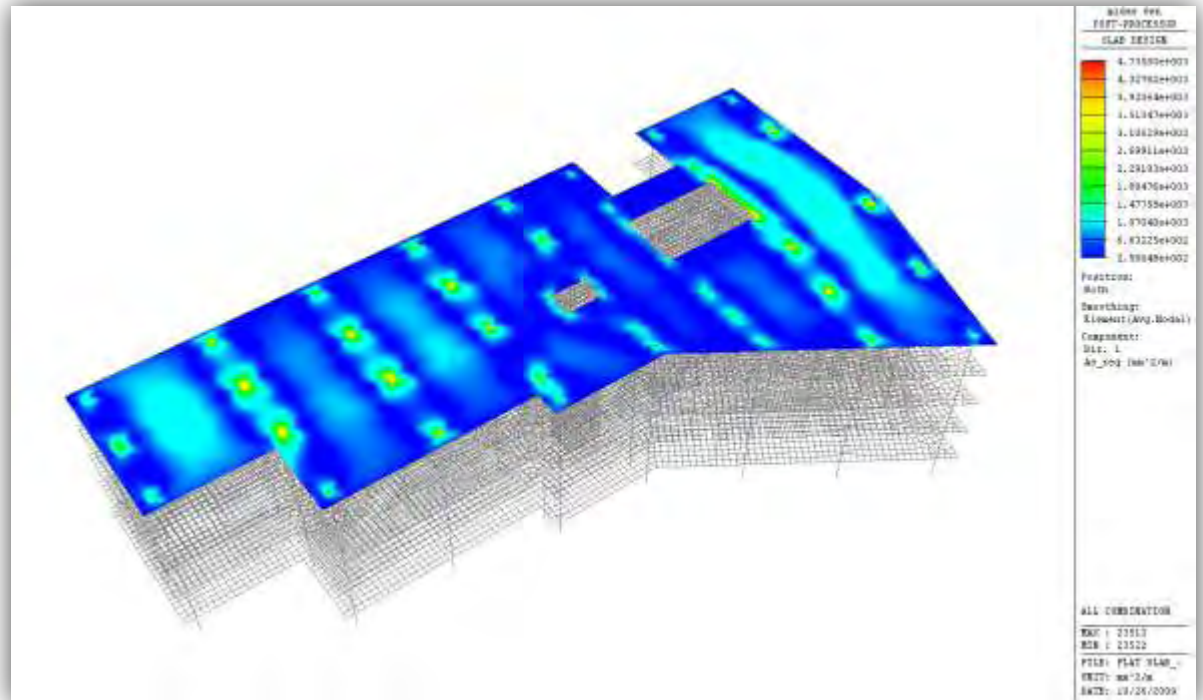


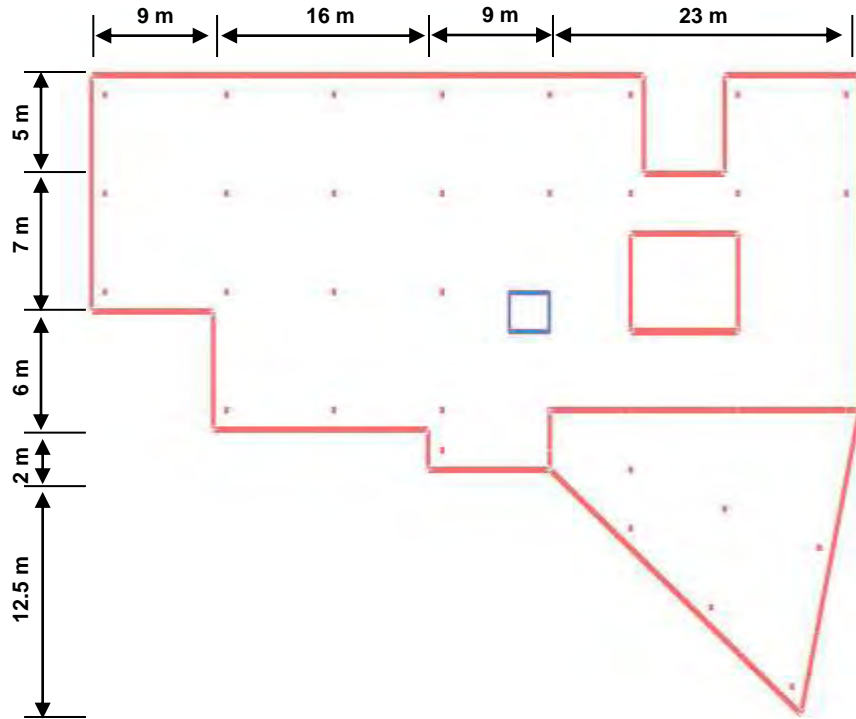
Contents

- **Step 1:** Model & Automesh
- **Step 2:** Design Parameters
- **Step 3:** Member Design
- **Step 4:** Slab/Wall Design

Automesh and Slab/Wall Design Tutorial

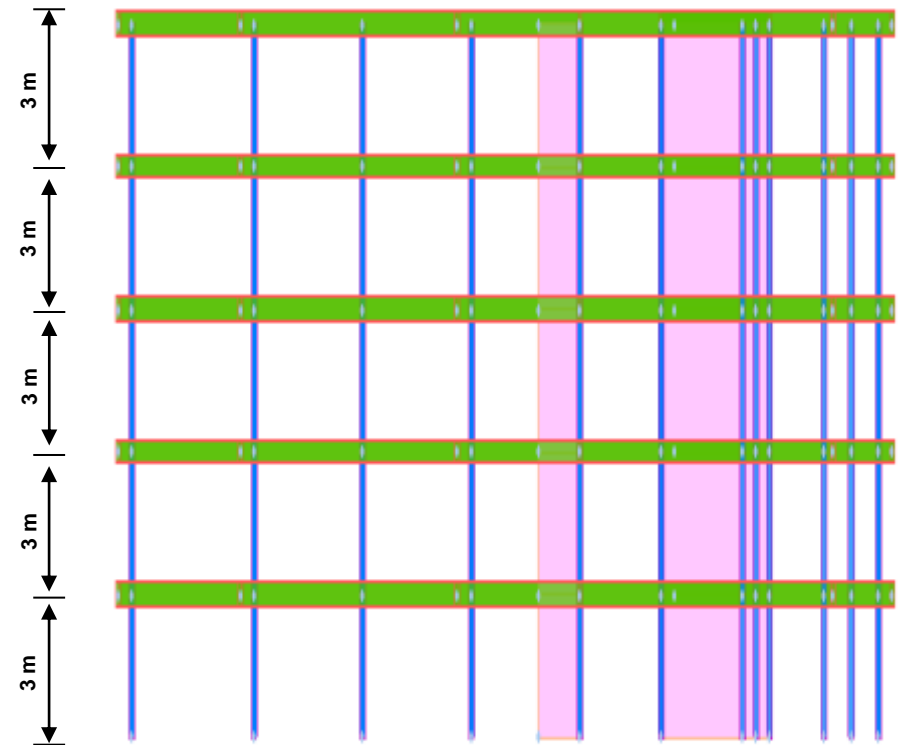


Overview



Typical Floor Plan

Sectional Elevation



Details of the Building

Applied Code

Eurocode-1:2005

Materials

- Beam : Concrete Grade C25/30
- Column: Concrete Grade C25/30
- Wall: Concrete Grade C30/37

Girder sections

Designation	Section Number	Section Dimension (mm)
Girder	1	500 x 400

Column section dimension

Designation	Story	Section Number	Column Dimension (mm)
Column	1~5F	2	400 x 400

Wall thickness

Designation	Thickness Number	Thickness Dimension (mm)
	1	200
	2	250

Applied Load

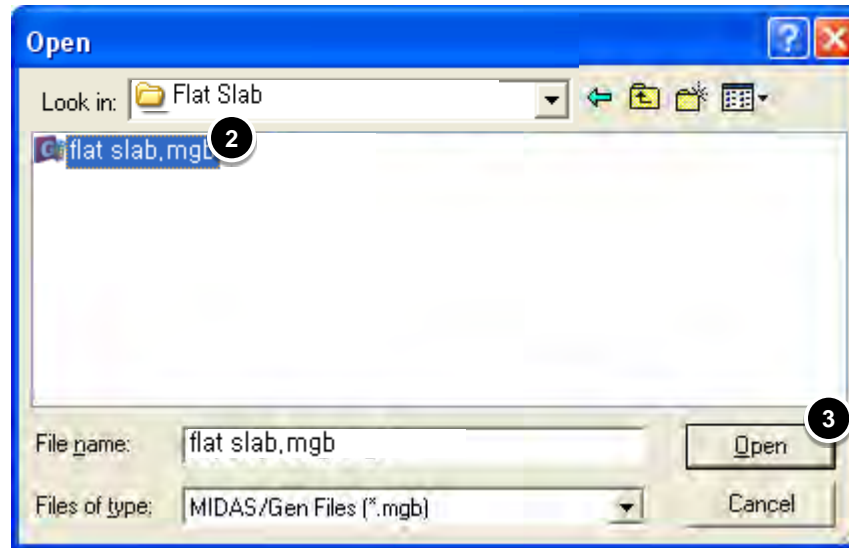
Load	Details	
Dead Load	Self Weight	Weight Density: 1 kN/m ³
Live Load	Pressure Load	Shopping areas : 4.0 kN/m ² Office areas : 2.0 kN/m ²
Wind Load	X-dir./ Y-dir.	Eurocode-1(2005) Terrain Category : II
Response Spectrum Load	X-dir./ Y-dir.	Eurocode-8(2004) Spectrum Parameters: TYPE 1 Ground Type : B Importance Factor : 1.0

01 Opening the Pre-generated Model File

Procedure

Opening the Pre-generated Model File

- 1 File > Open Project...
- 2 Select "flat slab.mgb".
- 3 Click [Open] button.

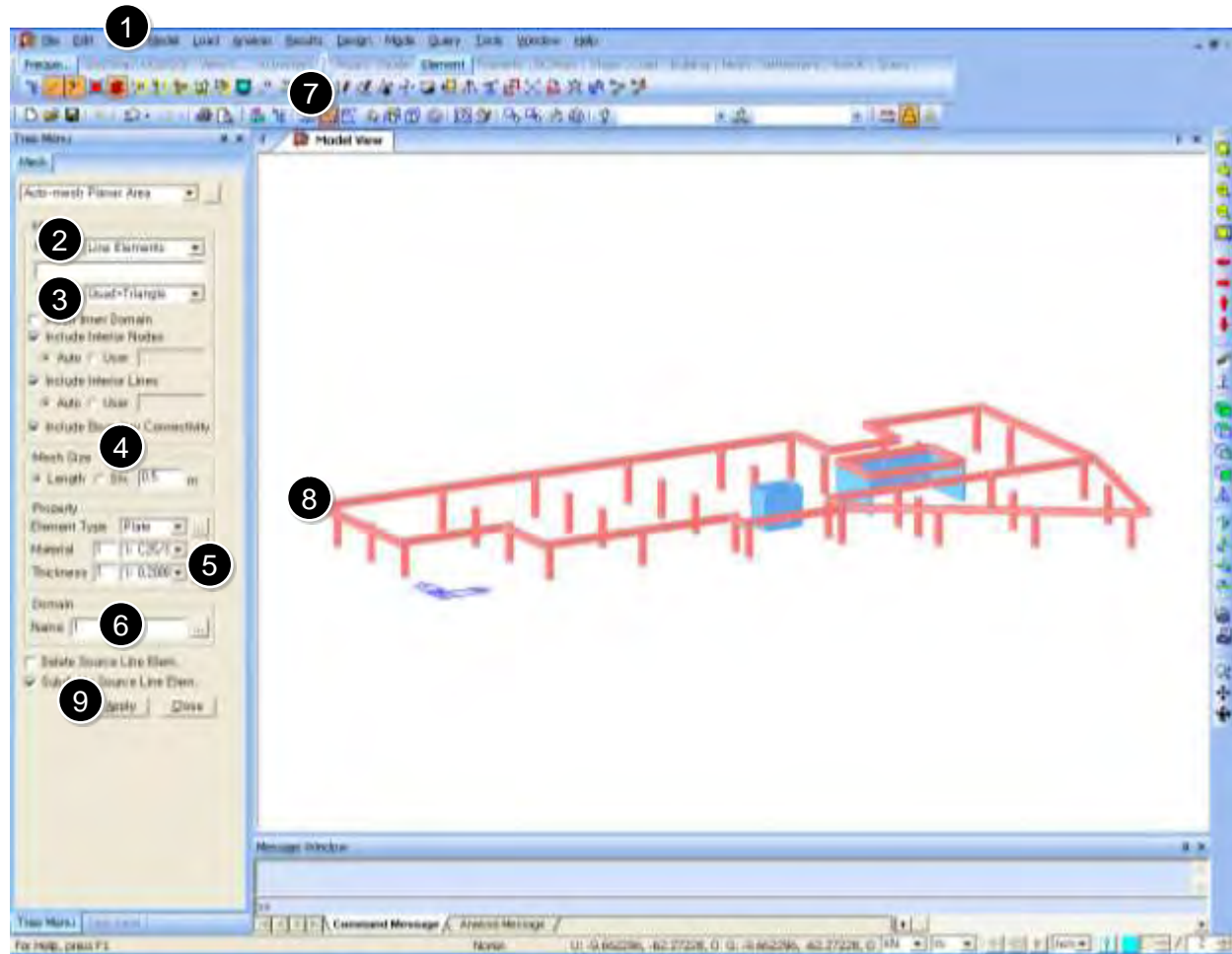


01 Auto-mesh Planar Area

Procedure

Generate meshed elements for slabs
Specify meshed area for auto-meshing (Line elements method).

- ① **Model > Mesh > Auto-mesh Planar Area**
- ② **Method : Line Elements**
- ③ **Type : Quad + Triangle**
- ④ **Mesh Size : Length : 0.5 m**
- ⑤ **Material : 1:C25/30
Thickness : 1:0.200**
- ⑥ **Domain : 1**
- ⑦ **Select by Window > Front View**
- ⑧ **Select Roof-Line**
- ⑨ **Iso View > Click [Apply]**

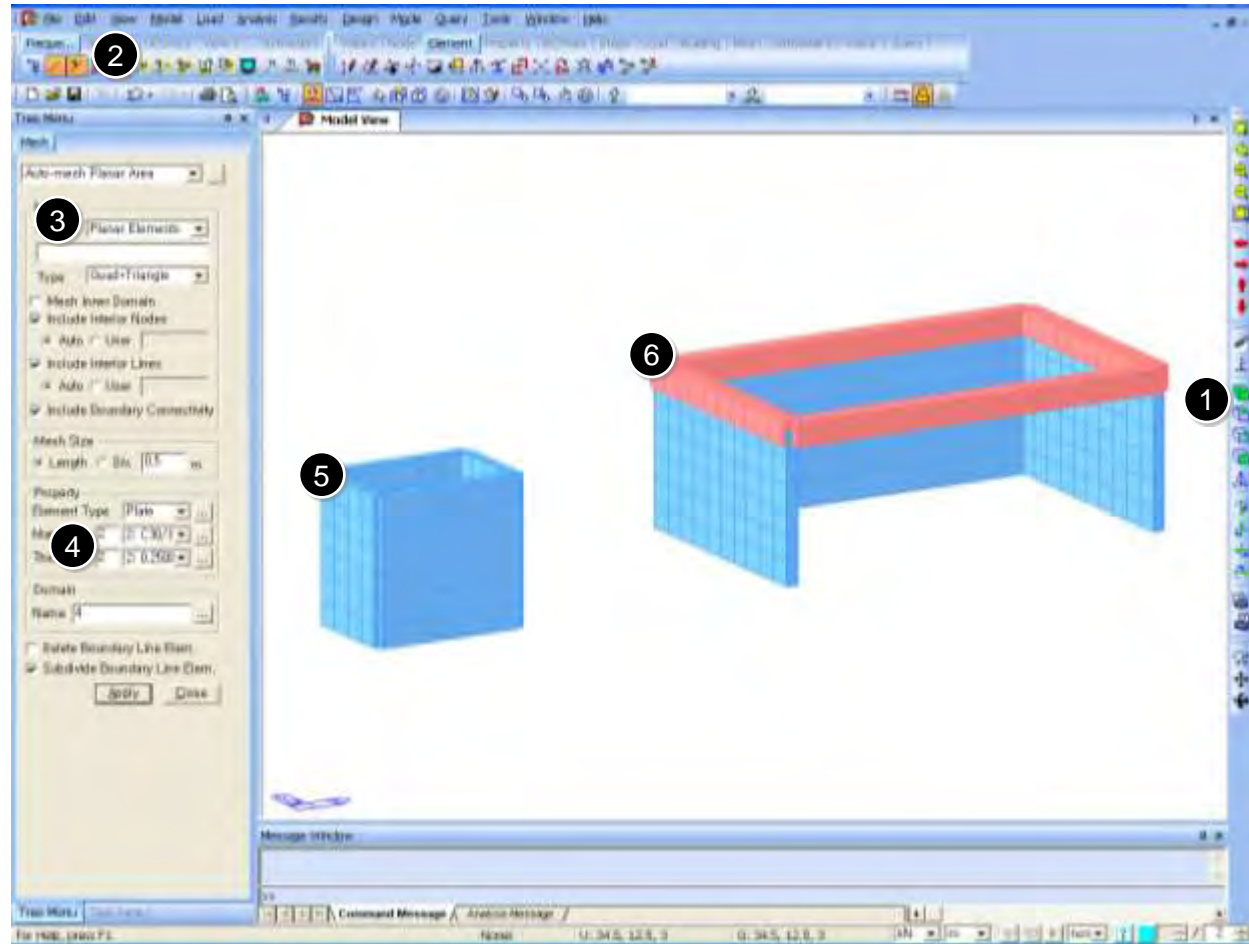


01 Auto-mesh Planar Area

Procedure

Generate meshed elements for walls
Specify meshed area for auto-meshing (Line elements method).

