Cairo University

PLPAK: BEM based software

Presented by
Prof. Youssef F. Rashed
Dr. Ahmed Fady Farid

www.be4e.com

هيئة تمويل العلوم والتكنولوجيا والابتكار
Science, Technology & Innovation Funding Authority

CUFE-BE

Cairo University
Faculty of Engineering
Boundary Elements Group

2021

Cairo University

PLPAK: BEM based software

Presented by
Prof. Youssef F. Rashed
Dr. Ahmed Fady Farid

www.be4e.com

2021

Cairo University
Faculty of Engineering
Boundary Elements Group

CUFE-BE

www.be4e.com

Cairo University

Table of contents

CUFE-BE

www.be4e.com

Cairo University

Table of contents

CUFE-BE

www.be4e.com

Cairo University

What is the PLPAK?

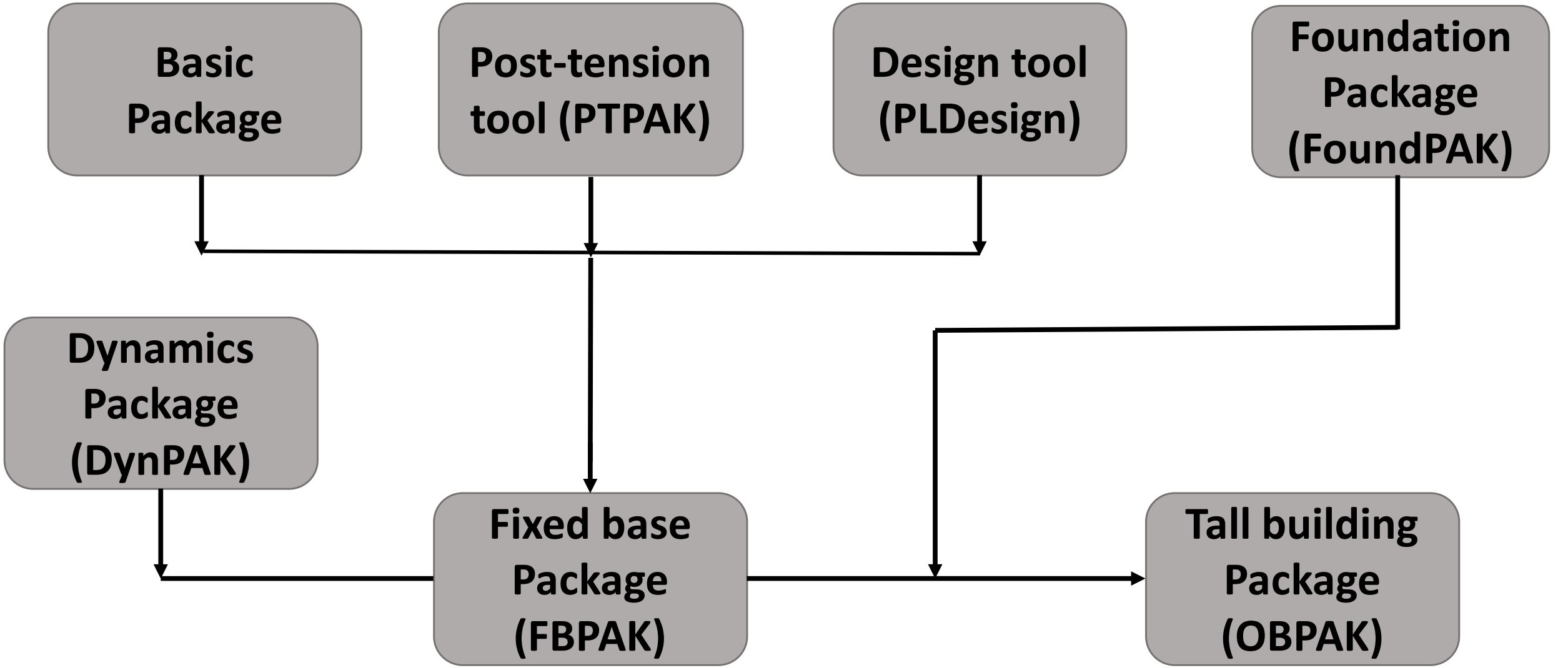
- PLPAK (plate analysis package) is a structural analysis software package for plate bending structures based on the boundary element method for shear deformable plate bending theory.
- The PLPAK-Basic is a software package for structural analysis of building slabs and foundations.
- The PLPAK solves single floor at the time; each floor consists of single slab with several openings.
- The PLPAK deals with the real geometry of structural element so we can reach for more realistic simulation for the structure.
- The PLPAK is very easy to learn and doesn't require any previous knowledge of boundary elements.
- The PLPAK has also been verified by papers published in highly ranked journals. And its results are verified by several other analytical and reliable numerical methods, as well as proving to be much quicker at solving irregular large practical models.

CUFE-BE

www.be4e.com

Cairo University

1. Introduction



CUFE-BE

www.be4e.com

Cairo University

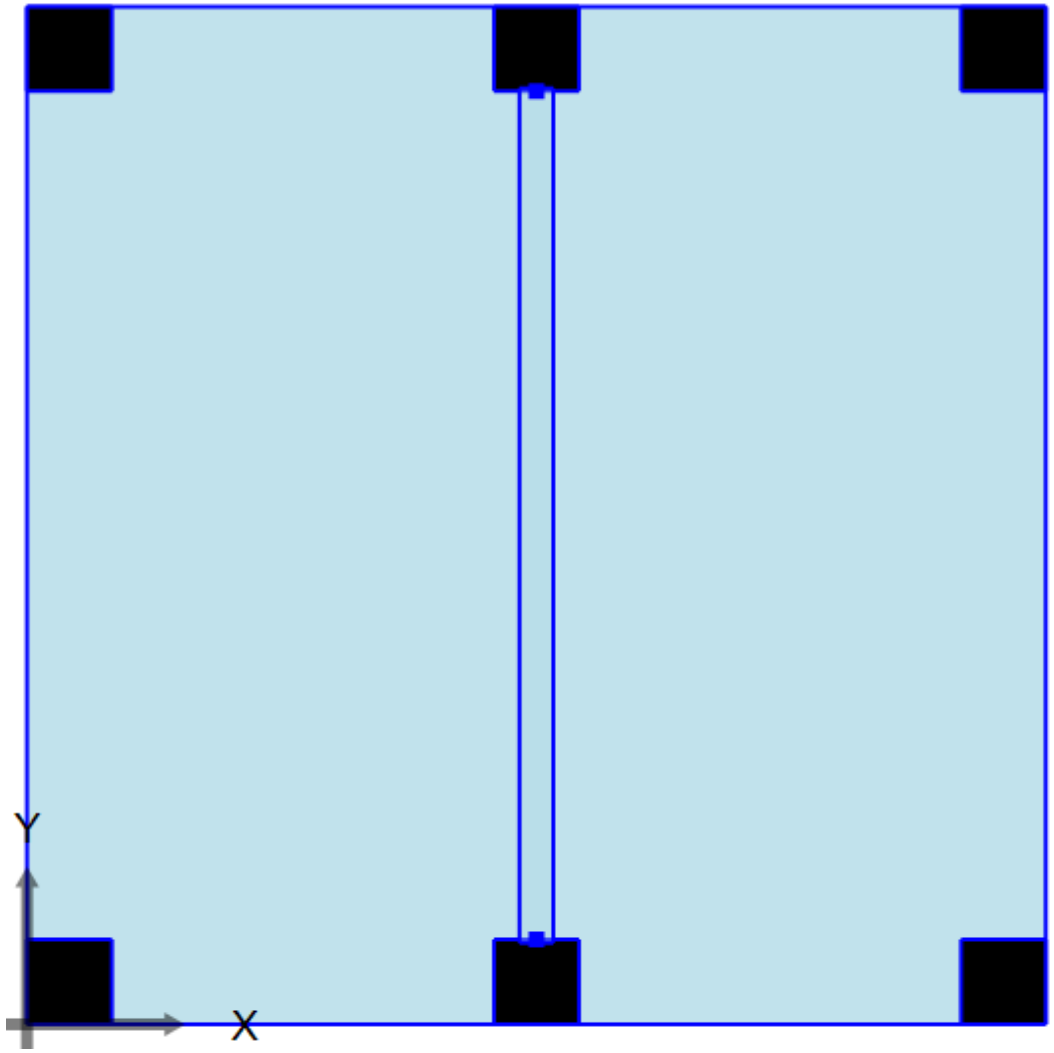
Table of contents

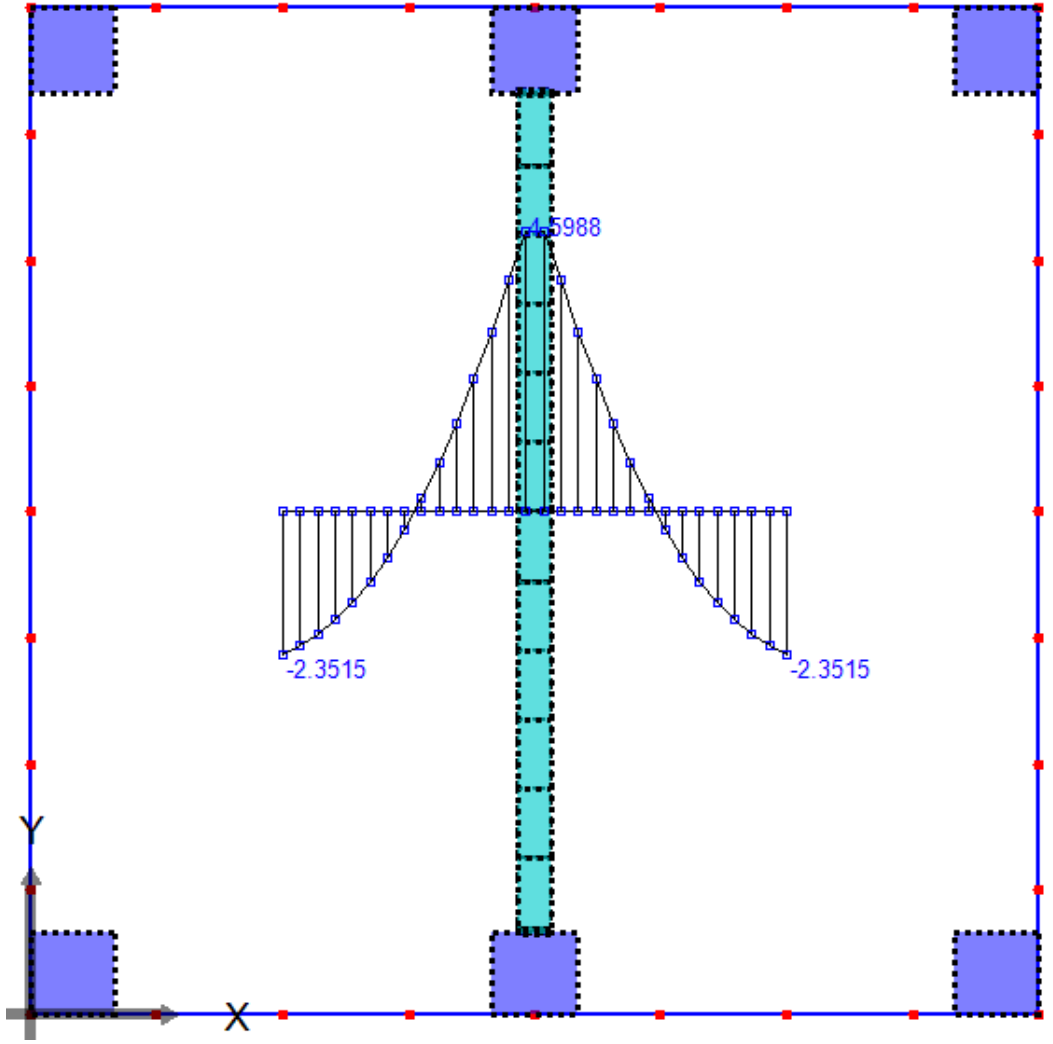
CUFE-BE

www.be4e.com

Cairo University

2. Basic package (PLPAK Basic)



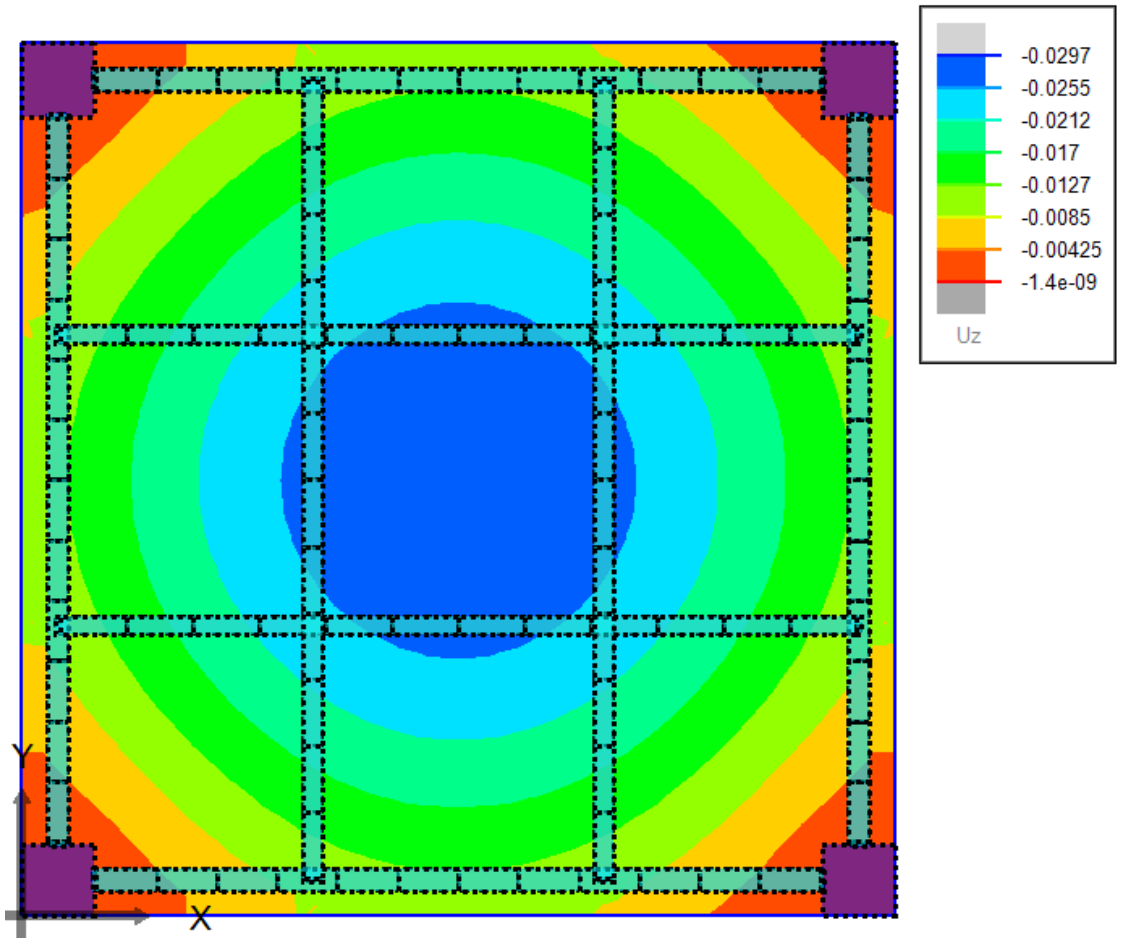


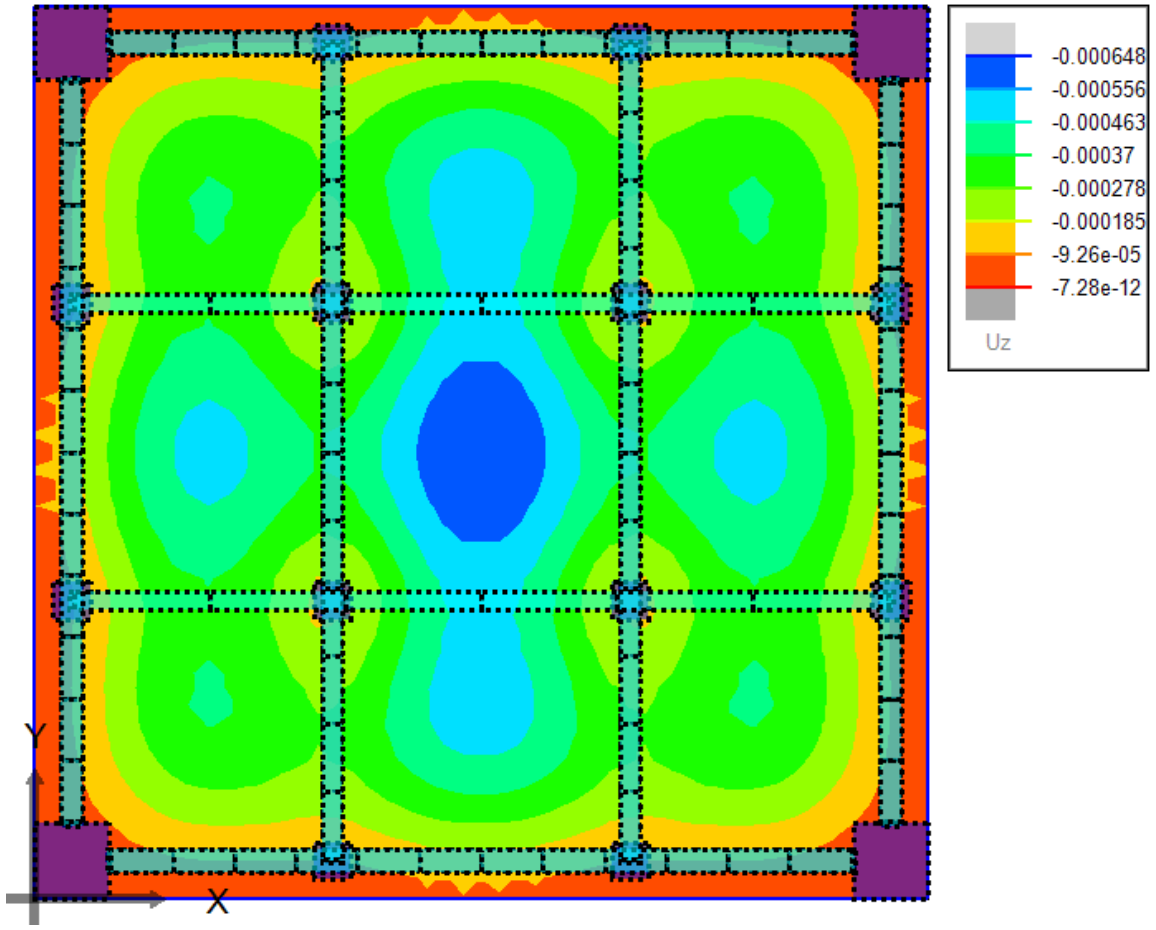
CUFE-BE

www.be4e.com

Cairo University

2. Basic package (PLPAK Basic)



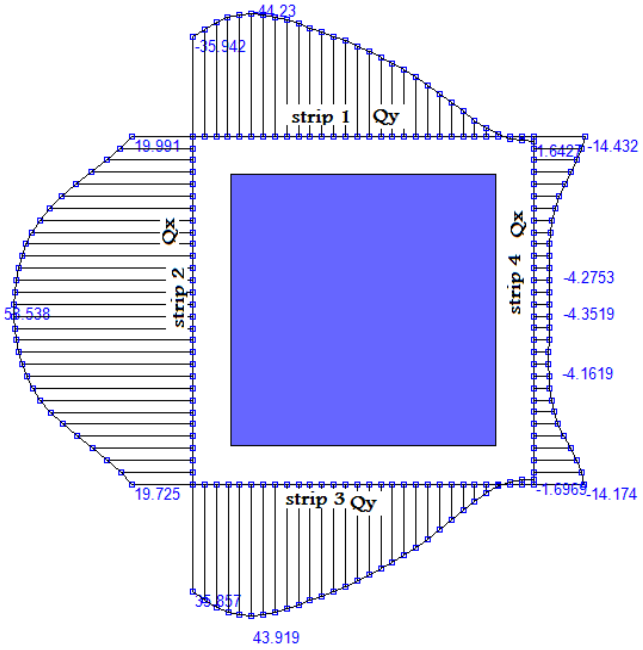


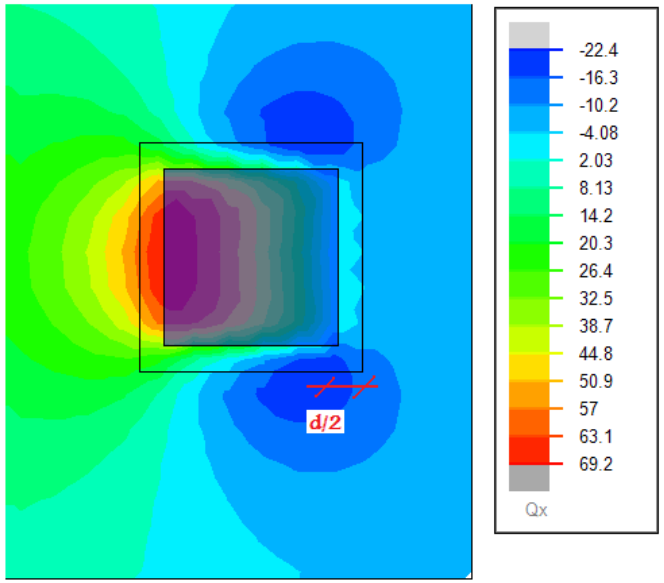
CUFE-BE

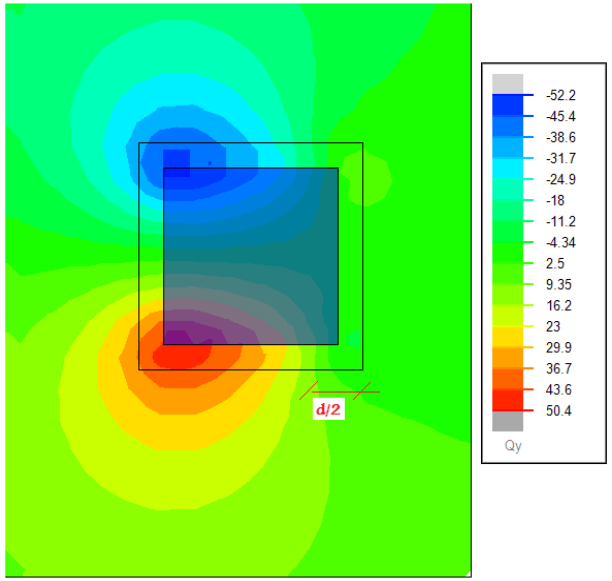
www.be4e.com

Cairo University

2. Basic package (PLPAK Basic)





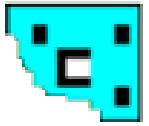


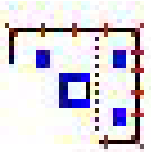
CUFE-BE

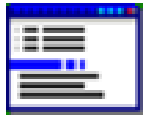
www.be4e.com

Cairo University

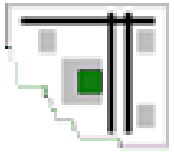
PLPAK Basic – package components:

1- Generator (PLGen). 

2- Boundary element numerical model viewer (PLView). 

3- Manager (PLCoreMan). 

4- Post-processing (PLPost). 

5- Design tool (PLDesign) 

CUFE-BE

www.be4e.com

Cairo University

A. **PLGen – Model generator**

B. PLView – Numerical model

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

The PLGen is responsible for generating the model showing every structural element. Generating the model is in main three steps:

1. **Edit model information**

2. **Build model and define its elements**

3. **Edit the boundary element divisions**

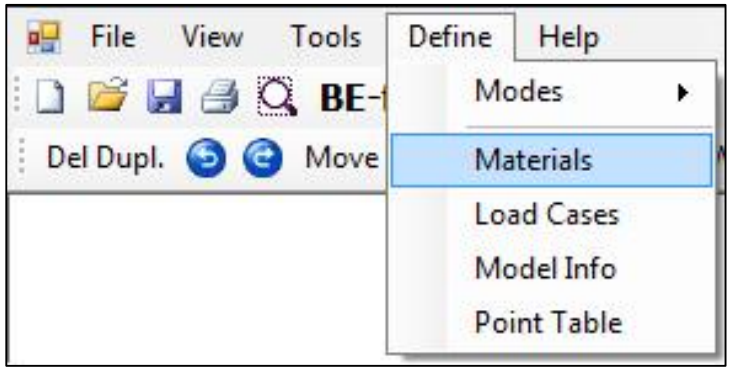
CUFE-BE

www.be4e.com

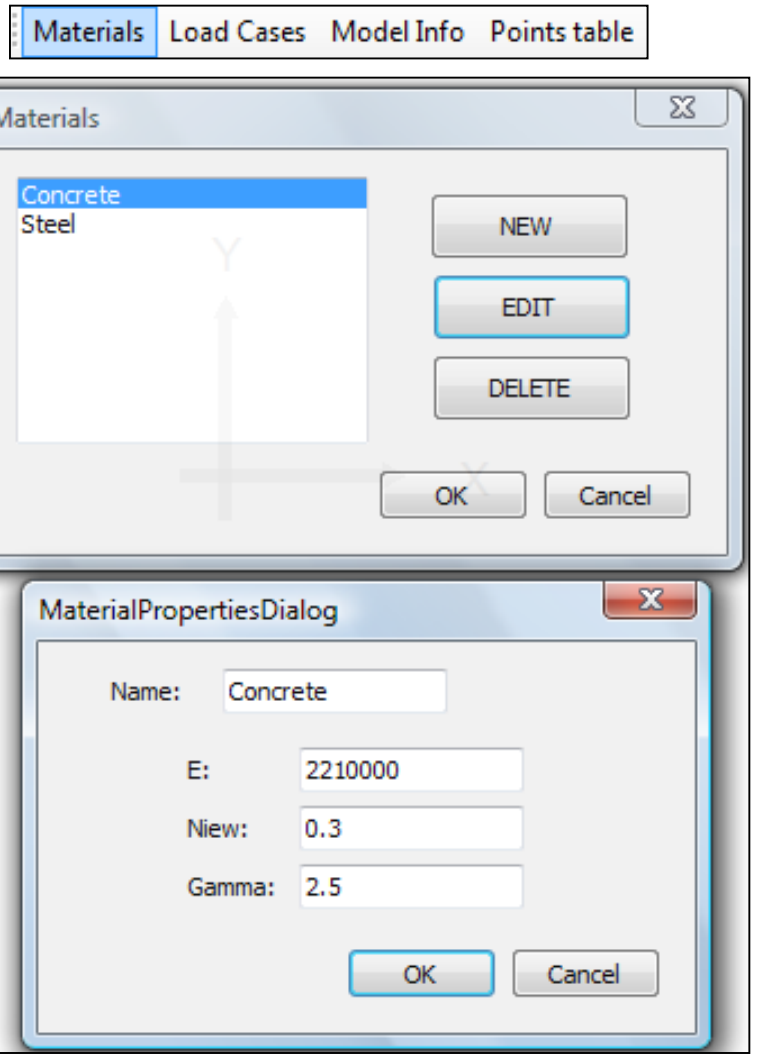
Cairo University

1. Edit model information

In the model information we will define material properties from material tab



OR



The user can define the properties of the construction material such as Young's modulus, Poisson's ratio and Gamma of the materials.

It has to noted that PLPAK is a dimensionless software, that is mean that the user should input the information in a compatible units.

