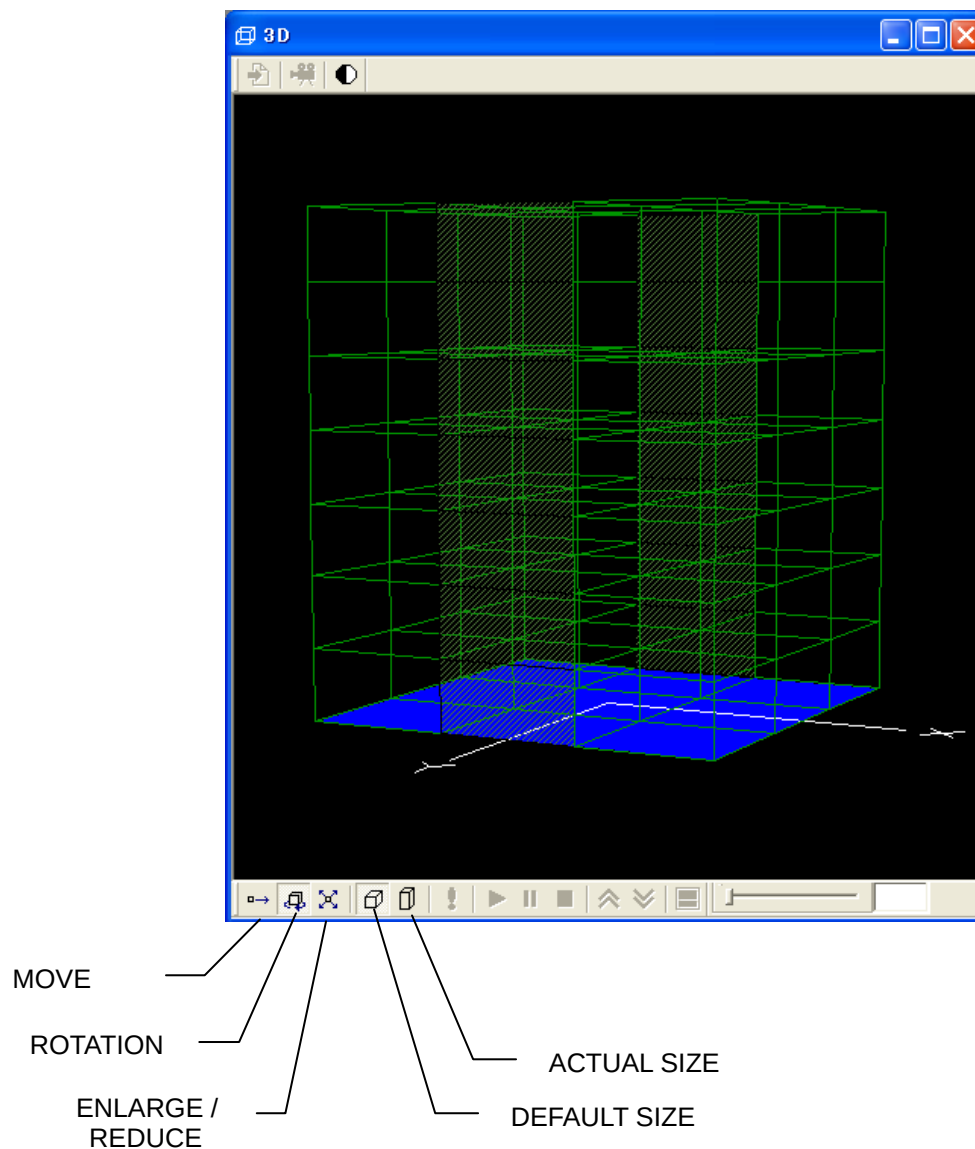
It is marked as a default setting.

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.

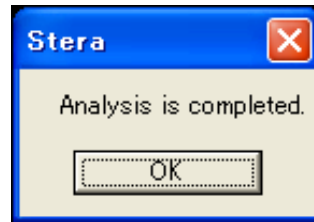
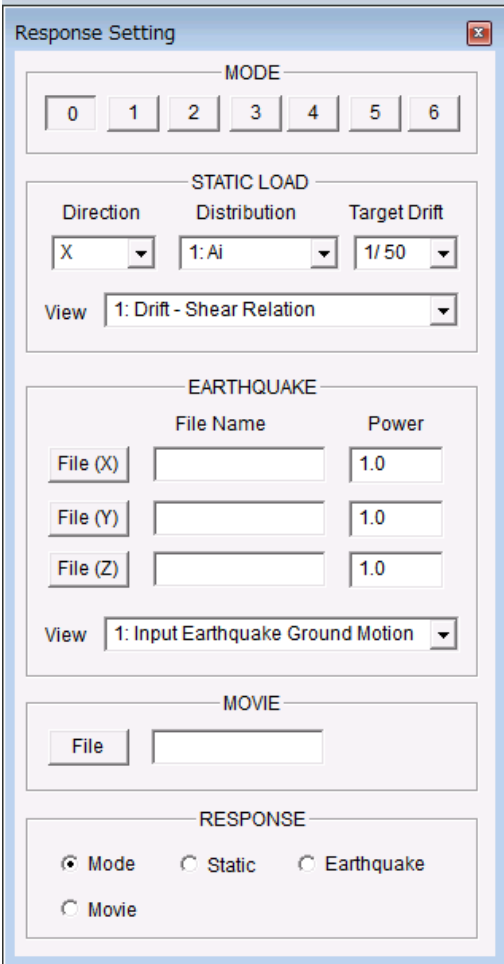
[2] [Actual] () use the actual ratio between span and story height using input data.



[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

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	Power
File (X)	1.0
File (Y)	1.0
File (Z)	1.0

View 1: Input Earthquake Ground Motion

MOVIE

File

RESPONSE

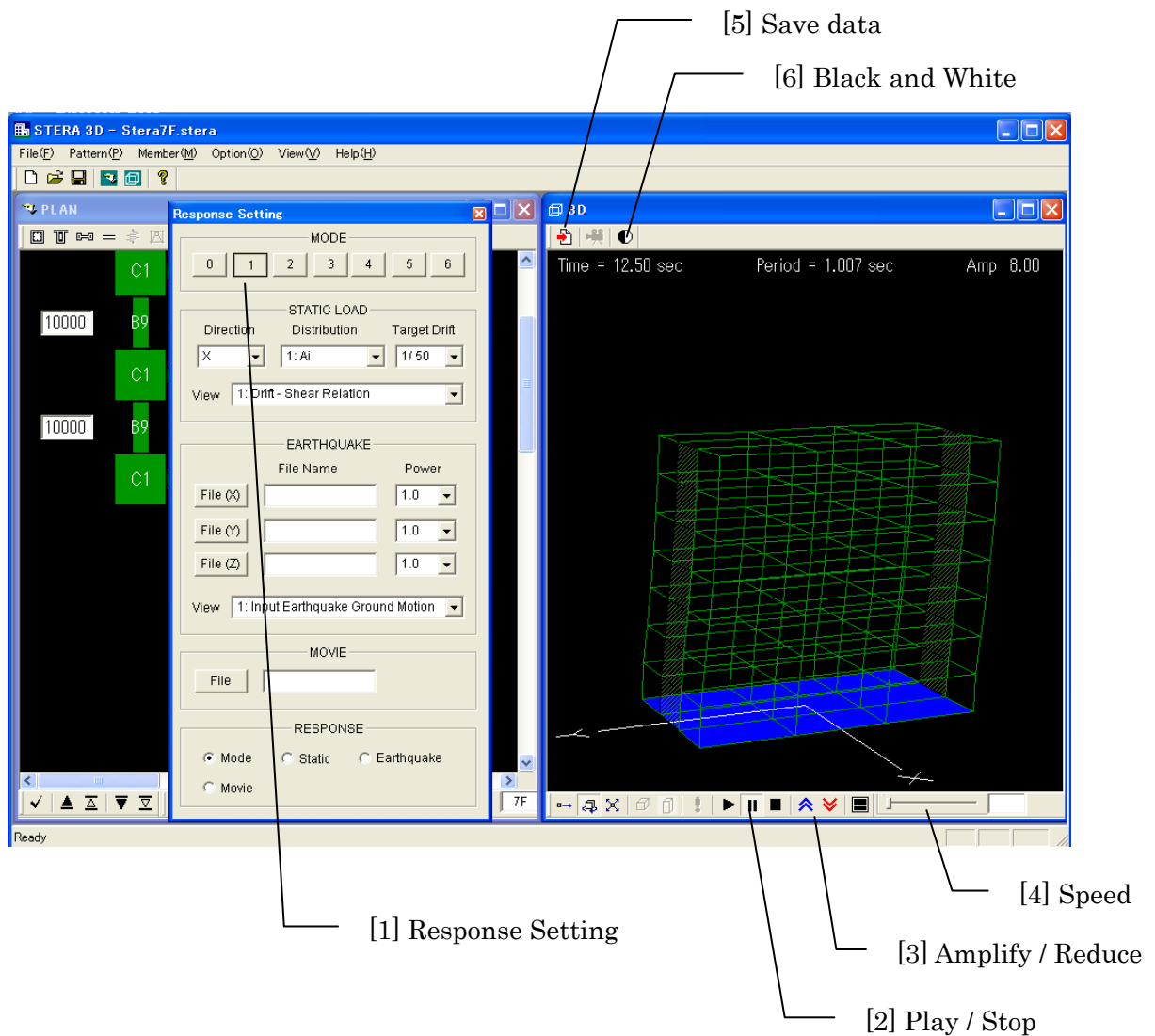
☒ Mode
 ☐ Static
 ☐ Earthquake

☐ Movie

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 (33) 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.