- ① Top View >
Select Wall-Line
- ② Activate > Iso View
- ③ Method : Planar Elements
- ④ Material : 2:C30/37
Thickness : 2:0.250
- ⑤ Domain : 2
Select Wall > Click [Apply]
- ⑥ Domain : 3
Select Wall > Click [Apply]



01 Auto-mesh Planar Area

Procedure

Generate meshed elements with opening

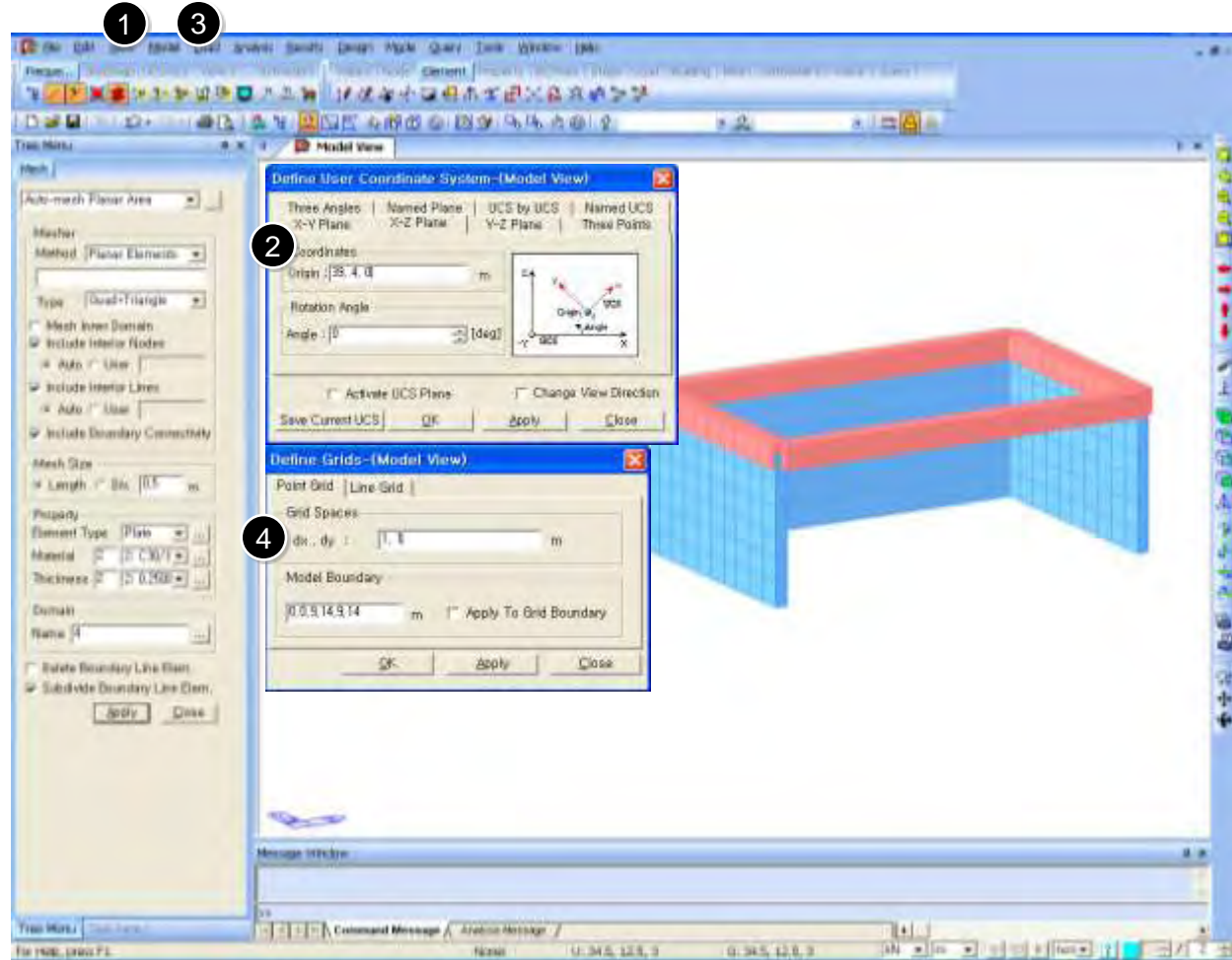
Specify meshed area for auto-meshing (Nodes method).

① **Model >**
User Coordinate System >
X-Z Plan

② Origin : 39, 4, 0
Click : [Apply] > [Close]

③ **Model > Grids >**
Define Point Grids

④ dx, dy : 1, 1
Click : [Apply] > [Close]



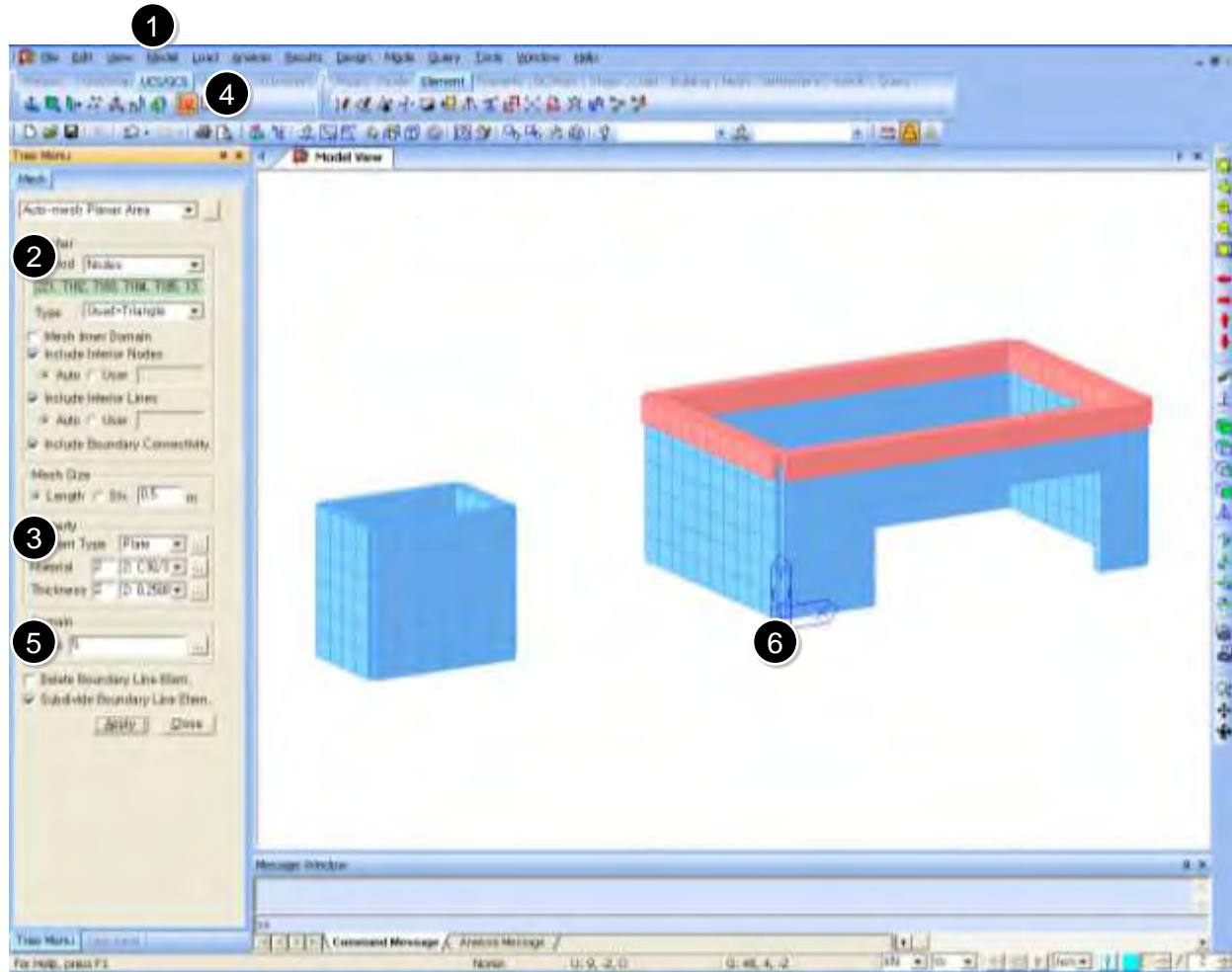
01 Auto-mesh Planar Area

Procedure

Generate meshed elements with opening

Specify meshed area for auto-meshing (Nodes method).

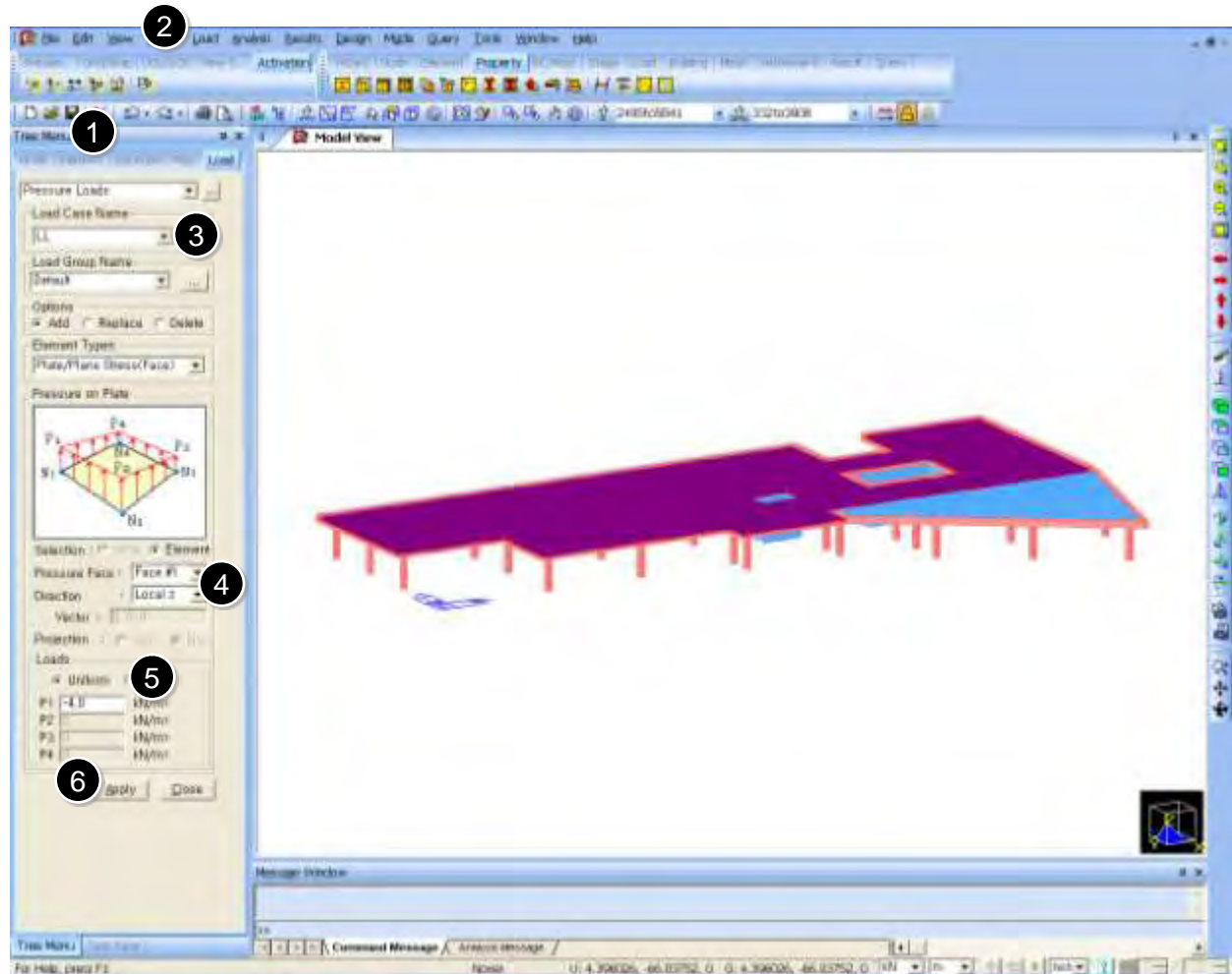
- ① **Model > Mesh > Auto-mesh Planar**
- ② **Method : Nodes**
- ③ **Material : 2:C30/37**
Thickness : 2:0.250
- ④ **Display Node Numbers**
(Toggle On)
- ⑤ **Domain : 4**
- ⑥ **Click Nodes > Click : [Apply] > [Close] > Activate All**



Procedure

Apply floor loads

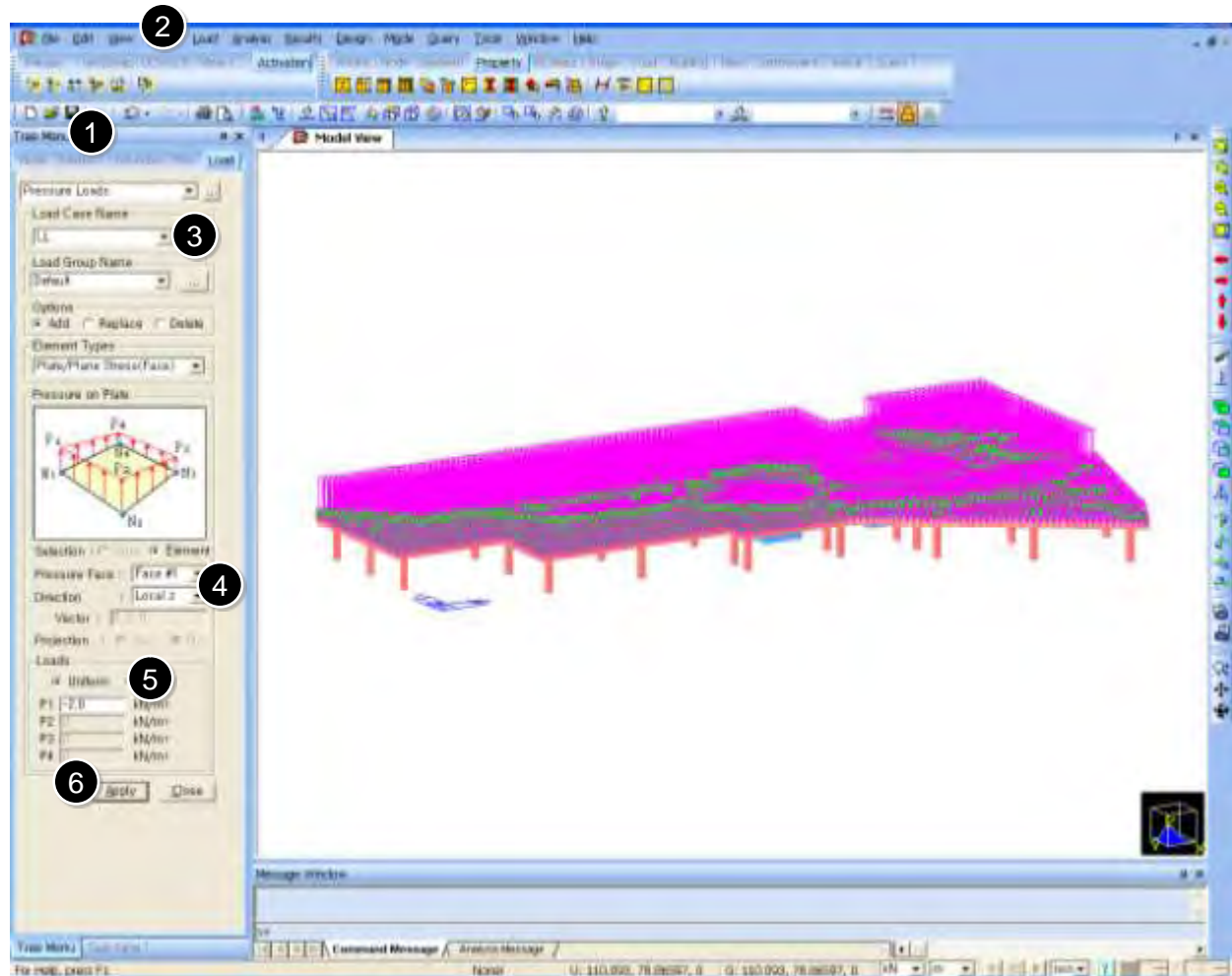
- ① Tree Menu > Work > Domain1 [1] > Double Click
- ② Load > Pressure Loads
- ③ Load Case Name : LL
- ④ Direction : Local z
- ⑤ Loads : P1 : -4.0kN
Shopping areas
D1 : Areas in general retail shops
- ⑥ Click [Apply] > [Close]



Procedure

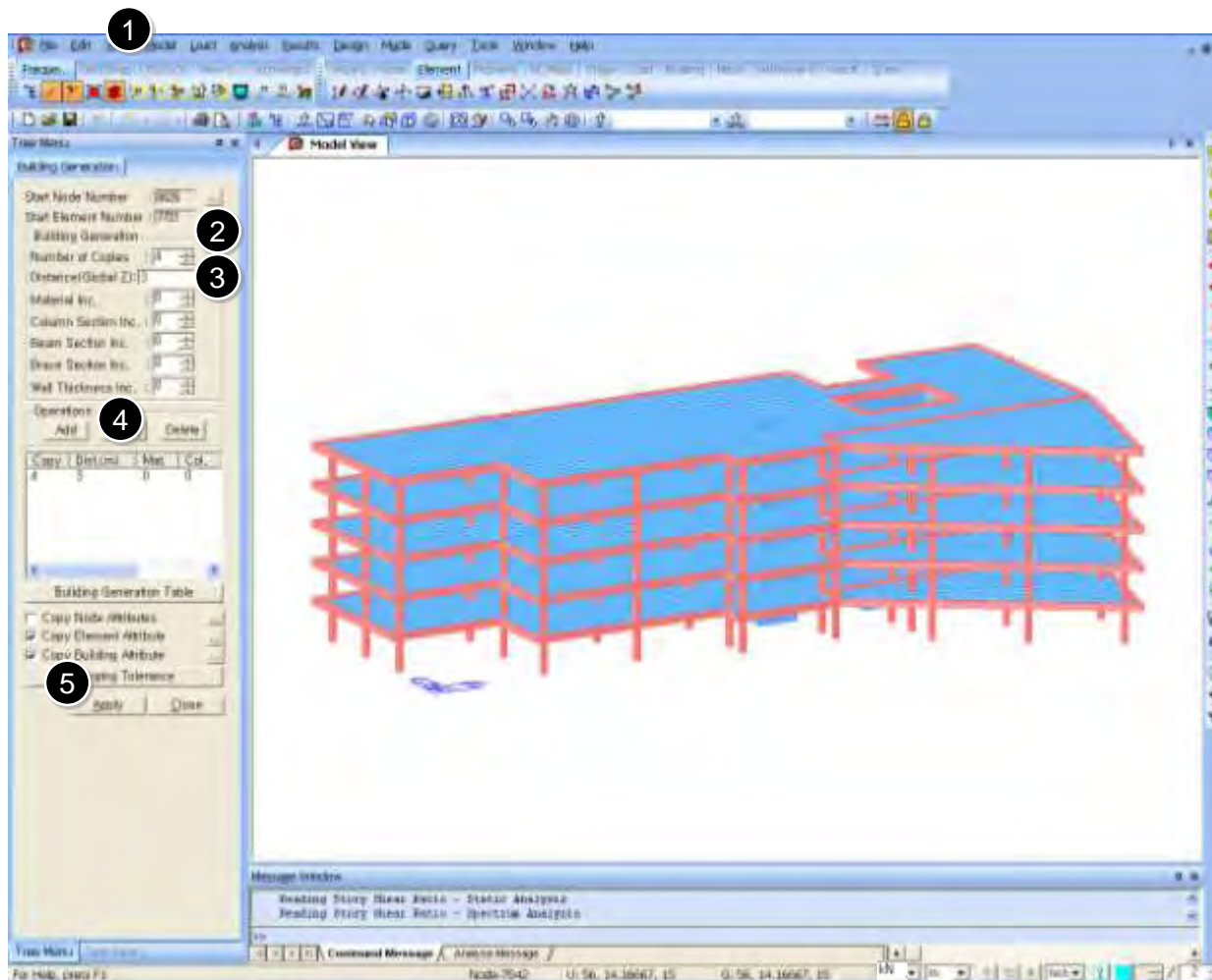
Apply floor loads

- ① Tree Menu > Work > Domain1 [2] > Double Click
- ② Load > Pressure Loads
- ③ Load Case Name : LL
- ④ Direction : Local z
- ⑤ Loads : P1 : -2.0kN
Office areas
- ⑥ Click [Apply]