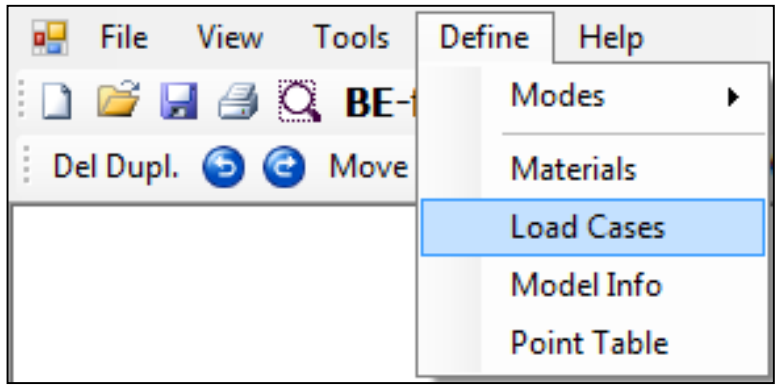
CUFE-BE

www.be4e.com

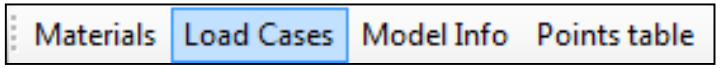
Cairo University

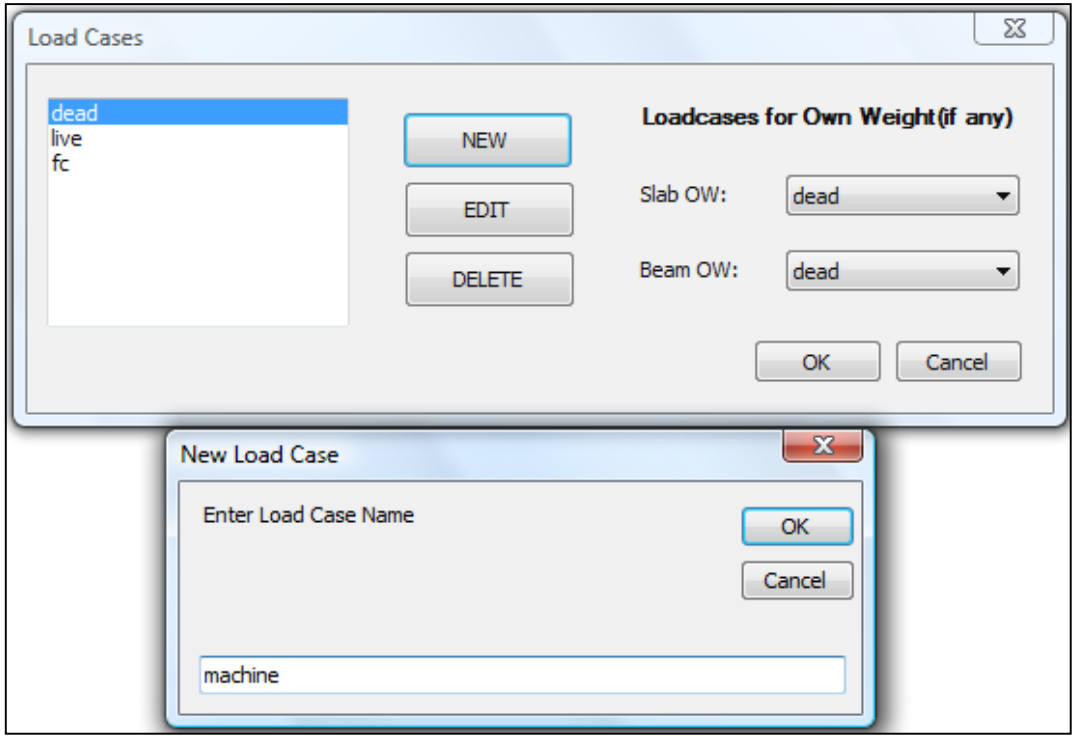
1. Edit model information

Load cases information is also a type of model information which is determined by user.



OR





The user can define different load cases and which one can include the slab and beam own weight.

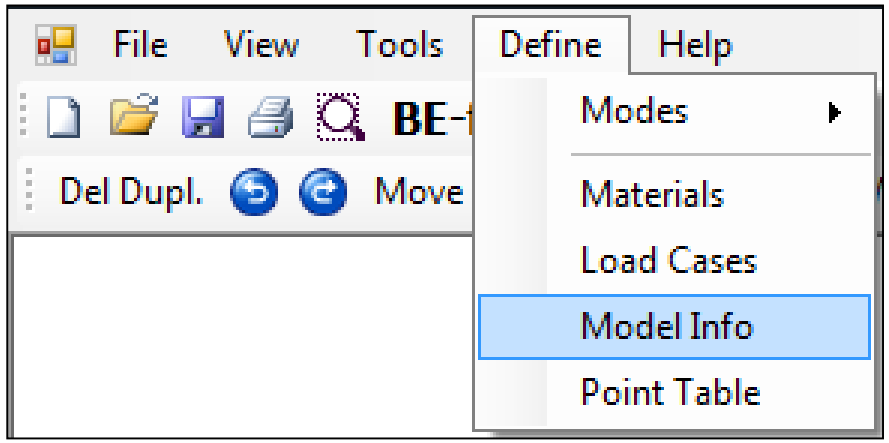
CUFE-BE

www.be4e.com

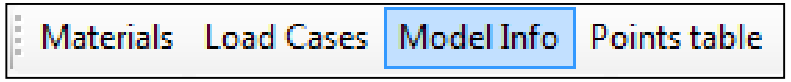
Cairo University

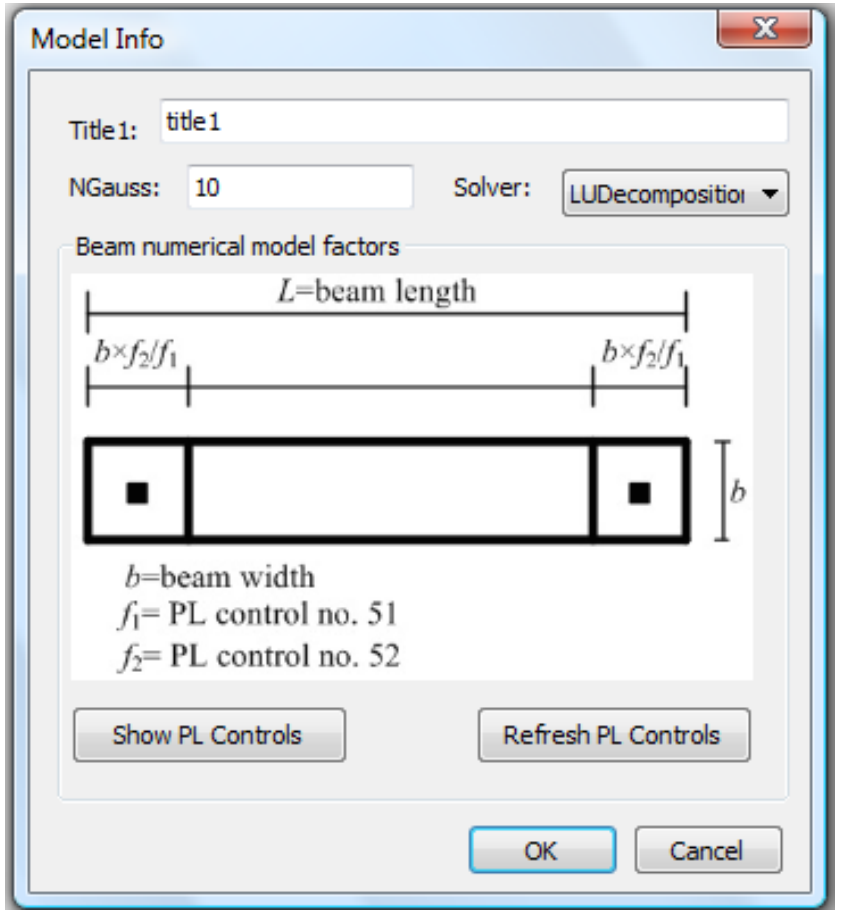
1. Edit model information

There are another information can be changed from model info tab.



OR



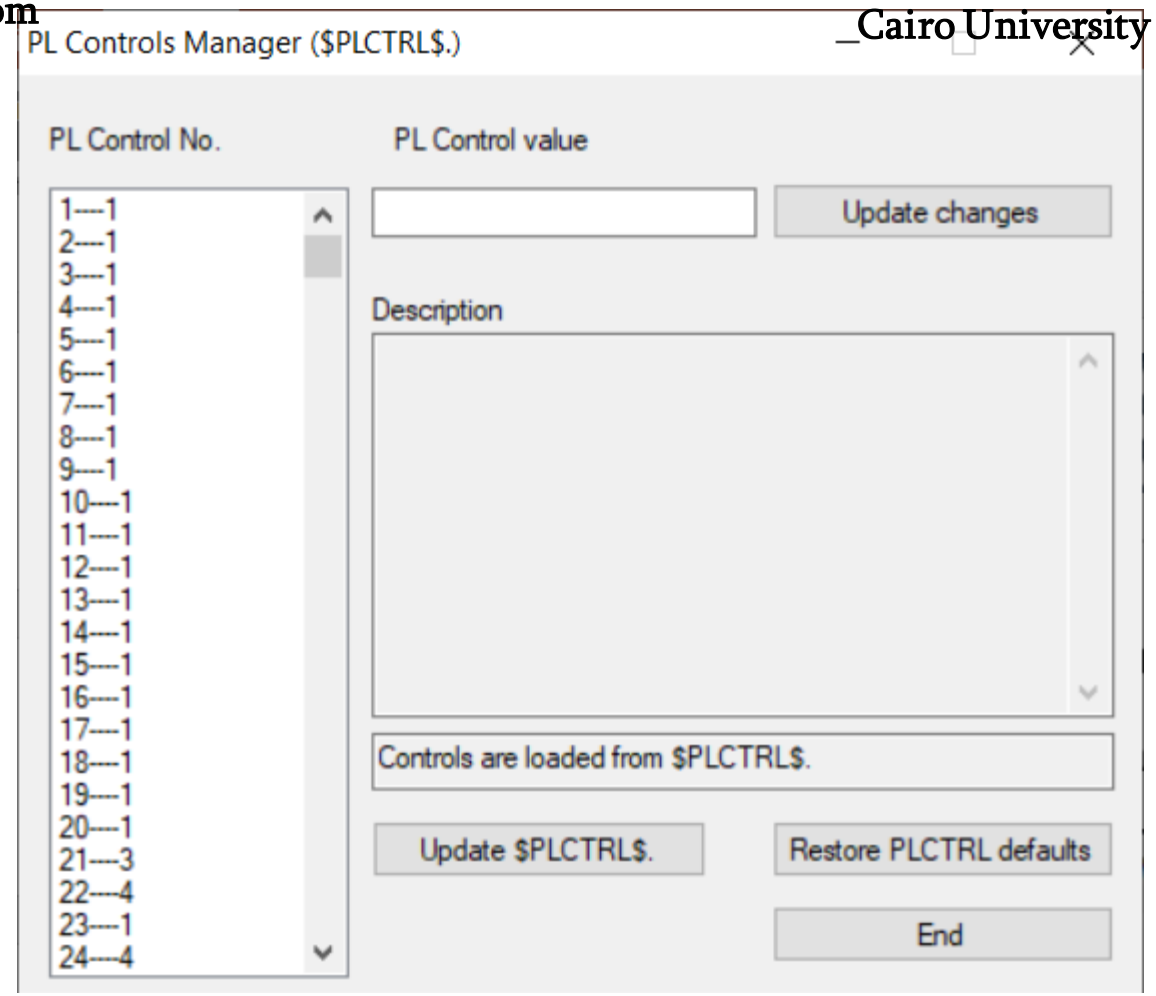


- The user can change number of Gauss points to decrease time consumption in modeling but the number should be even number.
- The user can change the type of solver either LU Decomposition, Gauss Elimination, or GPU solver.
- Also the user can change the PL Controls.

1. Edit model information

PL Controls are 400 Ctrl for:

- Modelling aspects.
- Printing out data.
- Solver and numerical model.



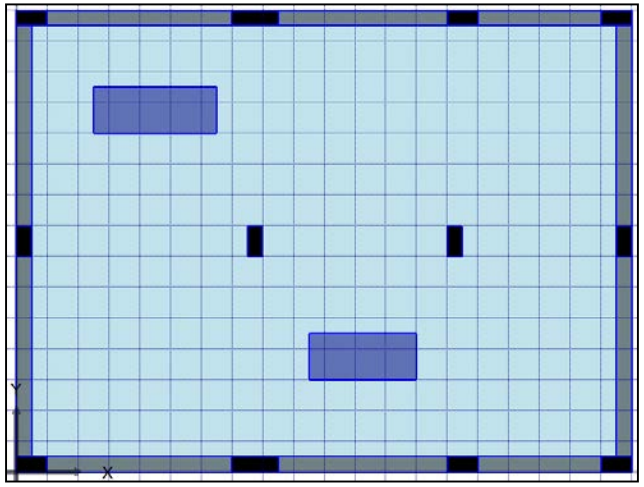
- PLPAK gas its default PL Controls.
- In case of changing any control you need to update $PLCTRL$ file form **Update $PLCTRL$.** button.
- **Restore PLCTRL defaults** button restore them to the default values.

2. Build model and define its elements

The user can insert the model by three ways

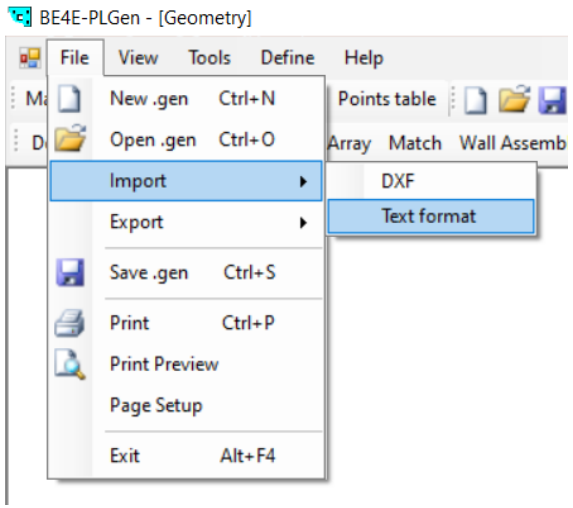
Drawing Model from PLGen

This option is useful for small models.



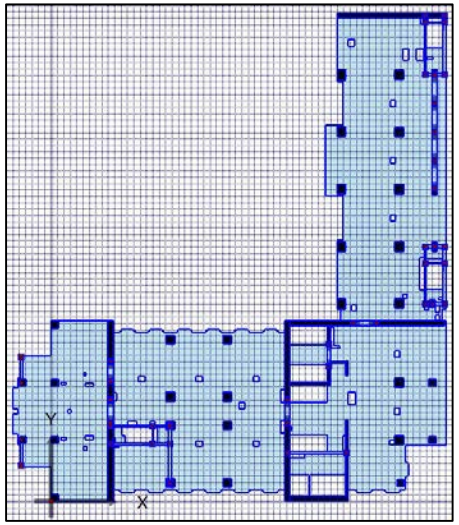
Importing Model from text files

This option is useful for developers.



Importing (.Dxf) file (AutoCAD file)

This option is useful for large models or detailed models.



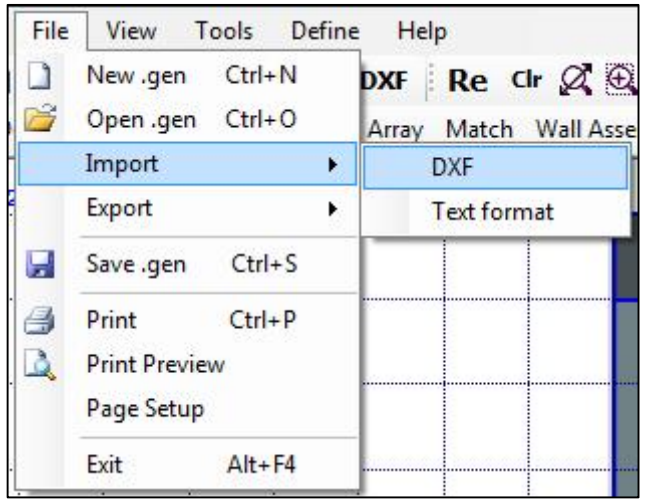
CUFE-BE

www.be4e.com

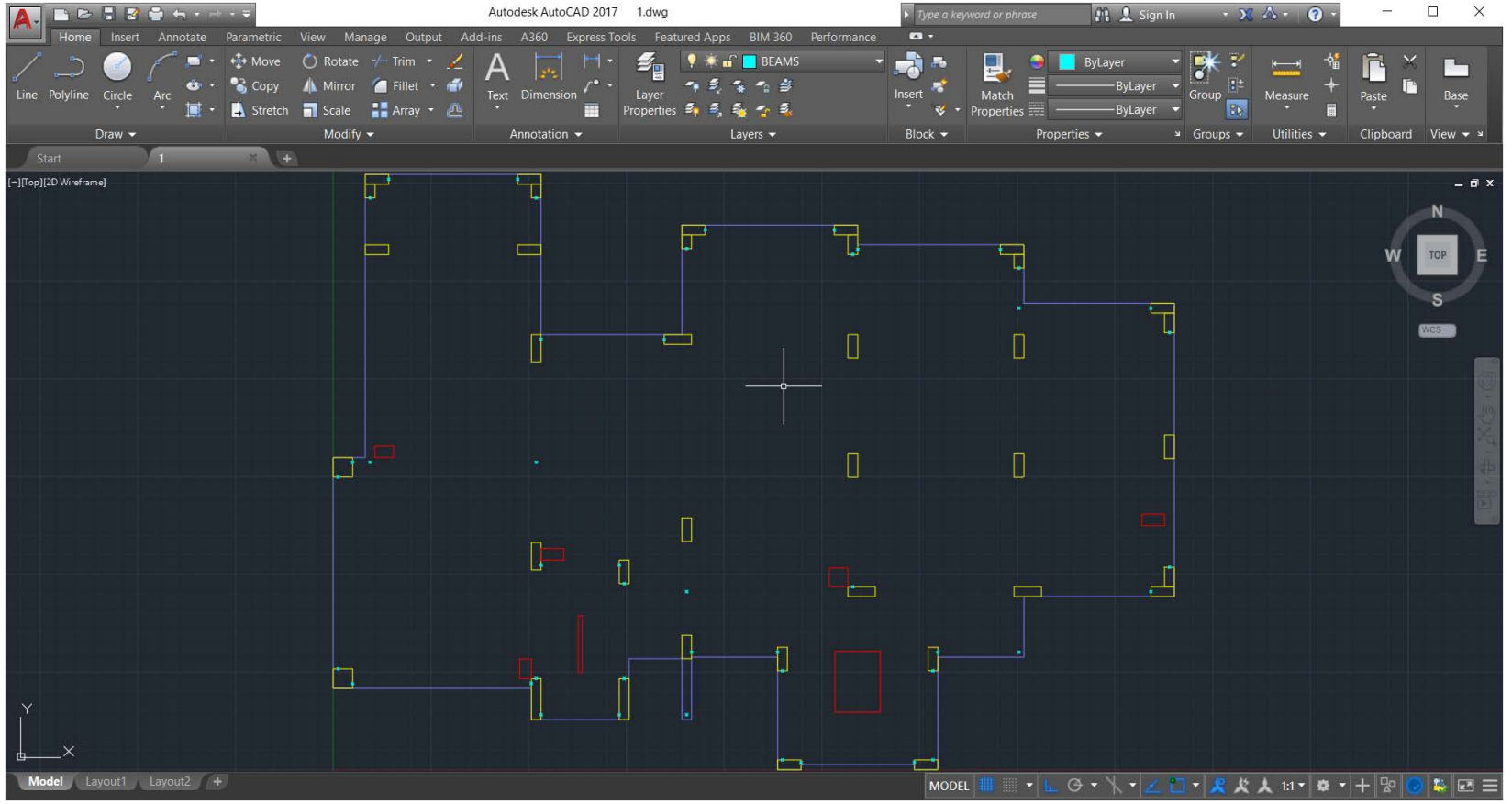
Cairo University

2. Build model and define its elements

A- Importing (.Dxf) file is from file menu then Import Dxf.



OR



2. Build model and define its elements

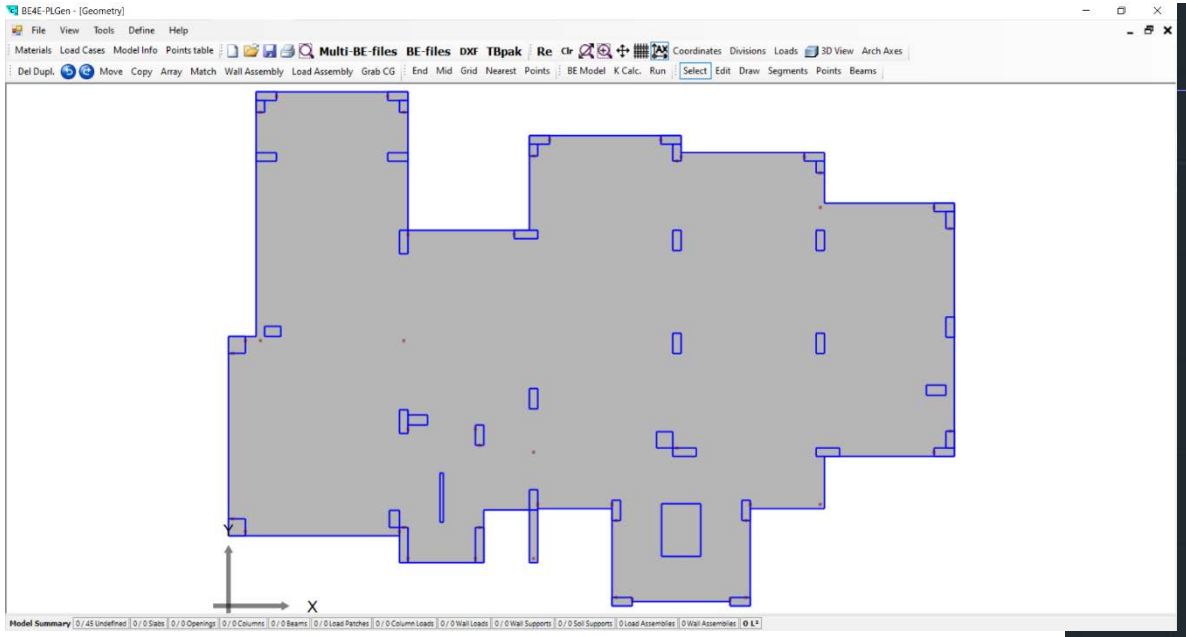
There are important notes that should be taken into consideration before Importing (.Dxf) file:

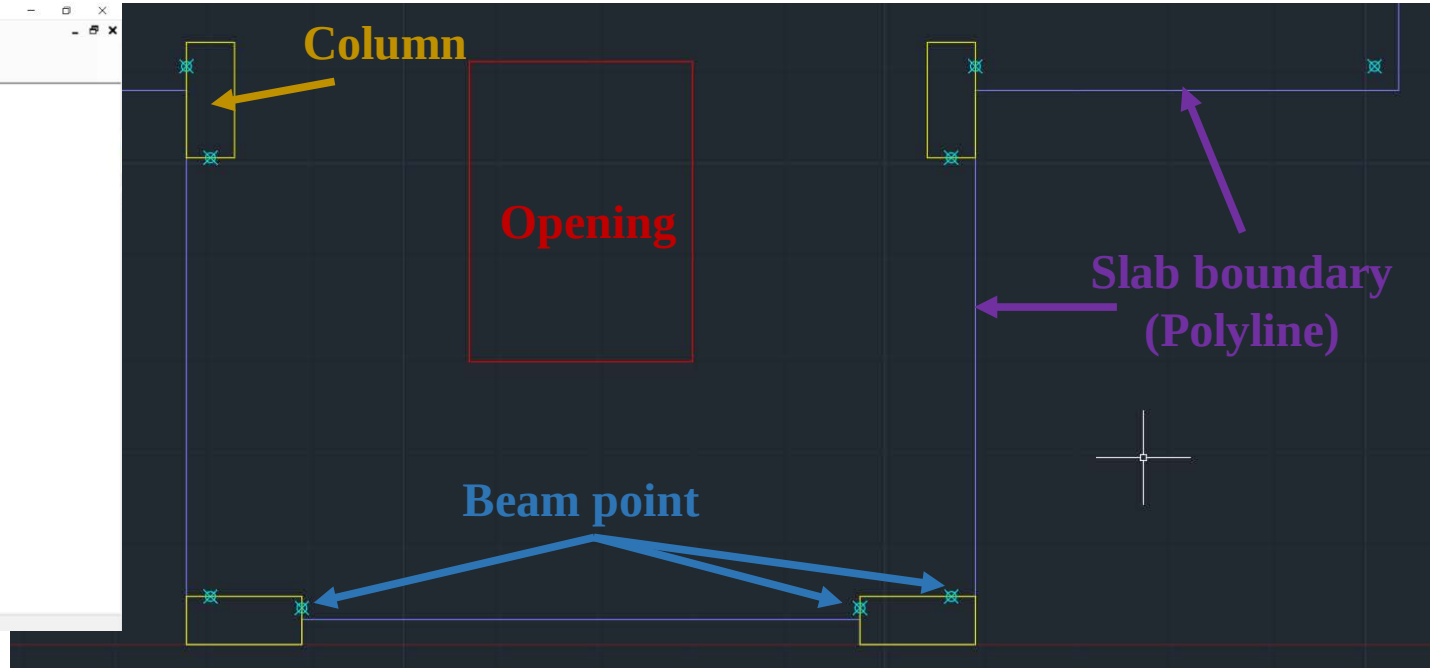
1- The slab line should be the outer line for the drawing.

2- All structural elements should be polyline in AutoCAD.

3- Beams should be inserted in AutoCAD is points at start/end of the beams.

4- All structural elements are drawn by four points only except the slab and the opening.



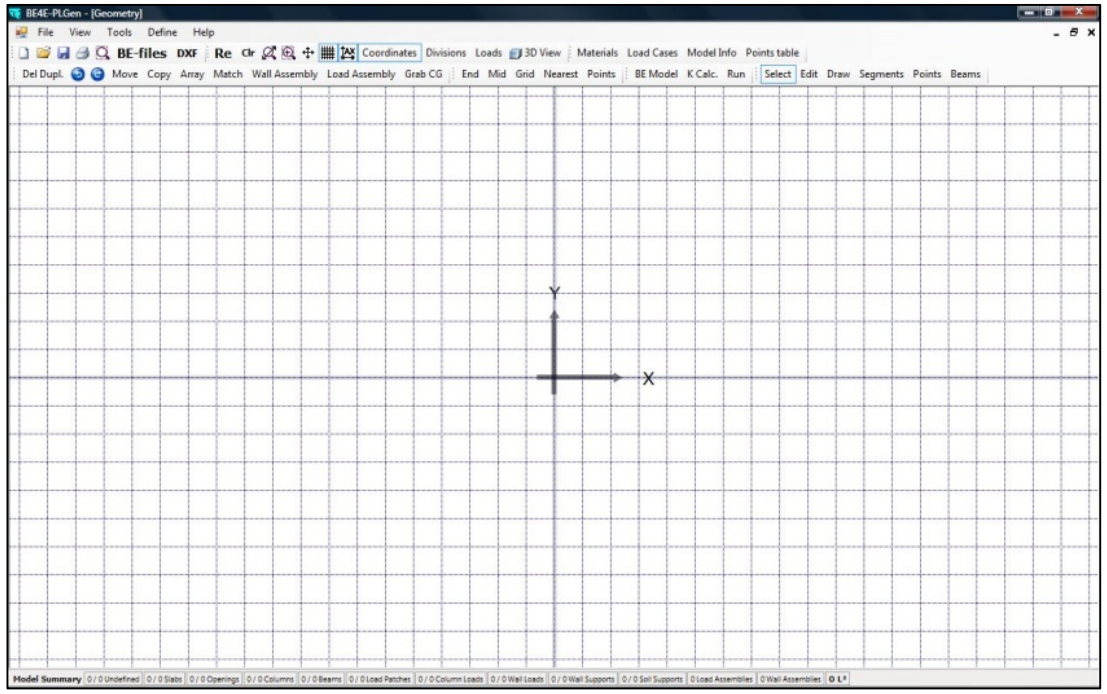


2. Build model and define its elements

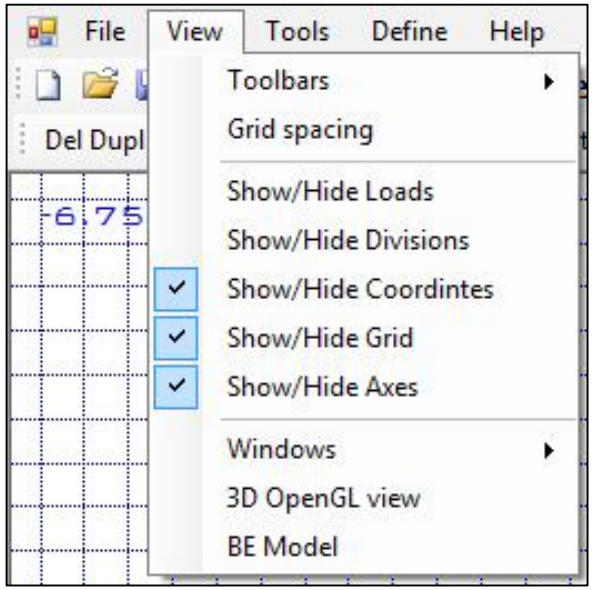
B- Drawing Model from PLGen.