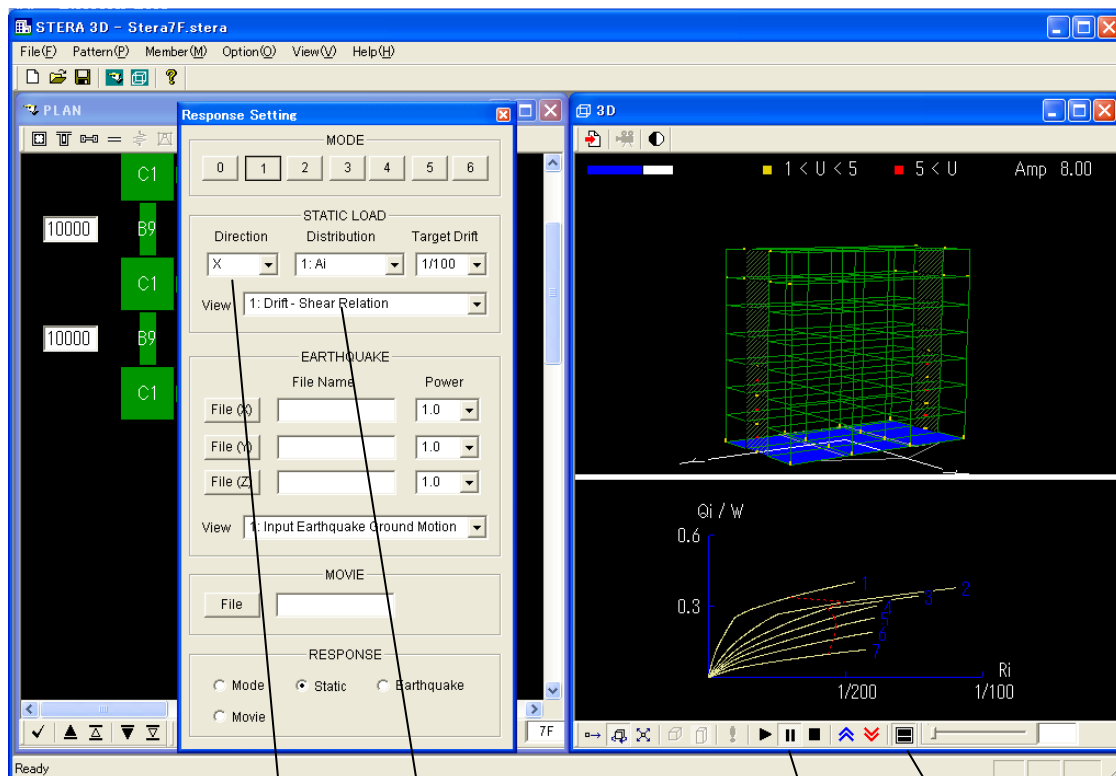
1. 1/50 2. 1/100 3. 1/200 4. Cyclic

[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.

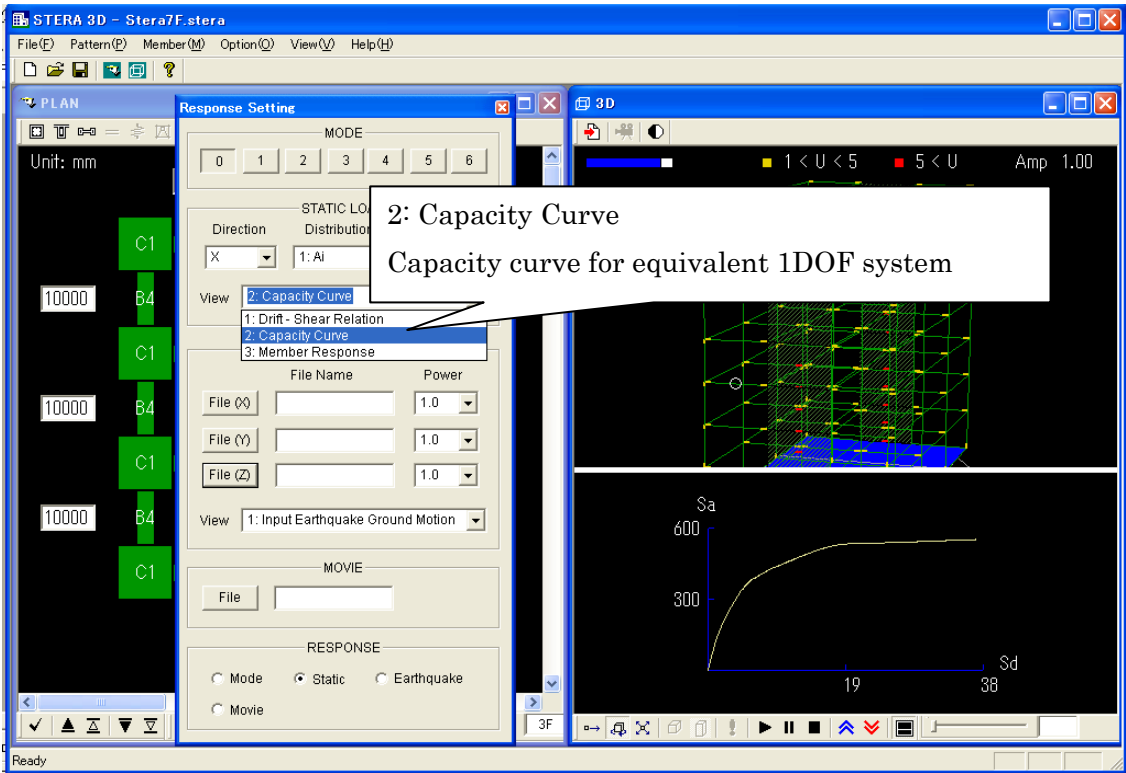
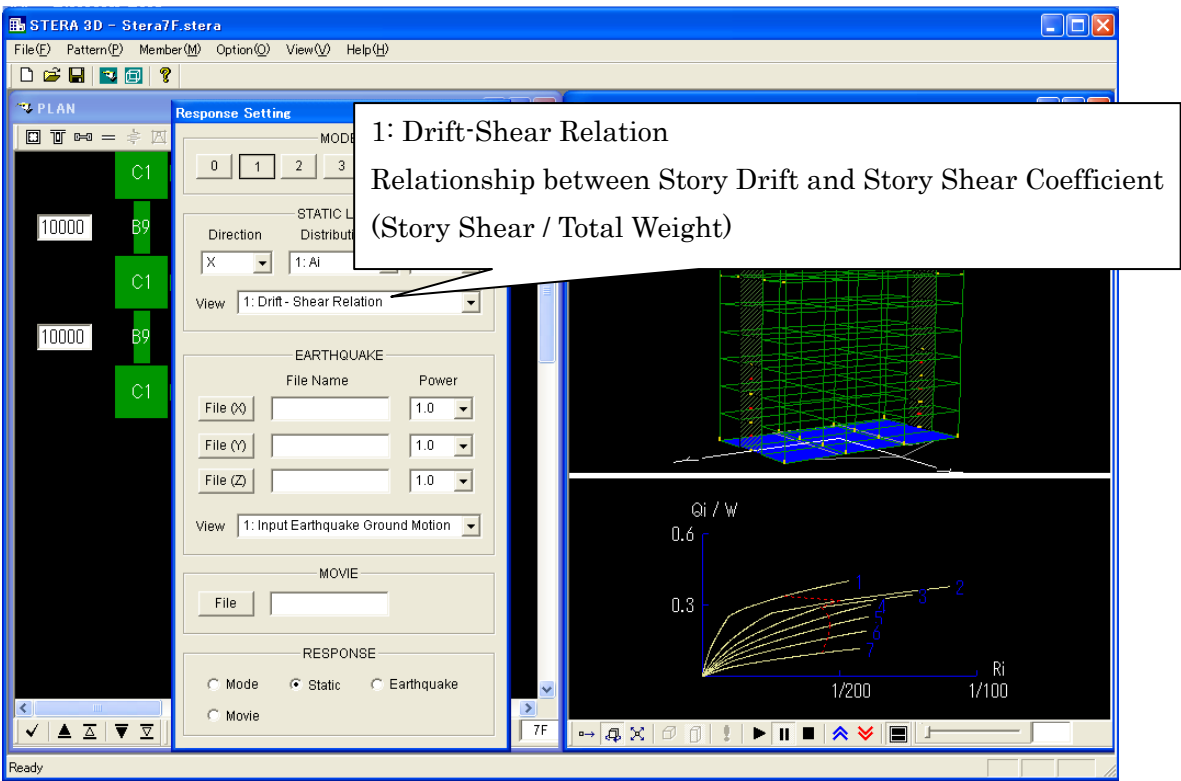