Procedure

- 1 Model > Building > Building Generation
- 2 Number of Copies : 4
- 3 Distance(Global z) : 3 m
- 4 Operations : Click [Add]
- 5 Select All > Click [Apply]



02 Auto Generate Story Data

Procedure

- ① Model > Building > Story > Auto Generate Story Data
- ② Select
- ③ Click [OK]
- ④ Click [Close]

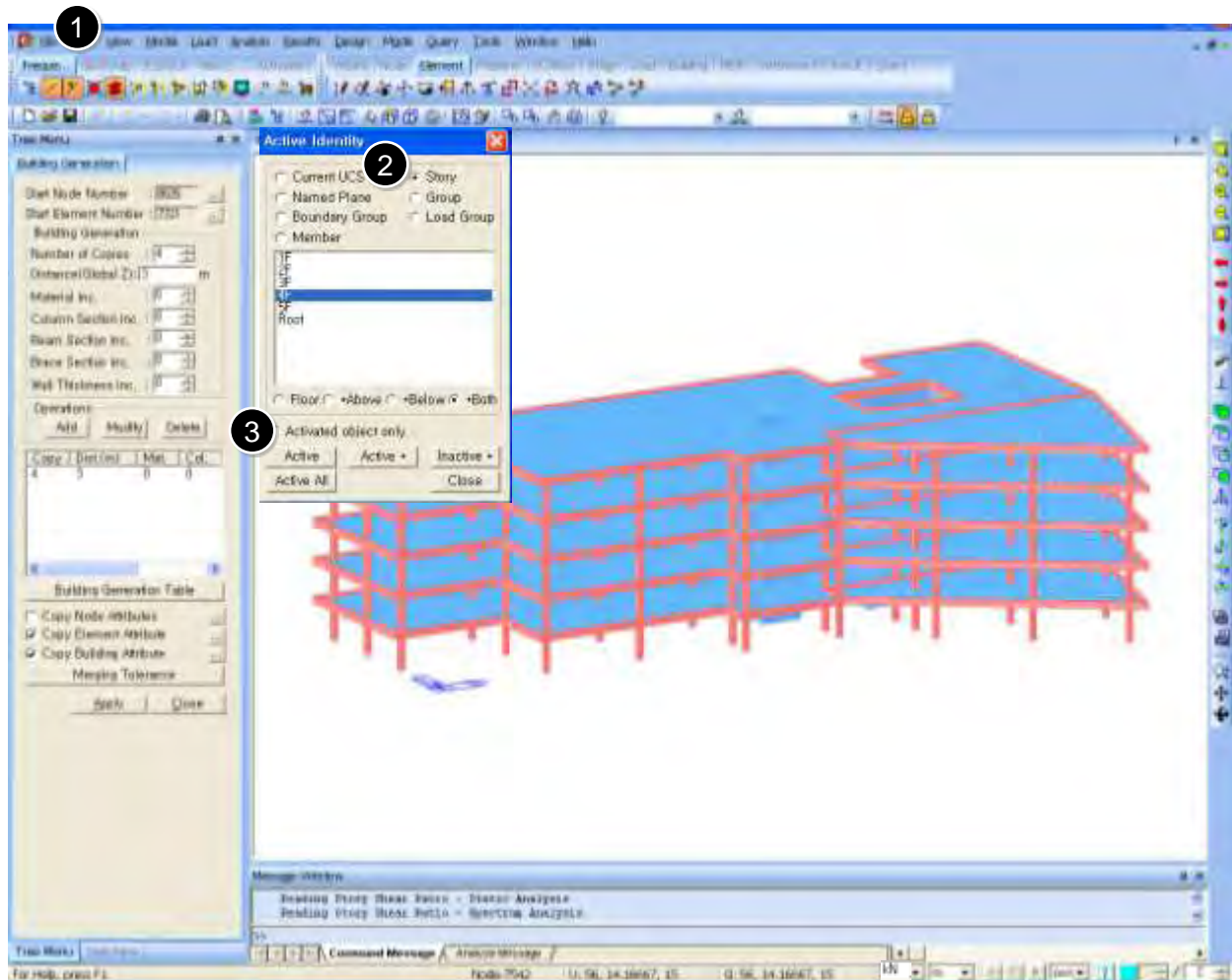
The screenshot shows the Midas Gen software interface with the 'Story Data' dialog box open. The dialog box contains a table with the following data:

Name	Level(m)	Height(m)	Floor Diaphragm
Roof	15.00	0.00	Consider
5F	12.00	3.00	Consider
4F	9.00	3.00	Consider
3F	6.00	3.00	Consider
2F	3.00	3.00	Consider
1F	0.00	3.00	Do not consider

The 'Automatic Generation of Story Data' dialog box is also open, showing a list of levels and a checkbox for 'Include Accidental Eccentricity'.

Procedure

- ① View > Activities > Active Identity
- ② Click : Story > 4F
- ③ Click : [Active] > [Close]



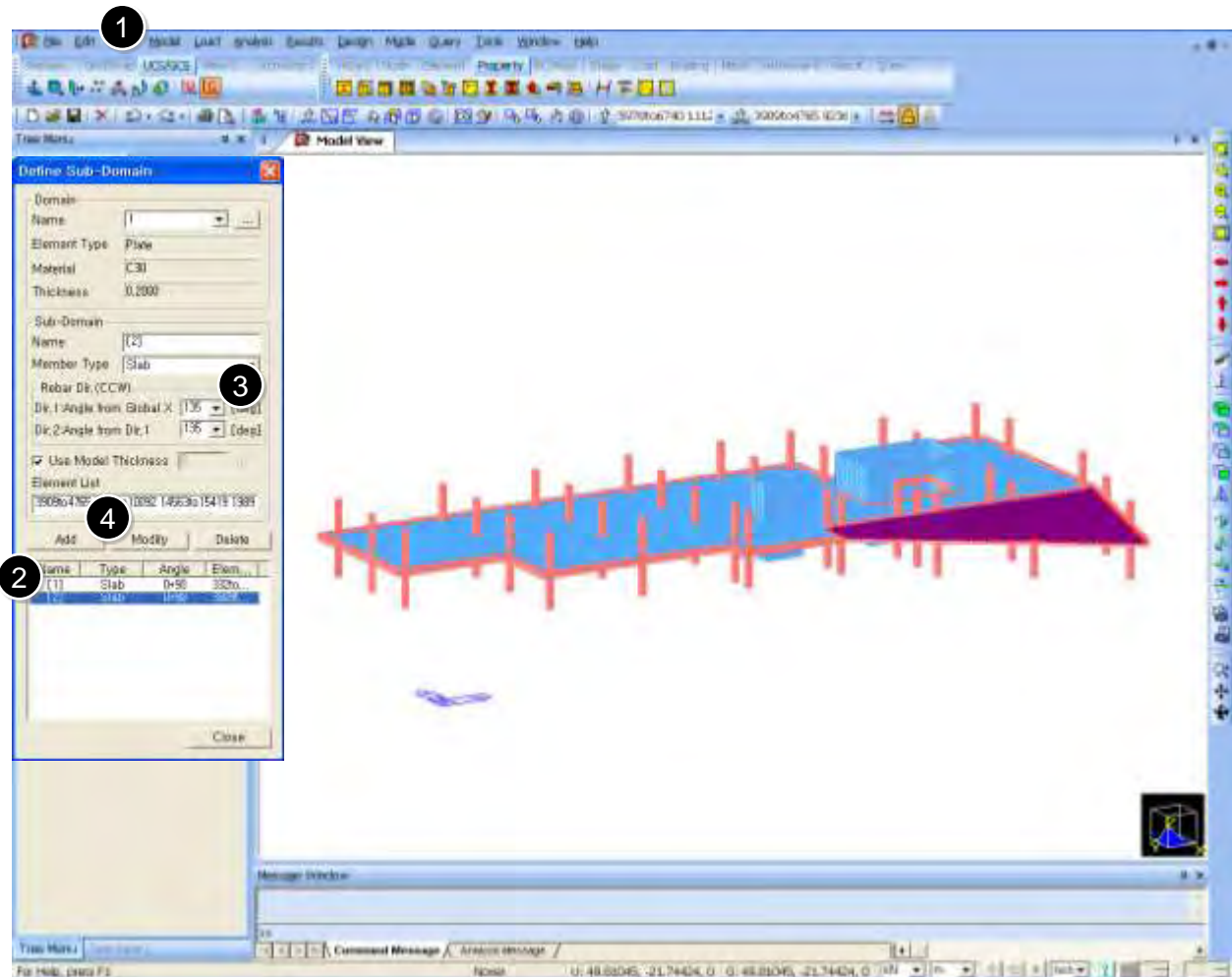
02 Define Sub-Domain

Procedure

Define sub-domain for design

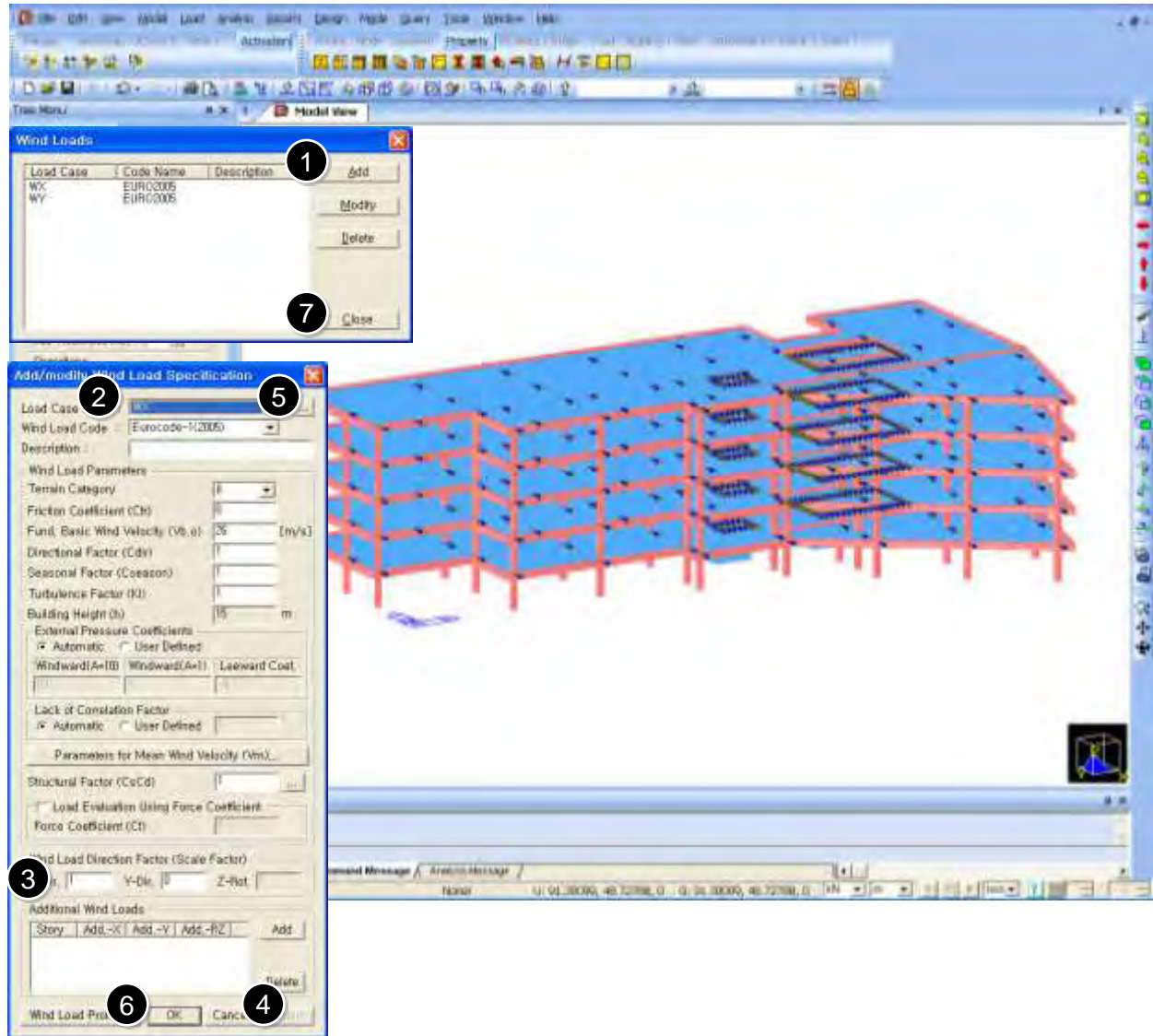
Reinforcement direction can be specified by sub-domains.

- ① **Model > Domain > Define Sub-Domain**
- ② Click : [2]
- ③ Rebar Dir.(CCW) :
Dir.1 : 135, Dir.2 : 135
- ④ Click : [Modify] > [Close]



Procedure

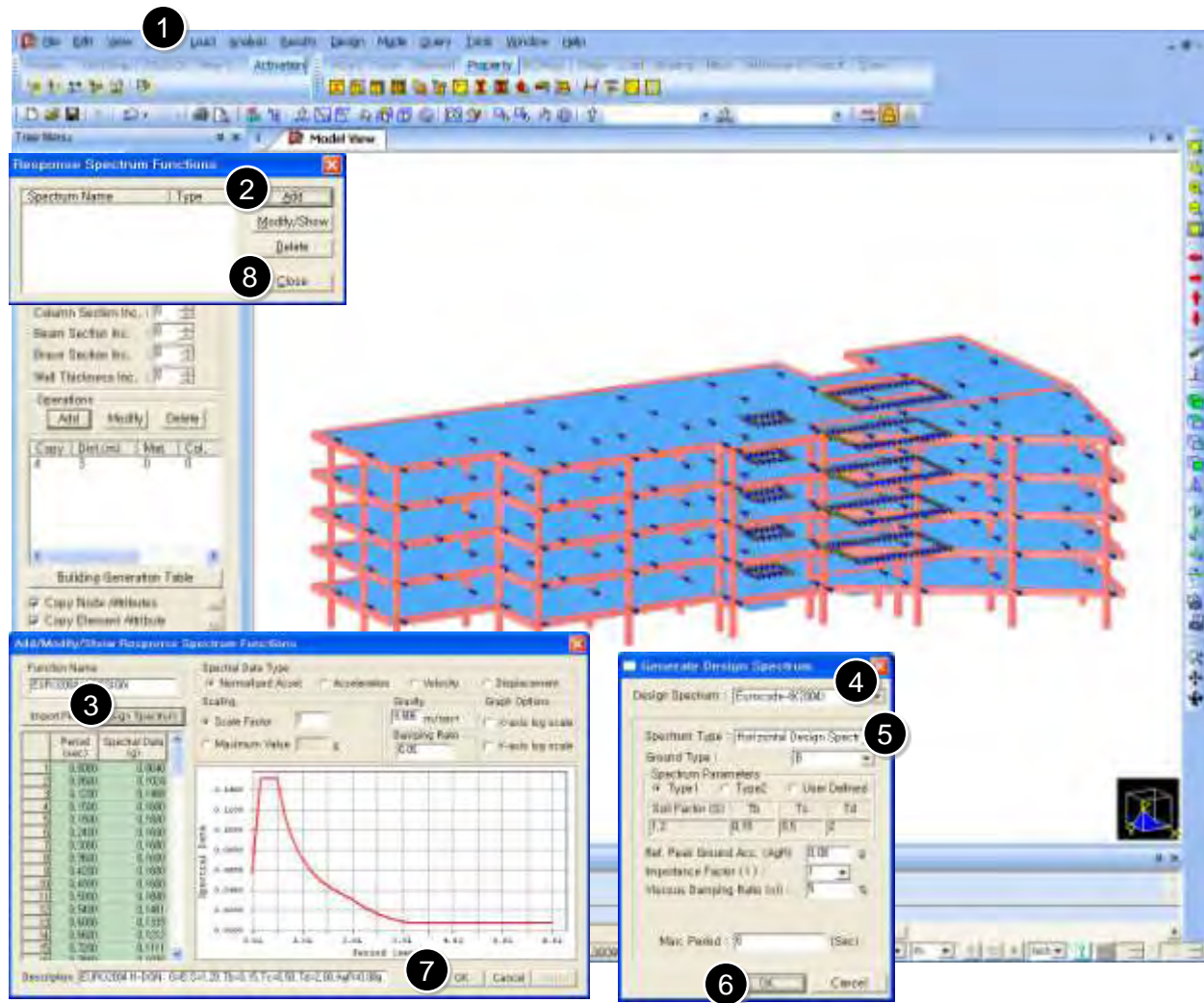
- ① Load > Lateral Loads > Wind Loads > Click [Add]
- ② Load Case Name : WX
Wind Load Code : Eurocode-1(2005)
- ③ Wind Load Direction Factor : X-Dir. : 1, Y-Dir. : 0
- ④ Click [Apply]
- ⑤ Load Case Name : WY
Wind Load Direction Factor : X-Dir. : 0, Y-Dir. : 1
- ⑥ Click [OK]
- ⑦ Click [Close]



02 Response Spectrum Functions

Procedure

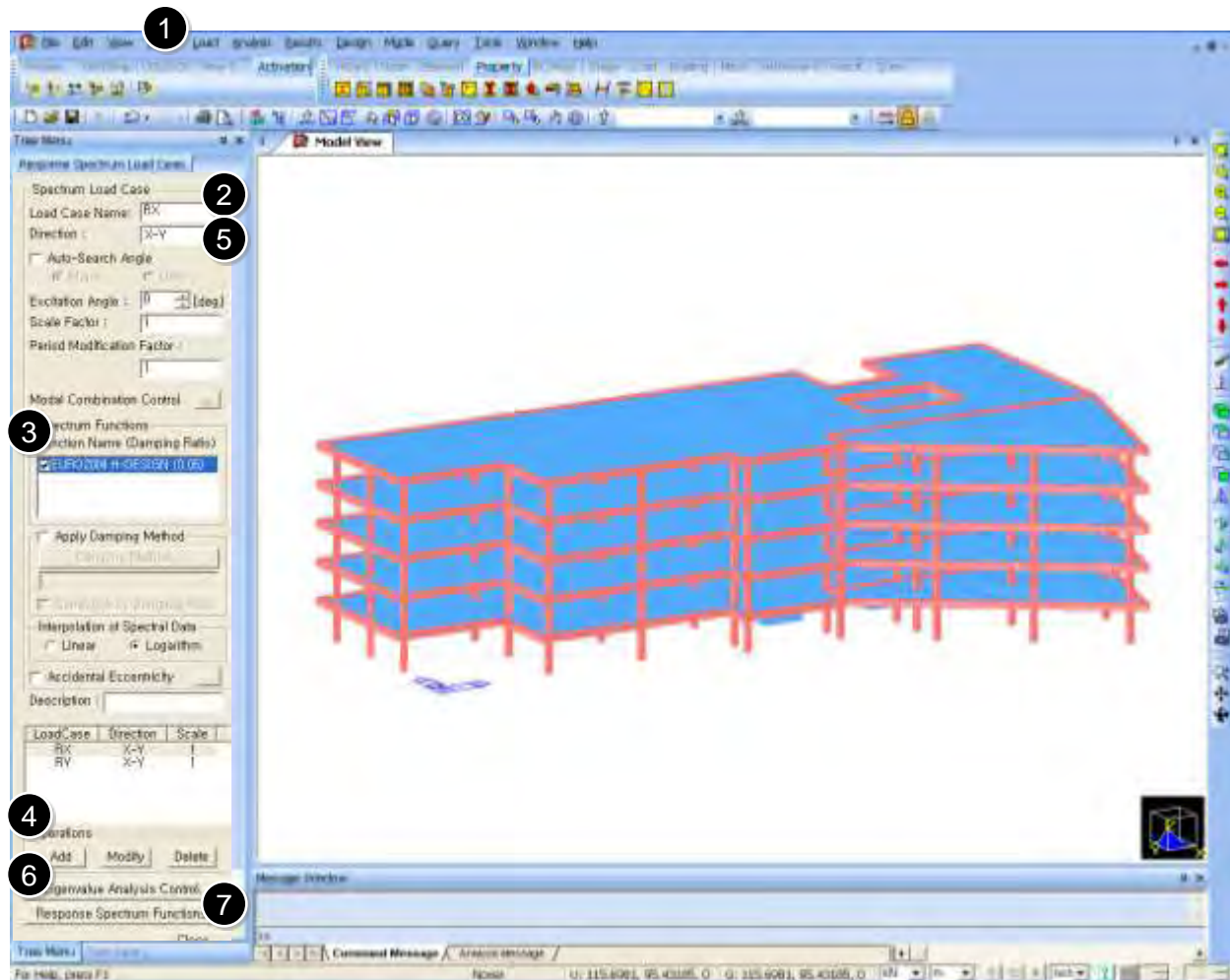
- ① Load > Response Spectrum Analysis Data > Response Spectrum Functions
- ② Click [Add]
- ③ Click [Design Spectrum]
- ④ Design Spectrum : Eurocode-8(2004)
- ⑤ Spectrum Type : Horizontal Design Spectrum
- ⑥ Click [OK]
- ⑦ Click [OK]
- ⑧ Click [Close]