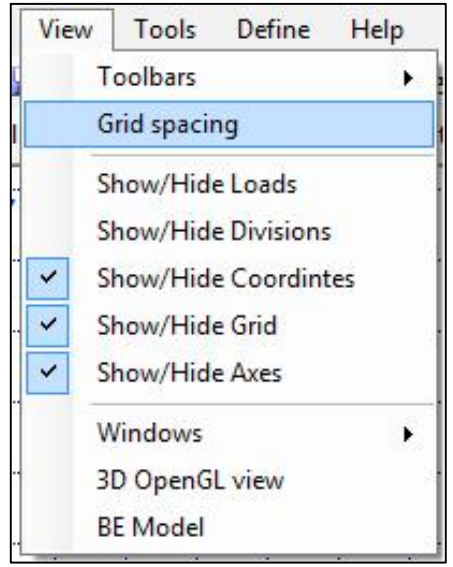
1- The user should show the Grids and show Coordinates.

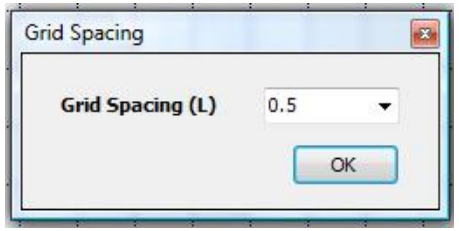
The user can change the Grid spacing from view menu.



OR







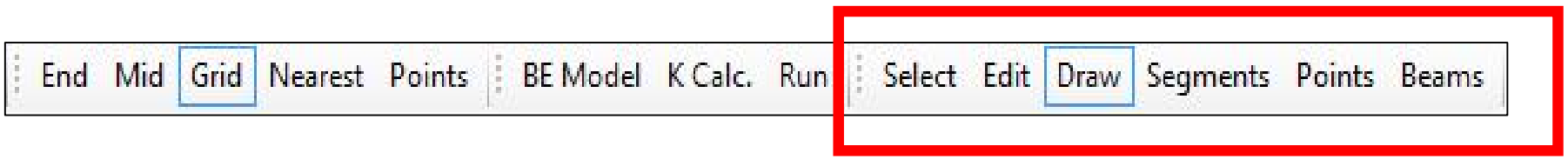
2. Build model and define its elements

B- Drawing Model from PLGen.

PLGen has six modes:

Select: to select the object.
Edit: to edit points or geometry of the object.
Draw: to draw an object.
Segments: to edit the number of divisions and boundary conditions of the boundary element (openings and slab only).
Points: to draw specific point with specific co-ordinates.
Beams: to draw a beam.

2- Select Draw tab and then Grid tab to draw the slab on the selected grids.



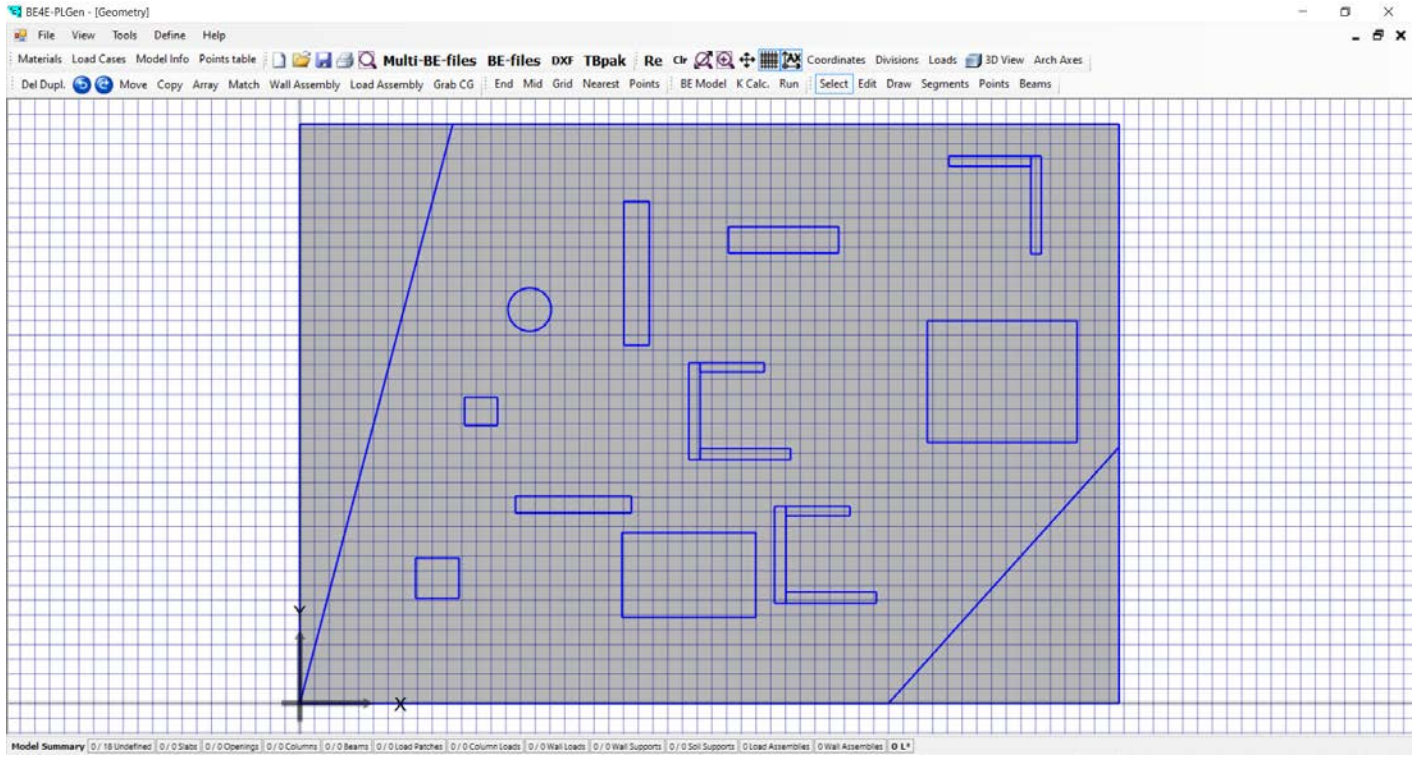
PLGen modes

2. Build model and define its elements

B- Drawing Model from PLGen.

3- Drawing the elements on the grids.

- Starting with the main slab by pressing left click on the four corners and closing with right click
- Then draw the support, load elements, and the opening but still we didn't define them.
- It doesn't matter if we draw clockwise or anticlockwise.
- In order to draw a circle, just click shift button during the drawing process after that press in any place of the outer perimeter of the circle.



2. Build model and define its elements

Objects in the PLGen can be categorized into three categories:

- Slab and openings (Domain of the problem). → Drawn using any number of points.
- Supporting elements. → Drawn using 4 points only.

Acolumn, Column, Wall support, Awall support, Soil support, Warping wall, Drop.

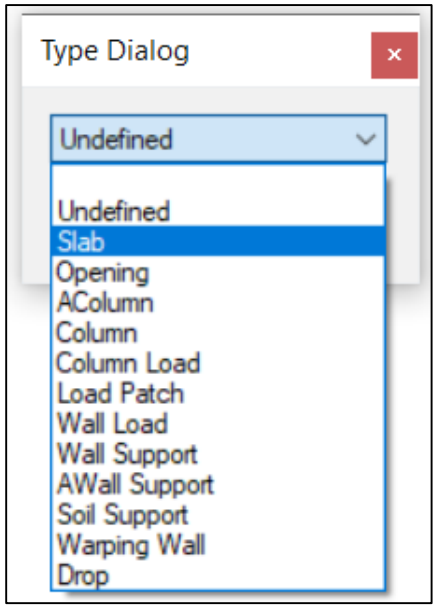
It has to be noted that, Acolumn, Awall support, Warping wall are special elements used in fixed base package.

- Loading elements. → Drawn using 4 point only.

Column load, Load patch, Wall load.

Defining different objects:

- Choose “select mode”.
- Click left click on the object to select it.
- Click right click to choose object type.

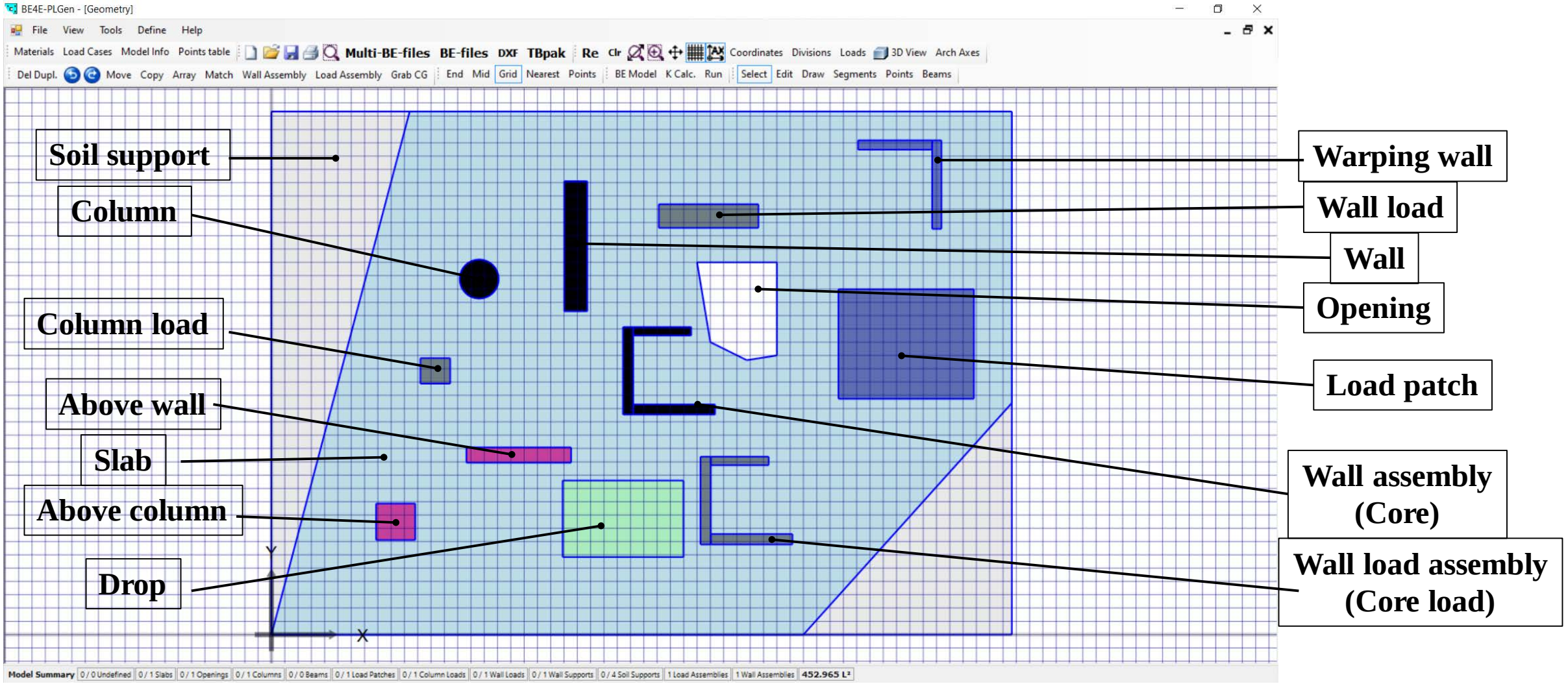


CUFE-BE

www.be4e.com

Cairo University

2. Build model and define its elements

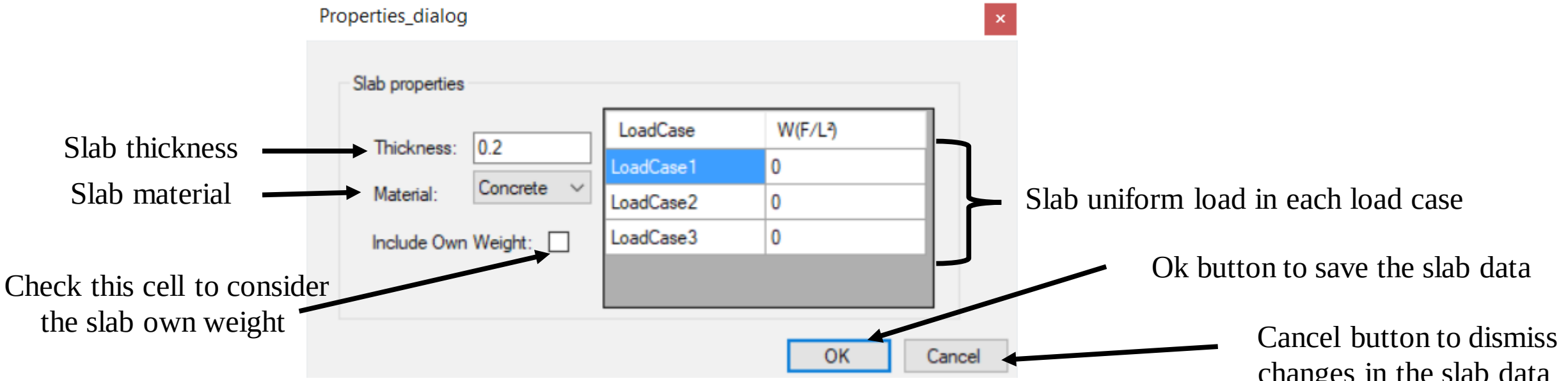


2. Build model and define its elements

Slab

Click on right button on a selected slab to show its properties:

- Define its thickness.
- Define its material.
- Define its domain load for each load case.
- Consider its own weight either by check box or write the weight of slab in the dead load case.

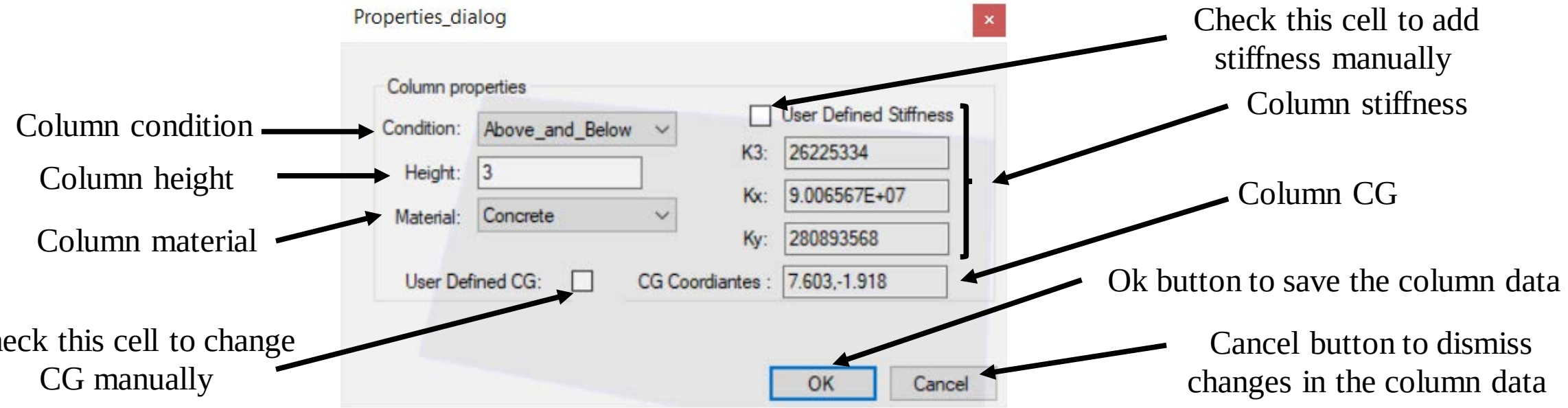


2. Build model and define its elements

Supporting elements (Column/Above column)

Click on right button on a selected column to show its properties:

- Column contains 3 stiffness (two rotations and one vertical translation DOFs).
- Define its condition (Below only, or above and below the slab).
- Define its height.
- Define its material.
- Column CG and its stiffness are computed automatically, and the user can edit them manually.

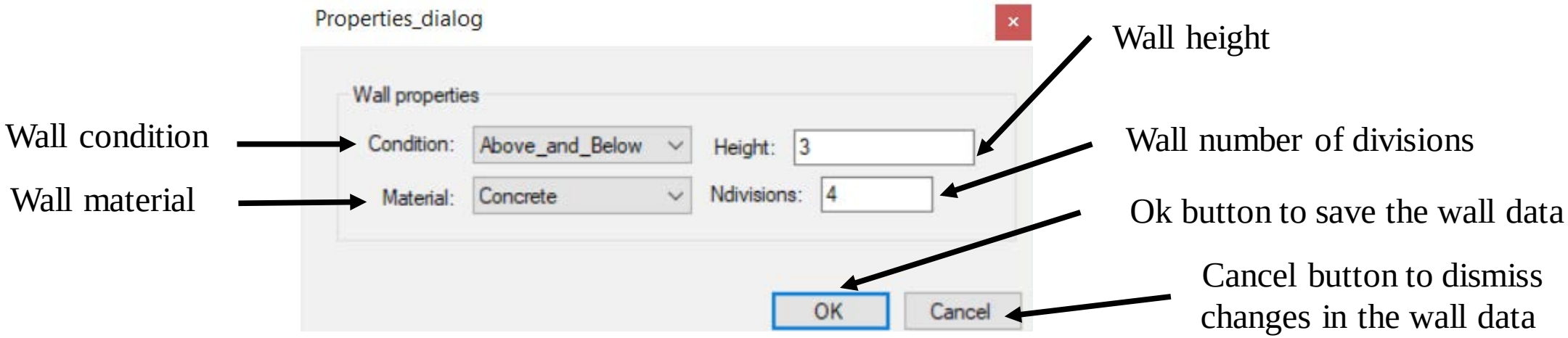


2. Build model and define its elements

Supporting elements (Wall support/ Above wall support)

Click on right button on a selected wall support to show its properties:

- Wall support is divided into supporting cell, in only one direction, combined together to form wall stiffness.
- Define its condition (Below only, or above and below the slab).
- Define its height.
- Define its material.
- Define its divisions.

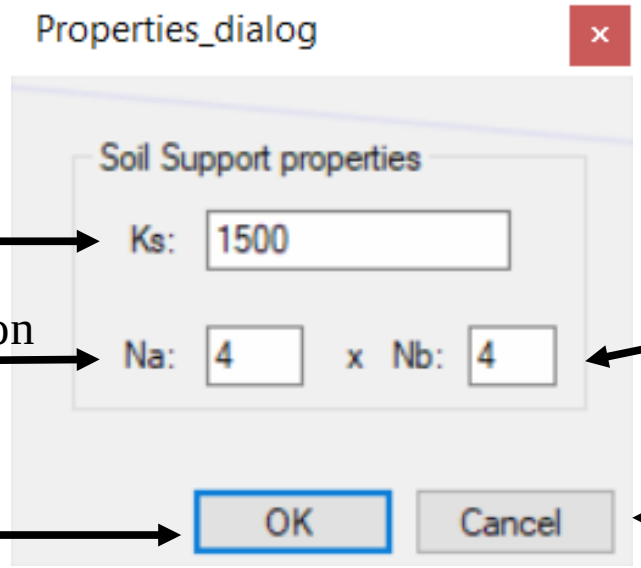


2. Build model and define its elements

Supporting elements (Soil support)

Click on right button on a selected soil support to show its properties:

- Soil support is divided into supporting cell in two the directions.
- Soil cell contains only vertical translation DOF.
- Define its condition (Below only, or above and below the slab).
- Define its height.
- Define its material.
- Define its divisions.



Soil stiffness / unit area

Soil number of divisions in 'a' direction

Soil number of divisions in 'b' direction

Ok button to save the soil data

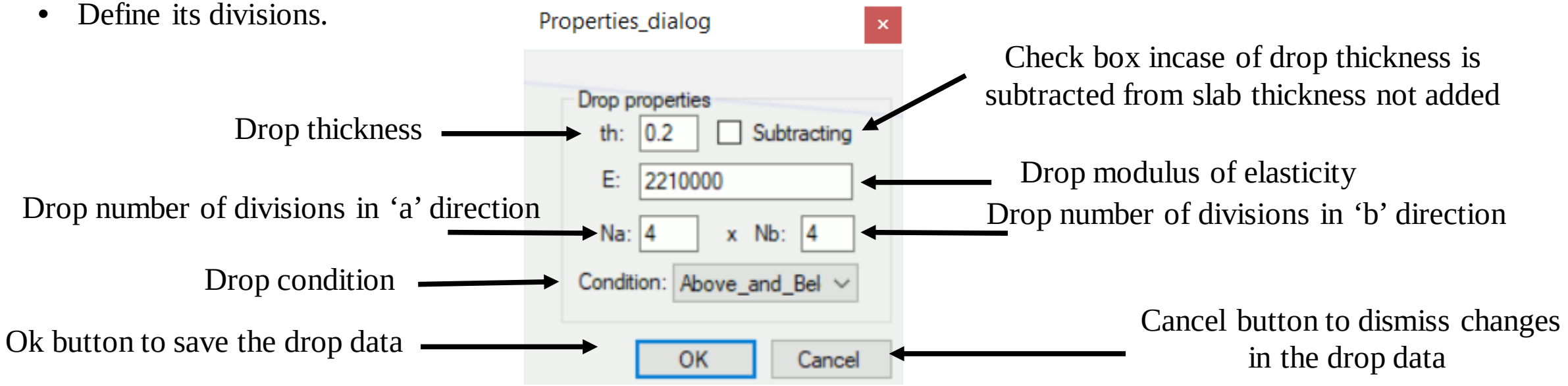
Cancel button to dismiss changes in the soil data

2. Build model and define its elements

Supporting elements (Drop)

Click on right button on a selected drop to show its properties:

- Drop is divided into supporting cell in two the directions.
- Drop cell contains three DOFs (two rotations and one vertical translation).
- Define its thickness (The additional or subtracting thickness without slab thickness).
- Define its modulus of elasticity.
- Define its condition (Above and below, below only, or as assigned).
- Define its divisions.



2. Build model and define its elements

Supporting elements (Wall assembly)

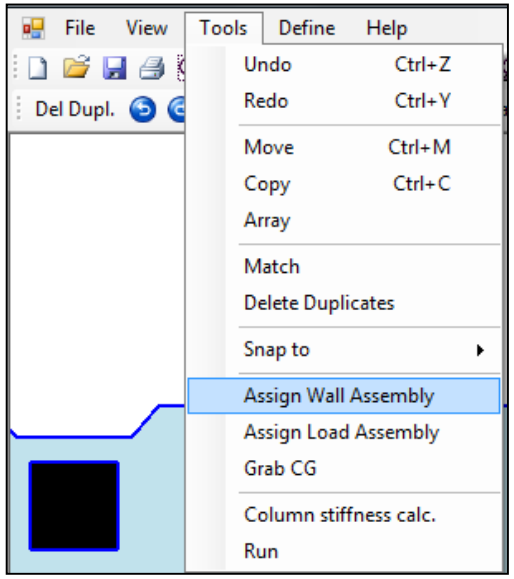
Assemblies is used if the user want to combine either support together like cores or any shape of shear walls etc.

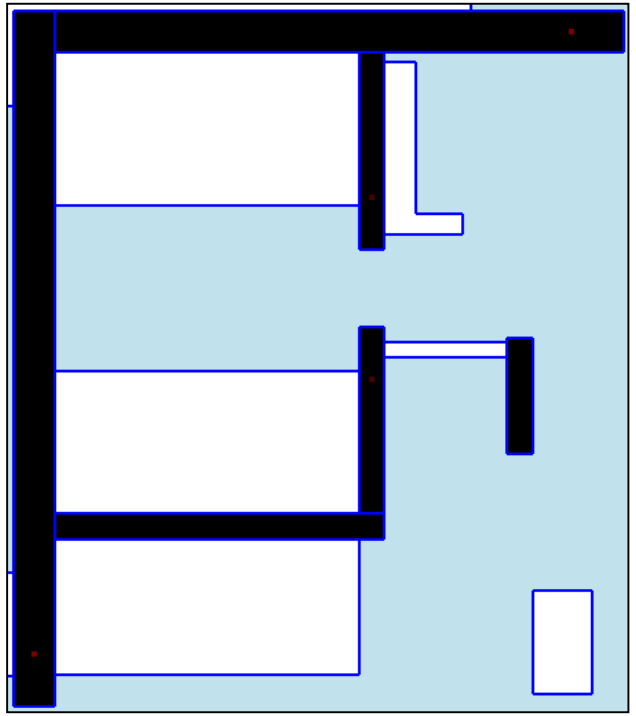
1- Assign wall assembly (core) elements as wall support.

2- Select all walls that need to be combined then click on wall assembly button.

If the user press right click on the walls a new dialog similar to wall support opens, but this dialog deals with all shear walls as a one unit.

OR



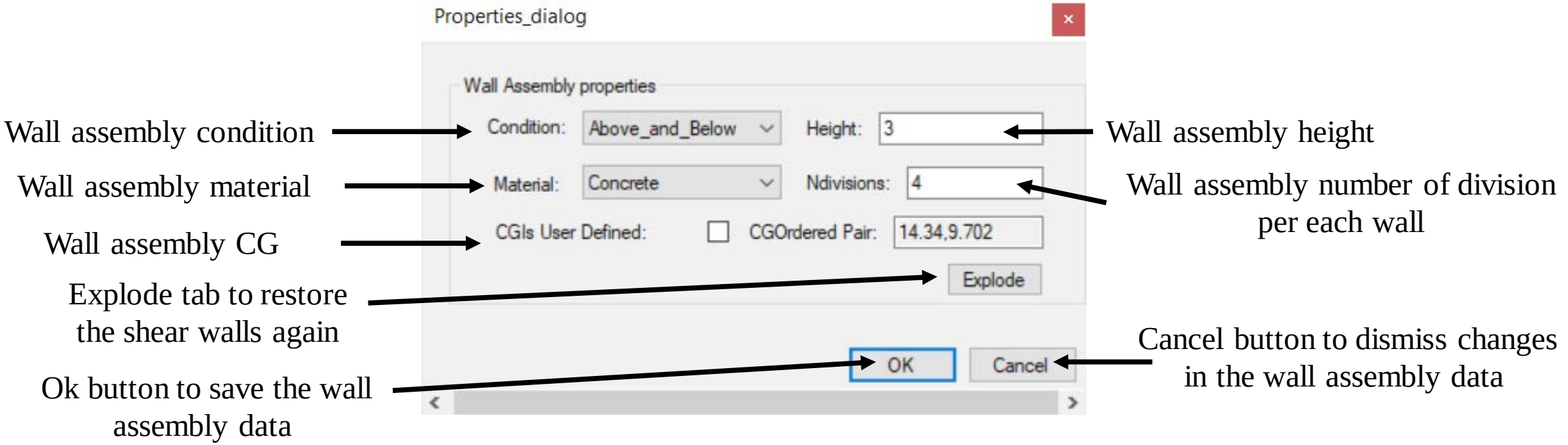


2. Build model and define its elements

Supporting elements (Wall assembly)

The user can change the condition of the wall, the material type, height of the wall and the number of divisions.