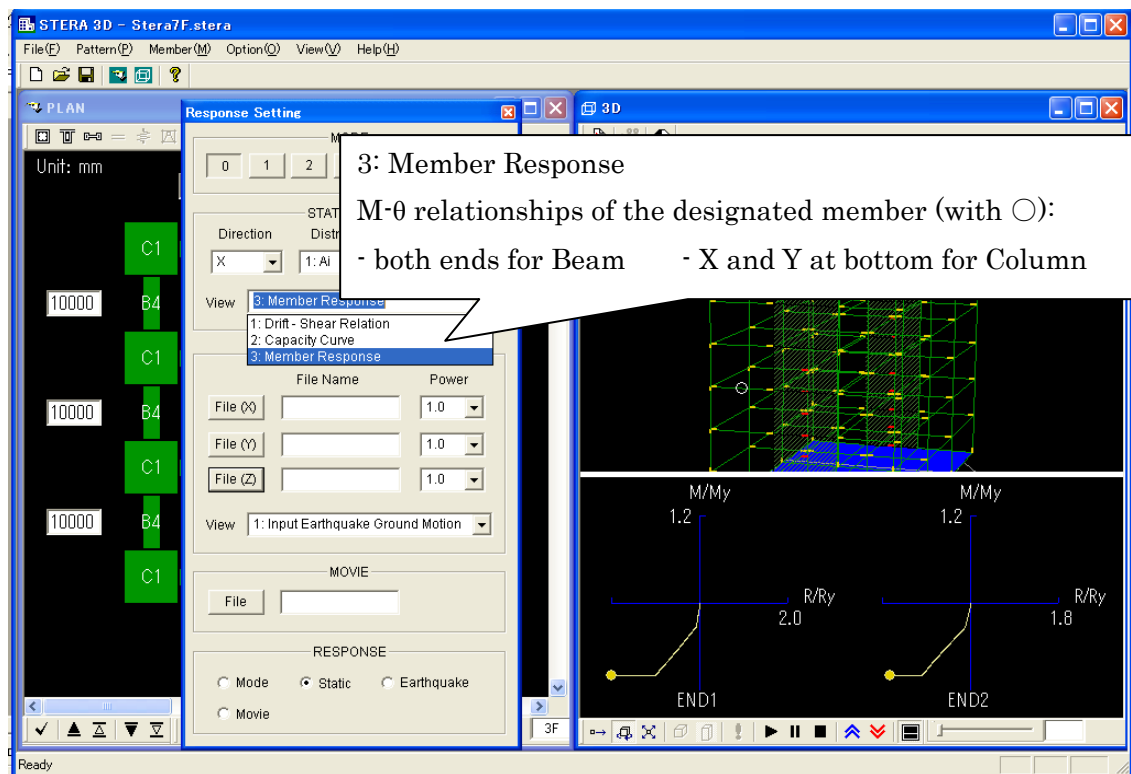
[1]

[2]

[3]

[4]





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

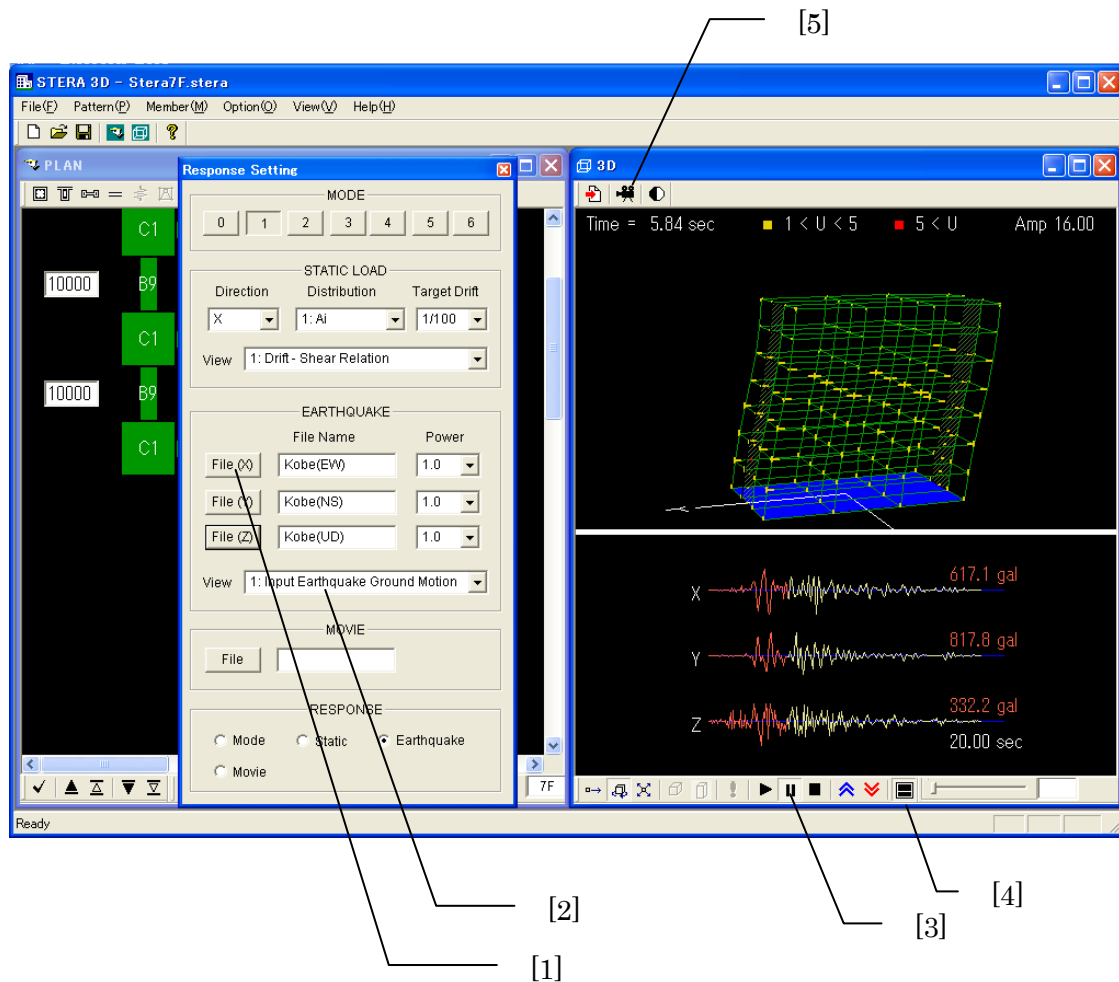
[2] Please select the response for the lower view window.