02 Response Spectrum Load Cases

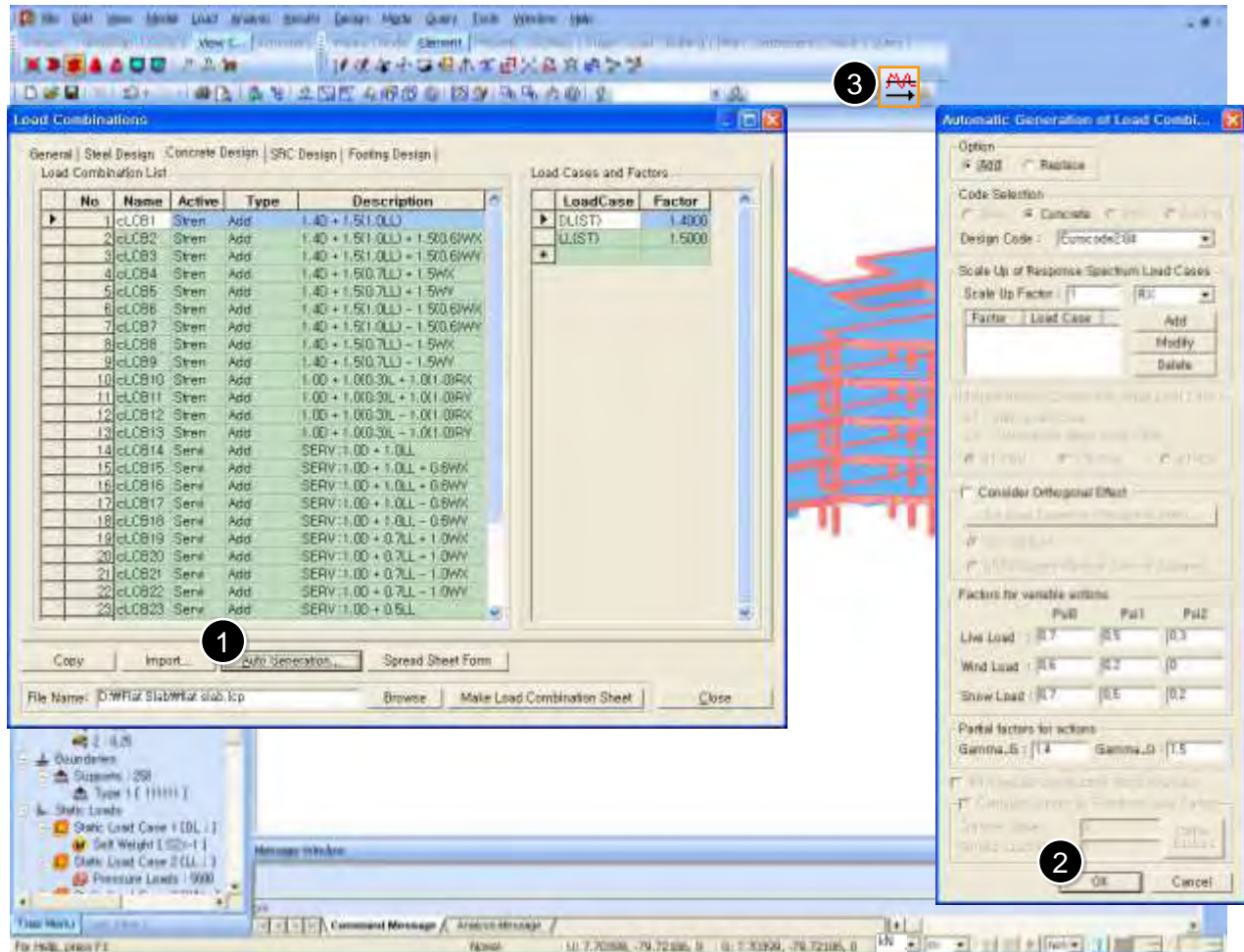
Procedure

- 1 Load > Response Spectrum Analysis Data > Response Spectrum Load Cases
- 2 Load Cases Name : RX
Excitation Angle : 0
- 3 Check : **EURO2004 H-Design**
- 4 Click **[Add]**
- 5 Load Cases Name : RY
Excitation Angle : 90
> Click **[Add]**
- 6 Click **[Eigenvalue Analysis control]** > **[OK]**
- 7 Click **[Close]**



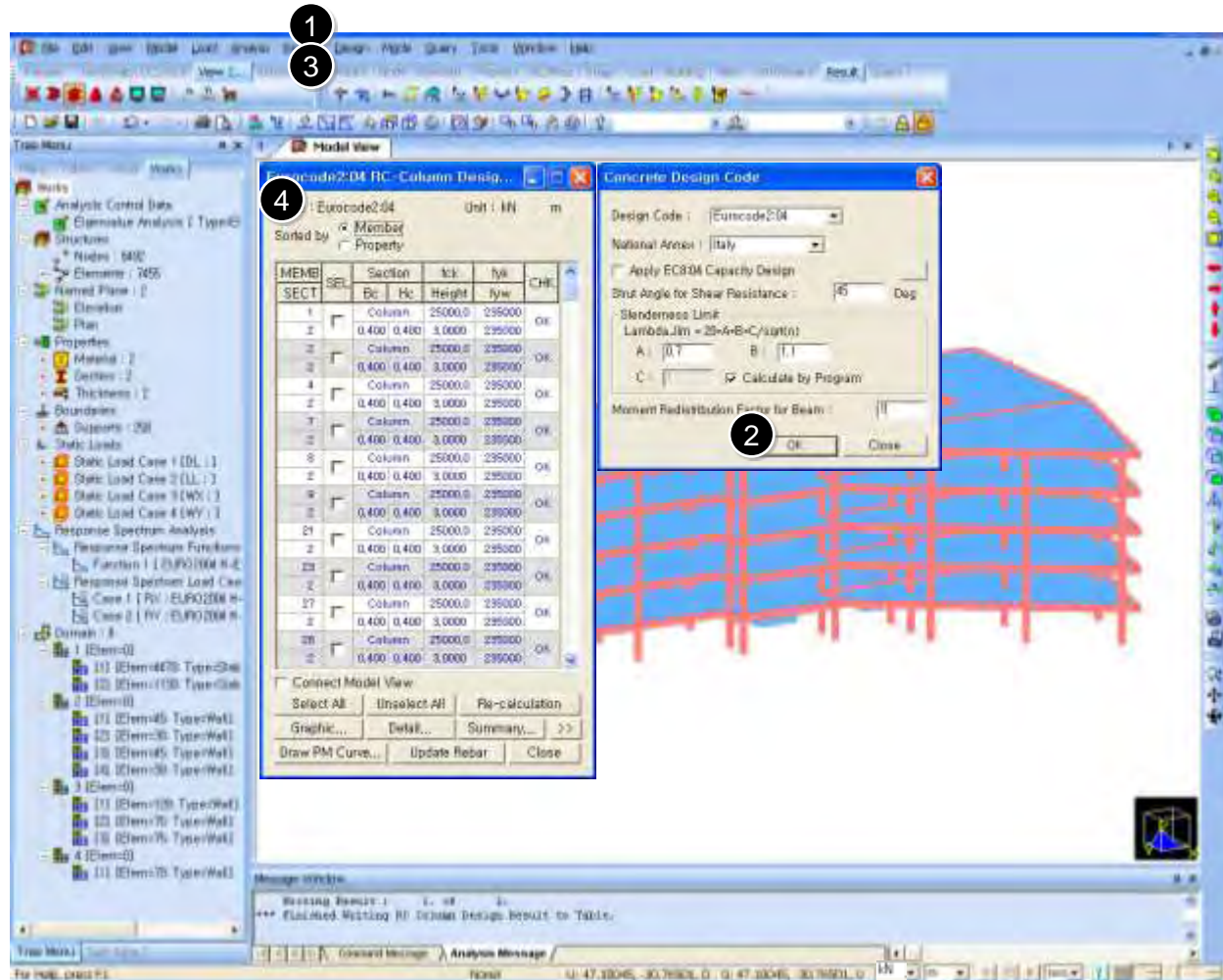
Procedure

- ① Results > Combinations > Concrete Design > Auto Generation
- ② Click [OK], Click [Close]
- ③ Perform Analysis



Procedure

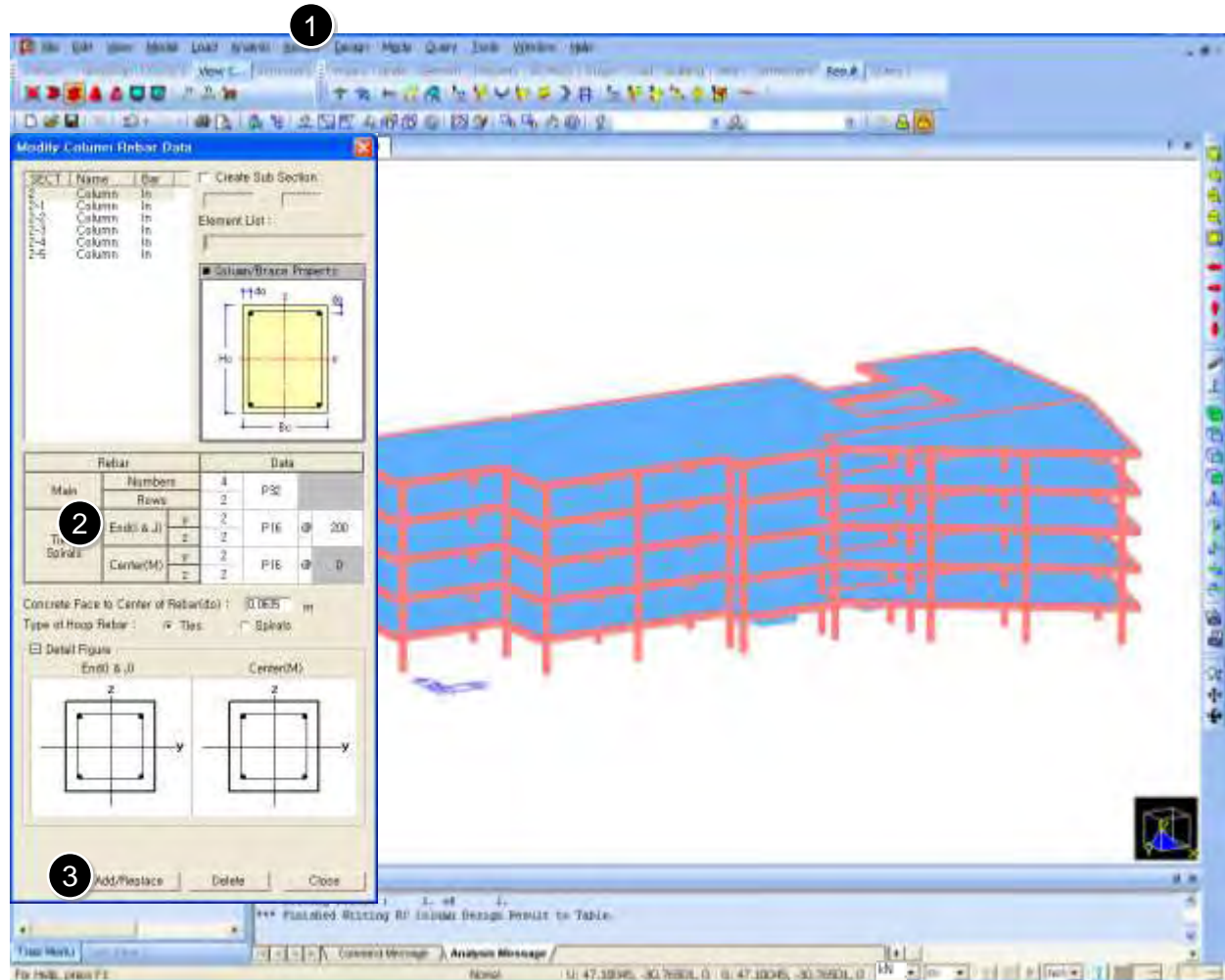
- 1 Design >
Concrete Design Parameter >
Concrete Design Code
- 2 Click [OK]
- 3 Design >
Concrete Code Design >
Column Design
- 4 Sorted by : Member >
Click [Close]



03 Modify Column Rebar Data

Procedure

- ① Design > Concrete Design Parameter > Modify Column Rebar Data
- ② Main : P32
End : P16@200 / Center : P16
- ③ Click [Add/Replace] > [Close]



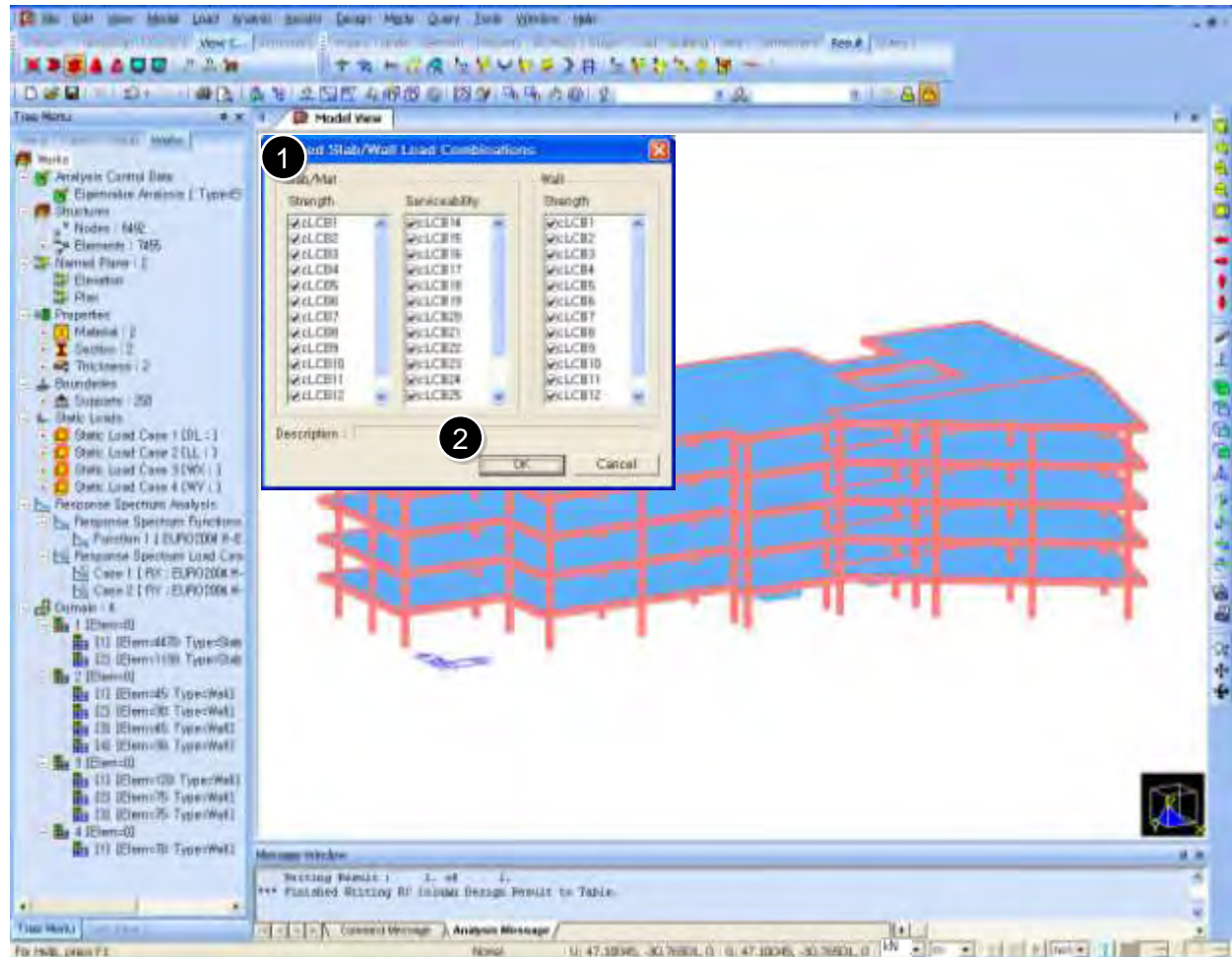
04 Slab/Wall Load Combinations

Procedure

Slab/Wall Load Combination

Select the load combinations for the slab/wall element design.