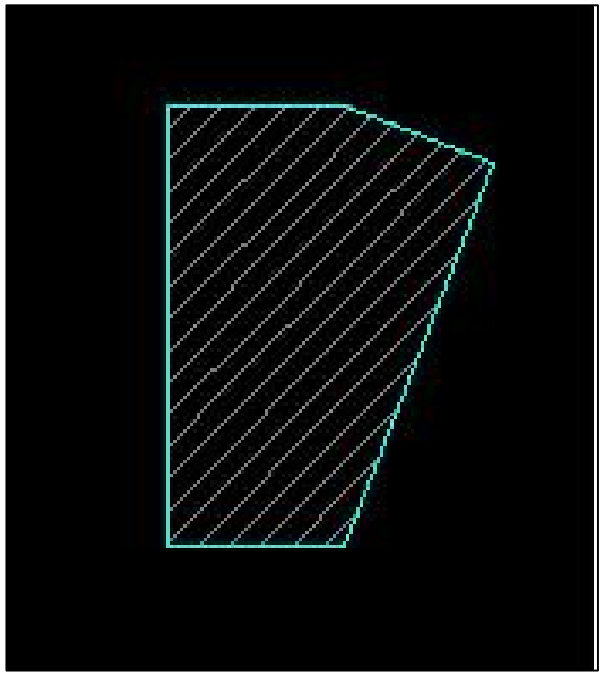
The Explode tab restore the five shear walls again.



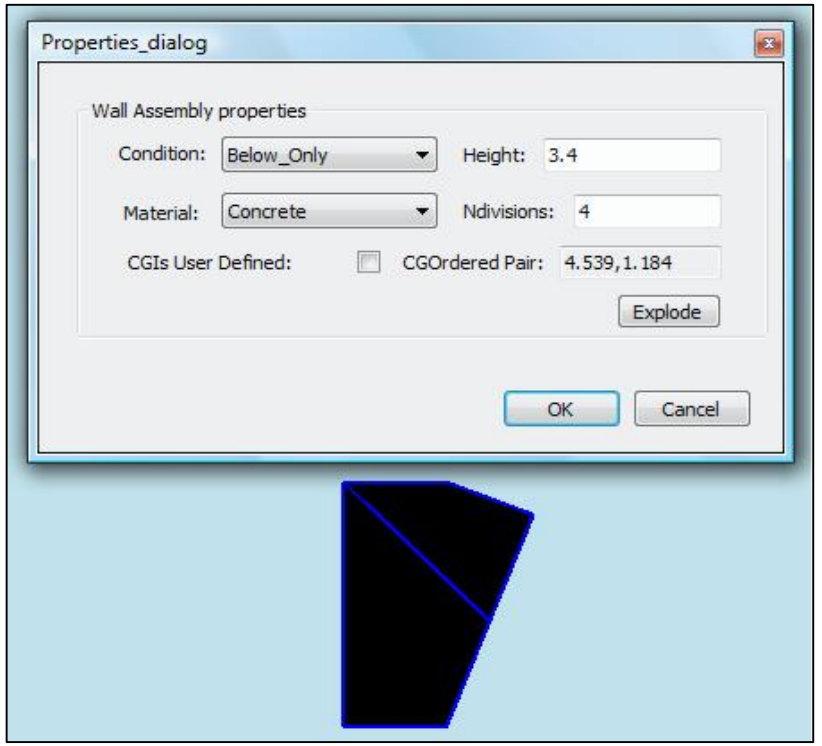
2. Build model and define its elements

Supporting elements (Non-quadratic column)

The user must draw them in the PLGen or AutoCAD as two column each column is a quadratic column, after importing them in the generator (PLGen) assign them as column or wall support, then use wall assembly.



Non-quadratic column



Non-quadratic column in PLGen

CUFE-BE

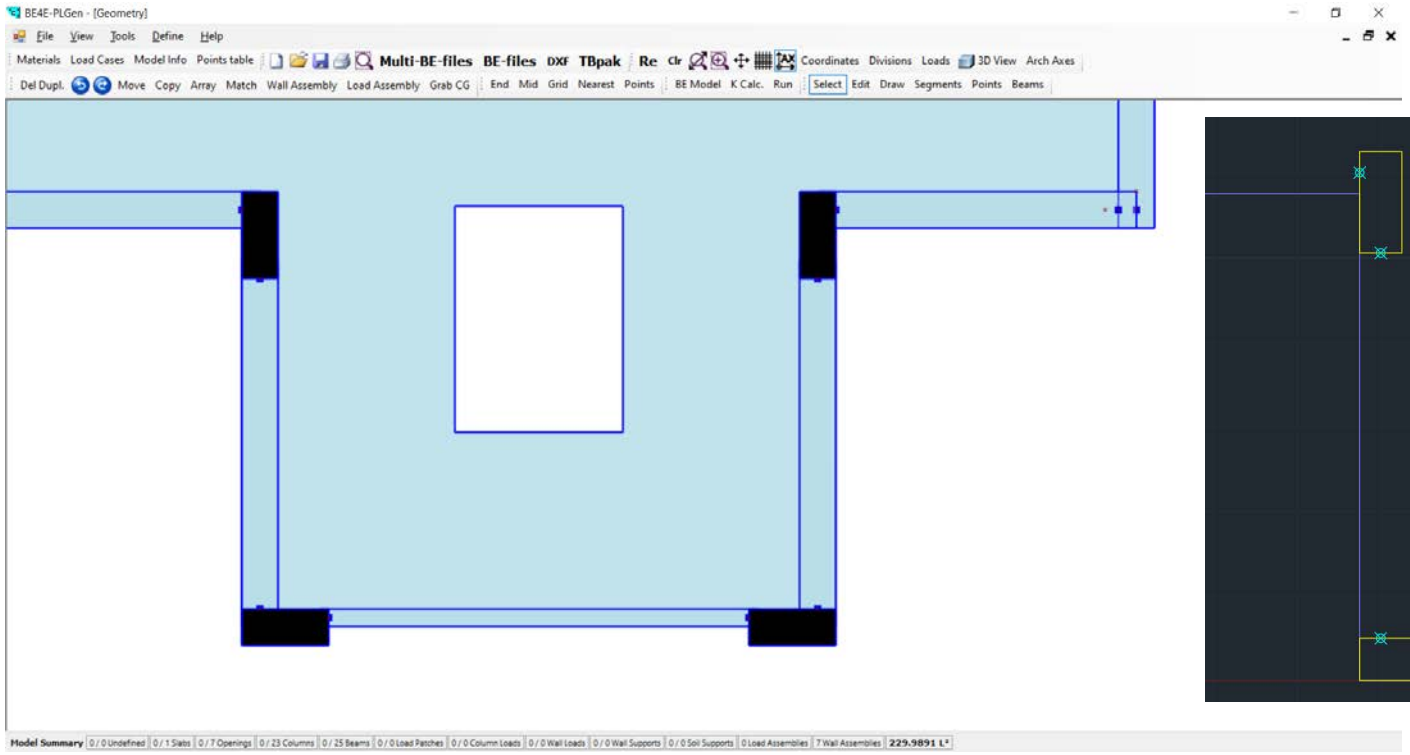
www.be4e.com

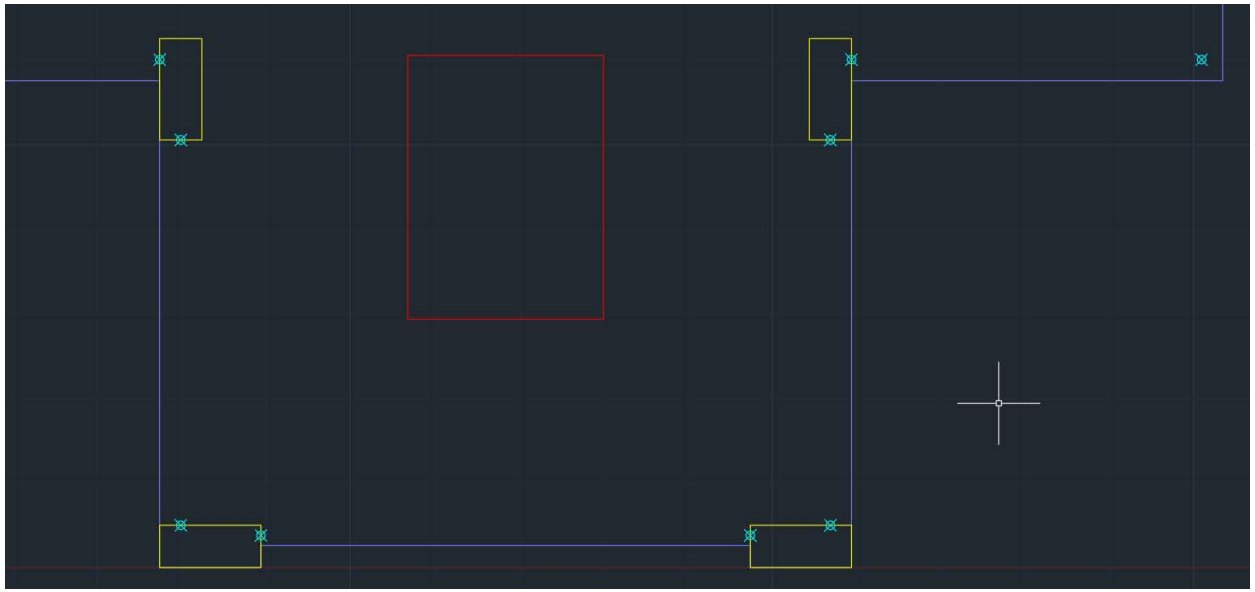
Cairo University

2. Build model and define its elements

Supporting elements (Beams)

- First change PLGen mode to Beams.
- Beams can be modeled by drawing them from PLGen using sniping tools, or by importing the beam start/end as points from AutoCAD (DXF) file.



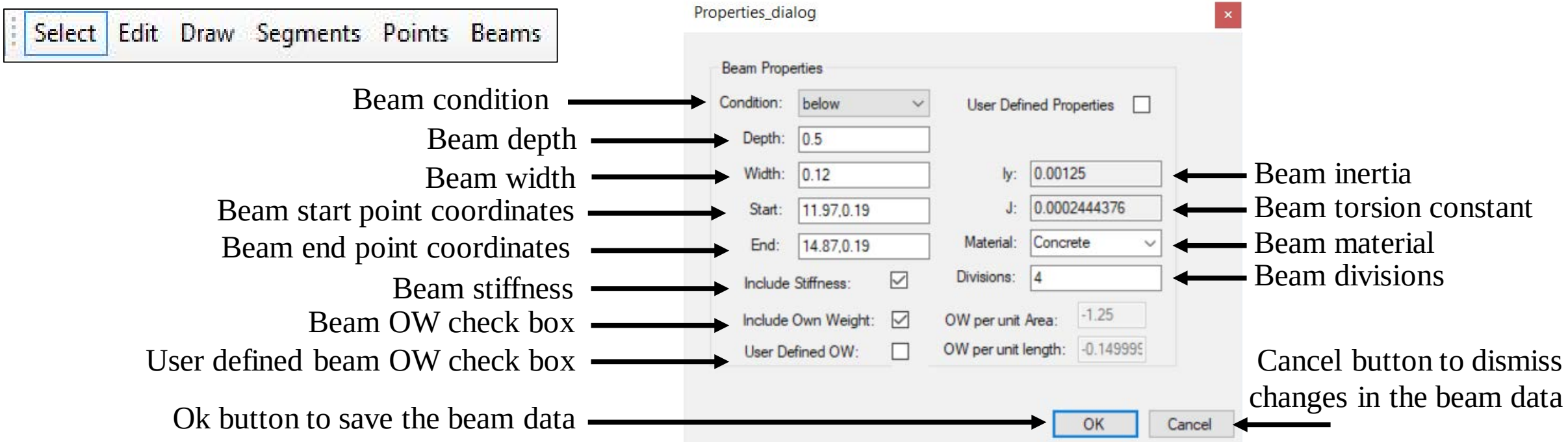


2. Build model and define its elements

Supporting elements (Beams)

For showing beam properties the user should change from beam mode to select mode, then click on right button on a selected beam to show its properties:

- The user can change the beam condition (below or above), the beam dimensions, include stiffness (incase of loading beam), include Own Weight, number of division, user defined properties (moment of inertia & torsion constant).



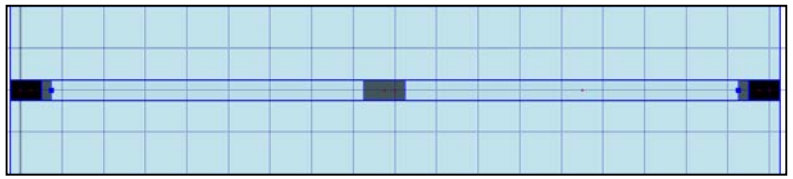
2. Build model and define its elements

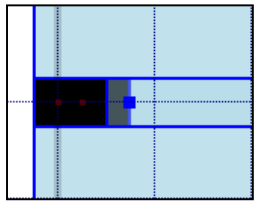
Supporting elements (Beams)

The user has an option to make the beams in his model either hinged or fixed.

In case of hinged beams

The beam inserted in column less than or equal to the half beam width.

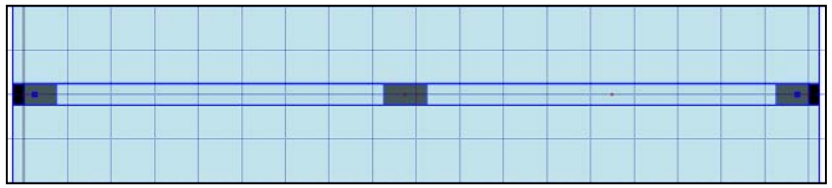


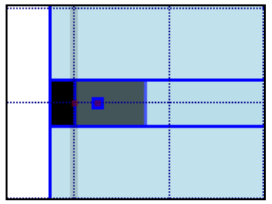


$L_{in} \leq 0.5\ B_{width}$

In case of fixed beams

If the beam drawn to cover the column, it will be act as fixed beam.





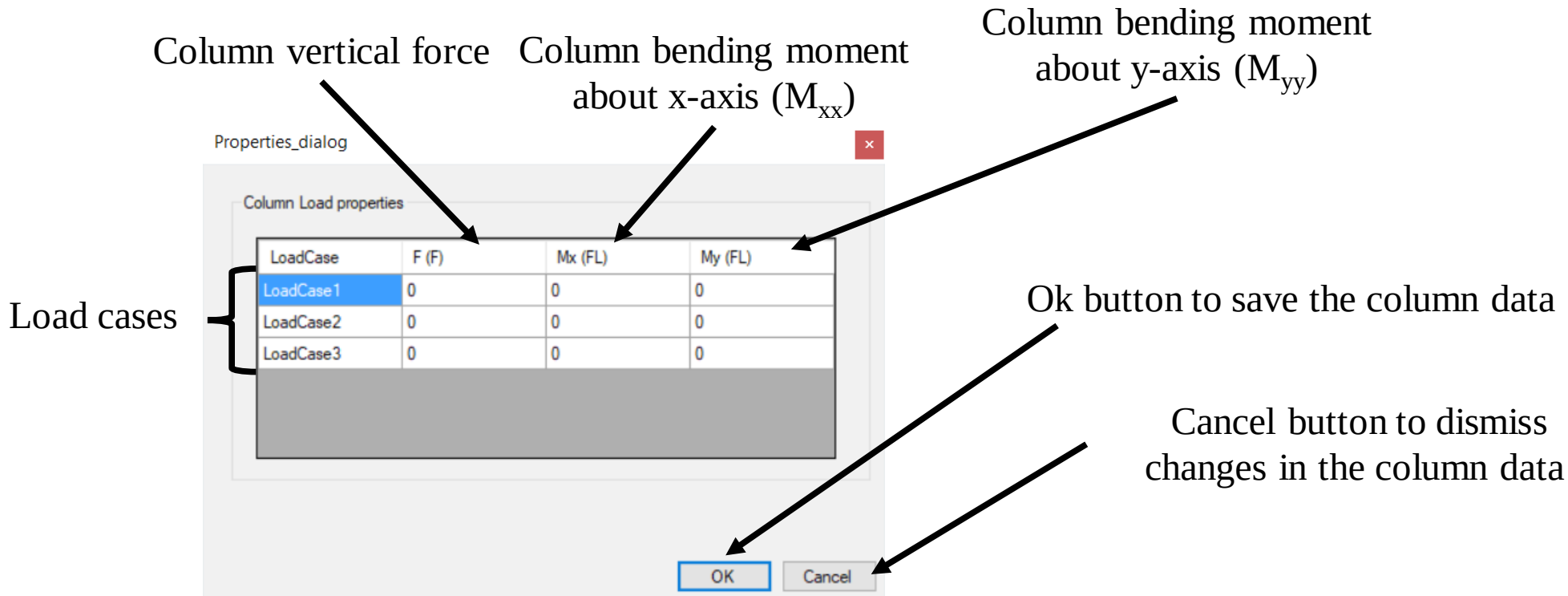
$L_{in} \geq 0.5\ B_{width}$

2. Build model and define its elements

Loading elements (Column load)

Click on right button on a selected column load to show its properties:

- Column contains three load values (two moments and one vertical force).
- Define column loads for each load case.

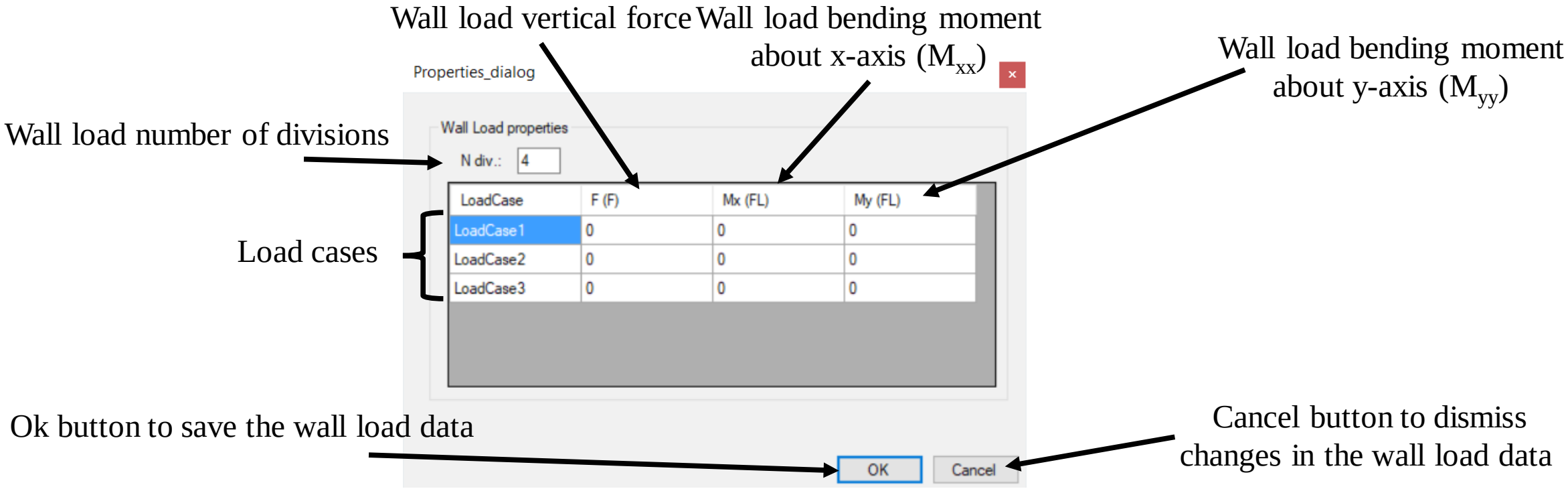


2. Build model and define its elements

Loading elements (Wall load)

Click on right button on a selected wall load to show its properties:

- Wall load is divided into loading cell, in only one direction, combined together to form wall load.
- Define wall loads for each load case.

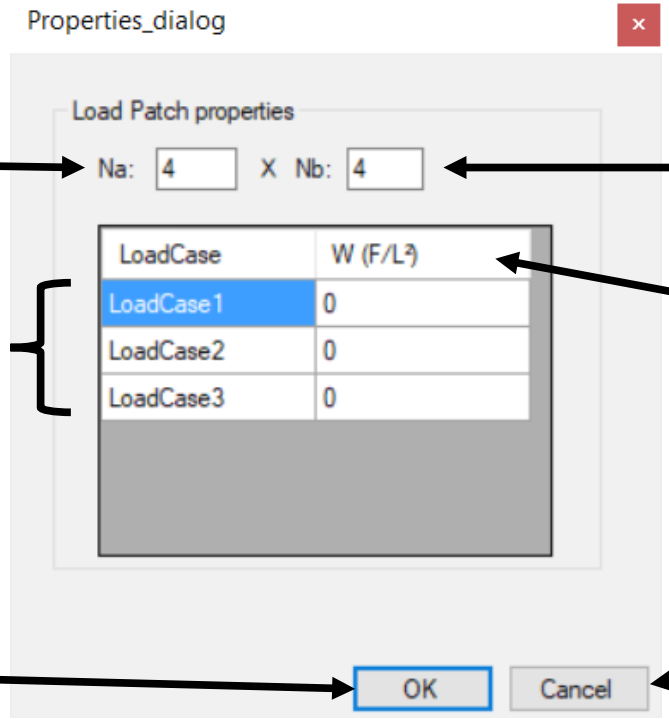


2. Build model and define its elements

Loading elements (Load patch)

Click on right button on a selected load patch to show its properties:

- Load patch is divided into loading cells in two the directions.
- load cell contains only vertical uniform load.
- Define its uniform load for each load case.



Load patch number of divisions in 'a' direction

Load patch number of divisions in 'b' direction

Load cases

Uniform load value

Ok button to save the load patch data

Cancel button to dismiss changes in the load patch data

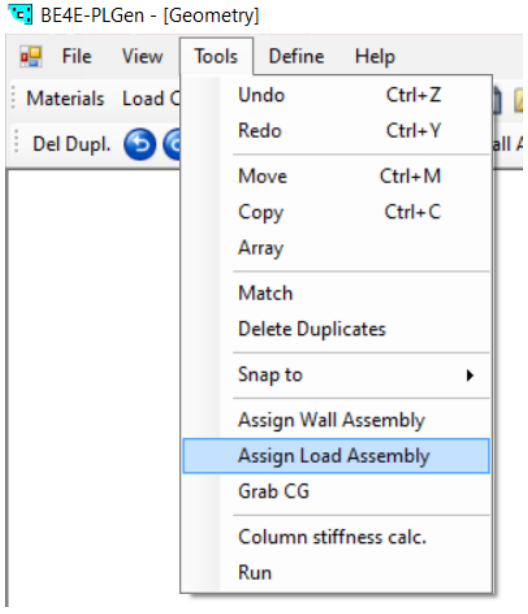
2. Build model and define its elements

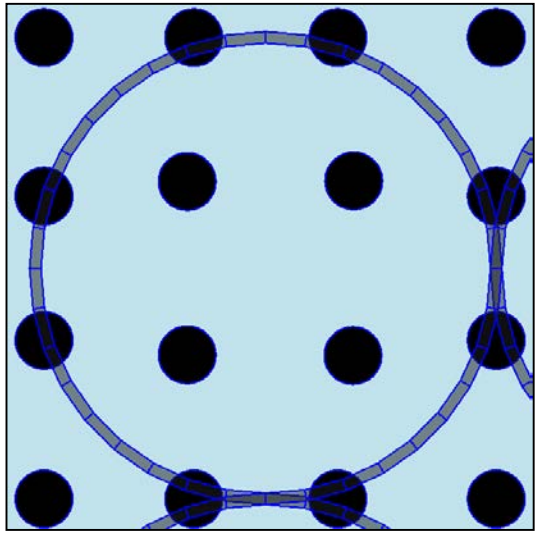
Loading elements (Wall load assembly)

Load assemblies is used if the user want to combine either load together like core's load or any shape of shear wall's load.
1- Assign wall load assembly (core) elements as wall load.
2- Select all wall loads that need to be combined then click on wall assembly button.
If the user press right click on the wall load a new dialog similar to wall load opens,
but this dialog deals with all wall loads as a one unit.

This example silo rested on rafted piles, the silo consists of number of wall loads and we want to combine them together.

OR

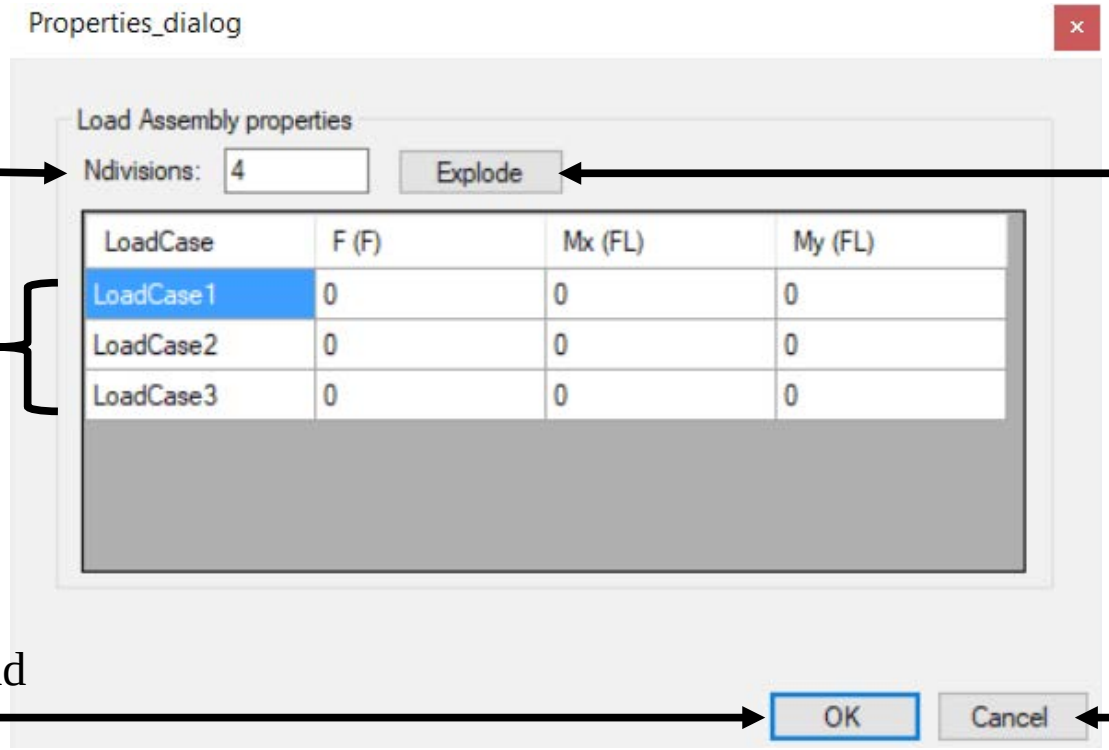




2. Build model and define its elements

Loading elements (Wall load assembly)

- Define wall load assembly for each load case.
- The explode tab restore the wall loads again.