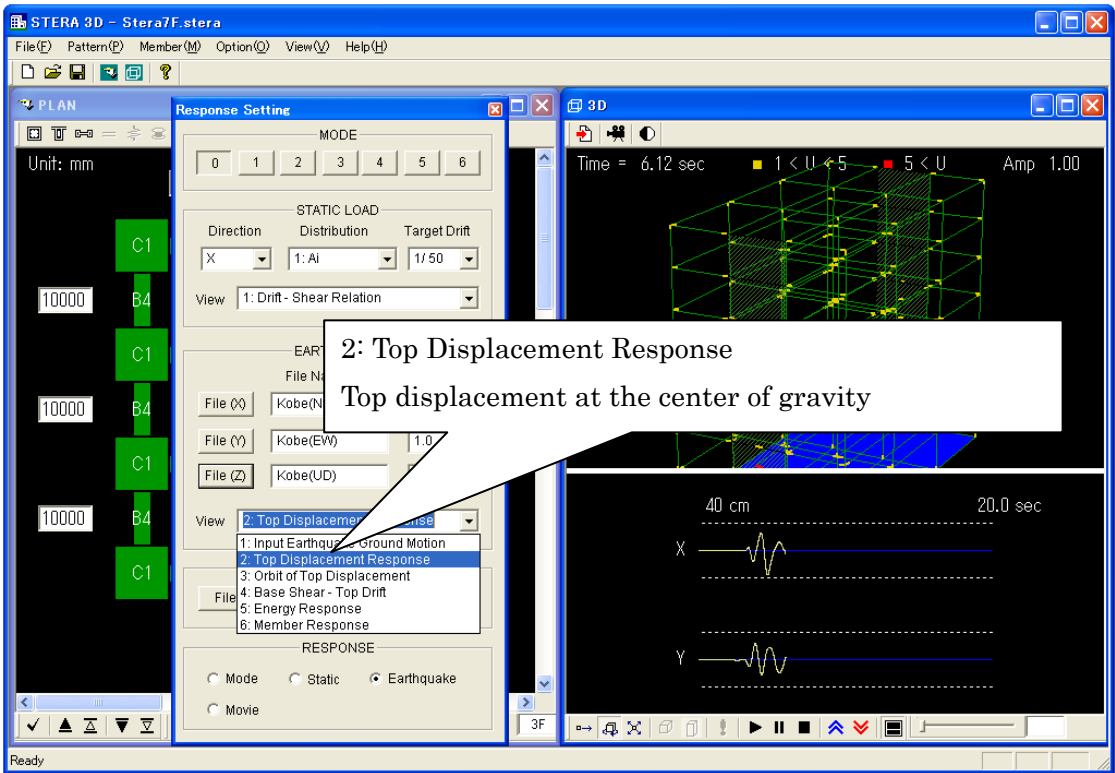
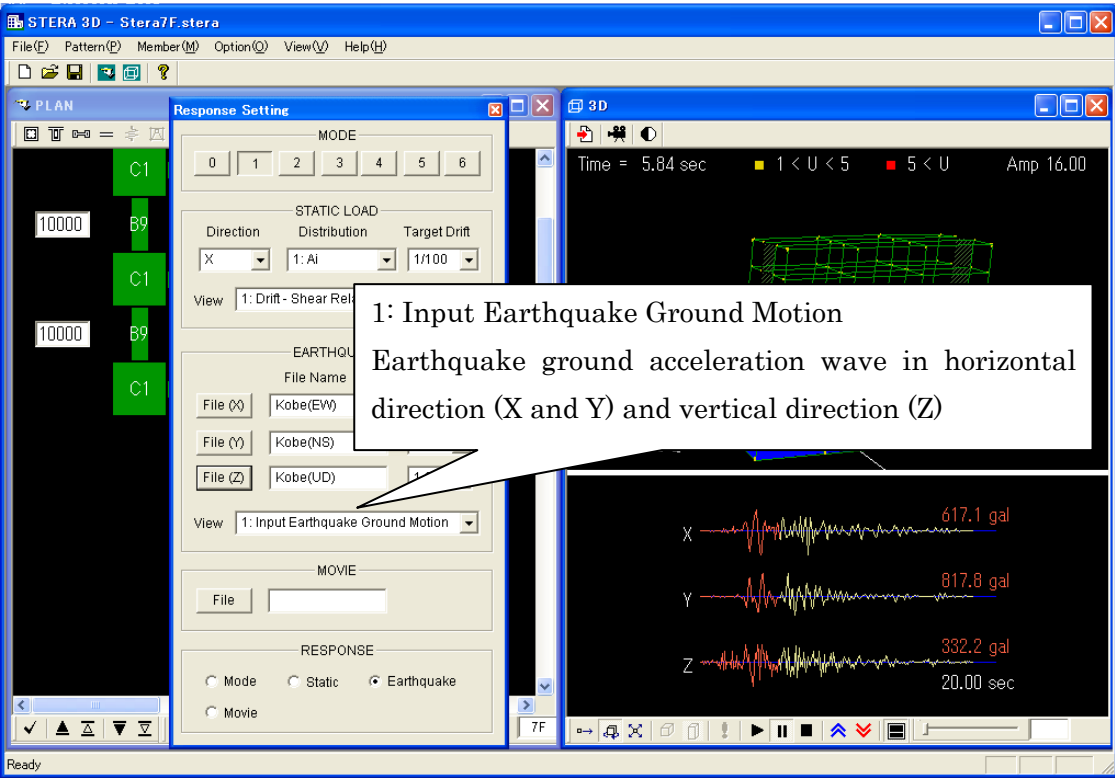
[3] On the 3D VIEW, (▶) starts, (⏸) pauses and (■) stops the response.

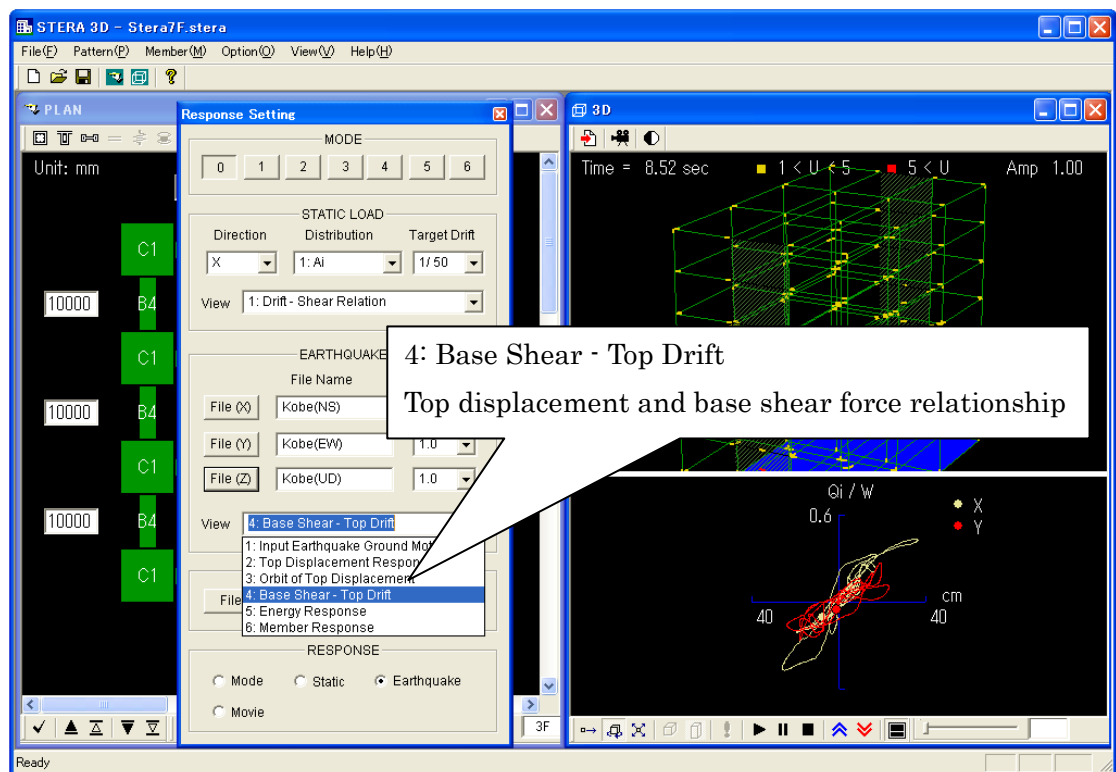
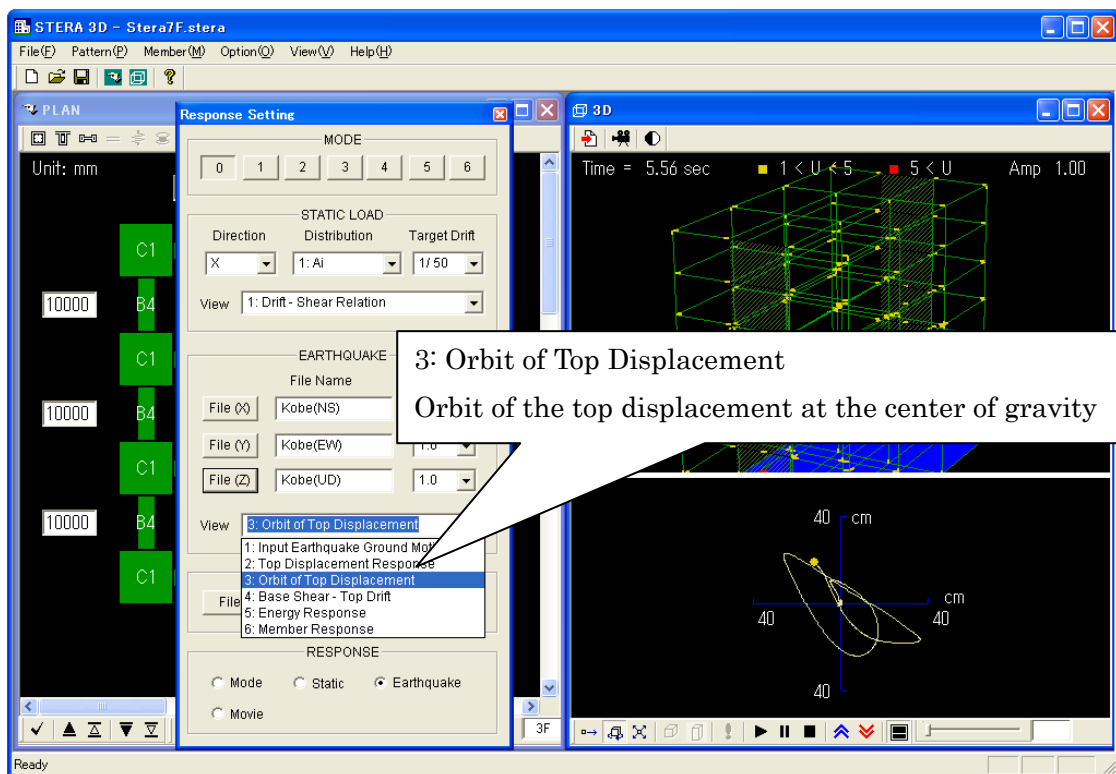
In the lower view, you can see the input earthquake wave and present status.