- ① Design > Meshed Slab/Wall Design > Slab/Wall Load Combinations
- ② Click [OK]



04 Design Criteria for Rebar

Procedure

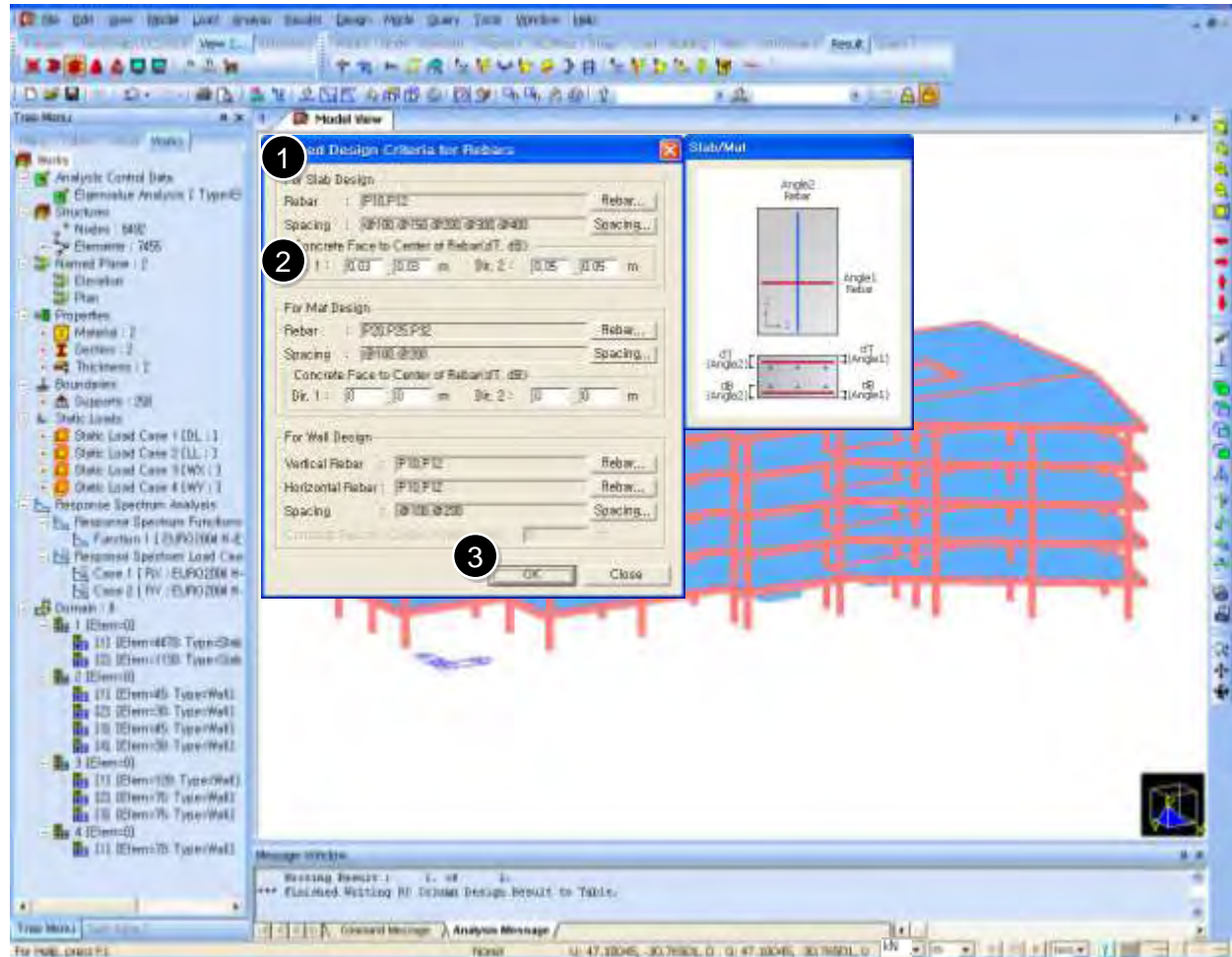
Specify rebar size

Enter the standard sizes of rebars used in the design of reinforcement for slab/wall elements.

① Design > Meshed Slab/Wall Design > Design Criteria for Rebar

② For Slab Design :
Angle 1 : 0.03 m, 0.03 m
Angle 2 : 0.05 m, 0.05 m

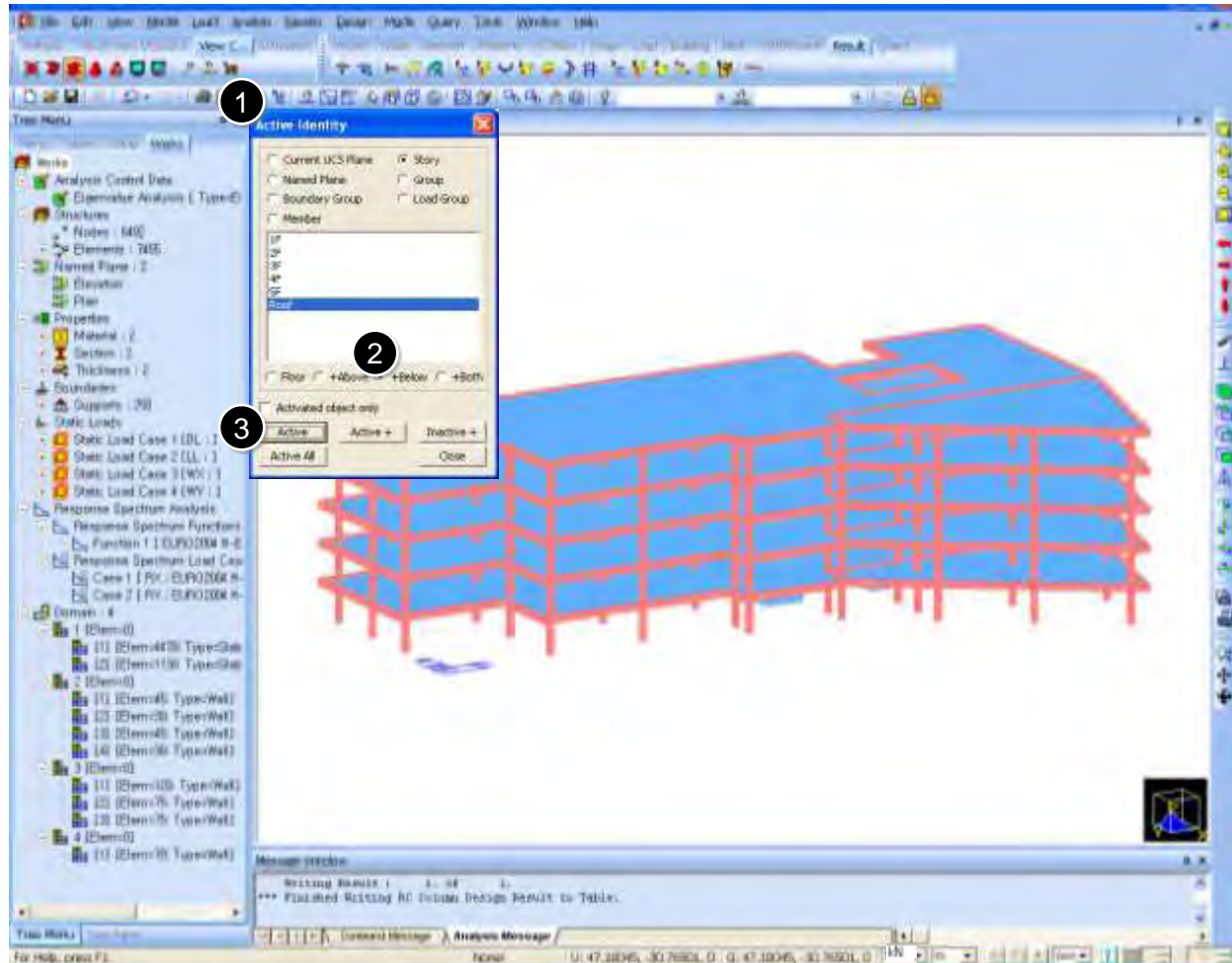
③ Click [OK]



04 Active Identity

Procedure

- ① View > Activities > Active Identity
- ② Click : Story > 3F
Check : +Below
- ③ Click : [Active] > [Close]



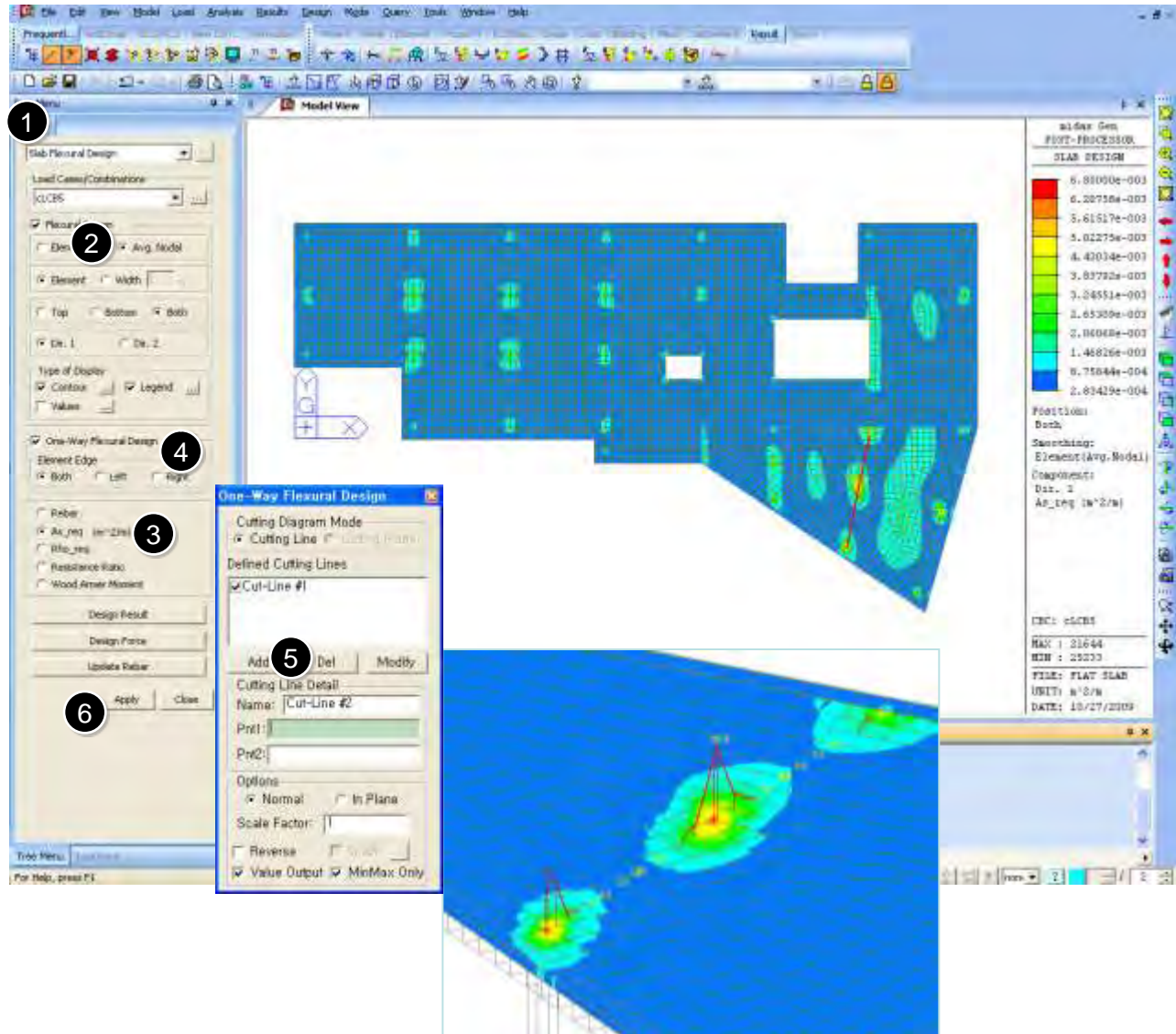
04 Slab Flexural Design

Procedure

Slab Flexural Design

Check the flexural design results for slab elements in contour.

- 1 Design > Meshed Slab/Wall Design > Slab Flexural Design
- 2 Select [Avg. Nodal].
- 3 Check [As_req(m²/m)]
- 4 Check on **One-Way Flexure Design** option and click [...] button
- 5 Defined Cutting Lines [Add]
 - ⚙ Display the bending moments of the floor slab elements along a cutting line, and produce the design results of reinforcement.
- 6 Click [Apply]



04 Slab Flexural Design

Procedure

1 Design >

Meshed Slab/Wall Design >

Slab Flexural Design

2 Select [Avg. Nodal].

3 Click [Design Result]

- Produce the detail flexural design results of slab elements in a text format.

4 Click [Design Force]

- Produce the flexural design forces of slab elements in a tabular format.

5 Click [Update Rebar]

- Update the rebar quantity for each slab element. The updated rebar data is used for strength verification.

The screenshot displays the MIDAS/Gen software interface for Slab Flexural Design. The main window shows a table of design forces for various slab elements. The table has columns for Element, Node, and design forces (LCB, Mmax, Mmin) for both Top and Bottom surfaces. A text editor window is open, showing the output of the design result, including material properties and design parameters.

Elem	Node	Top		Bottom	
		LCB	Mmax (kN-m)	LCB	Mmin (kN-m)
24872	24873	0.00	0.00	0.00	0.00
24872	24874	0.00	0.00	0.00	0.00
24872	24875	0.00	0.00	0.00	0.00
24872	24876	0.00	0.00	0.00	0.00
24872	24877	0.00	0.00	0.00	0.00
24872	24878	0.00	0.00	0.00	0.00
24872	24879	0.00	0.00	0.00	0.00
24872	24880	0.00	0.00	0.00	0.00
24872	24881	0.00	0.00	0.00	0.00
24872	24882	0.00	0.00	0.00	0.00
24872	24883	0.00	0.00	0.00	0.00
24872	24884	0.00	0.00	0.00	0.00
24872	24885	0.00	0.00	0.00	0.00
24872	24886	0.00	0.00	0.00	0.00
24872	24887	0.00	0.00	0.00	0.00
24872	24888	0.00	0.00	0.00	0.00
24872	24889	0.00	0.00	0.00	0.00
24872	24890	0.00	0.00	0.00	0.00
24872	24891	0.00	0.00	0.00	0.00
24872	24892	0.00	0.00	0.00	0.00
24872	24893	0.00	0.00	0.00	0.00
24872	24894	0.00	0.00	0.00	0.00
24872	24895	0.00	0.00	0.00	0.00
24872	24896	0.00	0.00	0.00	0.00
24872	24897	0.00	0.00	0.00	0.00
24872	24898	0.00	0.00	0.00	0.00
24872	24899	0.00	0.00	0.00	0.00
24872	24900	0.00	0.00	0.00	0.00
24872	24901	0.00	0.00	0.00	0.00
24872	24902	0.00	0.00	0.00	0.00
24872	24903	0.00	0.00	0.00	0.00
24872	24904	0.00	0.00	0.00	0.00
24872	24905	0.00	0.00	0.00	0.00
24872	24906	0.00	0.00	0.00	0.00
24872	24907	0.00	0.00	0.00	0.00
24872	24908	0.00	0.00	0.00	0.00
24872	24909	0.00	0.00	0.00	0.00
24872	24910	0.00	0.00	0.00	0.00
24872	24911	0.00	0.00	0.00	0.00
24872	24912	0.00	0.00	0.00	0.00
24872	24913	0.00	0.00	0.00	0.00
24872	24914	0.00	0.00	0.00	0.00
24872	24915	0.00	0.00	0.00	0.00
24872	24916	0.00	0.00	0.00	0.00
24872	24917	0.00	0.00	0.00	0.00
24872	24918	0.00	0.00	0.00	0.00
24872	24919	0.00	0.00	0.00	0.00
24872	24920	0.00	0.00	0.00	0.00
24872	24921	0.00	0.00	0.00	0.00
24872	24922	0.00	0.00	0.00	0.00
24872	24923	0.00	0.00	0.00	0.00
24872	24924	0.00	0.00	0.00	0.00
24872	24925	0.00	0.00	0.00	0.00
24872	24926	0.00	0.00	0.00	0.00
24872	24927	0.00	0.00	0.00	0.00
24872	24928	0.00	0.00	0.00	0.00
24872	24929	0.00	0.00	0.00	0.00
24872	24930	0.00	0.00	0.00	0.00
24872	24931	0.00	0.00	0.00	0.00
24872	24932	0.00	0.00	0.00	0.00
24872	24933	0.00	0.00	0.00	0.00
24872	24934	0.00	0.00	0.00	0.00
24872	24935	0.00	0.00	0.00	0.00
24872	24936	0.00	0.00	0.00	0.00
24872	24937	0.00	0.00	0.00	0.00
24872	24938	0.00	0.00	0.00	0.00
24872	24939	0.00	0.00	0.00	0.00
24872	24940	0.00	0.00	0.00	0.00
24872	24941	0.00	0.00	0.00	0.00
24872	24942	0.00	0.00	0.00	0.00
24872	24943	0.00	0.00	0.00	0.00
24872	24944	0.00	0.00	0.00	0.00
24872	24945	0.00	0.00	0.00	0.00
24872	24946	0.00	0.00	0.00	0.00
24872	24947	0.00	0.00	0.00	0.00
24872	24948	0.00	0.00	0.00	0.00
24872	24949	0.00	0.00	0.00	0.00
24872	24950	0.00	0.00	0.00	0.00
24872	24951	0.00	0.00	0.00	0.00
24872	24952	0.00	0.00	0.00	0.00
24872	24953	0.00	0.00	0.00	0.00
24872	24954	0.00	0.00	0.00	0.00
24872	24955	0.00	0.00	0.00	0.00
24872	24956	0.00	0.00	0.00	0.00
24872	24957	0.00	0.00	0.00	0.00
24872	24958	0.00	0.00	0.00	0.00
24872	24959	0.00	0.00	0.00	0.00
24872	24960	0.00	0.00	0.00	0.00
24872	24961	0.00	0.00	0.00	0.00
24872	24962	0.00	0.00	0.00	0.00
24872	24963	0.00	0.00	0.00	0.00
24872	24964	0.00	0.00	0.00	0.00
24872	24965	0.00	0.00	0.00	0.00
24872	24966	0.00	0.00	0.00	0.00
24872	24967	0.00	0.00	0.00	0.00
24872	24968	0.00	0.00	0.00	0.00
24872	24969	0.00	0.00	0.00	0.00
24872	24970	0.00	0.00	0.00	0.00
24872	24971	0.00	0.00	0.00	0.00
24872	24972	0.00	0.00	0.00	0.00
24872	24973	0.00	0.00	0.00	0.00
24872	24974	0.00	0.00	0.00	0.00
24872	24975	0.00	0.00	0.00	0.00
24872	24976	0.00	0.00	0.00	0.00
24872	24977	0.00	0.00	0.00	0.00
24872	24978	0.00	0.00	0.00	0.00
24872	24979	0.00	0.00	0.00	0.00
24872	24980	0.00	0.00	0.00	0.00
24872	24981	0.00	0.00	0.00	0.00
24872	24982	0.00	0.00	0.00	0.00
24872	24983	0.00	0.00	0.00	0.00
24872	24984	0.00	0.00	0.00	0.00
24872	24985	0.00	0.00	0.00	0.00
24872	24986	0.00	0.00	0.00	0.00
24872	24987	0.00	0.00	0.00	0.00
24872	24988	0.00	0.00	0.00	0.00
24872	24989	0.00	0.00	0.00	0.00
24872	24990	0.00	0.00	0.00	0.00
24872	24991	0.00	0.00	0.00	0.00
24872	24992	0.00	0.00	0.00	0.00
24872	24993	0.00	0.00	0.00	0.00
24872	24994	0.00	0.00	0.00	0.00
24872	24995	0.00	0.00	0.00	0.00
24872	24996	0.00	0.00	0.00	0.00
24872	24997	0.00	0.00	0.00	0.00
24872	24998	0.00	0.00	0.00	0.00
24872	24999	0.00	0.00	0.00	0.00
24872	25000	0.00	0.00	0.00	0.00

04 Slab Flexural Design

Procedure

① Design >
Meshed Slab/Wall Design >
Slab Flexural Design

② Check [Resistance Ratio]

The ratio of the design moment to the moment resistance when the designed rebar spacing is applied.