Wall load assembly number of divisions

Load cases

Explode tab to restore the wall loads again

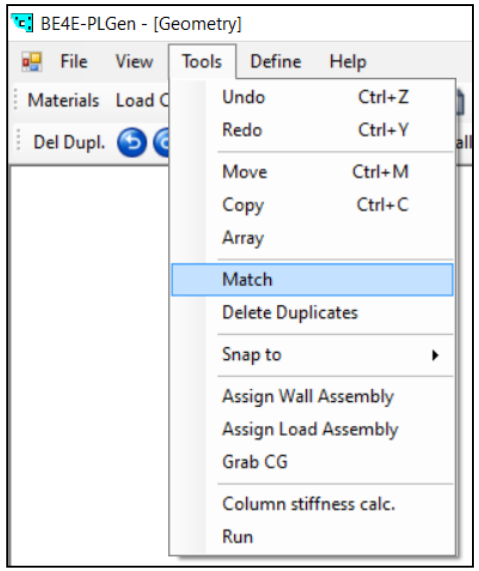
Ok button to save the wall load assembly data

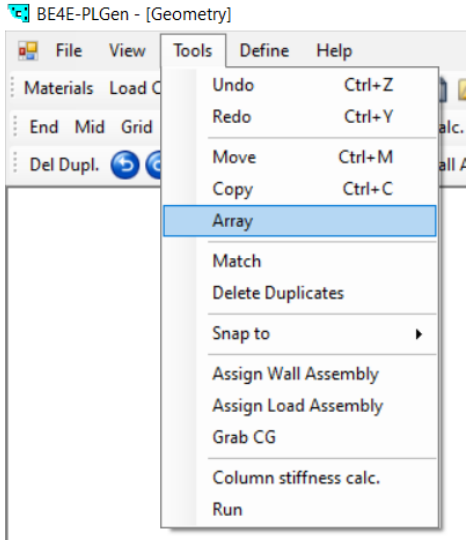
Cancel button to dismiss changes in the wall load assembly data

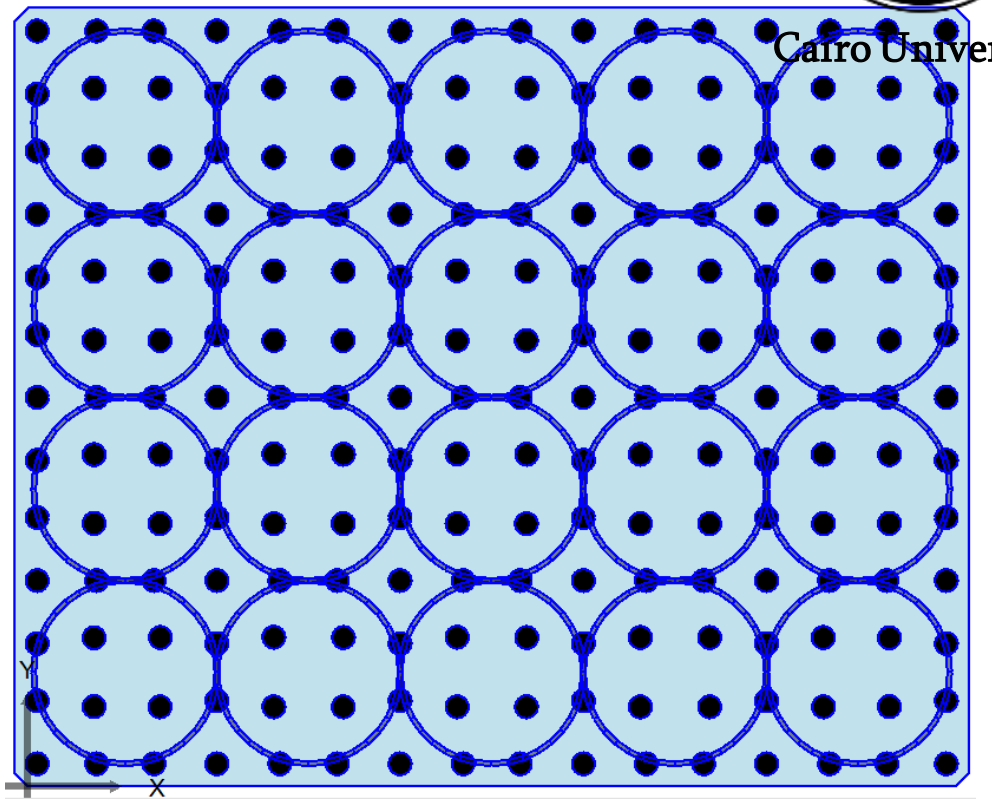
2. Build model and define its elements

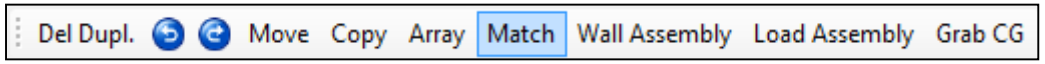
Other PLGen tools

- Array tool to draw array of an element.
- Match tool to match prosperities from element to another ones.





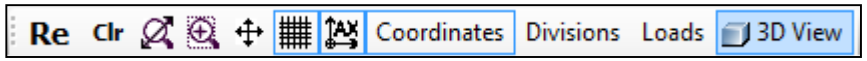




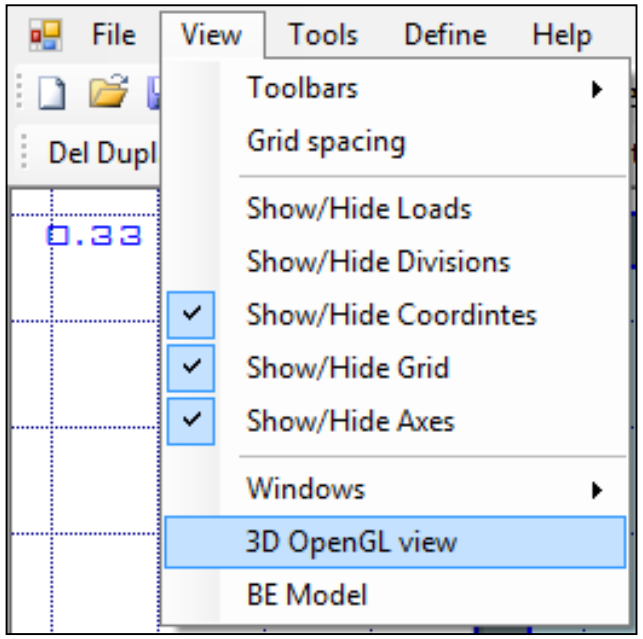
2. Build model and define its elements

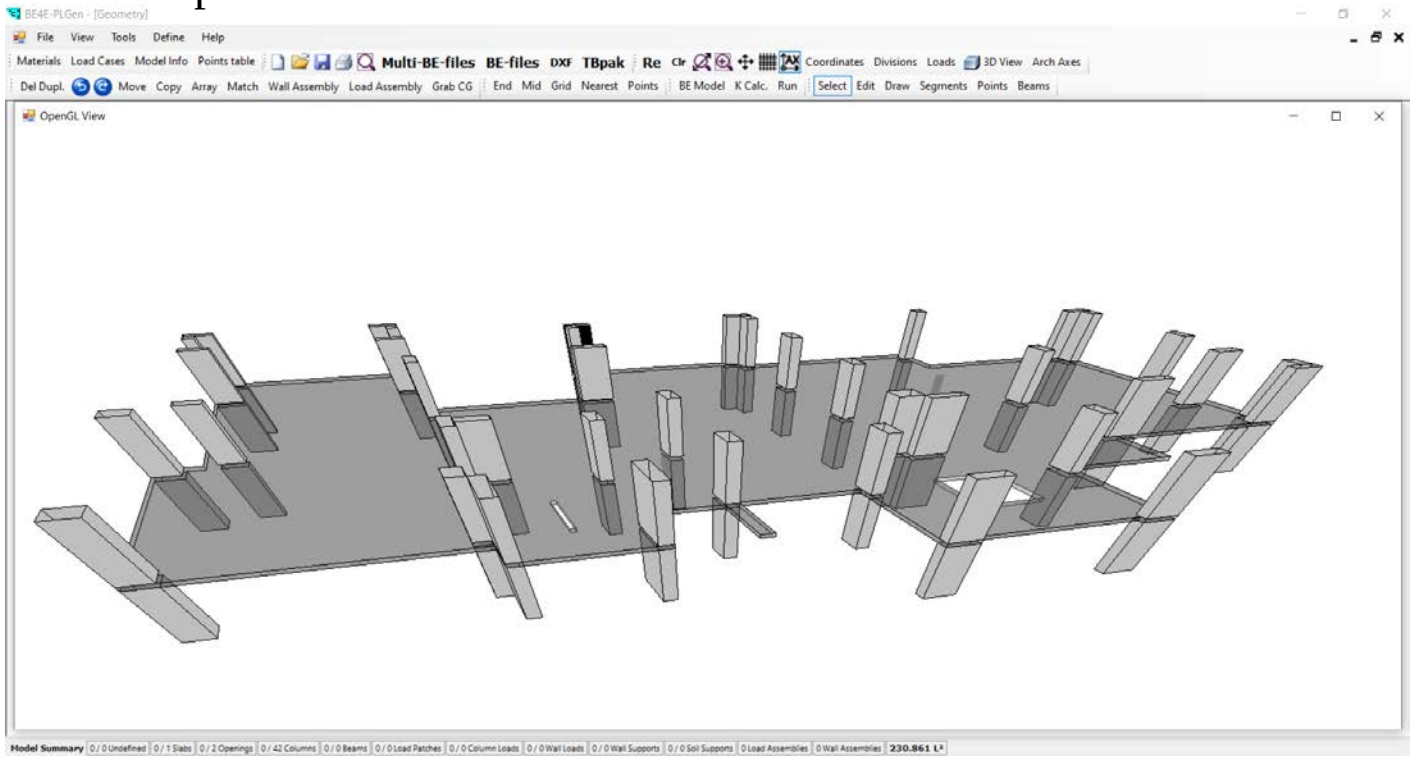
Other PLGen tools

- 3D view of the model after finishing the generator file.



- The user can also check that there is not any undefined shape from the lower bar.

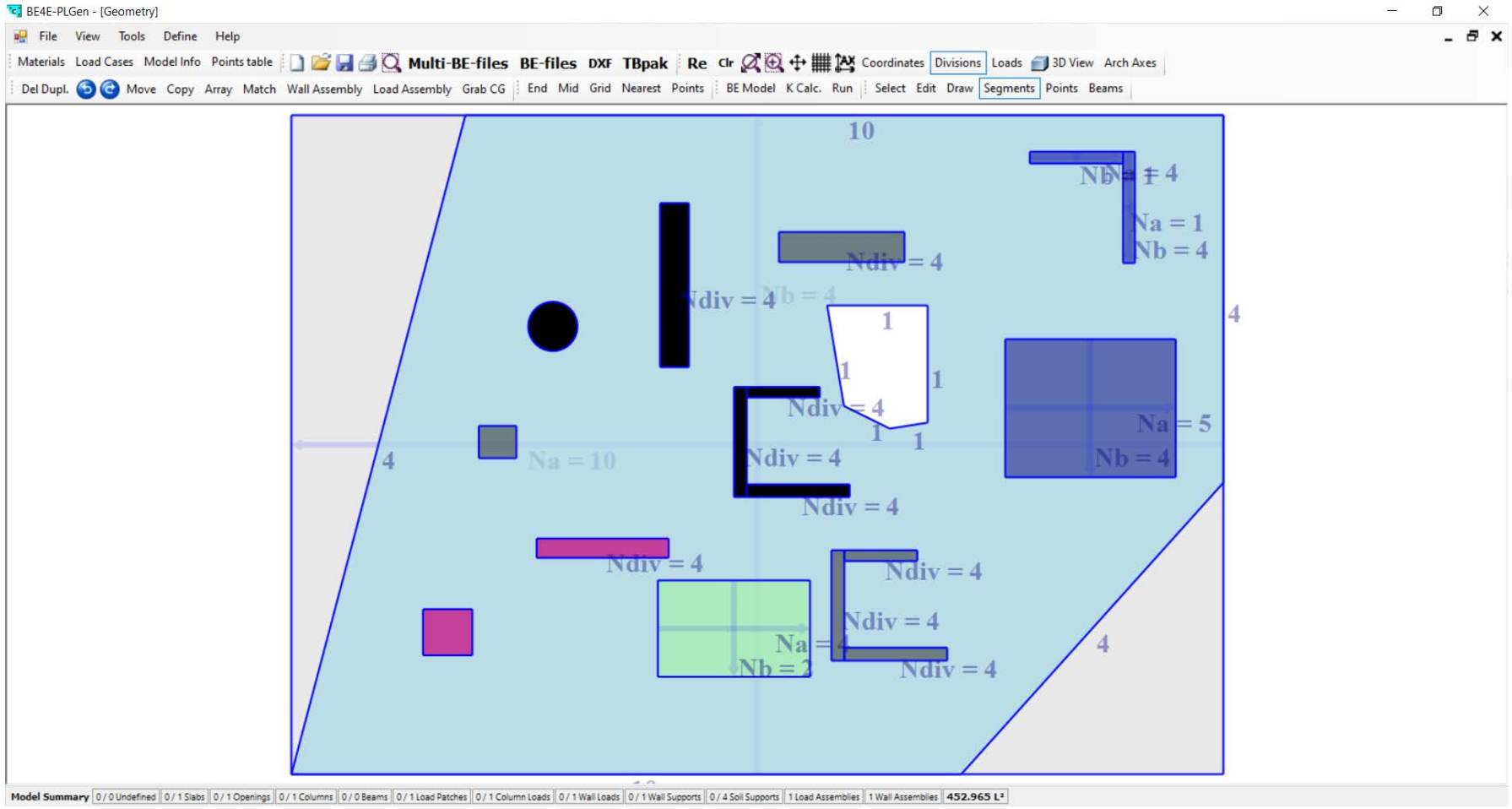




2. Build model and define its elements

Other PLGen tools

- User can view the number of division for each side of the slab or opening, and divisions of any elements.



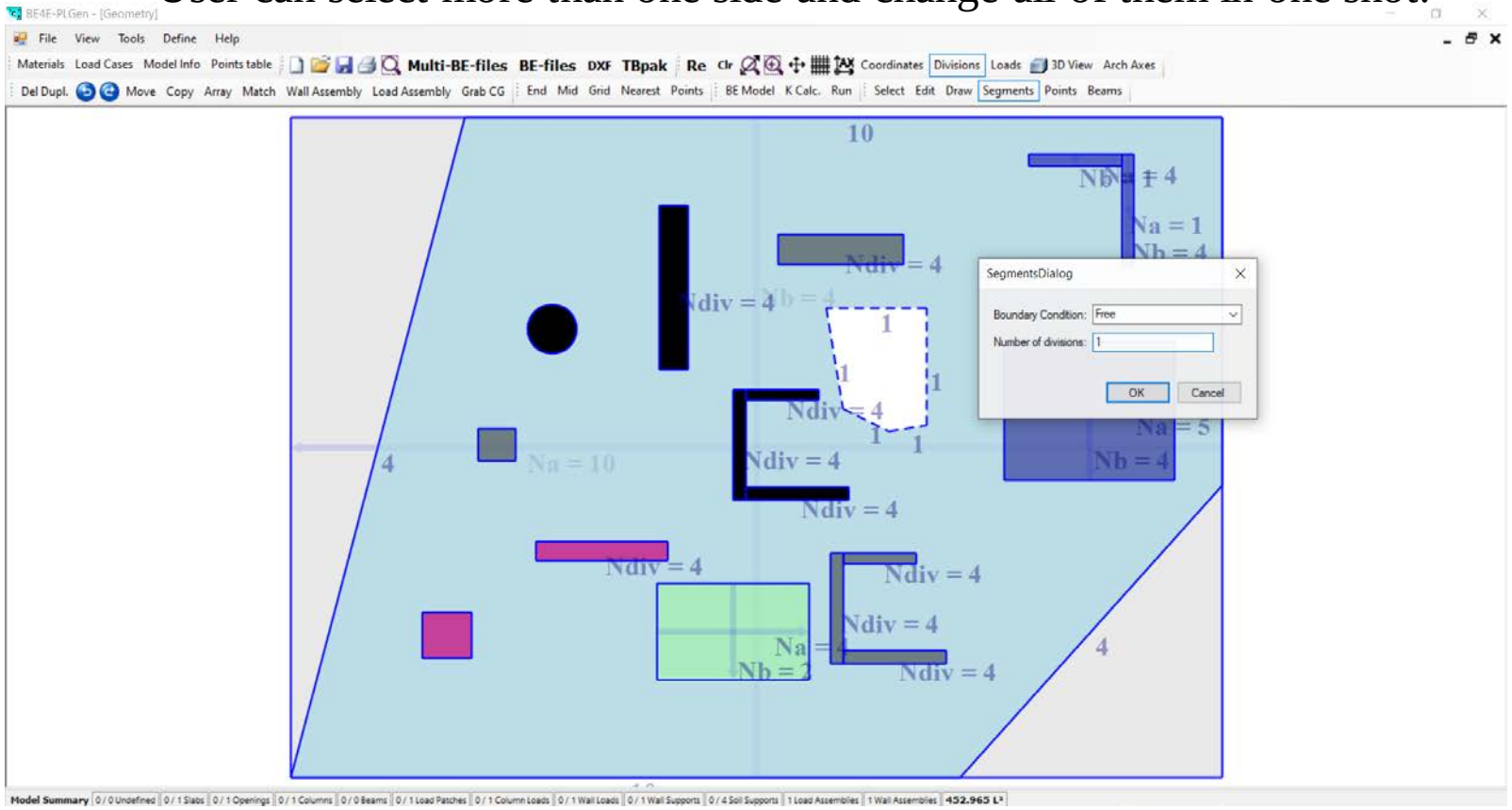
CUFE-BE

www.be4e.com

Cairo University

3. Edit the boundary element division

- The default number of boundary elements is four.
- Change PLGen mode to Segments mode.
- Select the side which need to be changed by left click then right click to open the dialog, which contains the boundary condition (free, hinged, fixed, symmetry about x/y –axes) and the number of divisions / boundary elements.
- User can select more than one side and change all of them in one shot.



CUFE-BE

www.be4e.com

Cairo University

A. **PLGen – Model generator**
   1. **Edit model information** ✓
   2. **Build model and define its elements** ✓
   3. **Edit the boundary element divisions** ✓

B. PLView – Numerical model

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

A. PLGen – Model generator

B. PLView – Numerical model

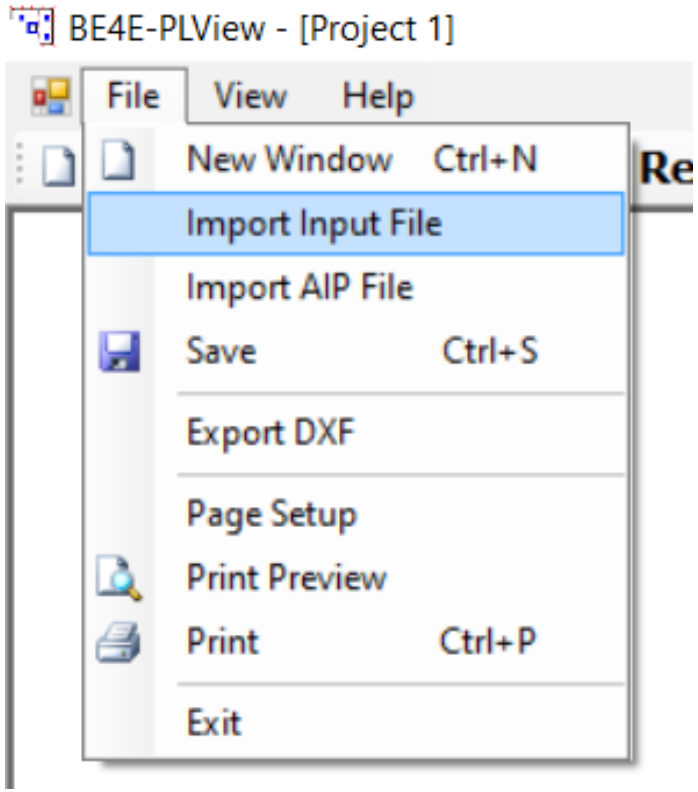
C. PLCoreMan – Manager and solver

D. PLPost – Post processing

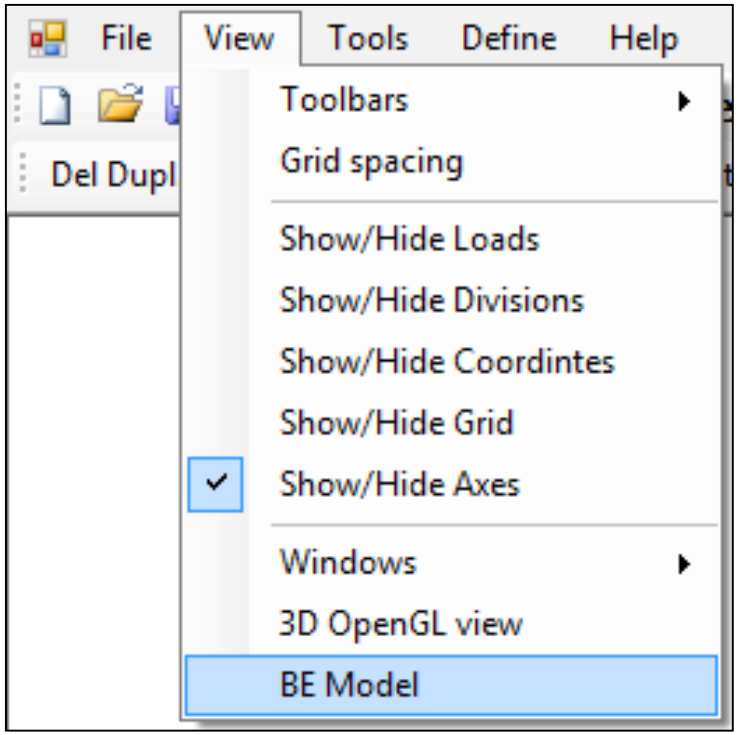
E. PLDesign – Design tool

F. PLPAK modelling capabilities

- PLView is used to view and check the boundary element numerical model before running the model.
- User can check all entered information.
- User can open PLView directly then load the *.in file, or from PLGen by clicking BE Model button.



From PLView



OR

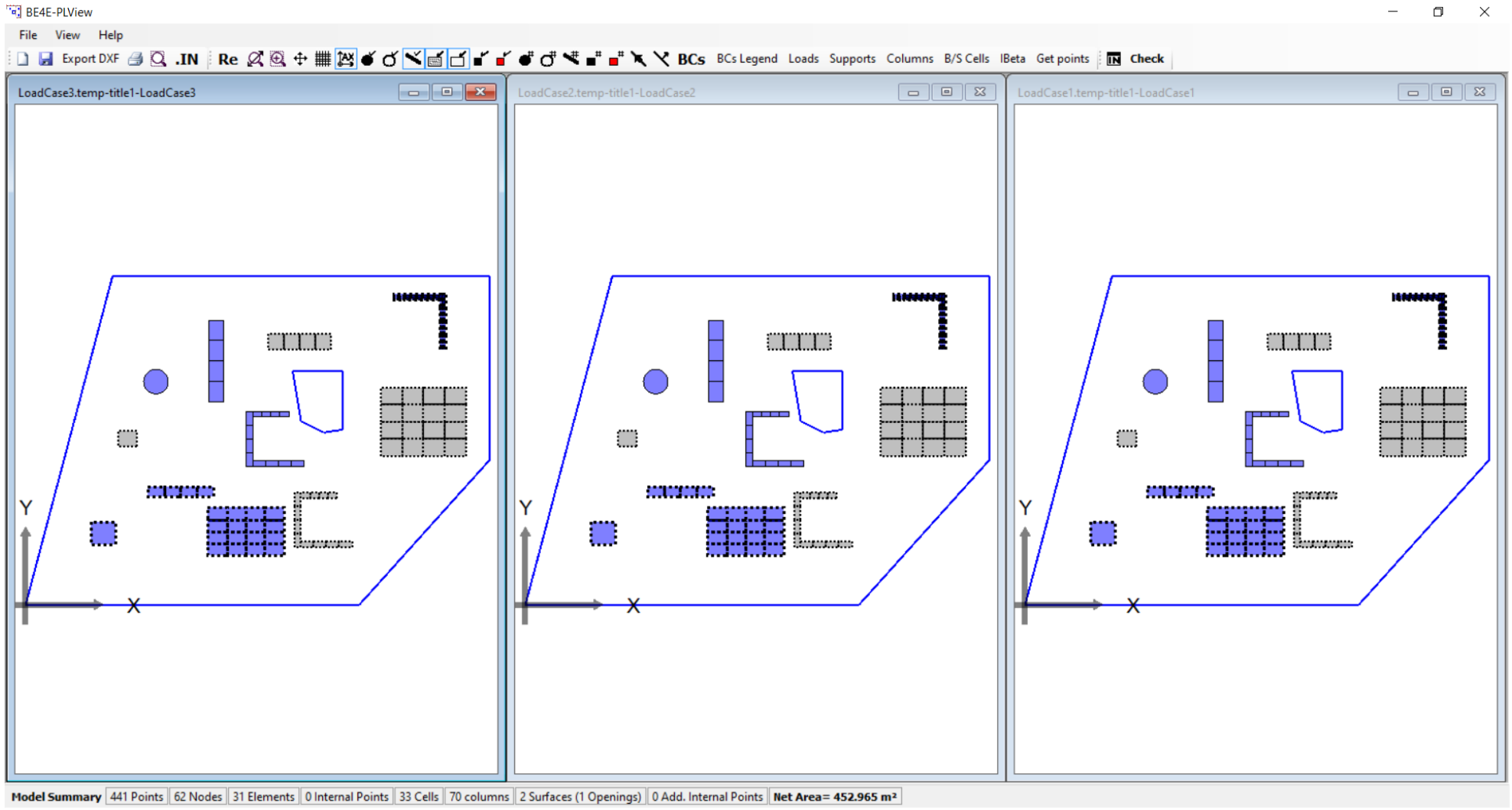
From PLGen

CUFE-BE

www.be4e.com

Cairo University

- PLView open window for each load case.
- The model will be unable to run in cases of, two node have the same coordinates or two supporting cells have the same center.