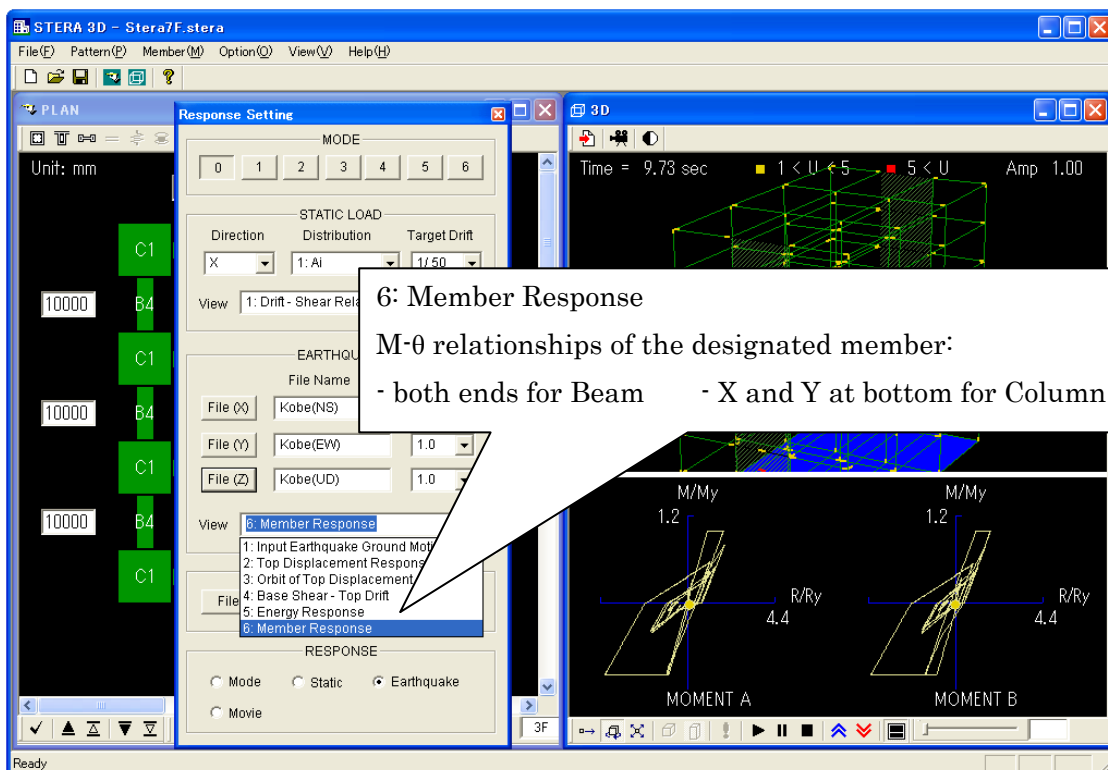
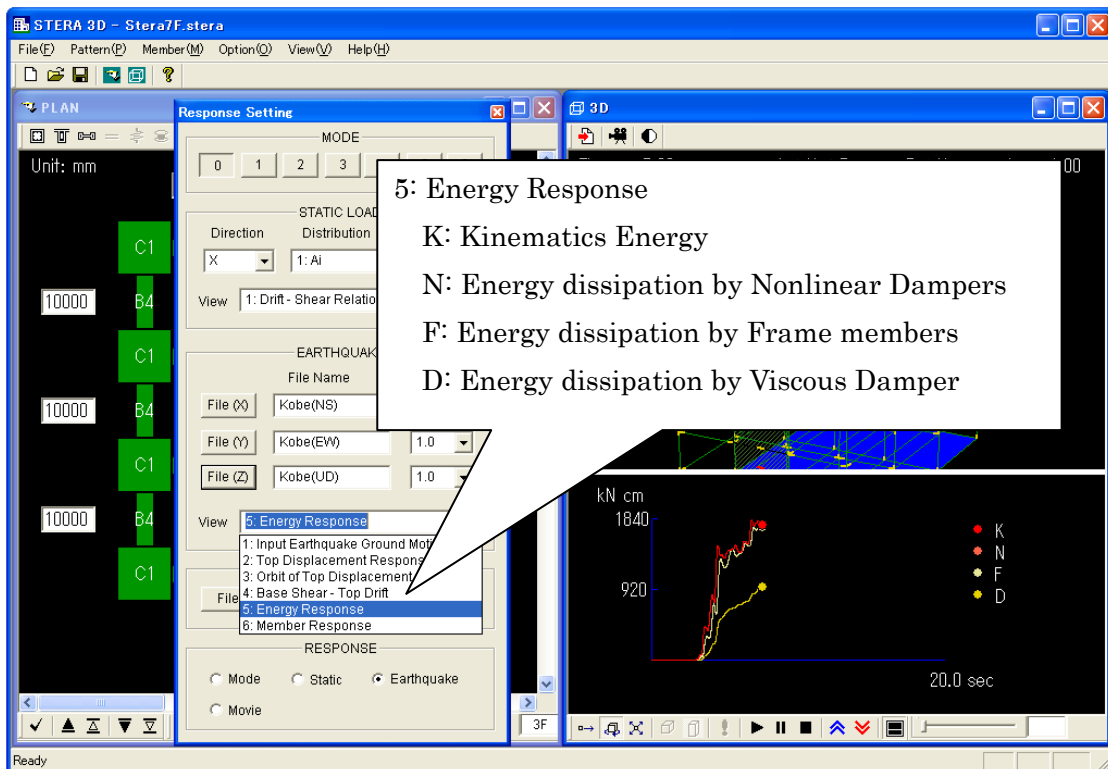
[4] (🖥️) will change the view from 2-screen to 1-screen and vise versa.

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









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
1 st data (ID)	INT	0 or 1	0: Earthquake ground acceleration data only 1: Earthquake ground acceleration data and ground displacement data
2 nd data (NDATA)	INT	Number of data	If ID=1, the number of data for acceleration must be the same as that for displacement.
3 rd data (DT)	REAL	Time interval	(sec)
4 th data and later	REAL	Acceleration	1, 2, ..., NDATA (cm/sec ²)
		Displacement	1, 2, ..., NDATA (cm)

The maximum data size multiplying number of input earthquake (NDATA) and separation number (NDIV) is 60,000. (NDATA * NDIV < 60,000).