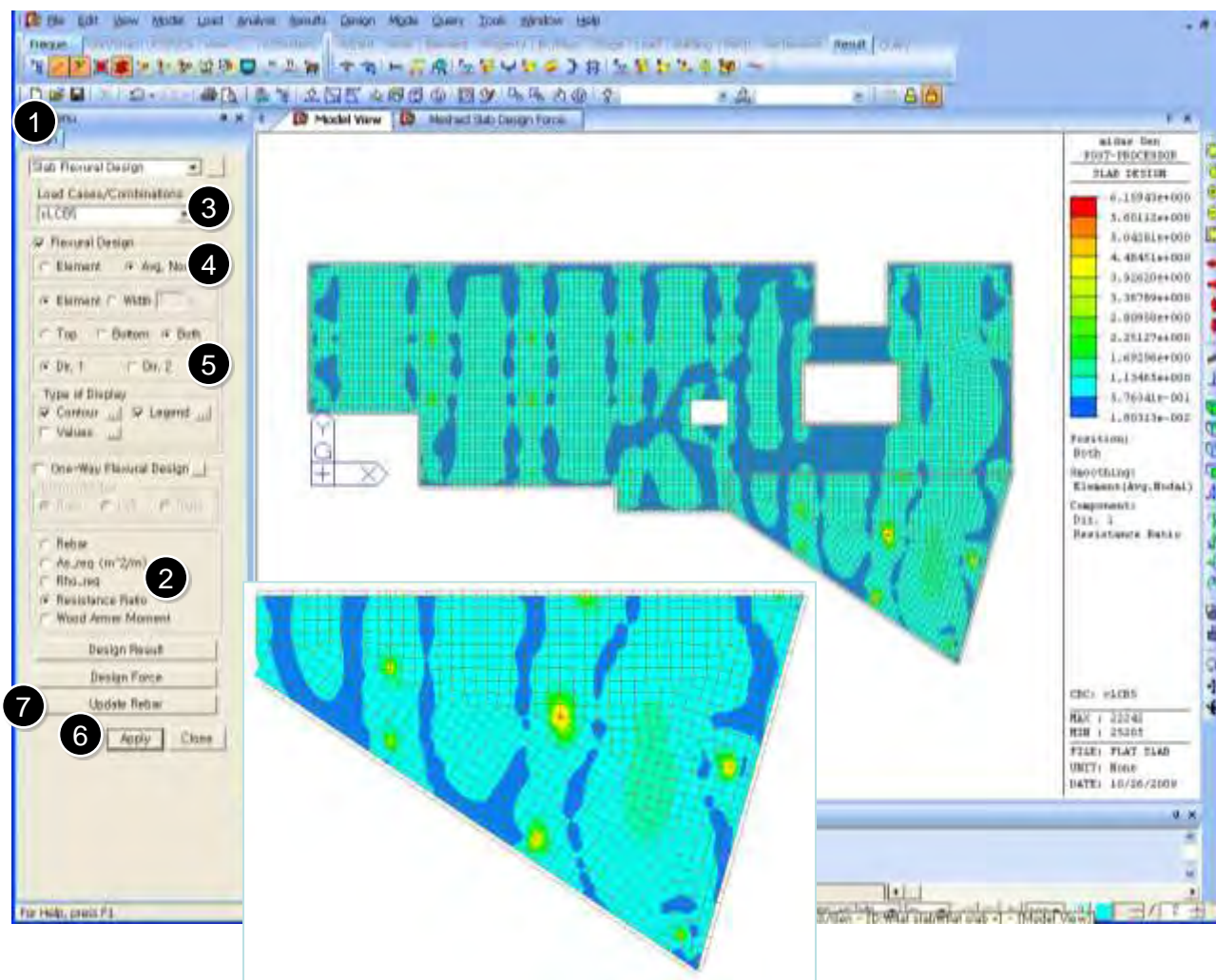
③ Load Cases/ Combinations
: cLCB5

④ Select [Avg. Nodal].

⑤ Check [Dir.1]

⑥ Click [Apply]

⑦ Click [Update Rebar]



Procedure

[Smoothing]

Design > Meshed Slab/Wall Design >
Slab Flexural Design

Flexural Checking

Element Avg. Nodal

Element Width m

Top Bottom Both

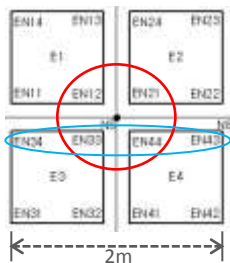
Dir. 1 Dir. 2

Type of Display

Contour ... Legend ...

Values ...

Average Nodal and Width smoothing



Avg. Nodal of EN33 =
 $(EN12+EN21+EN33+EN44)/4$

Width 2m of EN33 =
 $(EN33+EN34+EN43+EN44)/4$

For practical design, smooth moment distributions are preferred. By selecting the smoothing option, the program can consider the smooth moment in slab design.

Element Avg. Nodal

Element: Design results are displayed using the internal forces calculated at each node of elements. (no smoothing)

Avg. Nodal: Design results are displayed using the average internal nodal forces of the contiguous elements sharing the common nodes.

Element Width m

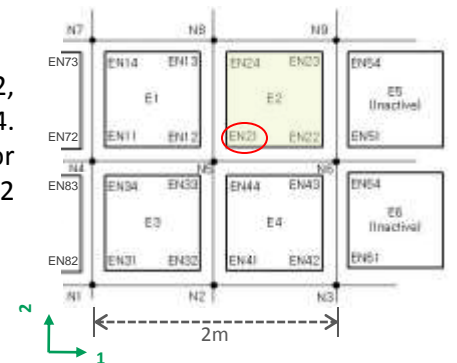
Element: Design results are produced for moments at each node of slab elements. (no smoothing)

Width: Design result of slab elements at each node is produced using the average of the bending moments of the contiguous slab elements with the specified width.

(Example) Design force for Node. EN21

In one plate element, 4 internal forces exist. For the element E2, member forces exist at the node EN21, EN22, EN23 and EN24. Following equations show how the smoothing option works for the node EN21. (Assume that rebar direction is selected as Angle 2 for Width smoothing direction.)

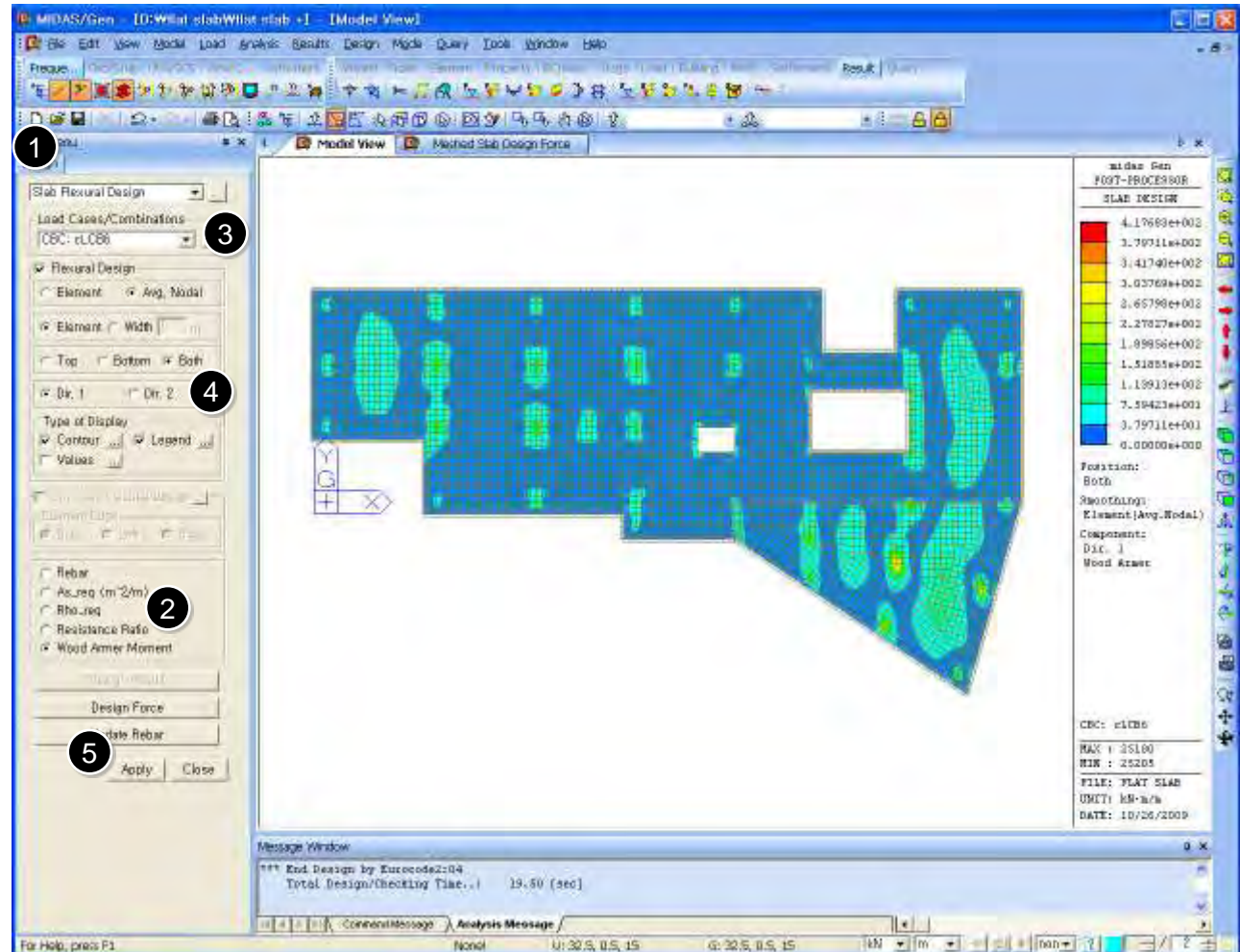
- (1) **Element + Element:** EN21
- (2) **Avg. Nodal +Element:** $(EN12+EN21+EN33+EN44)/4$
- (3) **Element + Width 2m:** $(EN11+EN12+EN21+EN22)/4$
- (4) **Avg. Nodal + Width 2m:** $\{(EN11+EN34+EN72+EN83)/4 + (EN12+EN21+EN33+EN44)/4 + (EN22+ EN43+ EN51+EN64)/4 \}/3$



04 Slab Flexural Design

Procedure

- ① Design > Meshed Slab/Wall Design > Slab Flexural Design
- ② Check [Wood Armer Moment]
 - 🔊 Display the Wood Armer Moments in contour.
- ③ Load Cases/ Combinations : CBC : cLCB6
- ④ Check [Dir.1]
- ⑤ Click [Apply]



04 Slab Flexural Design

Procedure

[Wood Armer Moment]

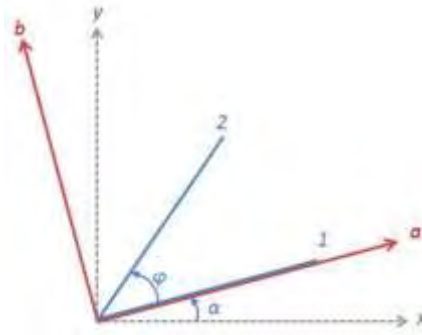
From the analysis results, following plate forces about the local axis are calculated

- m_{xx}

- m_{yy}

- m_{xy}

In order to calculate design forces in the reinforcement direction, angle α and φ will be taken as following figure:



x, y: local axis of plate element

1, 2: reinforcement direction

α : angle between local x-direction and reinforcement direction 1

φ : angle between reinforcement direction 1 and reinforcement direction 2

Firstly, internal forces (m_{xx} , m_{yy} and m_{xy}) are transformed into the a-b coordinate system.

$$m_a = \frac{m_{xx} + m_{yy}}{2} + \frac{m_{xx} - m_{yy}}{2} \cos 2\alpha + m_{xy} \sin 2\alpha$$

$$m_b = \frac{m_{xx} + m_{yy}}{2} - \frac{m_{xx} - m_{yy}}{2} \cos 2\alpha - m_{xy} \sin 2\alpha$$

$$m_{ab} = -\frac{m_{xx} - m_{yy}}{2} \sin 2\alpha + m_{xy} \cos 2\alpha$$

Procedure

[Wood Armer Moment]

Then, Wood-Armer moments are calculated as follows:

[Bottom Rebar]

$$m_{ud1} = m_a - 2m_{ab} \cot \varphi + m_b \cot^2 \varphi + \left| \frac{m_{ab} - m_b \cot \varphi}{\sin \varphi} \right|$$

$$m_{ud2} = \frac{m_b}{\sin^2 \varphi} + \left| \frac{m_{ab} - m_b \cot \varphi}{\sin \varphi} \right|$$

When $m_{ud1} < 0$ and $m_{ud2} > 0$,

$$m_{ud1} = 0$$

$$m_{ud2} = \max \left\{ 0, \frac{m_b + |(m_{ab} - m_b \cot \varphi)^2 / (m_a - 2m_{ab} \cot \varphi + m_b \cot^2 \varphi)|}{\sin^2 \varphi} \right\}$$

When $m_{ud1} > 0$ and $m_{ud2} < 0$,

$$m_{ud1} = \max \left\{ 0, m_a - 2m_{ab} \cot \varphi + m_b \cot^2 \varphi + \left| \frac{(m_{ab} - m_b \cot \varphi)^2}{m_b} \right| \right\}$$

$$m_{ud2} = 0$$

When $m_{ud1} < 0$ and $m_{ud2} < 0$,

$$m_{ud1} = 0$$

$$m_{ud2} = 0$$

[Top Rebar]

$$m'_{ud1} = m_a - 2m_{ab} \cot \varphi + m_b \cot^2 \varphi - \left| \frac{m_{ab} - m_b \cot \varphi}{\sin \varphi} \right|$$

$$m'_{ud2} = \frac{m_b}{\sin^2 \varphi} - \left| \frac{m_{ab} - m_b \cot \varphi}{\sin \varphi} \right|$$

When $m'_{ud1} > 0$ and $m'_{ud2} < 0$,

$$m'_{ud1} = 0$$

$$m'_{ud2} = \min \left\{ 0, \frac{m_b - |(m_{ab} - m_b \cot \varphi)^2 / (m_a - 2m_{ab} \cot \varphi + m_b \cot^2 \varphi)|}{\sin^2 \varphi} \right\}$$

When $m'_{ud1} < 0$ and $m'_{ud2} > 0$,

$$m'_{ud1} = \min \left\{ 0, m_a - 2m_{ab} \cot \varphi + m_b \cot^2 \varphi - \left| \frac{(m_{ab} - m_b \cot \varphi)^2}{m_b} \right| \right\}$$

$$m'_{ud2} = 0$$

When $m'_{ud1} > 0$ and $m'_{ud2} > 0$,

$$m'_{ud1} = 0$$

$$m'_{ud2} = 0$$

04 Slab Shear Checking

Procedure

Slab Shear Checking

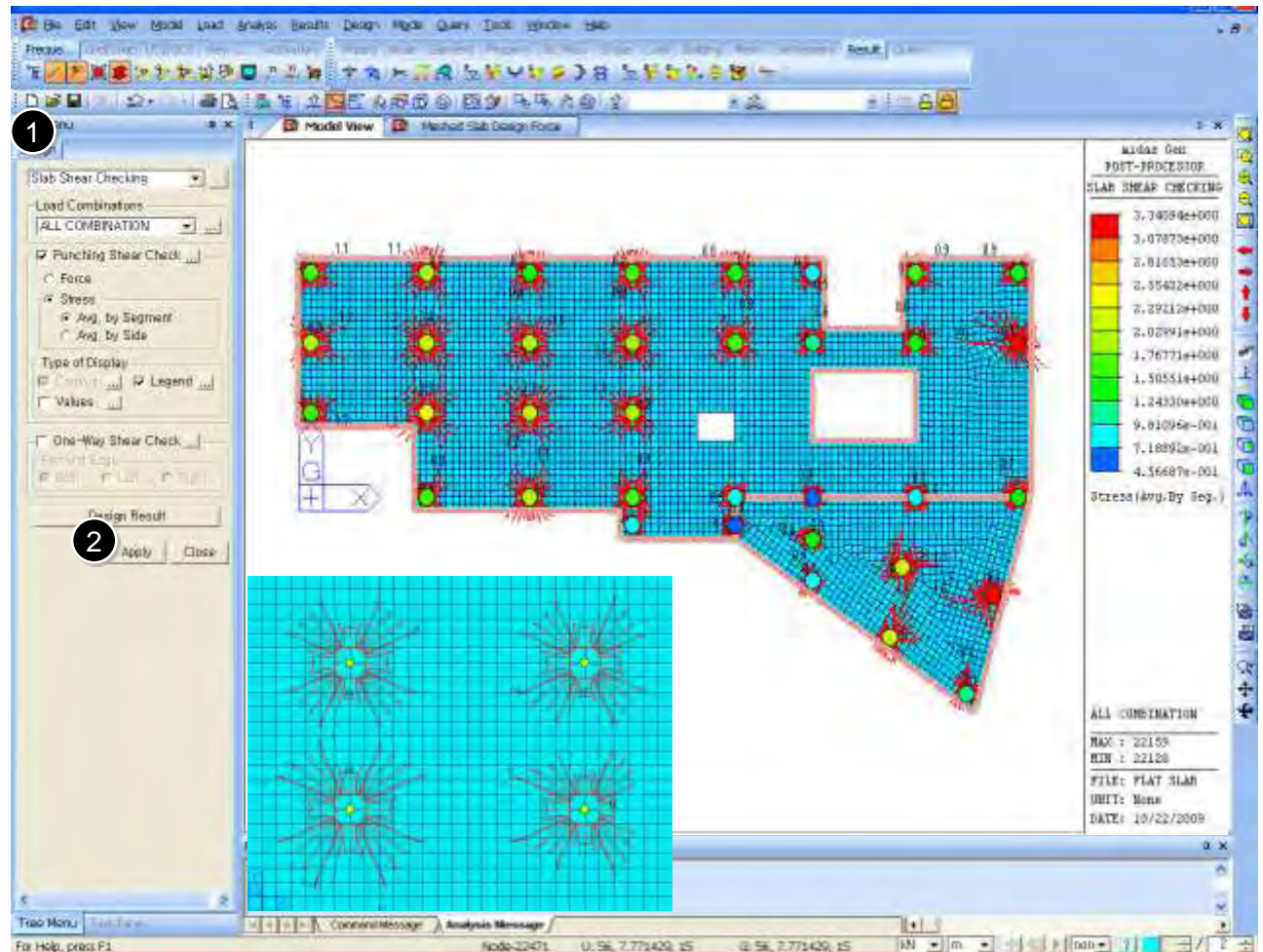
Produce the two-way shear (punching shear) check results at the supports of slab elements or at concentrated loads and the one-way shear check results along the user-defined Shear Check Lines.

1 Design >

Meshed Slab/Wall Design >

Slab Shear Checking

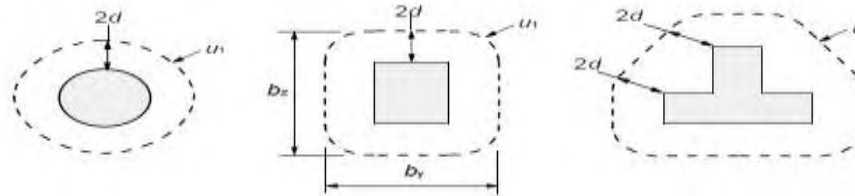
2 Click [Apply]



Procedure

[Punching Shear Check(By Force)]

In this method, the program takes the axial force in the column supporting the slab as the shear force (V_{Ed}). The basic control perimeter (u_1) is taken at a distance $2d$ from the column face (as shown in the diagram below).