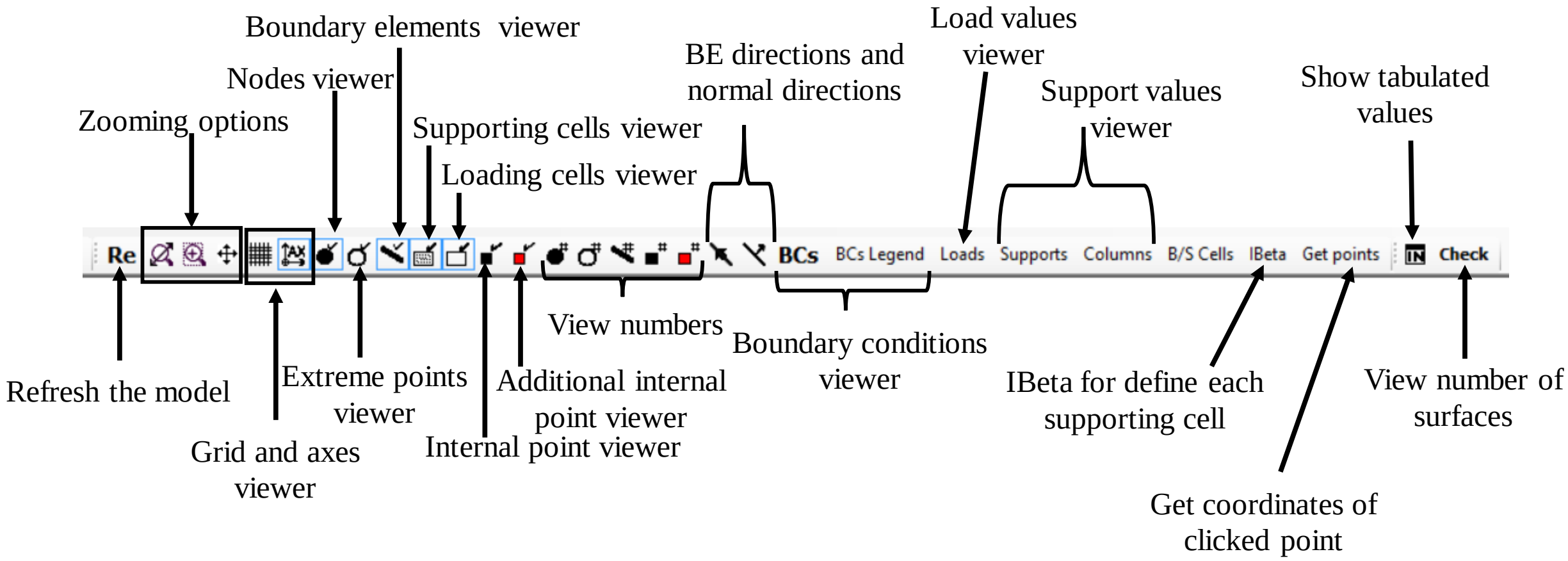


CUFE-BE

www.be4e.com

Cairo University

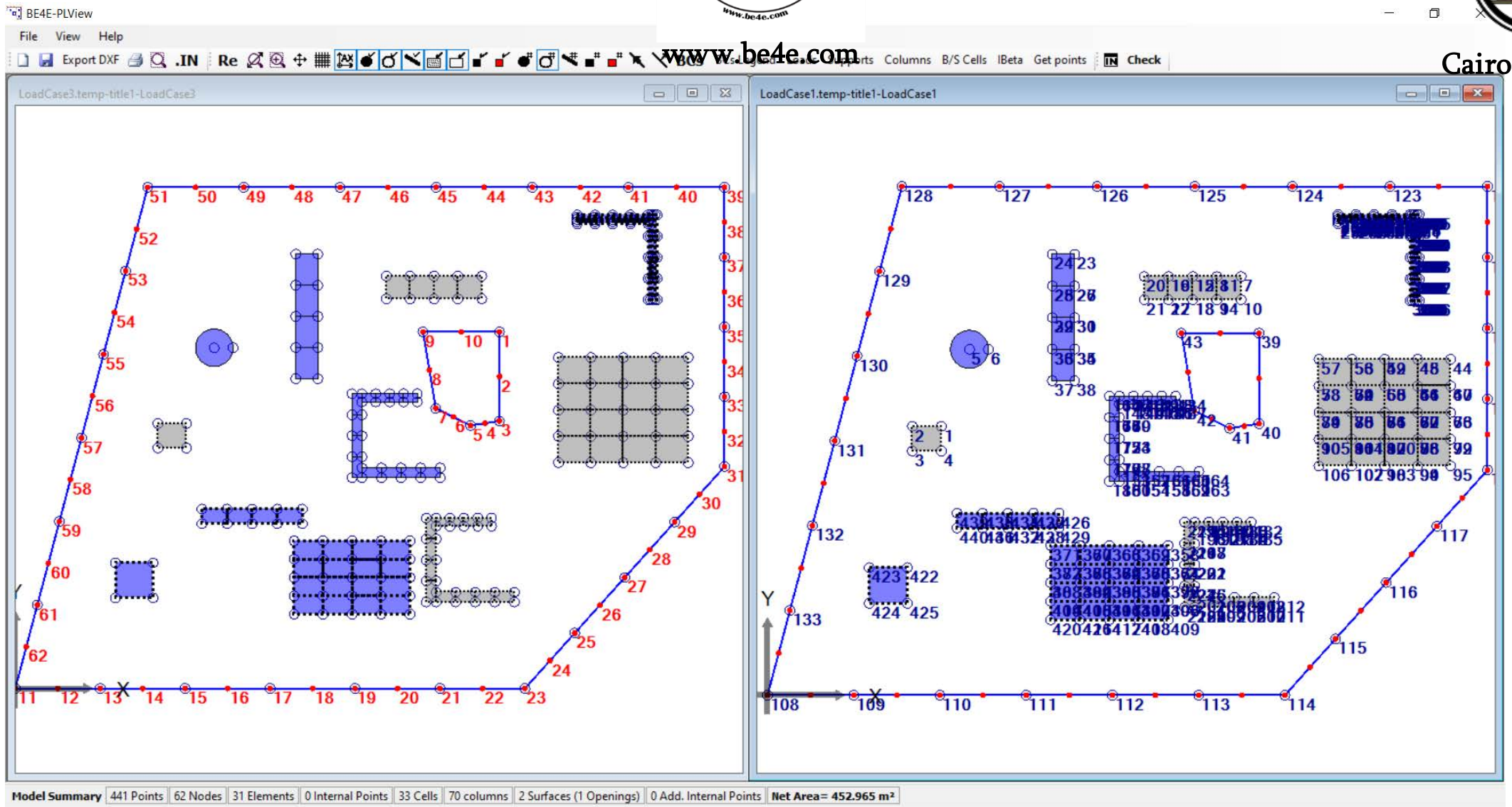
- In PLView user can use these features.



CUFE-BE

www.be4e.com

Cairo University

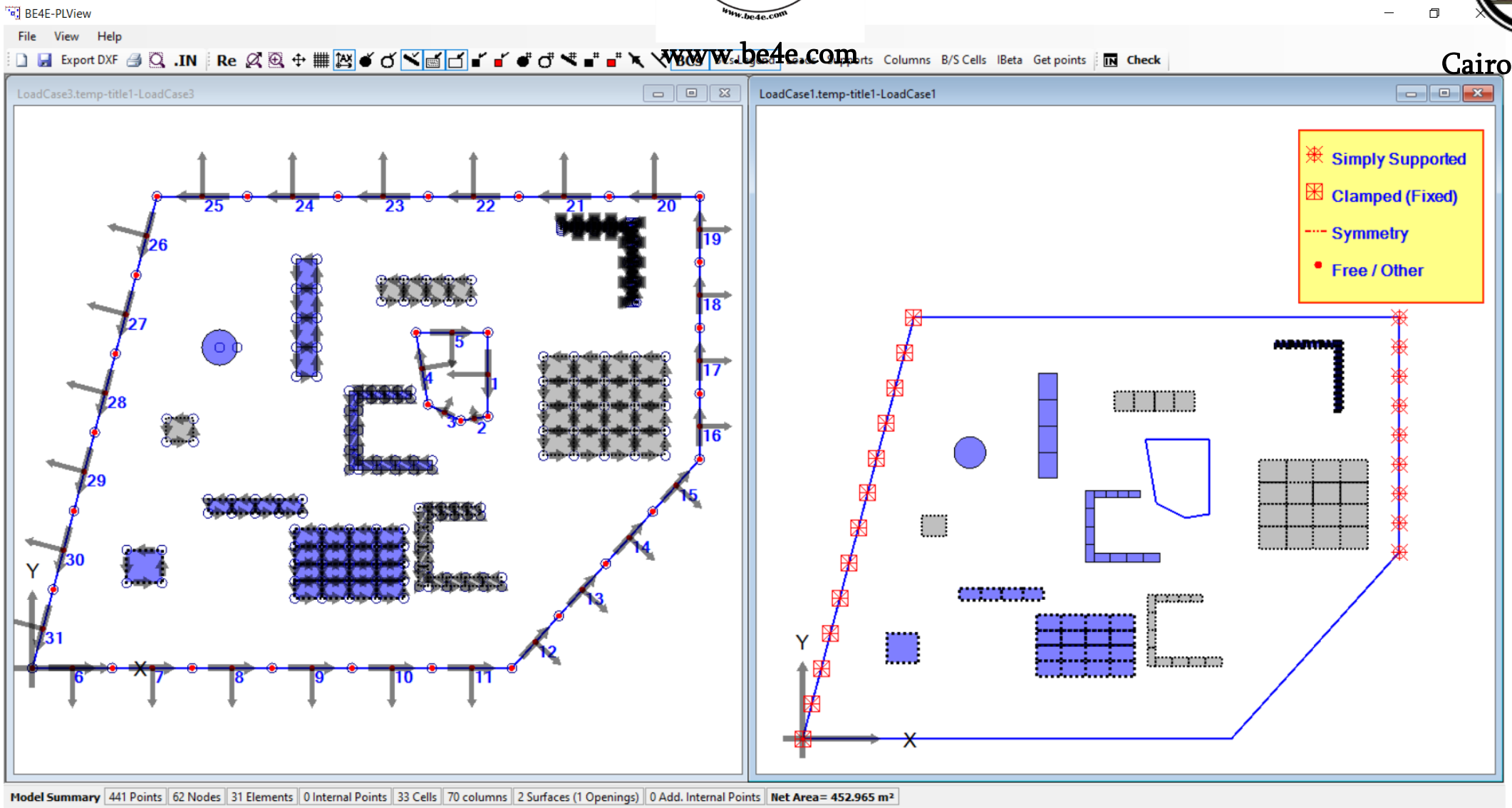


BE model of slab showing nodes, and extreme points numbers

CUFE-BE

www.be4e.com

Cairo University



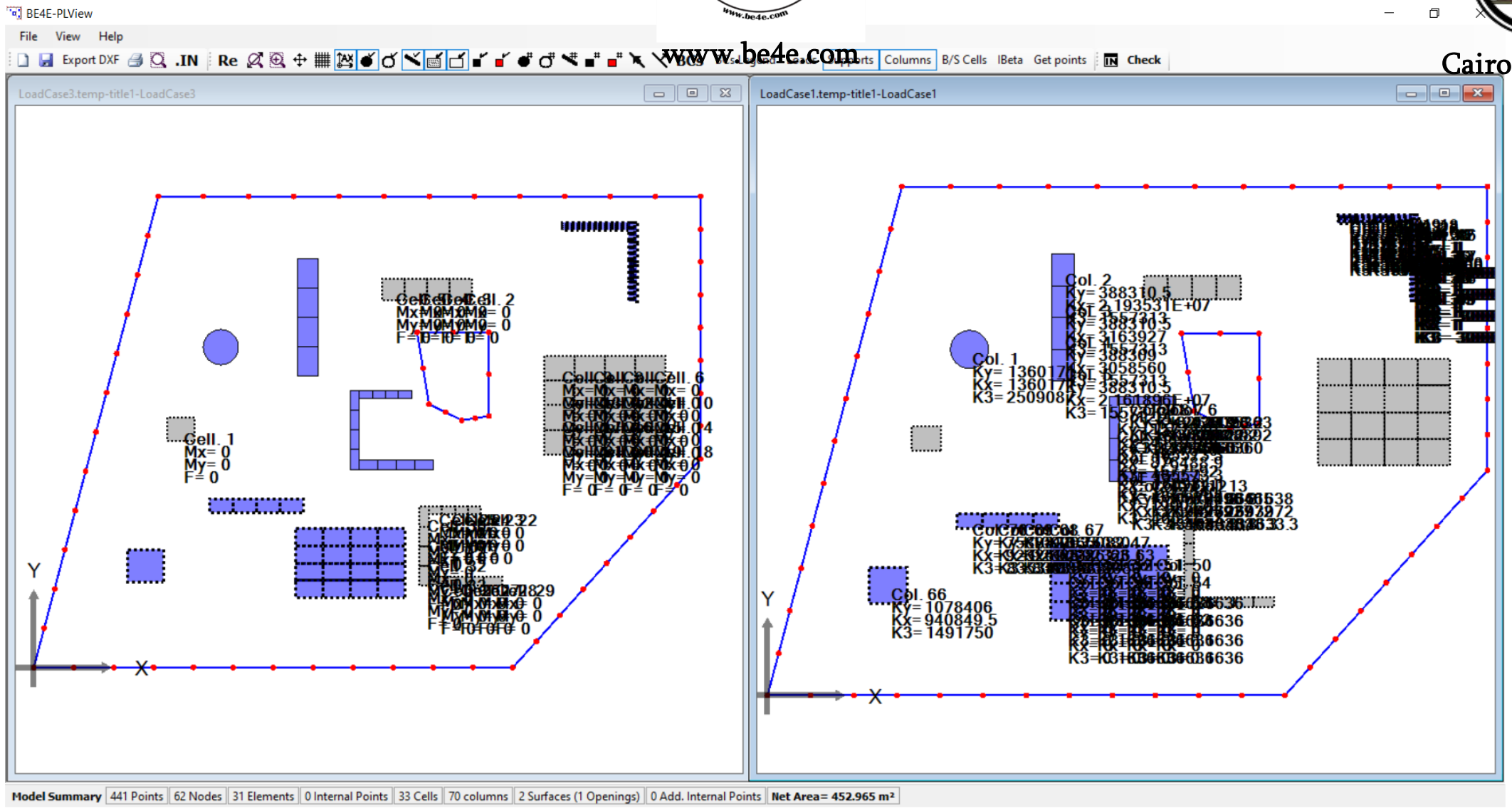
BE model showing BE number, directions, and normal directions

BE model showing boundary conditions

CUFE-BE

www.be4e.com

Cairo University



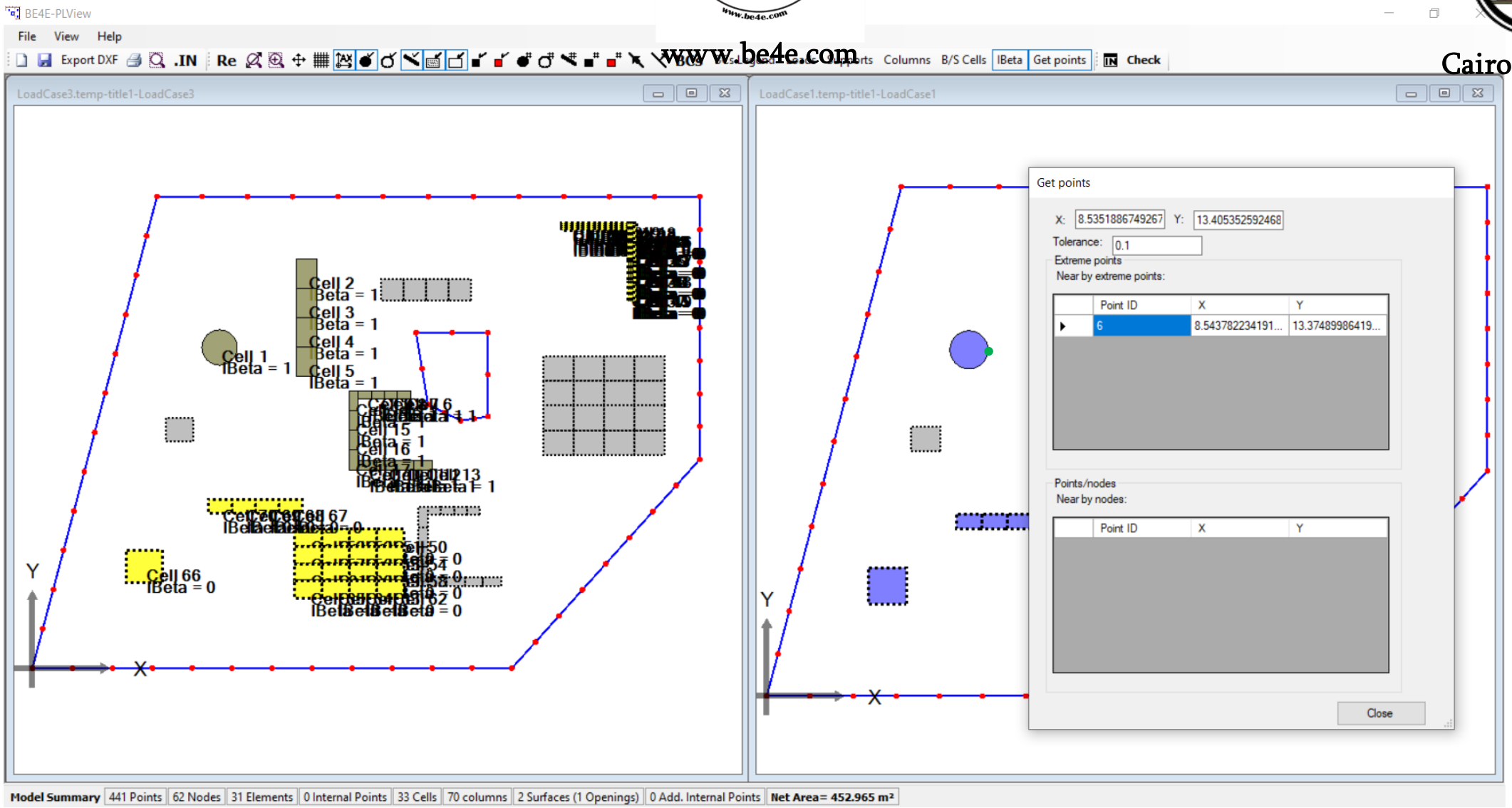
BE model showing load values on loading cells

BE model showing stiffness values on supporting cells

CUFE-BE

www.be4e.com

Cairo University



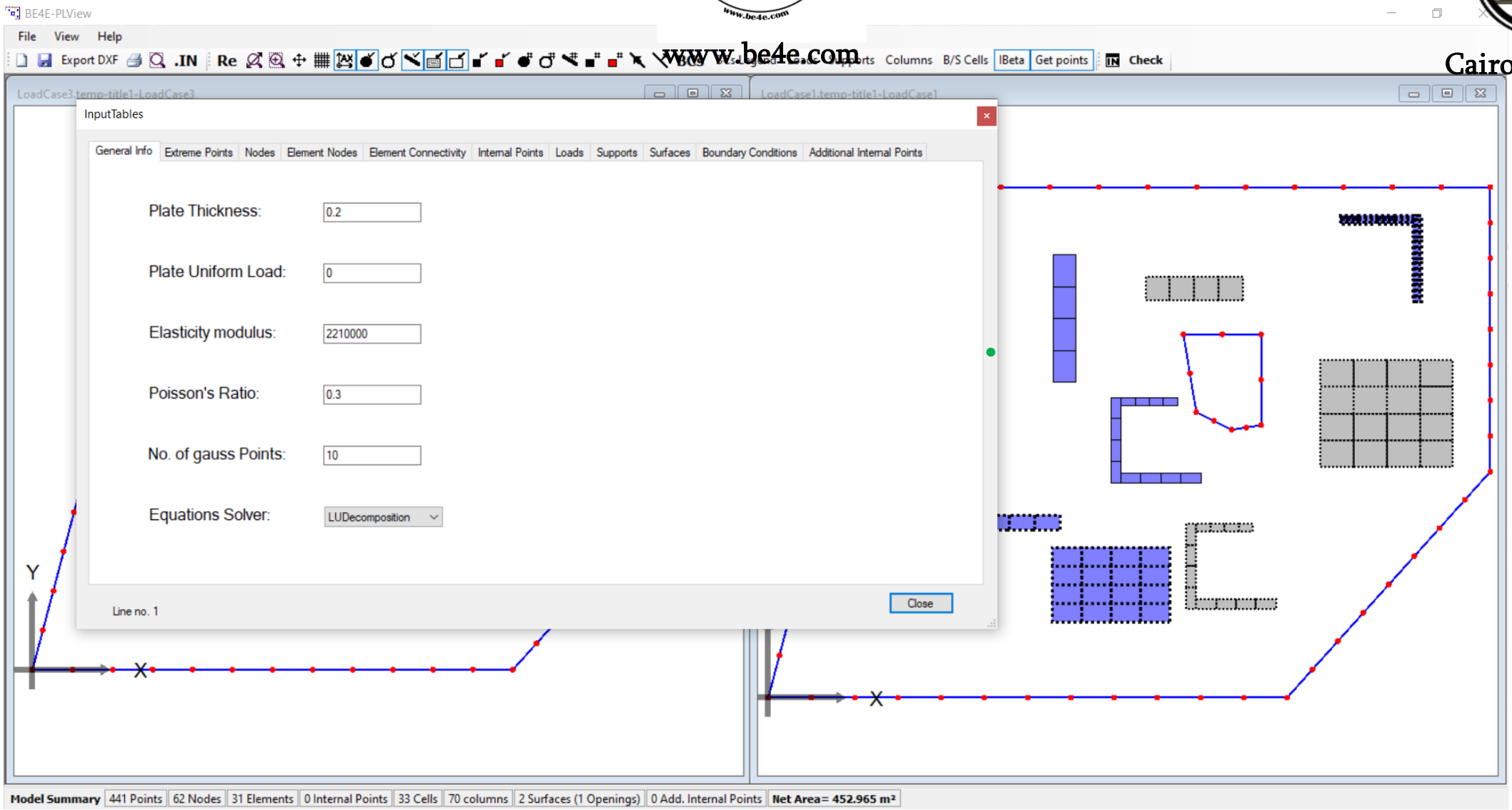
BE model showing IBeta values on supporting cells

BE model showing clicked extreme point coordinates

CUFE-BE

www.be4e.com

Cairo University

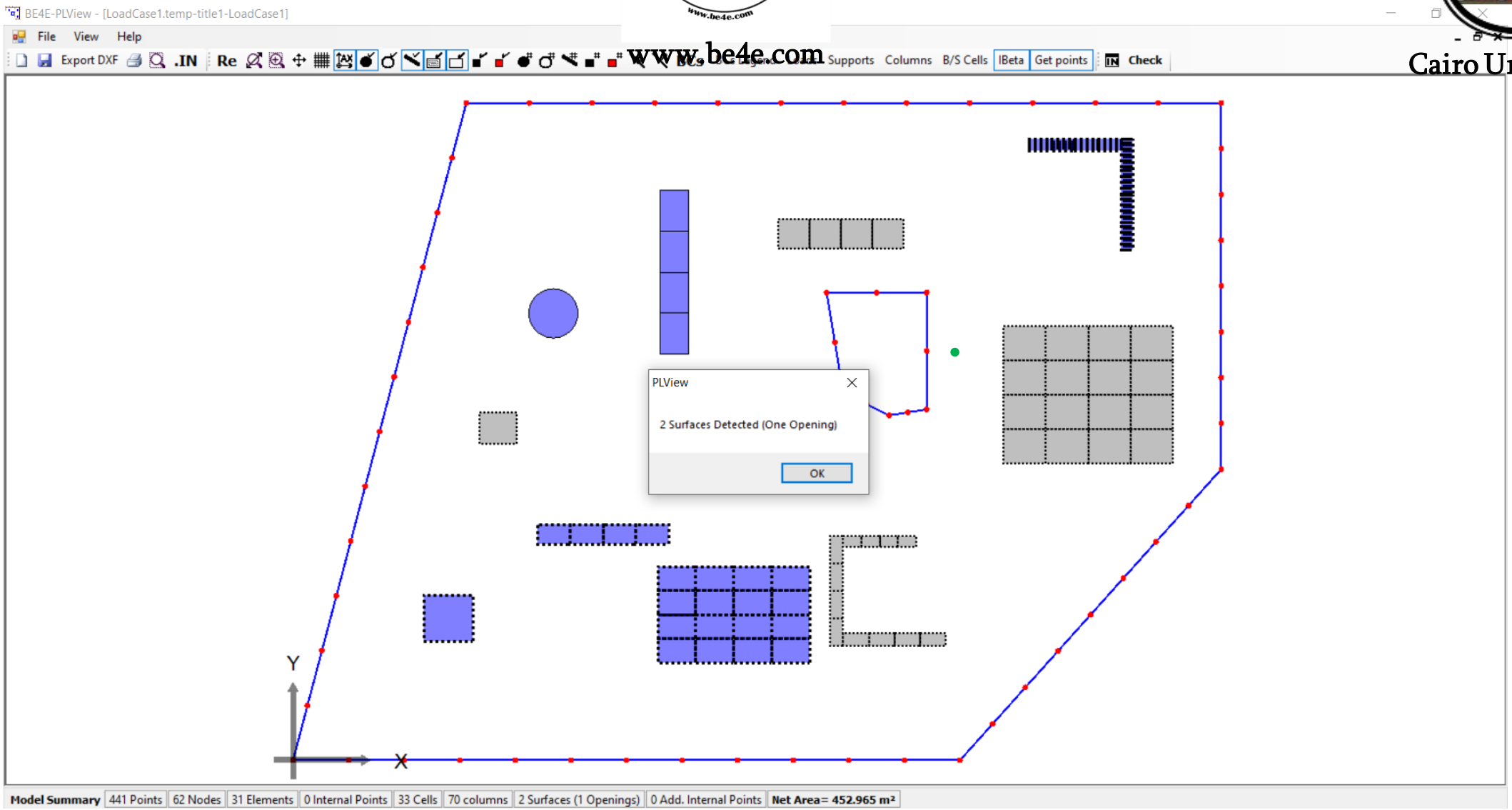


Tabulated values of the model

CUFE-BE

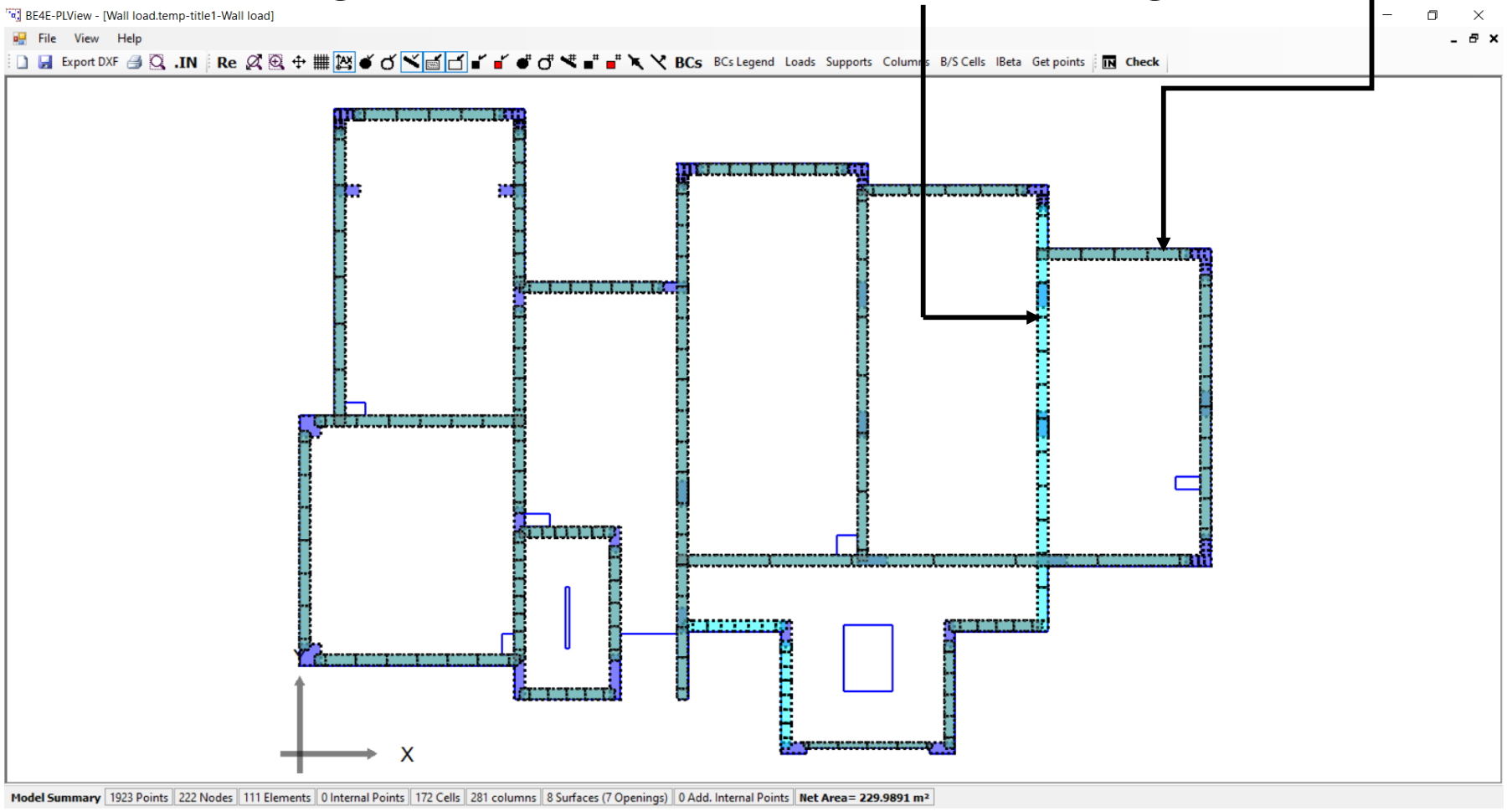
www.be4e.com

Cairo University



Number of surfaces in the model by clicking the Check button

- In the PLView the user can see the number of division for each beam.
- In case of the beam color is light green, it means that it doesn't contain beam own weight.
- In case the beam color is Dark green, it means that it contains beam own weight.