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

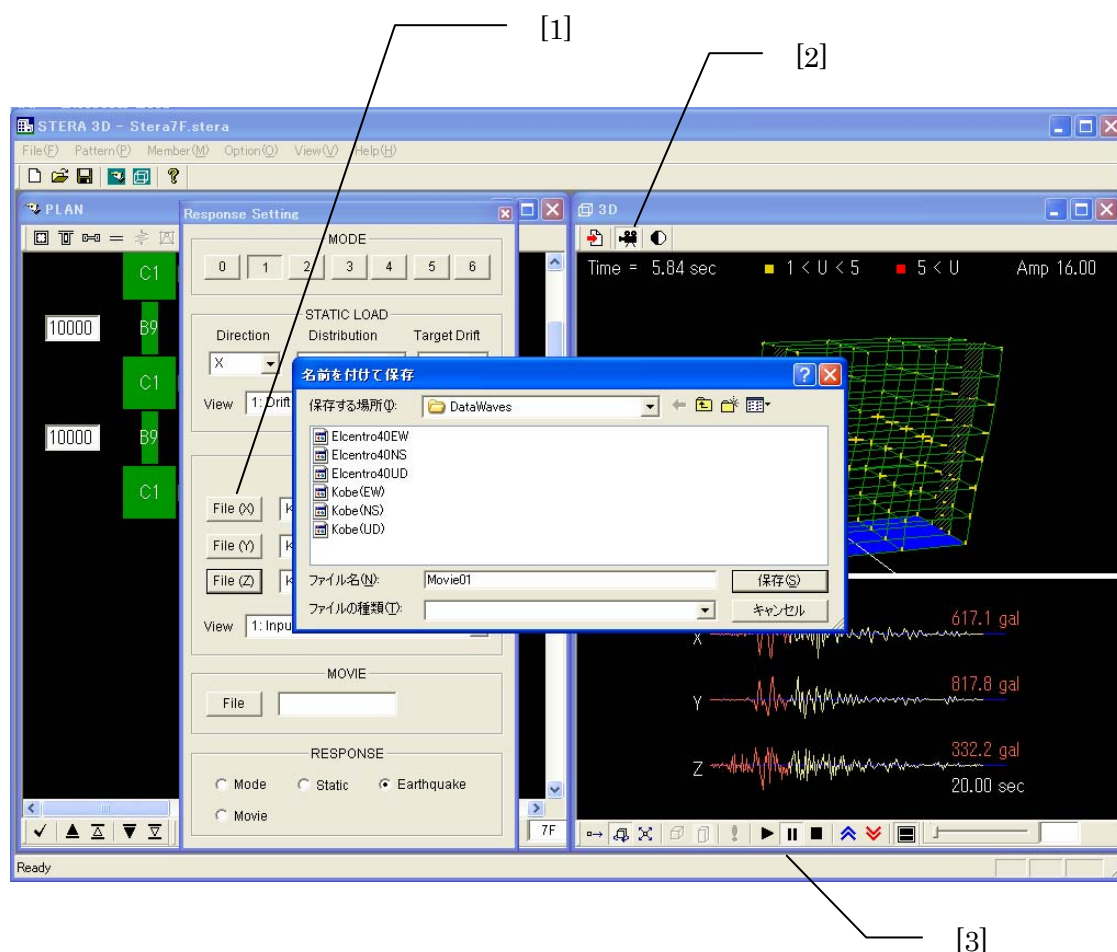
Generally, it takes long time to calculate earthquake response of a building. You can save the response of the building in a movie file and later you can open the movie to see the response quickly.

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”.

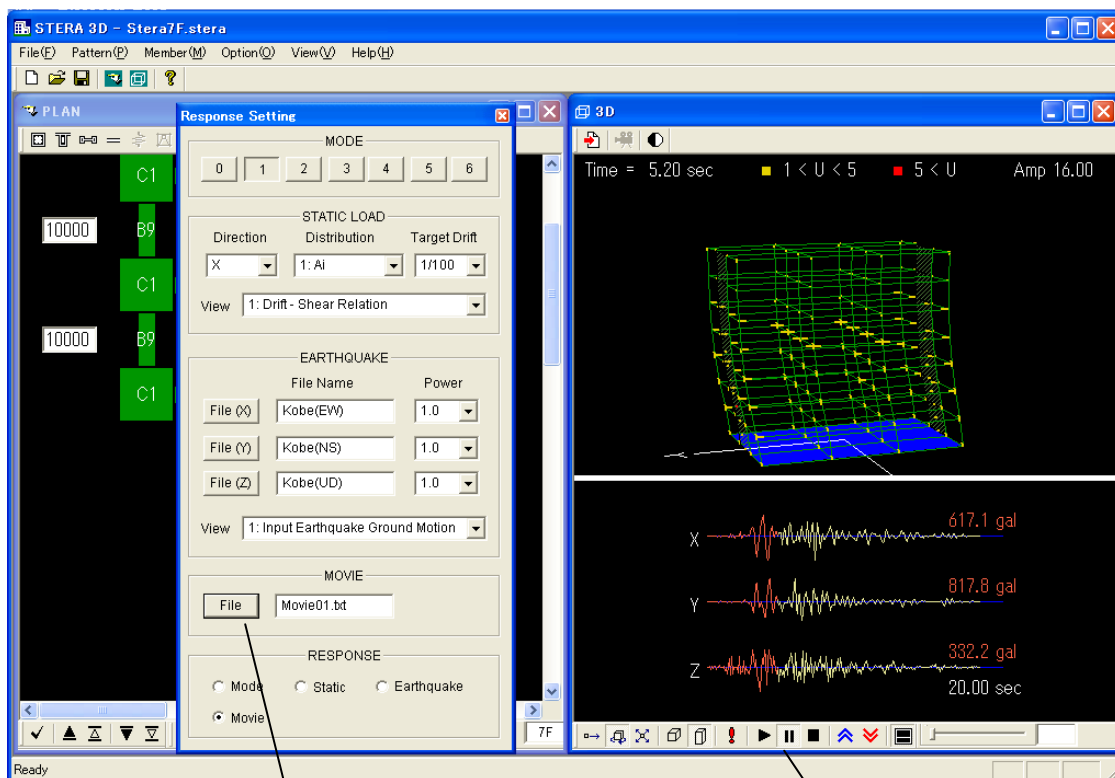
[3] () displays the response. () stops the response.



2) Play movie

[1] On the RESPONSE SETTING DIALOG, please push **File** in the “MOVIE” menu to select a movie file.

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



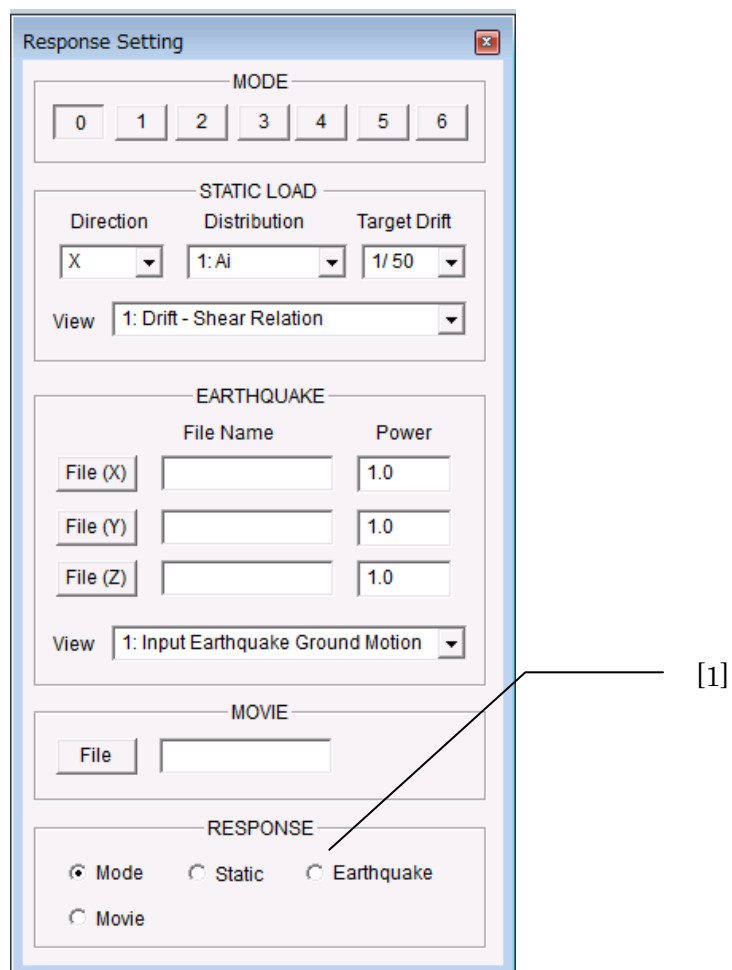
[1]

[2]