The maximum shear force is calculated by multiplying V_{Ed} with shear enhancement factor β . The value of β is different for different columns. (as given in the code)

1. Internal rectangular Column Uniaxial bending	$\beta = 1 + k \frac{M_{Ed}}{V_{Ed}} \frac{u_1}{W_1}$ $W_1 = \frac{c_1^2}{2} + c_1 c_2 + 4c_2 d + 16d^2 + 2mb_1$
2. Internal rectangular Column biaxial bending	$\beta = 1 + 1.3 \sqrt{\left(\frac{a_x}{b_x}\right)^2 + \left(\frac{a_y}{b_y}\right)^2}$
3. Rectangular Edge Column: axis of bending parallel to slab edge, eccentricity is towards interior.	$\beta = \frac{u_1}{u_{int}}$
4. Rectangular Edge Column: bending about both the axes, eccentricity perpendicular to slab edge is towards exterior.	$\beta = 1 + k \frac{M_{Ed}}{V_{Ed}} \frac{u_1}{W_1}$ $W_1 = \frac{c_1^2}{2} + c_1 c_2 + 4c_2 d + 16d^2 + 2mb_1$
5. Rectangular Edge Column: bending about both the axes, eccentricity perpendicular to slab edge is towards interior.	$\beta = \frac{u_1}{u_{int}} + k \frac{M_{Ed}}{V_{Ed}} \frac{u_1}{W_1}$ $W_1 = \frac{c_1^2}{4} + c_1 c_2 + 4c_2 d + 8d^2 + mb_1$
6. Rectangular Corner Column, eccentricity is towards interior	$\beta = \frac{u_1}{u_{int}}$
7. Rectangular Corner Column, eccentricity is towards exterior	$\beta = 1 + k \frac{M_{Ed}}{V_{Ed}} \frac{u_1}{W_1}$ $W_1 = \frac{c_1^2}{2} + c_1 c_2 + 4c_2 d + 16d^2 + 2mb_1$
8. Interior Circular column	$\beta = 1 + 0.5 \frac{u_1}{D - 4d}$
9. Circular edge or corner column	No information in the code.

The shear resistance of the slab (without shear reinforcement) at the basic control section is given by $V_{Rd,c} = (0.18/\gamma_c)k(100\rho_1 f_{ck})^{1/3}(u_1 d)$, the value of ρ_1 is assumed to be 0.02.

$$V_{Rd,c} \geq (0.035k^{3/2} f_{ck}^{1/2})(u_1 * d)$$

If

• $V_{Ed} < V_{Rd,c}$: section is safe in punching shear

• $V_{Ed} > V_{Rd,c}$: provide shear reinforcement.

$$A_{sw}/s_r = (v_{Ed} - 0.75v_{Rd,c})(u_1 d) / (1.5d f_{ywd} e_f)$$

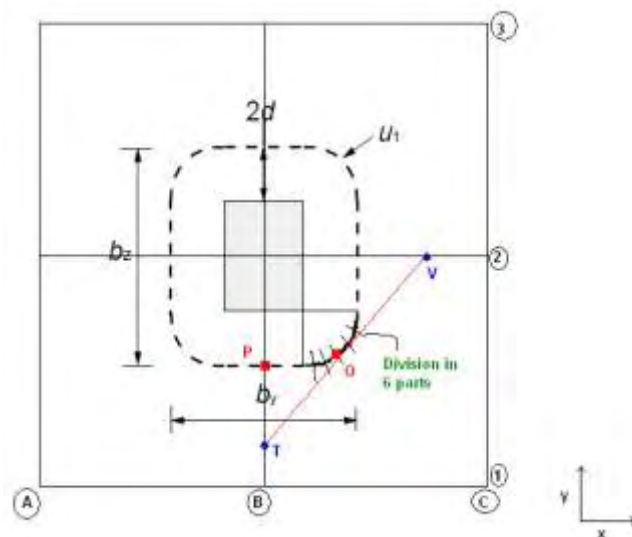
04 Slab Shear Checking

Procedure

[Punching Shear Check(By Stress)]

In these methods (The Stress Method), the Shear force along the critical section is taken and divided by the effective depth to calculate shear stress.

Therefore there is no need to calculate β (Beta), to consider moment transferred to the column.



(There are 4 plate elements intersecting at nodes. The nodes are marked by nomenclature of Grid Lines. As the center node is denoted by B2 , B on x-Axis and 2 on Y-Axis)

When slab is defined as the plate element, the program calculated stresses only at the nodes, in the analysis. So we have the stresses at B1, B2, C2 etc. (see the figure above) are calculated by the program.

Case 1 - To calculate stresses at the critical section that is u_1 in the given figure, for example we take the point P in the figure which lies in a straight line. The stress at B1 and B2 are known. The values at these nodes are interpolated linearly to find the stress at point P .

Case 2- Now if the point lies in the curve such as the point Q, then the software will divide the curve into 6 parts. At each point such as Q a tangent which intersects B1-B2 and C2-B2. The value of stresses at T and V are determined by linear interpolation of stresses which are known at for T (at B1 and B2) and for V (at C2 and B2). After knowing stresses at T and V the stress at Q is determined by linear interpolation of stresses at T and V.

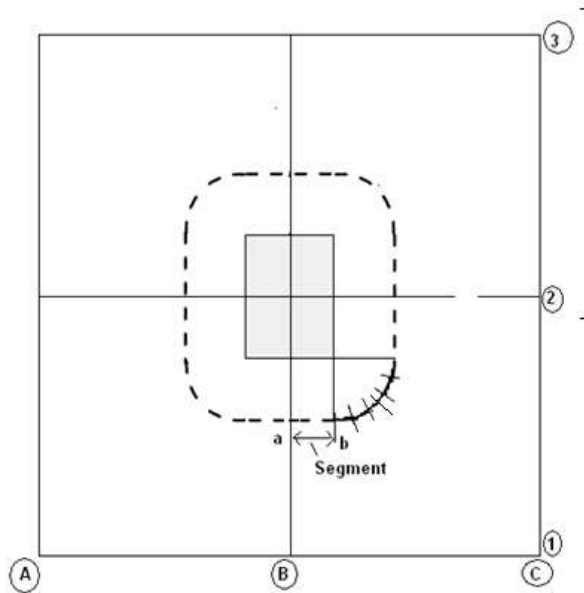
04 Slab Shear Checking

Procedure

[Punching Shear Check(By Stress)]

(Method 1: Average by elements.)

In this method the stresses at all the critical points is determined. The critical points divide the critical section into segments. The average value for all these segments is determined by dividing the stresses at the two ends of the segment by 2. After determining the average value for each segment, **the maximum** average value from all of the segments is reported as the Stress value for the critical Section.



a,b are stresses at the segment ends.

Average value for the segment will be $(a+b)/2$, and such average value for each segment is determined.

04 Slab Shear Checking

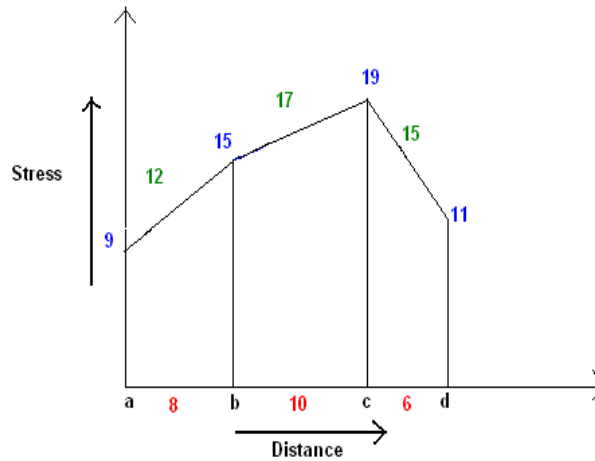
Procedure

[Punching Shear Check(By Stress)]

(Method 2: Average by Side)

In this method stresses at all critical points is determined and then average stress value is calculated by weighted mean.

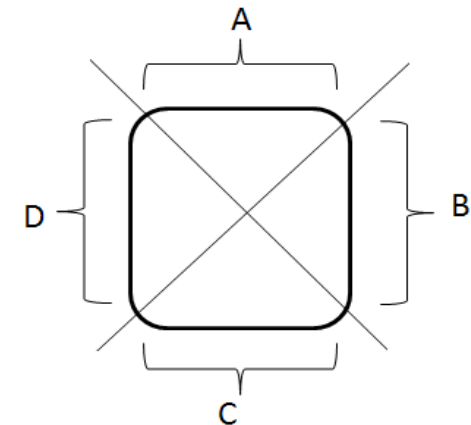
To calculate weighted mean , For example we have 4 critical points a, b, c, d.



- **Stress at critical points:** For example at 'a' its 9
- **Average of the segment:** For example in 'a' and 'b' its $(15+9)/2 = 12$
- **Distance Between the critical points:** For example between 'a' and 'b' its 8
- **Final Stress** = $(12 * 8 + 17 * 10 + 15 * 6) / (8+10+6)$, which is the weighted average.

We divide the Critical section into 4 sides as shown in figure.

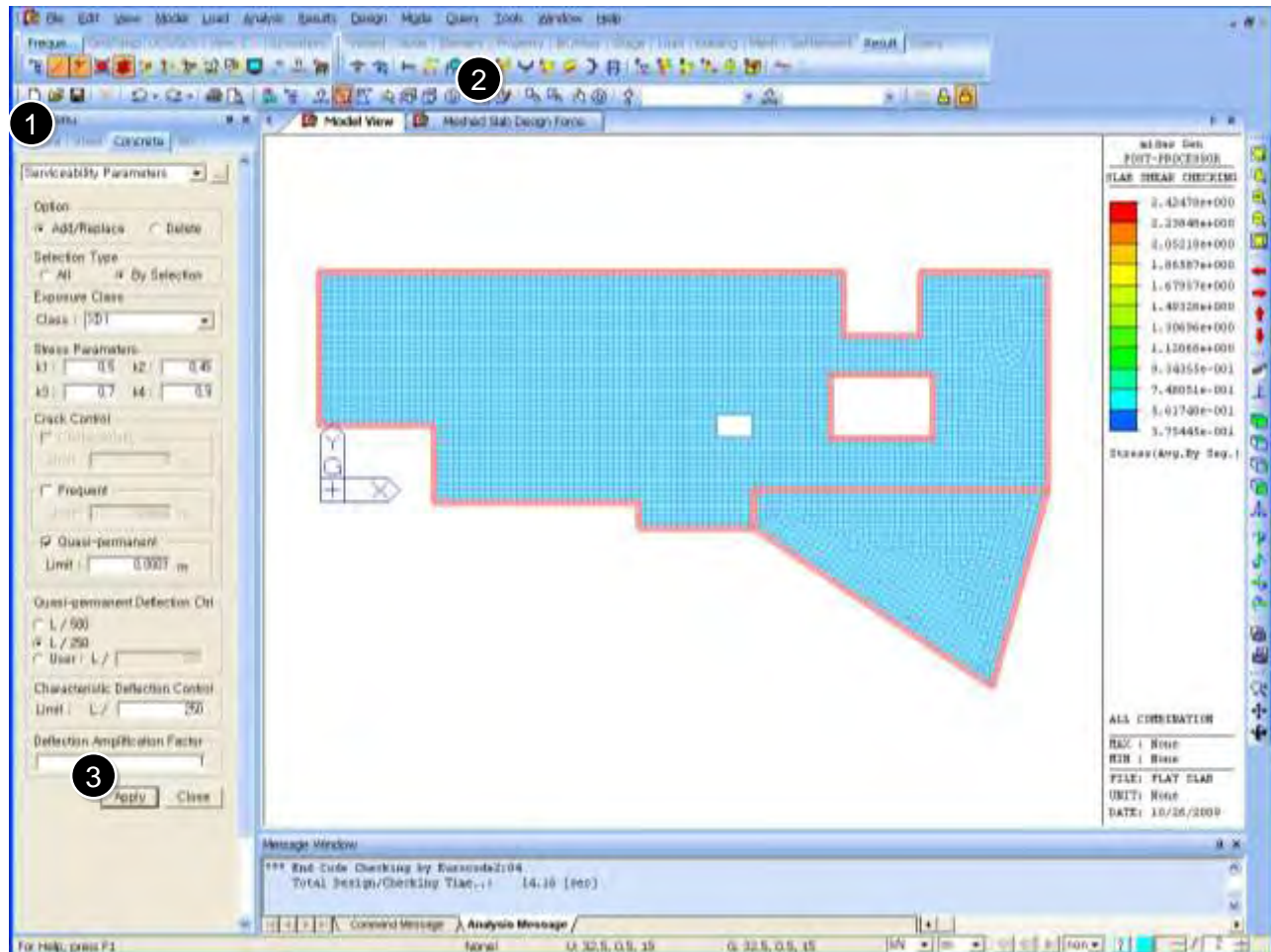
The weighted mean value for each side is determined and then the maximum value out of the 4 sides A, B, C, D is reported as the stress value.



04 Serviceability Parameter

Procedure

- ① Design > Concrete Design Parameter > Serviceability Parameter
- ② Select All
- ③ Click [Apply]



04 Serviceability Load Combination Type

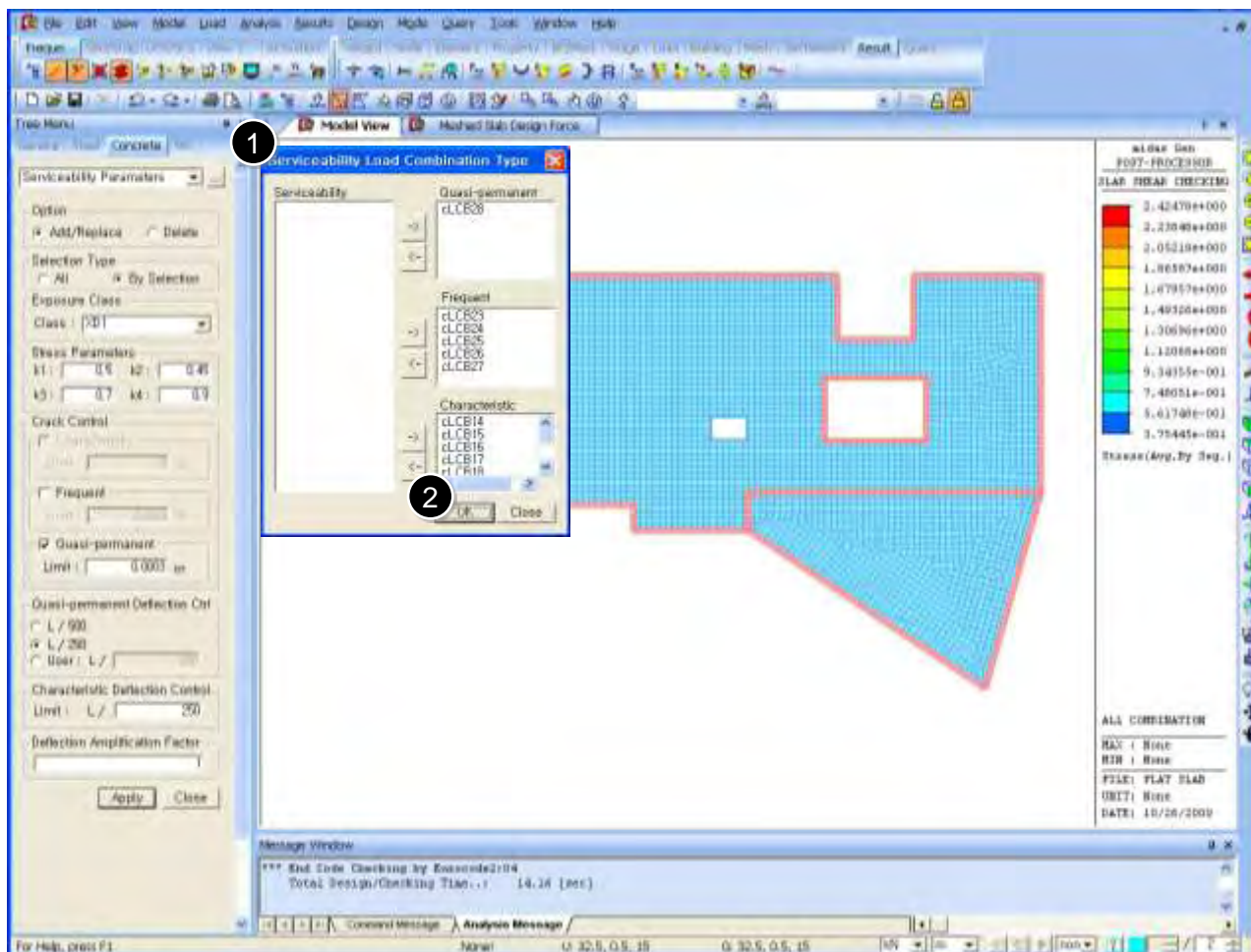
Procedure

- 1 Design >
Meshed Slab/Wall Design >
Serviceability Load
Combination Type

- 2 Click [OK] > [Close]

Serviceability load combination type is automatically assigned if 'Auto Generation' function has been used to generate load-combinations.

If the user manually defined load combinations, serviceability load combination type must be defined by the user. If serviceability load combination type is not specified, Slab Serviceability Checking is not performed.



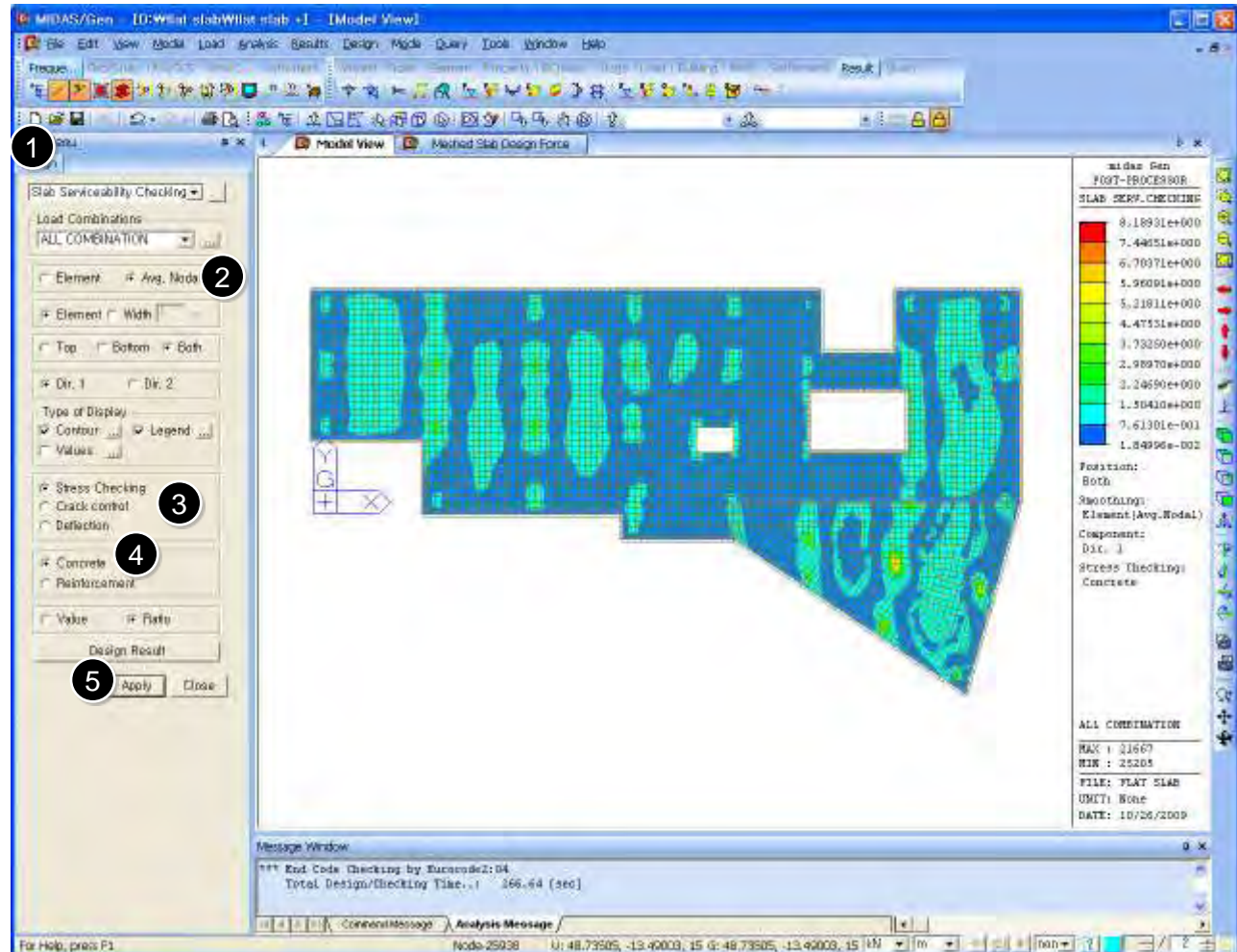
04 Slab Serviceability Checking

Procedure

Slab Serviceability Checking

Produce the serviceability check results for slabs.