CUFE-BE

www.be4e.com

Cairo University

A. **PLGen – Model generator** ✓

B. **PLView – Numerical model** ✓

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

A. PLGen – Model generator

B. PLView – Numerical model

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

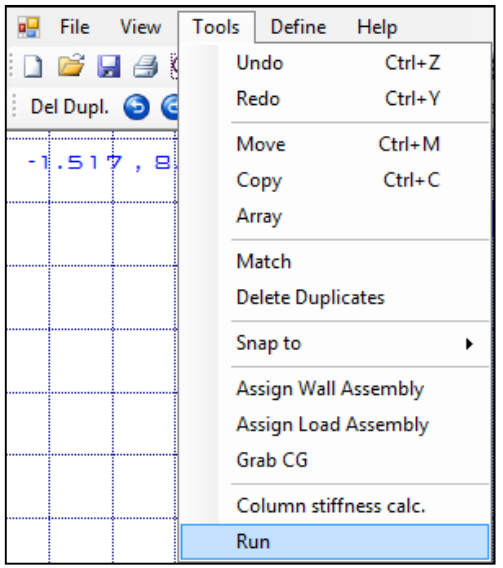
- PLCoreMan has several tasks:

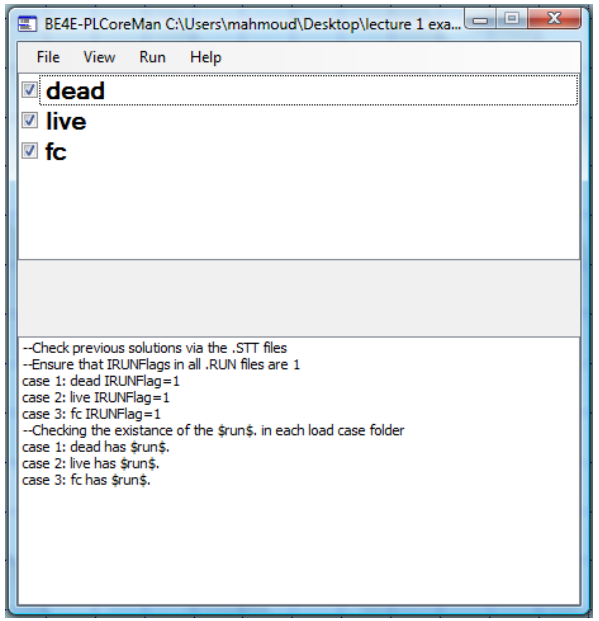
1- Run the model.

2- Transfer between PLPAK components (PLView & PLPost) or between other packages (PLDesign & EHSPAK & P-PPAK & PTPAK & NLPAK).

3- Open PL controls, manual, and about.

OR





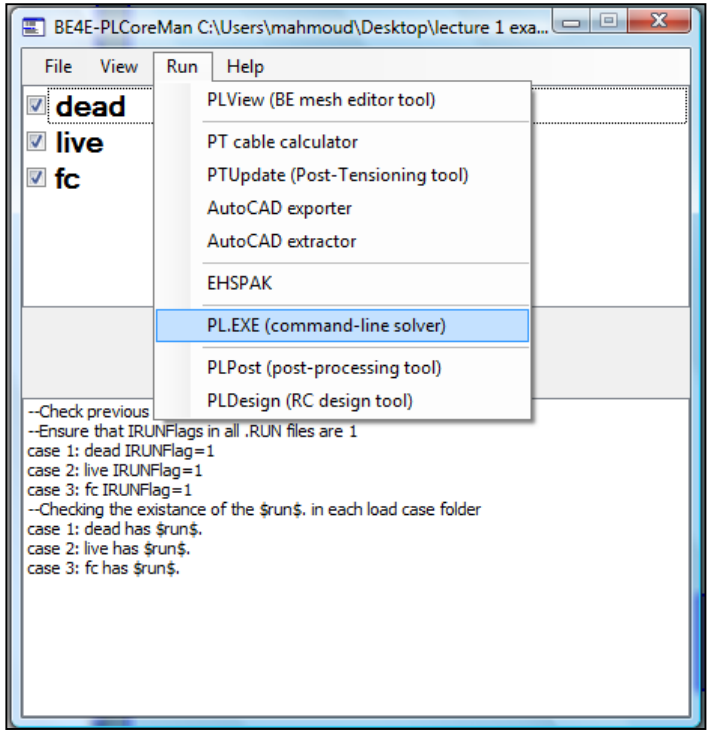
CUFE-BE

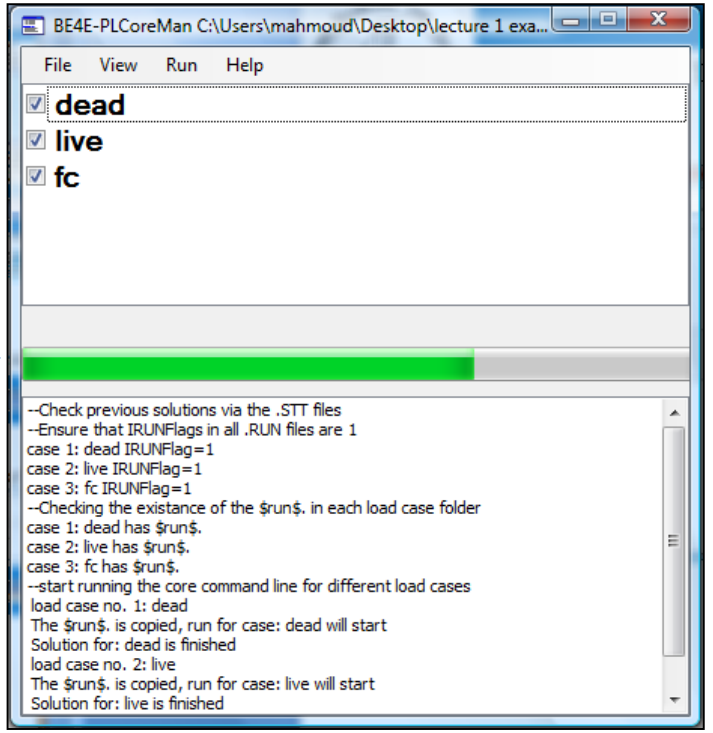
www.be4e.com

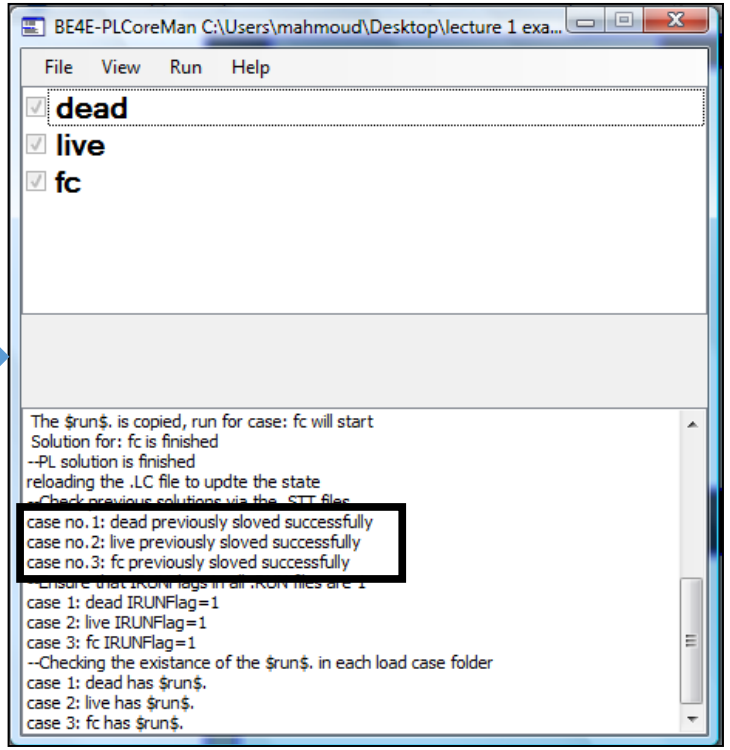
Cairo University

1- Run the model

- The user should see in the text window that the load cases run successfully.
- If the load cases didn't run successfully, model must be checked again in PLView.





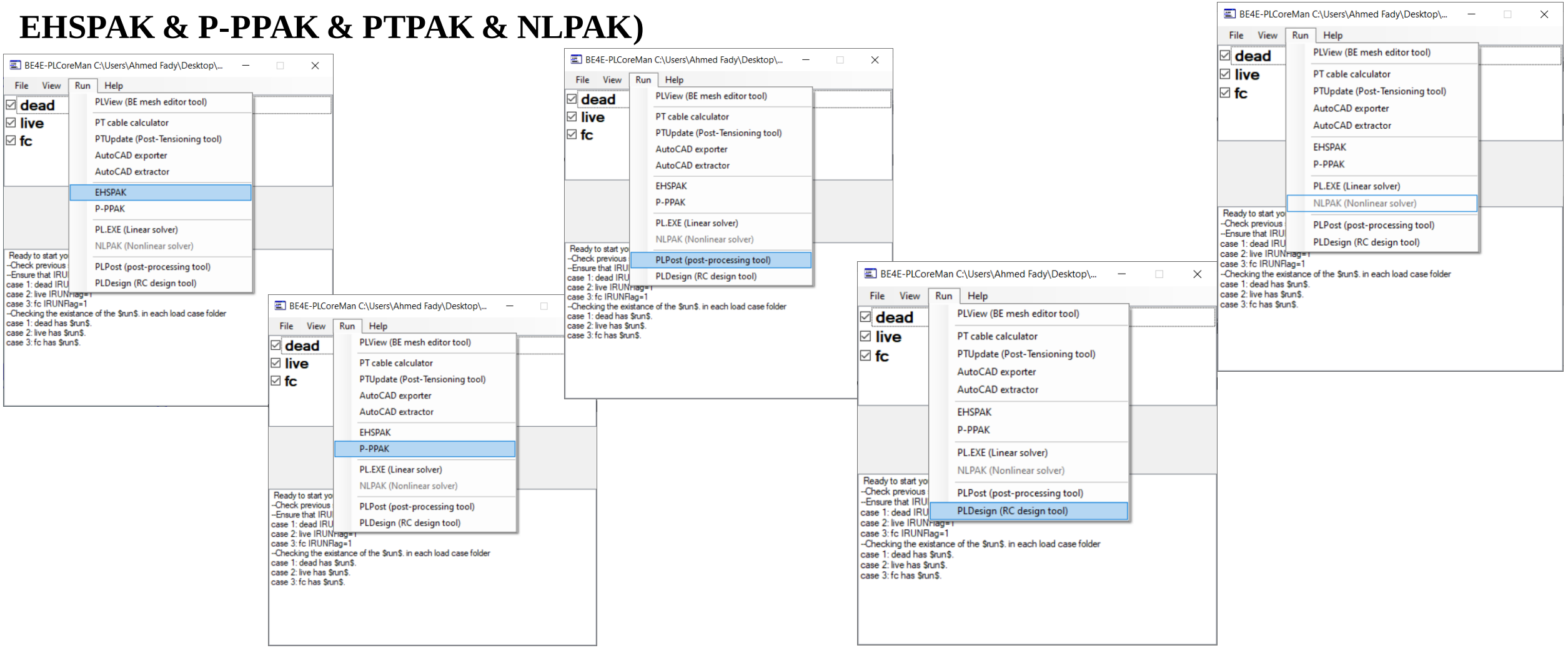


CUFE-BE

www.be4e.com

Cairo University

2- Transfer between PLPAK components (PLView & PLPost) or between other packages (PLDesign & EHSPAK & P-PPAK & PTPAK & NLPAK)

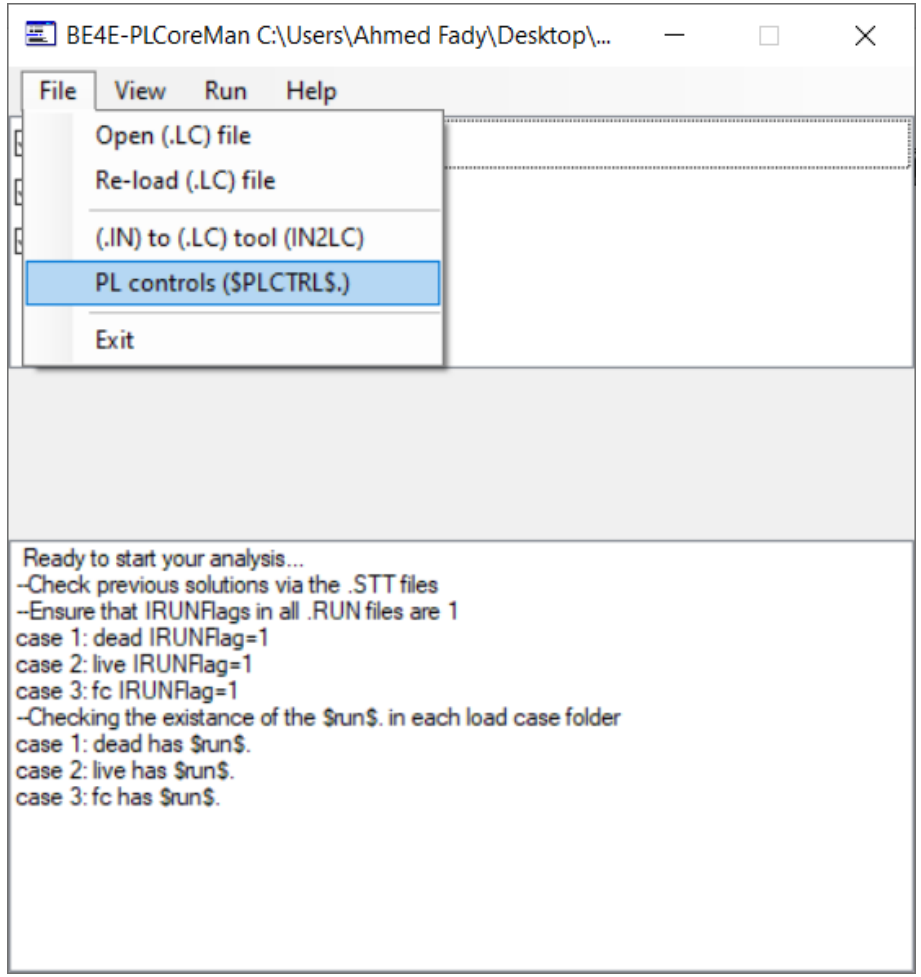


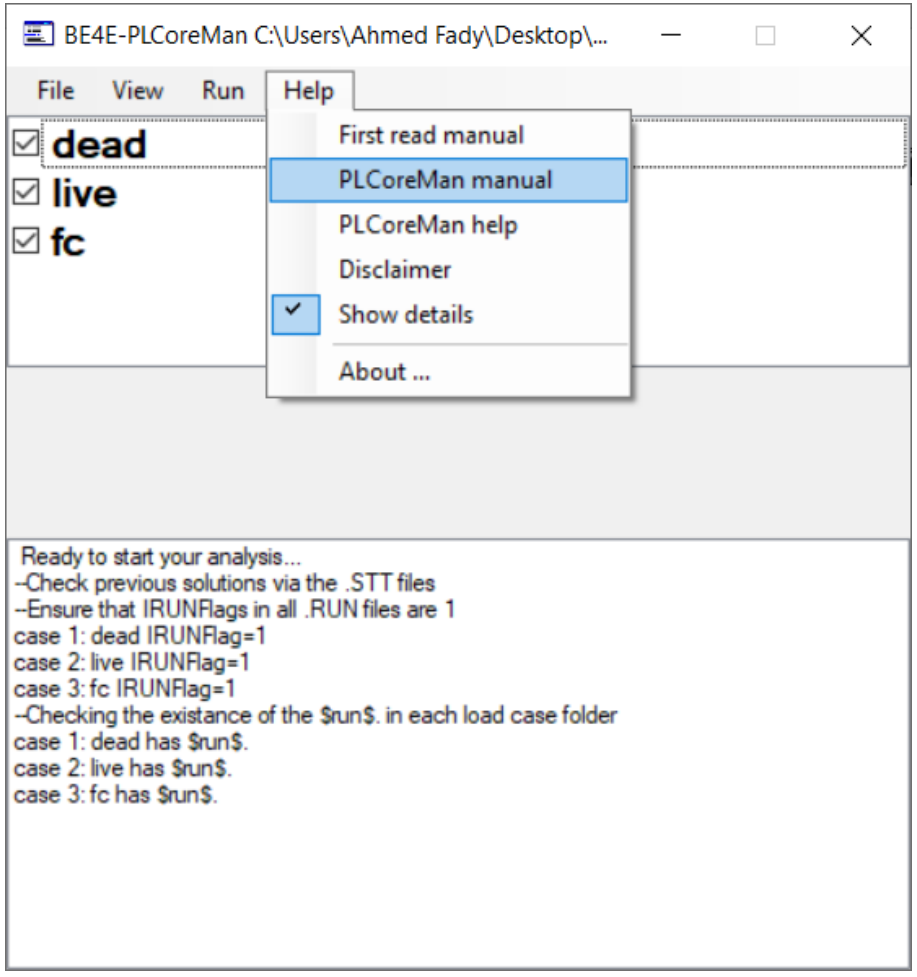
CUFE-BE

www.be4e.com

Cairo University

3- Open PL controls, manual, and about





CUFE-BE

www.be4e.com

Cairo University

A. PLGen – Model generator ✓

B. PLView – Numerical model ✓

C. PLCoreMan – Manager and solver ✓

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

A. PLGen – Model generator

B. PLView – Numerical model

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

The PLPost is the post-processing tool to demonstrate analysis results. PLPost can be categorized into four items:

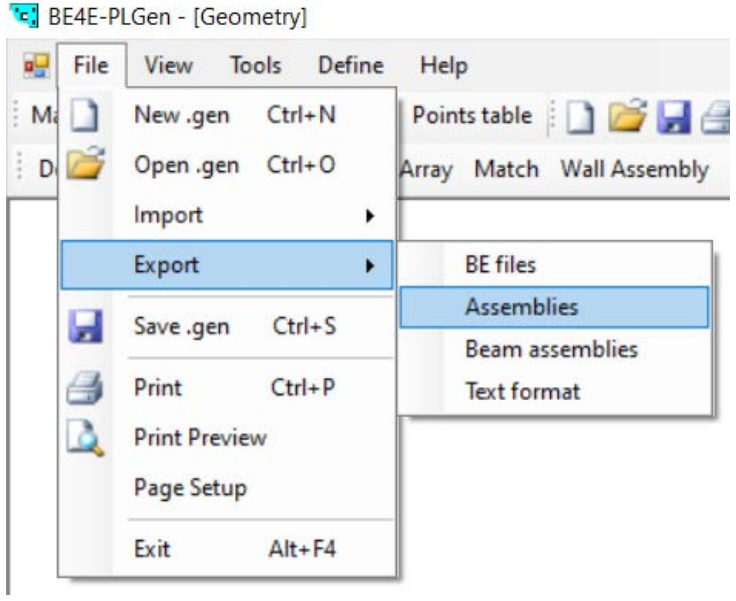
1. **Files exported from PLGen**
2. **Load combinations**
3. **Slab results**
    - **3.1. Contour results**
    - **3.2. Query result**
    - **3.3. Strip results**
    - **3.4. Supporting elements results**
4. **Beam results**

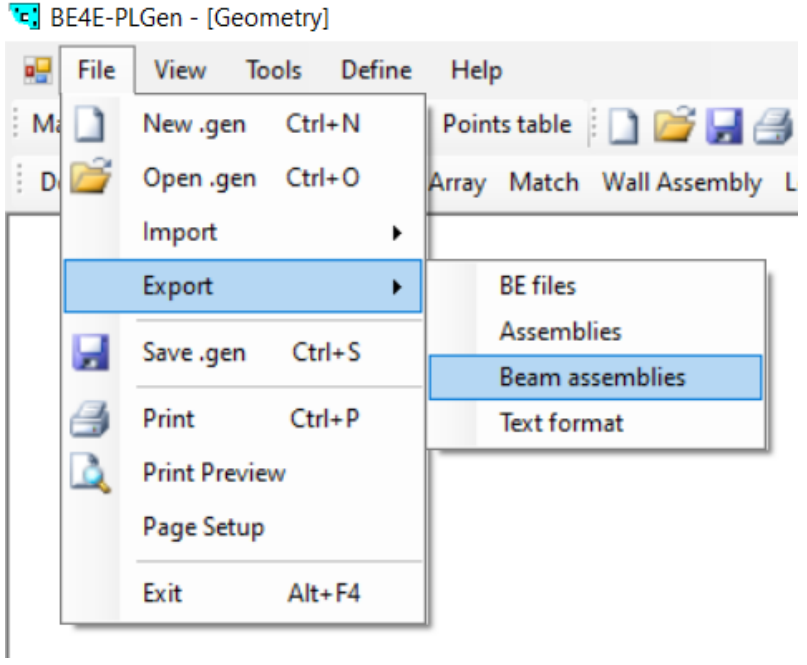
1. Files exported from PLGen

There are cases that user have to export file from PLGen before using PLPost:

- Export assemblies: this case is used to show the total loads of columns, shear walls and wall assemblies (cores).
- Export beam assemblies: this case is used to show the results of the beams.

Restore these files in the PLPost will be demonstrated later.



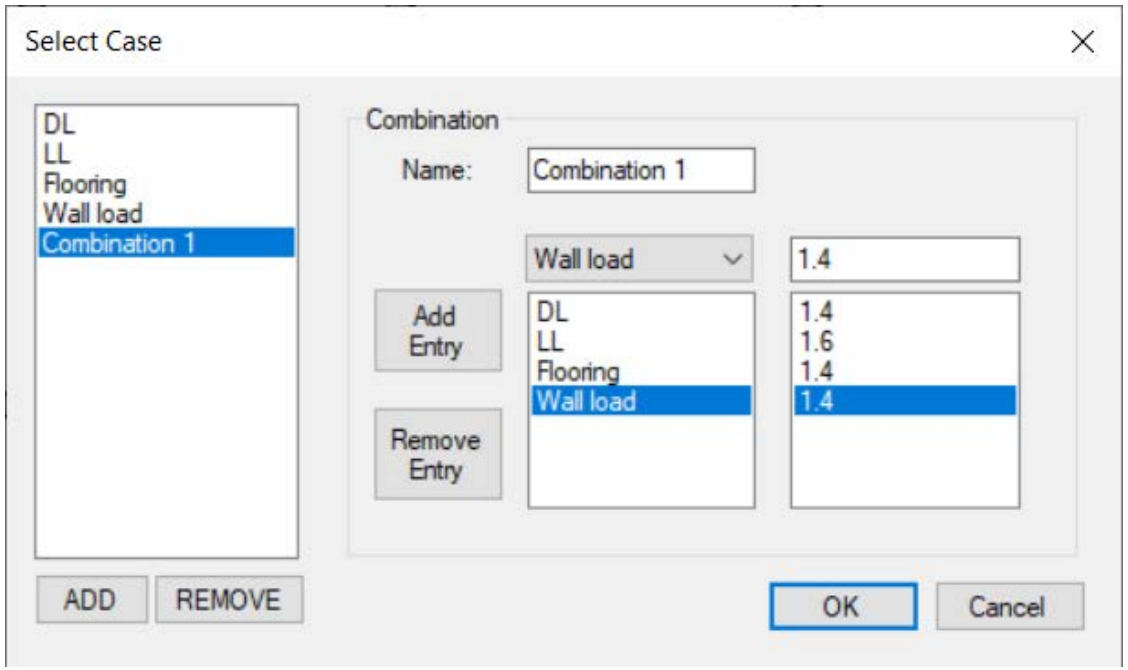


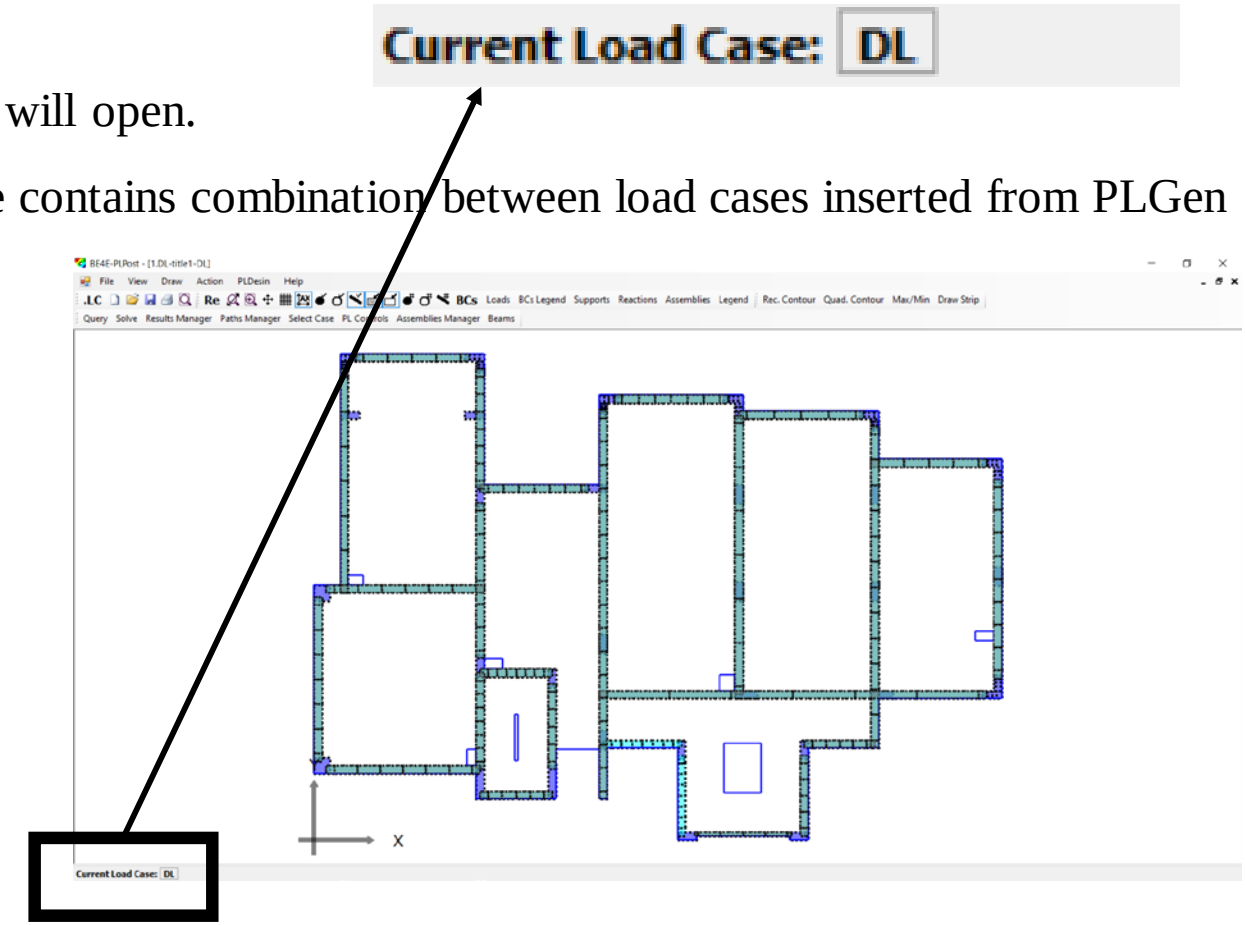
2. Load combinations

The lower tabs of the PLPost contain by default current load case (by default it is the first load case), can be changed by double click on it.

If the user press double click on it load combinations window will open.