5-6. Change Analysis

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

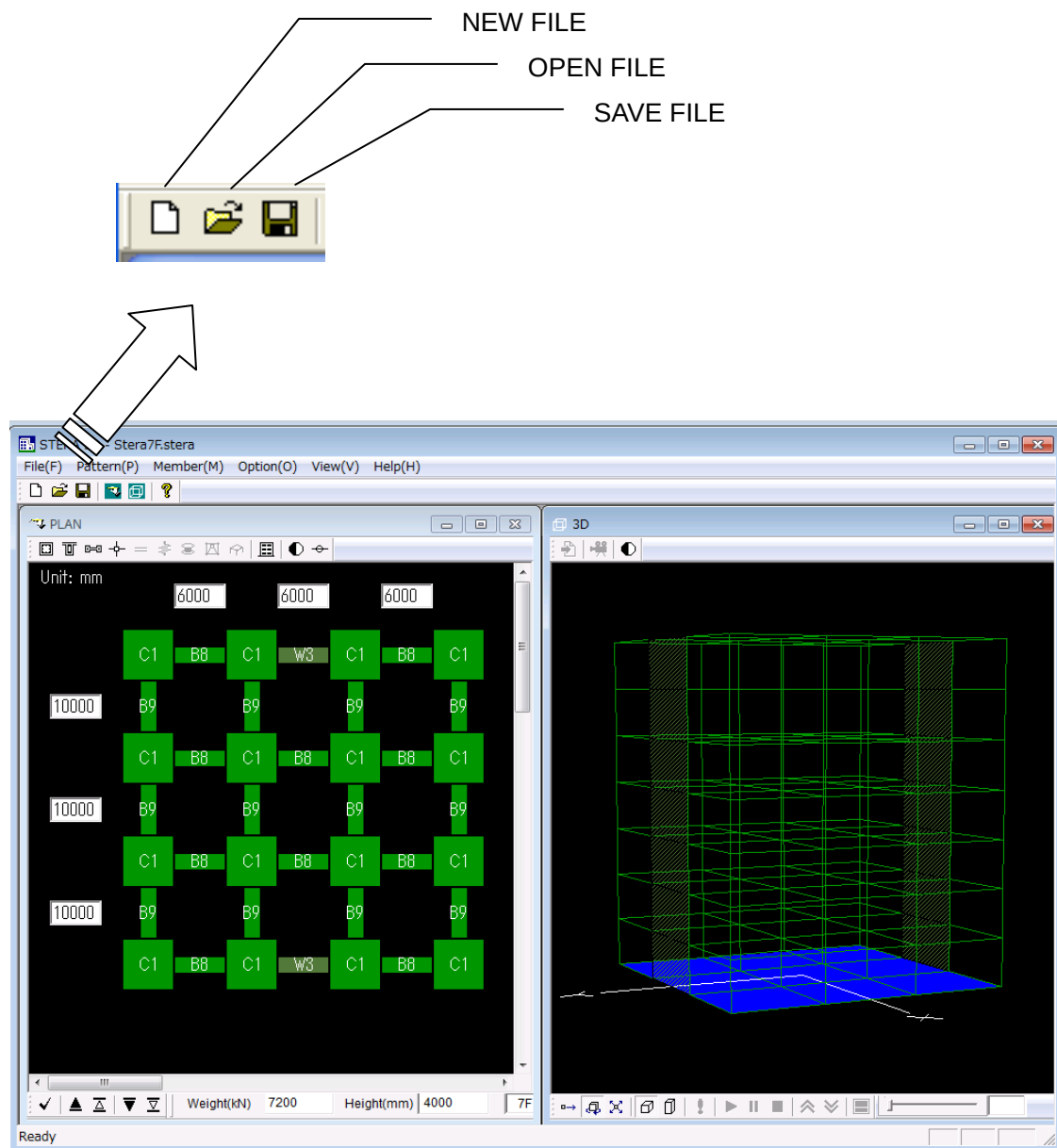
Mode: Modal Analysis
 Static: Nonlinear Static Push-Over Analysis
 Earthquake: Nonlinear Earthquake Response Analysis
 Movie: Movie for Nonlinear Earthquake Response Analysis



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”.



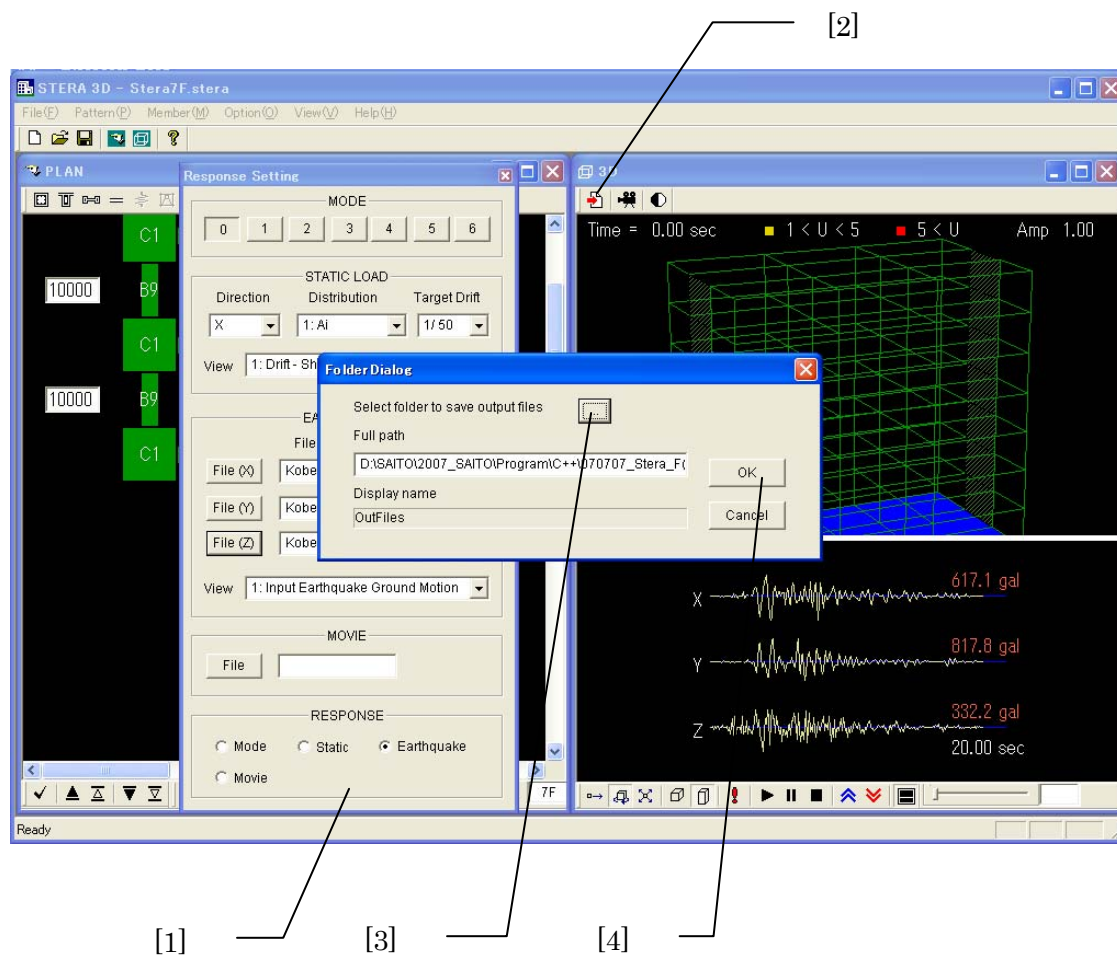
6-2. Save Results of Analysis into Text Files