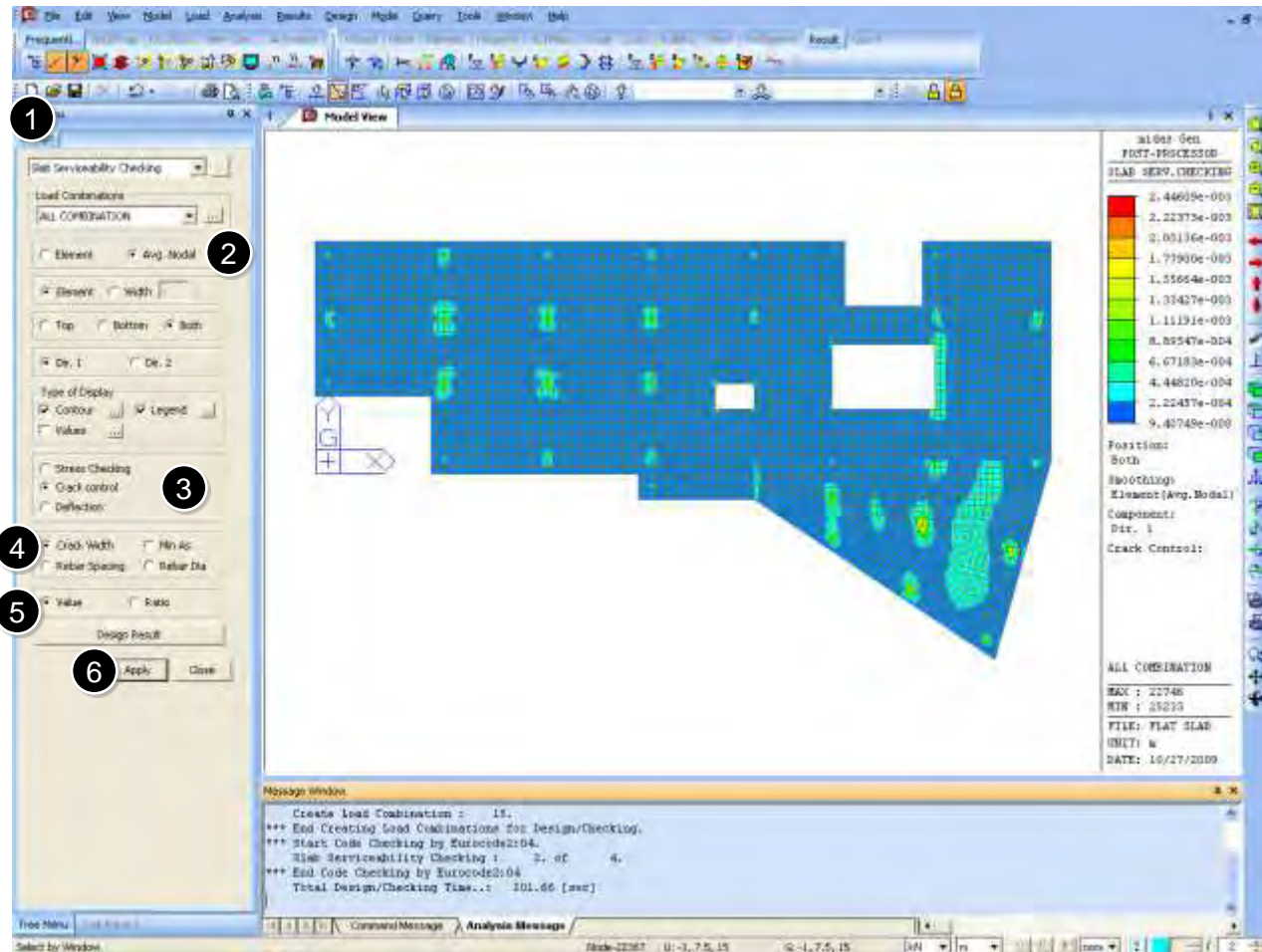
- ① **Design >**
Meshed Slab/Wall Design >
Slab Serviceability Checking
- ② Select **[Avg. Nodal]**.
- ③ Check **[Stress Checking]**
 - ☞ Display the compressive stress in the concrete.
- ④ Check **[Concrete]**
- ⑤ Click **[Apply]**



04 Slab Serviceability Checking

Procedure

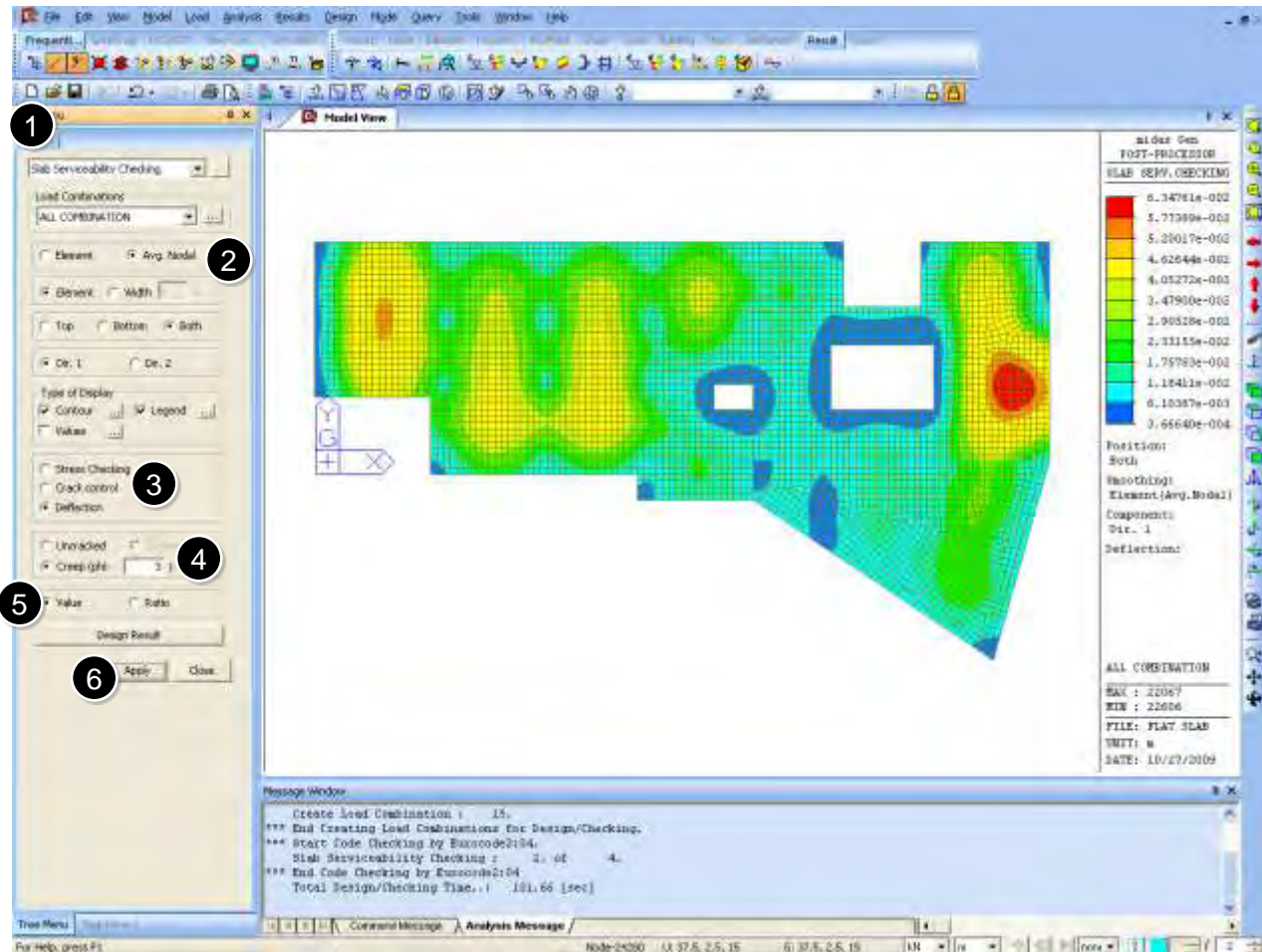
- 1 Design > Meshed Slab/Wall Design > Slab Serviceability Checking
- 2 Select [Avg. Nodal].
- 3 Check [Crack control]
 - ☞ Crack control is not performed for slab elements for which thickness is less than 200mm.
- 4 Check [Crack Width]
 - ☞ Display the value of crack width.
- 5 Select [Value]
- 6 Click [Apply]



04 Slab Serviceability Checking

Procedure

- 1 Design > Meshed Slab/Wall Design > Slab Serviceability Checking
- 2 Select [Avg. Nodal].
- 3 Check [Deflection]
- 4 Check [Creep]
 - ☞ Calculate the deflection for the uncracked section and compare it with the allowable deflection (deflection for the cracked section is not available yet) .
- 5 Select [Value]
- 6 Click [Apply]



Procedure

Wall Design

Perform the flexural design results for wall elements in contour.

Wall design is performed based on EN 1992-1-1:2004 Annex F (Tension reinforcement expressions for in-plane stress conditions).

1 View > Activities > Active All

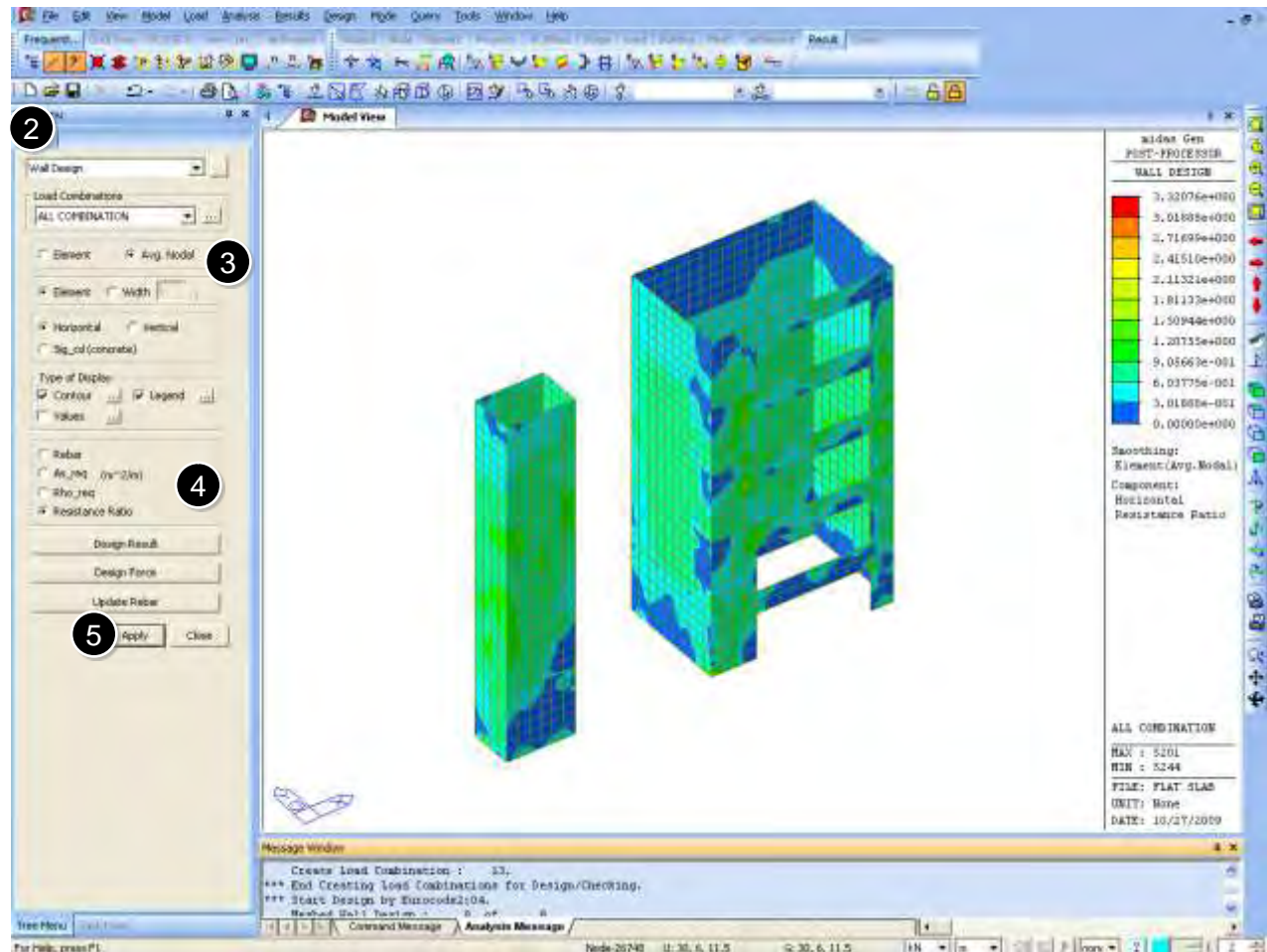
2 Design >
Meshed Slab/Wall Design >
Wall Design

Display the area of the required reinforcement.
Check [$A_{s_req}(m^2/m)$]

3 Select [Avg. Nodal].

4 Select [Resistance Ratio].

5 Click [Apply]



Procedure

- 1 Design > Meshed Slab/Wall Design > Wall Design
- 2 Click [Design Result]
- 3 Click [Design Force]

The screenshot shows the MIDAS/Gen software interface for 'Meshed Wall Design Force'. The main window displays a table of design force results for various elements. The table has columns for Elem, Node, LCB, F1st (kN/m²), LCB, F1st2 (kN/m²), LCB, and Sig_ed (kN/m²). The table lists 32 rows of data. A 'Design Force' button is highlighted in the left sidebar. A 'Message Window' at the bottom shows the completion of the design process: '*** End Design by Eurocode2:04 Total Design/Checking Time... 49.09 (sec)'.

Elem	Node	LCB	F1st (kN/m²)	LCB	F1st2 (kN/m²)	LCB	Sig_ed (kN/m²)
5201	6778	elCB5	0.00	elCB5	0.00	elCB5	1798.87
5201	6772	elCB5	346.91	elCB5	0.00	elCB5	2231.37
5201	6775	elCB9	3.88	elCB5	0.00	elCB5	3293.54
5201	6788	elCB5	0.00	elCB5	0.00	elCB5	1642.71
5202	6770	elCB5	0.00	elCB5	0.00	elCB5	-2312.48
5202	6775	elCB5	0.00	elCB5	0.00	elCB5	2093.48
5202	2493	elCB5	0.00	elCB5	0.00	elCB5	2024.70
5202	2494	elCB5	0.00	elCB5	0.00	elCB5	-2193.94
5203	18	elCB5	0.00	elCB5	0.00	elCB5	0.00
5203	6747	elCB5	2747.06	elCB5	0.00	elCB5	0.00
5203	6771	elCB1	244.15	elCB1	0.00	elCB1	0.00
5203	6764	elCB9	596.41	elCB1	0.00	elCB1	0.00
5204	6780	elCB5	0.00	elCB5	0.00	elCB5	0.00
5204	6755	elCB9	15.26	elCB5	0.00	elCB5	0.00
5204	6758	elCB5	0.00	elCB5	0.00	elCB5	0.00
5204	6781	elCB5	0.00	elCB5	0.00	elCB5	0.00
5205	6748	elCB8	549.23	elCB5	0.00	elCB5	0.00
5205	6749	elCB5	0.00	elCB5	0.00	elCB5	0.00
5205	6777	elCB5	0.00	elCB5	0.00	elCB5	0.00
5205	6776	elCB8	93.28	elCB5	0.00	elCB5	0.00
5206	6781	elCB5	0.00	elCB5	0.00	elCB5	0.00
5206	6768	elCB5	0.00	elCB5	0.00	elCB5	0.00
5206	6757	elCB5	0.00	elCB5	0.00	elCB5	0.00
5206	6769	elCB5	0.00	elCB5	0.00	elCB5	0.00
5207	6747	elCB5	2747.06	elCB5	0.00	elCB5	0.00
5207	6749	elCB8	946.29	elCB5	0.00	elCB5	0.00
5207	6778	elCB9	31.29	elCB5	0.00	elCB5	0.00
5207	6771	elCB7	244.15	elCB5	0.00	elCB5	0.00
5208	6762	elCB9	332.95	elCB5	0.00	elCB5	0.00
5209	6783	elCB9	195.62	elCB5	0.00	elCB5	0.00
5209	6782	elCB5	0.00	elCB5	0.00	elCB5	0.00
5209	6761	elCB9	247.20	elCB5	0.00	elCB5	0.00
5209	6762	elCB5	0.00	elCB5	0.00	elCB5	0.00
5209	6789	elCB5	0.00	elCB5	0.00	elCB5	0.00
5209	6768	elCB5	0.00	elCB5	0.00	elCB5	0.00
5209	6769	elCB5	0.00	elCB5	0.00	elCB5	0.00
5210	6772	elCB5	346.91	elCB5	0.00	elCB5	0.00
5210	6753	elCB5	0.00	elCB5	0.00	elCB5	0.00
5210	6754	elCB5	0.00	elCB5	0.00	elCB5	0.00
5210	6779	elCB9	3.88	elCB5	0.00	elCB5	0.00
5211	6748	elCB5	0.00	elCB5	0.00	elCB5	0.00
5211	6750	elCB3	1102.69	elCB5	0.00	elCB5	0.00
5211	6755	elCB5	0.00	elCB5	0.00	elCB5	0.00

Message Window
 *** End Design by Eurocode2:04
 Total Design/Checking Time... 49.09 (sec)