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

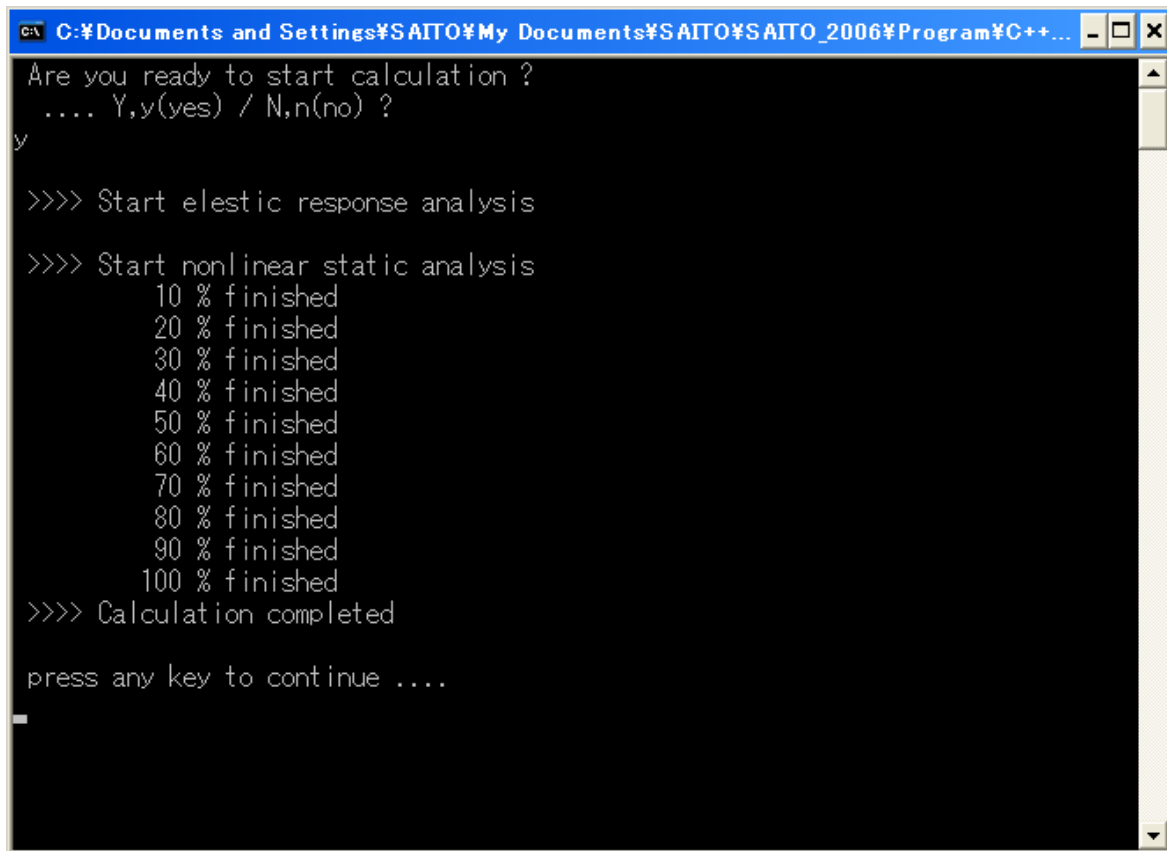
[1] On the RESPONSE SETTING DIALOG, please set the condition of analysis.

[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.



```
C:\Documents and Settings\SAITO\My Documents\SAITO\SAITO_2006\Program\C++...
Are you ready to start calculation ?
.... Y,y(yes) / N,n(no) ?
y
>>>> Start elastic response analysis
>>>> Start nonlinear static analysis
      10 % finished
      20 % finished
      30 % finished
      40 % finished
      50 % finished
      60 % finished
      70 % finished
      80 % finished
      90 % finished
     100 % finished
>>>> Calculation completed
press any key to continue ....
_
```

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

 data_beam	{	data_*** structural data of elements or structure
 data_bi		
 data_column		
 data_damper		
 data_spring		
 data_structure		
 data_wall		
 max_beam	{	max_*** maximum response of elements or structure
 max_bi		
 max_column		
 max_damper		
 max_spring		
 max_structure		
 max_wall		
 response_eccentricity	{	response_eccentricity: eccentricity and rigidity ratio response_eigen : natural periods and mode shapes response_member01,02,... : member response response_node : nodal response response_structure : story response
 response_eigen		
 response_energy		
 response_member01		
 response_member02		
 response_member03		
 response_member04		
response_node	{	
response_structure		

- 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.

					Natural Period	
++ 1-mode ++ t = 1.0065 sec						
		0.000	6.423	0.000		
x,y,z	mode	bx	by	bz		
1		Mode Vector		Stimulus Function		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
2		0.000	0.000	0.000		
	0.022	0.000	0.141	0.000		
	0.062	0.000	0.395	0.000		
	0.101	0.000	0.647	0.000		
	0.135	0.000	0.870	0.000		
	0.164	0.000	1.053	0.000		
	0.187	0.000	1.203	0.000		
	0.203	0.000	1.306	0.000		
3		0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		
	0.000	0.000	0.000	0.000		

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	sdv	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	0.2396E+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)
 sdv 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	sdv	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)
 sdv 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>
```

0 F : basement floor

```
< 1 F>
```

```
Center of rigidity (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>
```

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	-0.4998E-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	-0.1783E-04	0.3507E+04	0.000	0.8772E-07	0.4162E+02	0.000	
7.000		0.1333E-03	0.1498E+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

< Axial Force >

Disp	Force	Total Force from Spring
Dz	Nz	Nz2

< 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	-0.5189E-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	0.9608E-05	-0.1388E+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		0.1918E-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

< Axial Force >

Disp	Force	Total Force from Spring
Dz	Nz	Nz2

< 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

Disp.	Force.	Ductility Factor
Dz	Fz	Uz

[5] In case of Base Isolator

Disp.	Force.	Ductility Factor	
Dx	Qx	Ux	X-direction (Shear)
Dy	Qy	Uy	Y-direction (Shear)
Dv	Fv		Z-direction (Axial)

[6] In case of Damper and Nonstructural Wall

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

7) "response_node.txt"

Node number

0F

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.

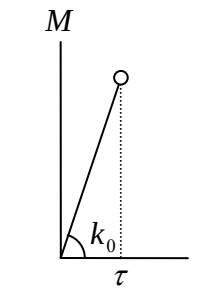
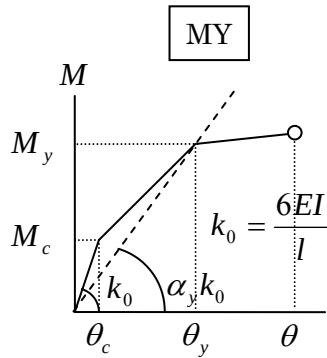
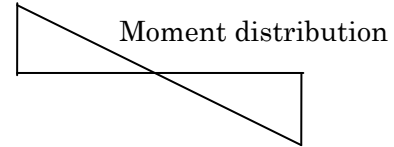
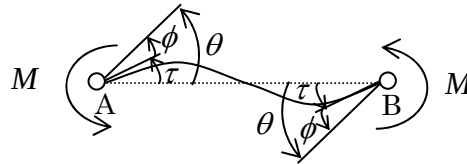
[1] "max_baem.txt"

Beam

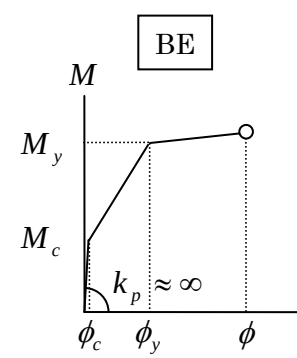
Ductility factor

EL.NO.=		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.=		disp	force	duct		disp	force	duct
MY 1	0.1892E-01	0.1102E+06	3.91		MX 1	0.2307E-04	0.6891E+04	0.00
CO 1	0.9352E+00	-0.5956E+03	-7.22 /		ST 1	0.9352E+00	0.1243E+04	7.22
CO 2	-0.6541E-02	-0.8083E+03	0.05 /		ST 2	-0.6541E-02	-0.1408E+03	-0.05
CO 3	0.9370E+00	-0.5952E+03	-7.23 /		ST 3	0.9370E+00	0.1246E+04	7.23
CO 4	-0.6149E-02	-0.7599E+03	0.05 /		ST 4	-0.6149E-02	-0.1323E+03	-0.05
CO 5	0.4656E+00	-0.1498E+03	-3.59 /		ST 5	0.0000E+00	0.0000E+00	0.00
MY 2	0.1627E-02	0.6002E+05	0.34		MX 2	0.1666E-03	0.1575E+05	0.00
CO 1	-0.4900E-02	-0.6055E+03	0.04 /		ST 1	-0.4900E-02	-0.1055E+03	-0.04
CO 2	0.8132E-01	-0.5916E+03	-0.63 /		ST 2	0.8132E-01	0.8726E+03	0.63
CO 3	-0.4907E-02	-0.6064E+03	0.04 /		ST 3	-0.4907E-02	-0.1056E+03	-0.04
CO 4	0.7735E-01	-0.5925E+03	-0.60 /		ST 4	0.7735E-01	0.8431E+03	0.60
CO 5	0.3856E-01	-0.1498E+03	-0.30 /		ST 5	0.0000E+00	0.0000E+00	0.00
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						

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	sdv	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	0.785E+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)
 sdv 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)								Member number	
0F	0	1	0	2	0	3	0	C---B---C---B---C--- B C 	
	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		
--- inelastic properties member = 1 ---(type = 1)								Properties	
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					