The user can add cases like ultimate, working cases, each case contains combination between load cases inserted from PLGen





CUFE-BE

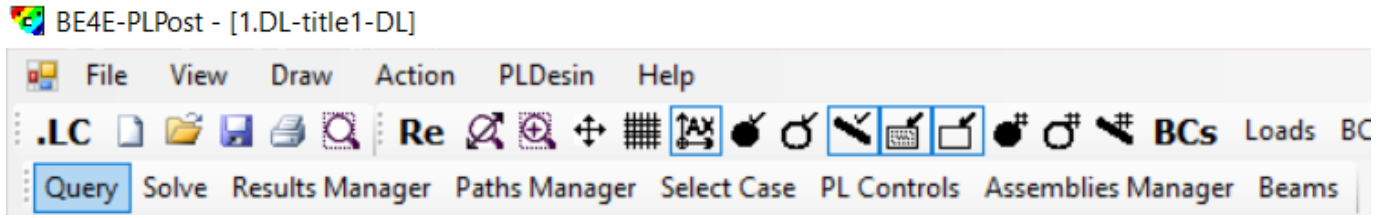
www.be4e.com

Cairo University

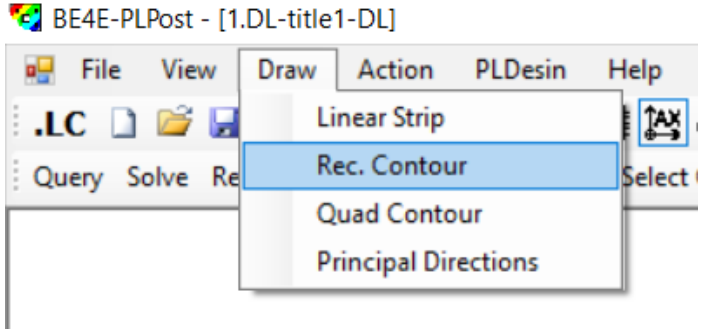
3. Slab results

There are 3 types for showing results in slab:

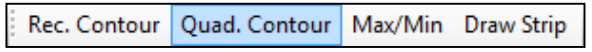
- Contour (main, quadratic, rectangular)
- Strip
- Query for specific point

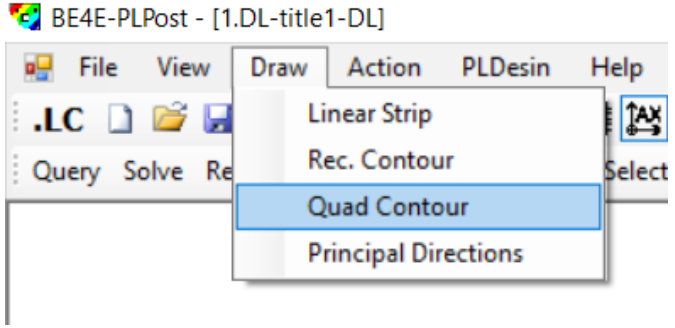


Draw rectangular contour

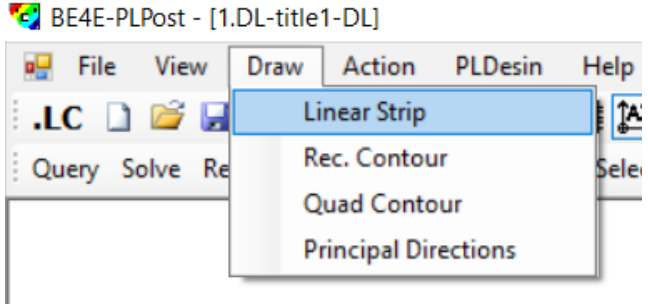


Draw quadratic contour





Draw strip



CUFE-BE

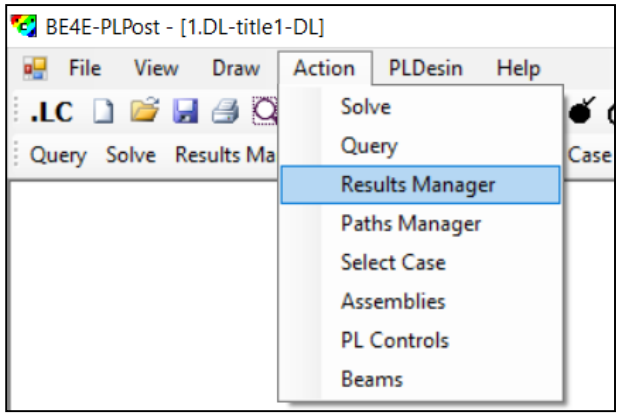
www.be4e.com

Cairo University

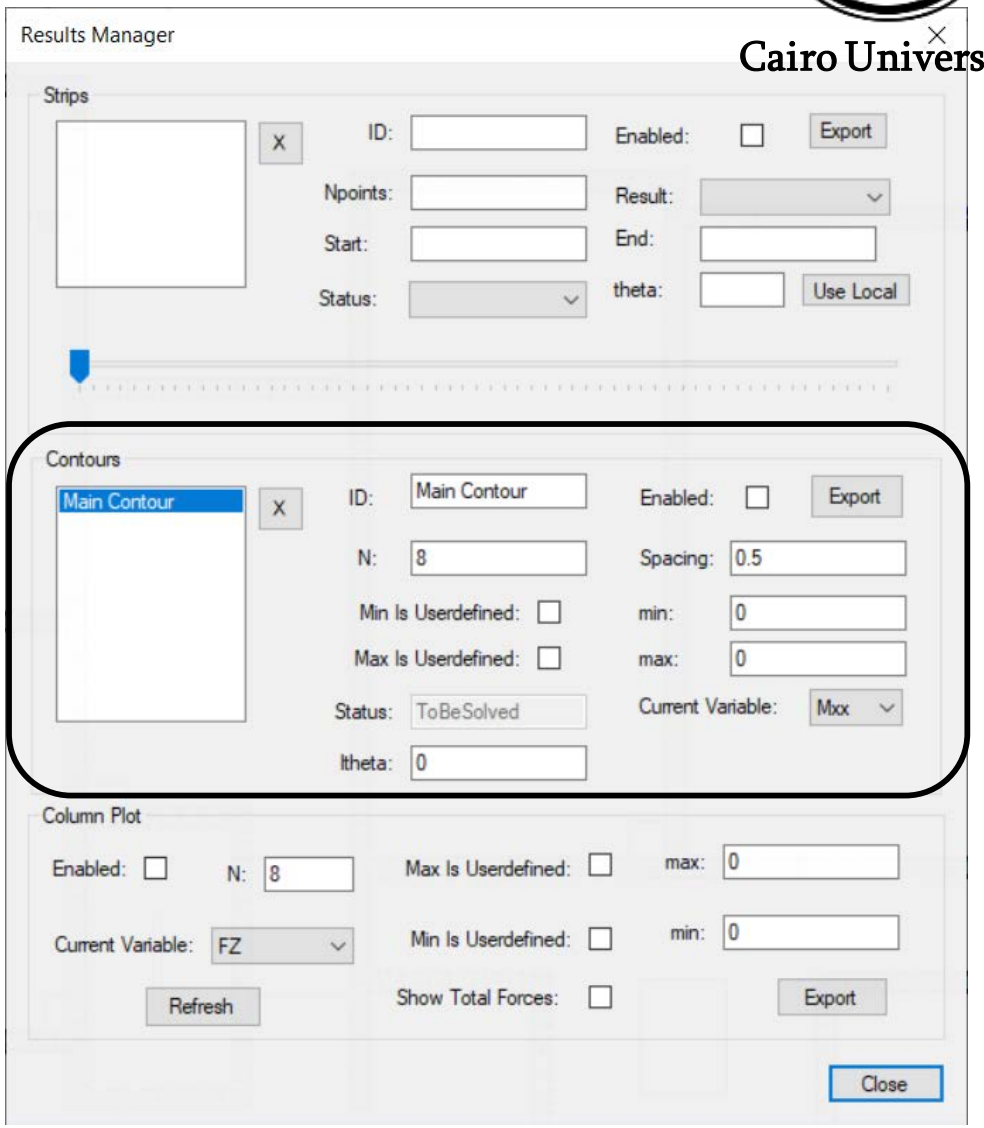
3. Slab results – contour results

Straining action for main contour using result manager:

- Open the results manager
- The results manager consists of three parts at the middle part (Contours) we have the Main Contour.
- Mark the check box (Enabled).
- Insert the spacing between grids.
- Insert number of colors (N).
- Choose the Current Variable
- Insert if there is min/max value for user define.
- Press on Close.



OR



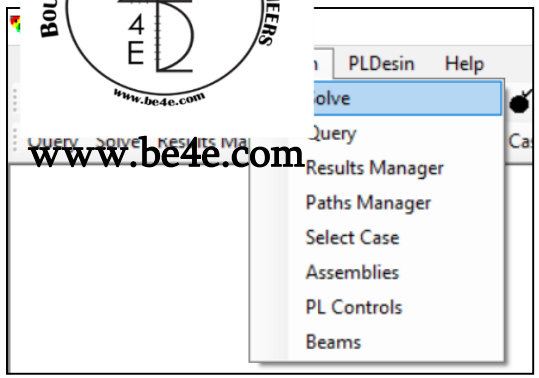
CUFE-BE

Cairo University

3. Slab results – contour results

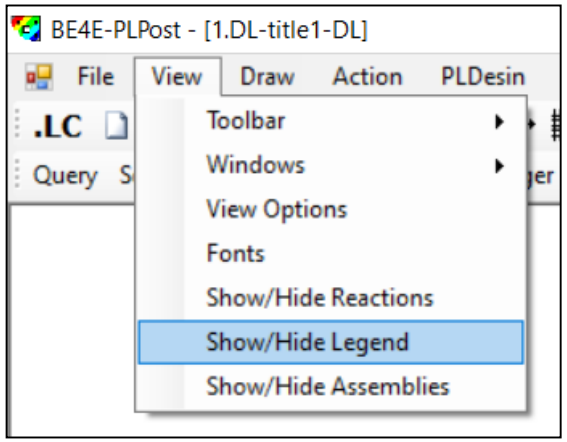
Straining action for main contour using result manager:

- Solve the main contour.

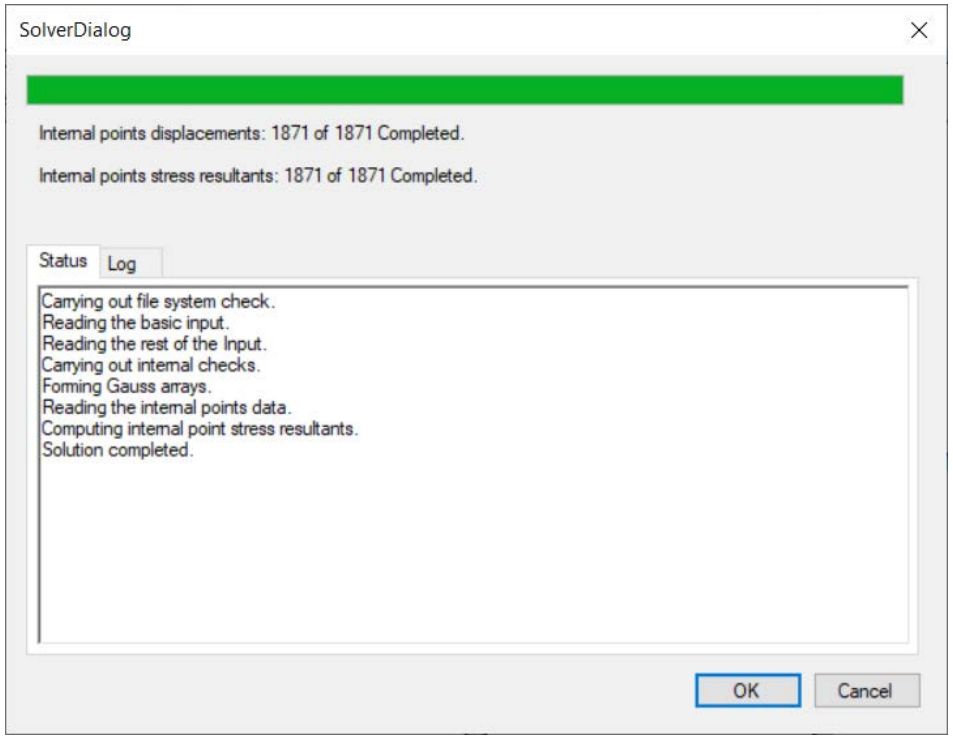


OR

- Solver dialog will appear and after solving press on (F3) or refresh.
- The user can show/hide the legend.



OR



CUFE-BE

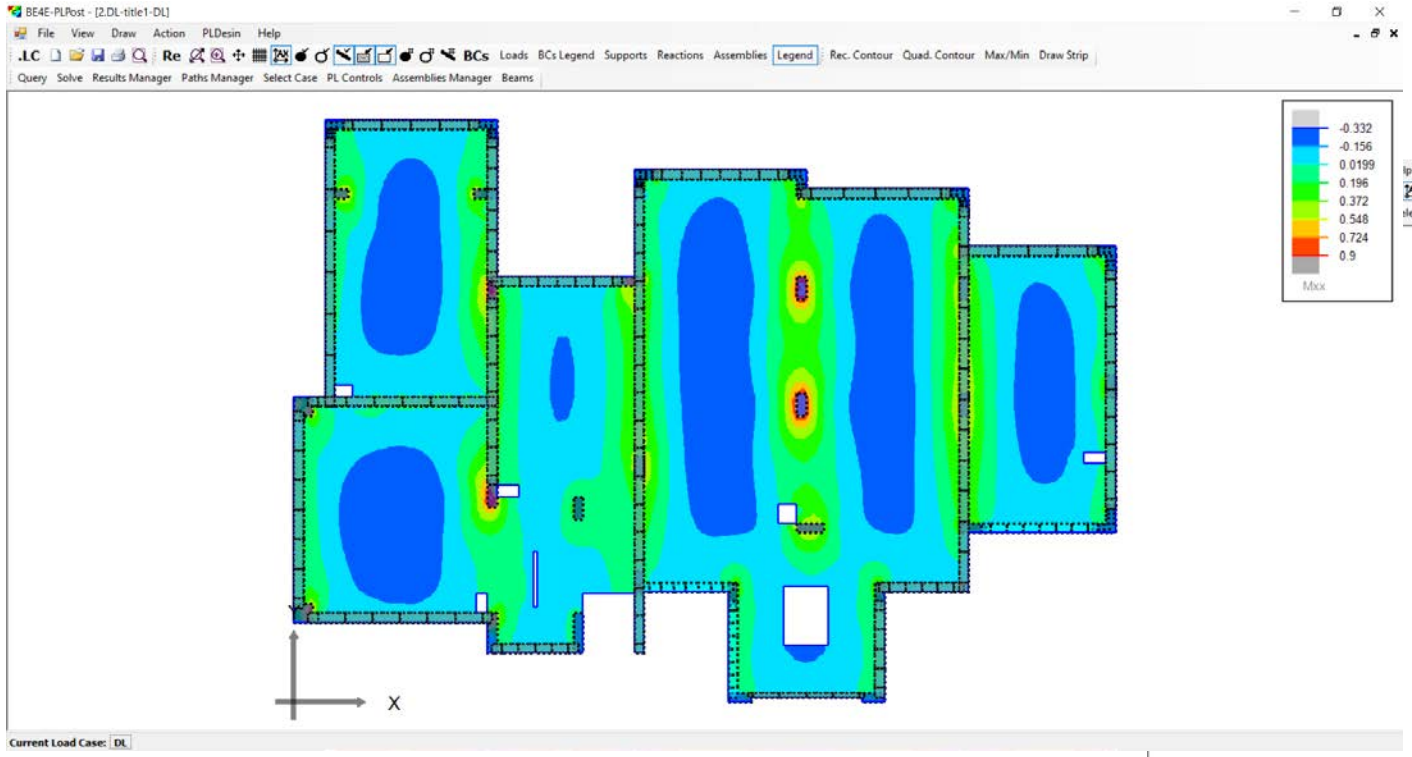
www.be4e.com

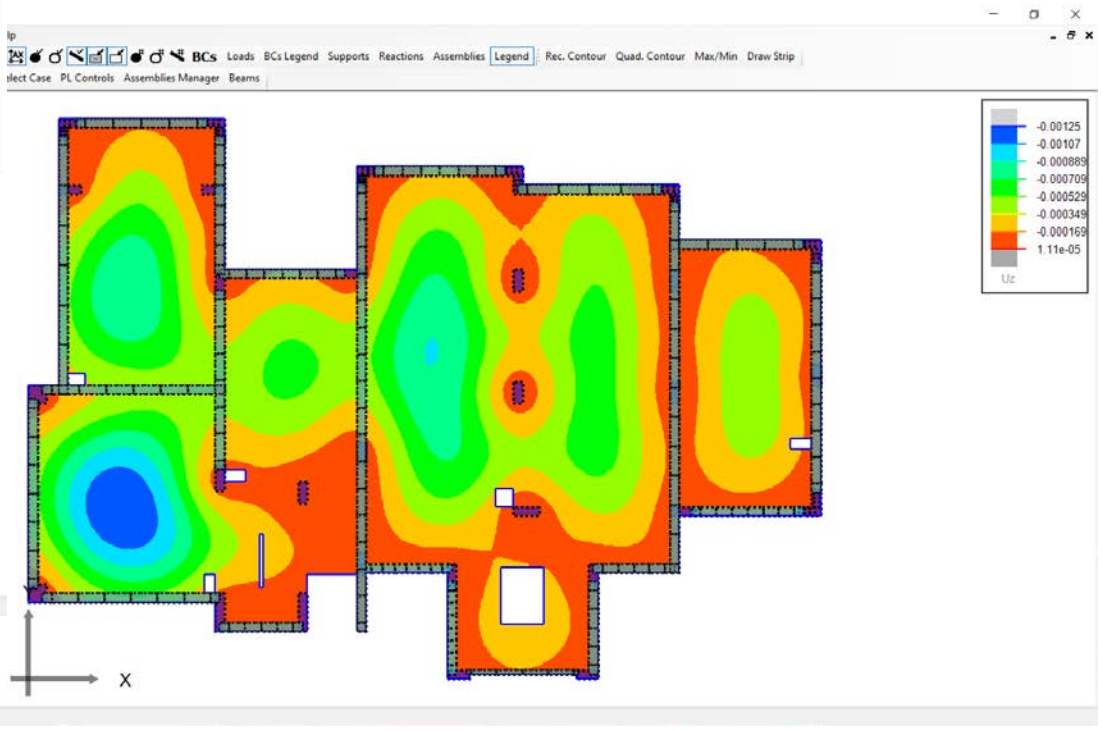
Cairo University

3. Slab results – contour results

Straining action for main contour using result manager:

- The user can see the slab straining actions in any direction, only by changing the current variable on Result Manager.





CUFE-BE

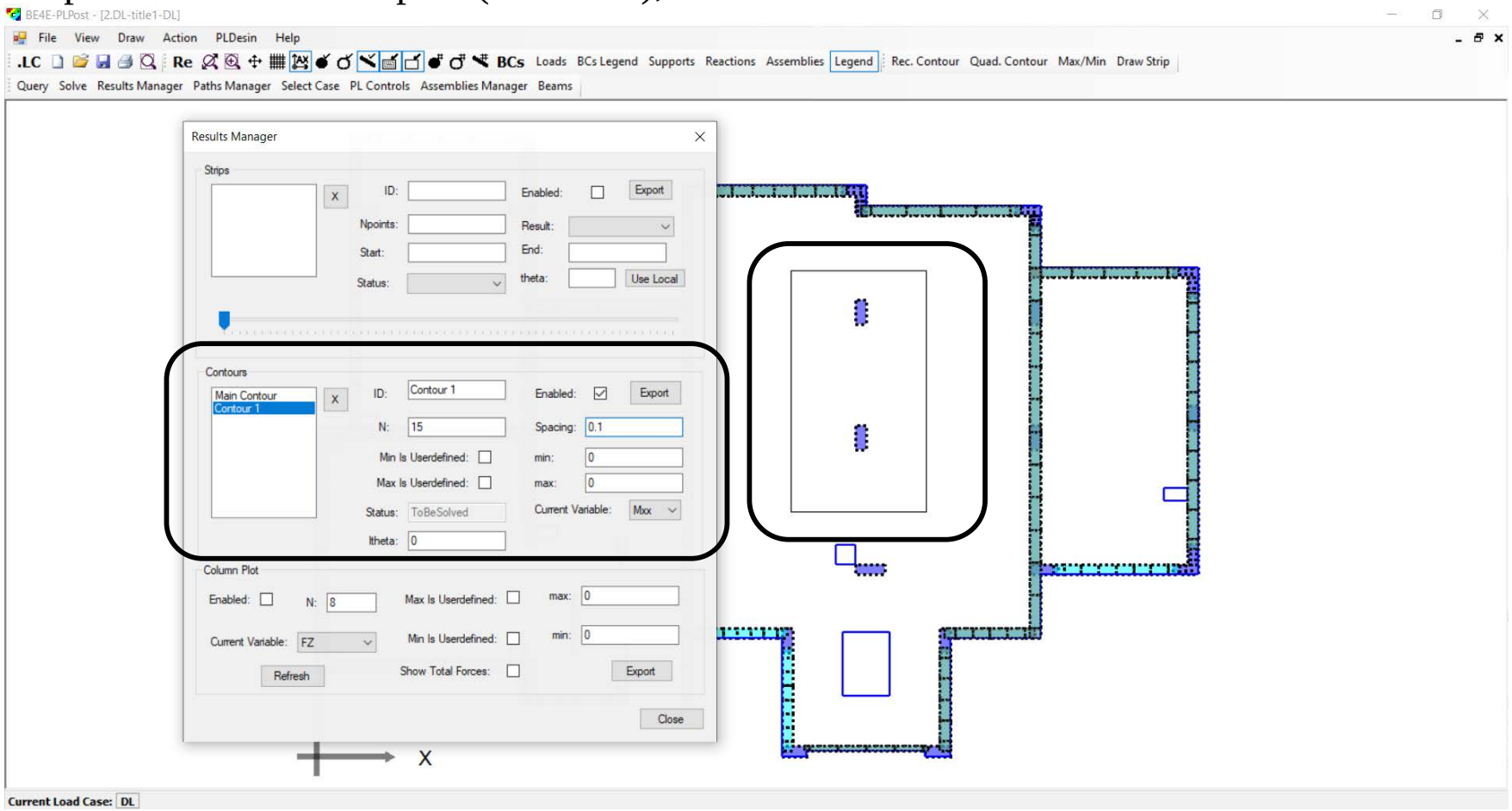
www.be4e.com

Cairo University

3. Slab results – contour results

Straining action for rectangular contour using result manager:

- Draw the rectangular contour.
- The results manager consists of three parts at the middle part (Contours), it has the Main Contour in addition to Contour 1.
- Contour 1 is created and it's automatically enabled.
- Insert the spacing between grids.
- Insert number of colors (N).
- Choose the Current Variable
- Edit the min/max value for user define (if exist).
- Press on Close.
- Solve the contour.



CUFE-BE

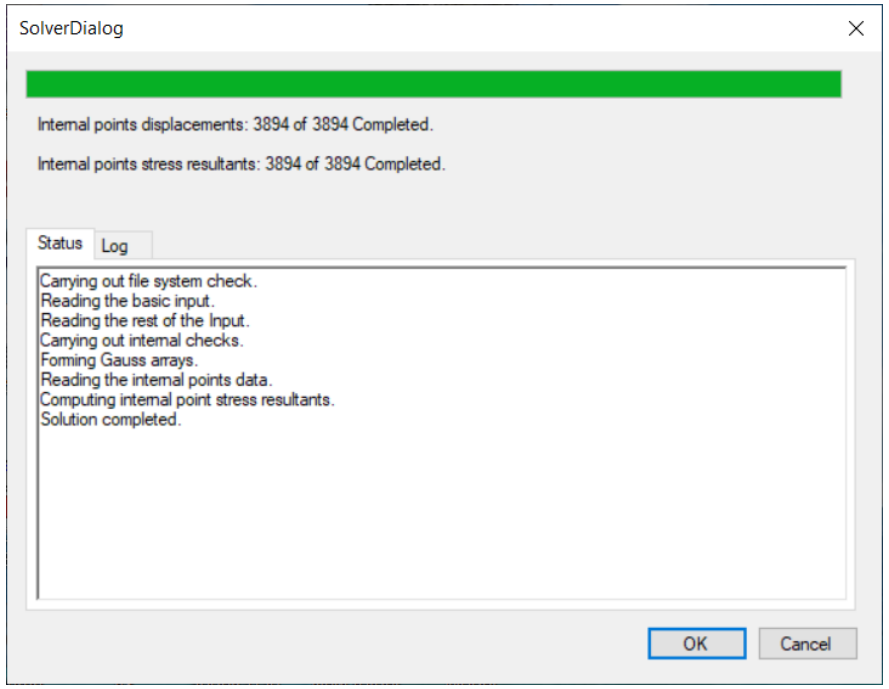
www.be4e.com

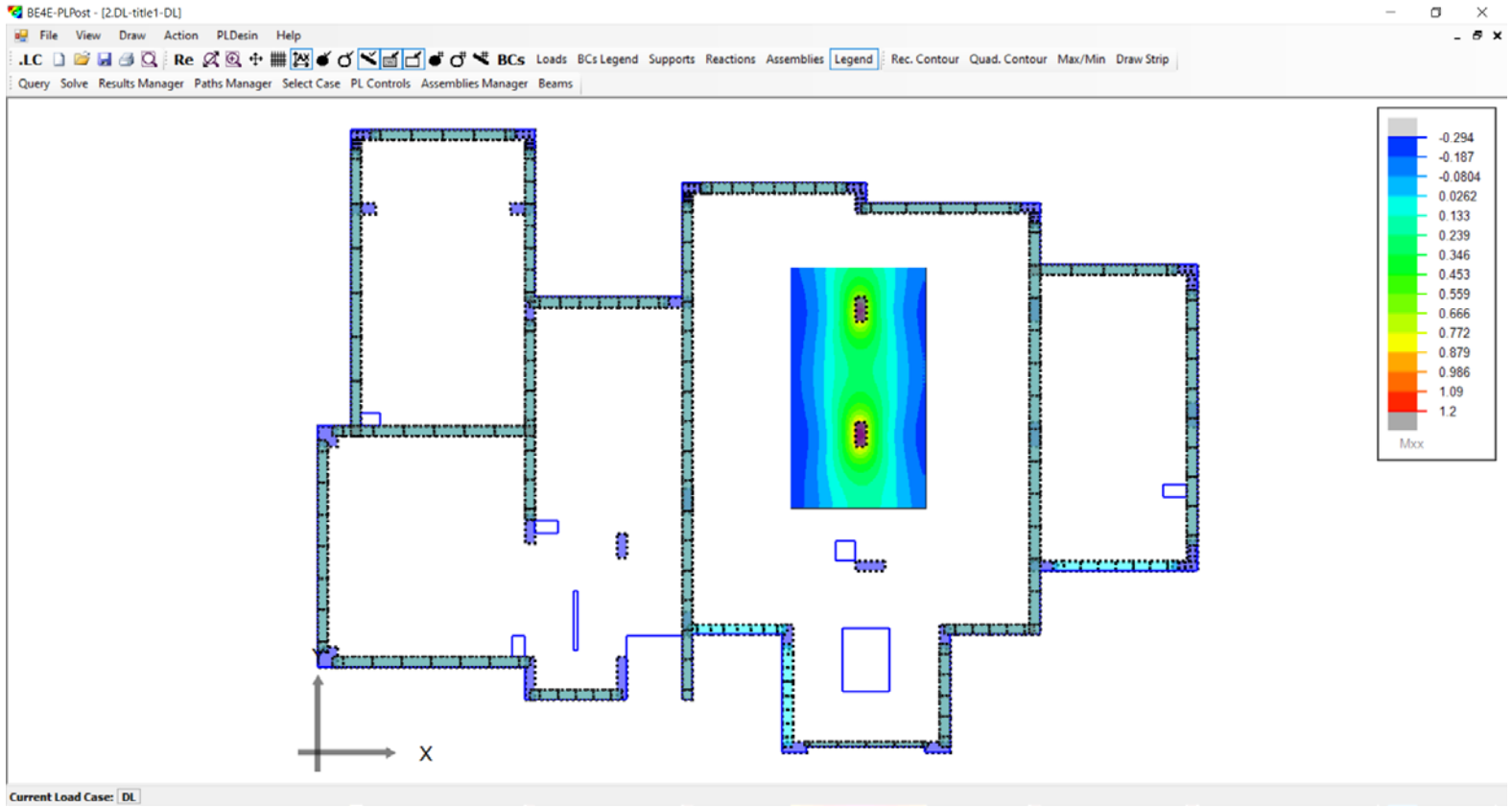
Cairo University

3. Slab results – contour results

Straining action for rectangular contour using result manager:

- Solve the main contour.
- Solver dialog will appear and after solving press on (F3) or refresh.
- The user can show/hide the legend.





CUFE-BE

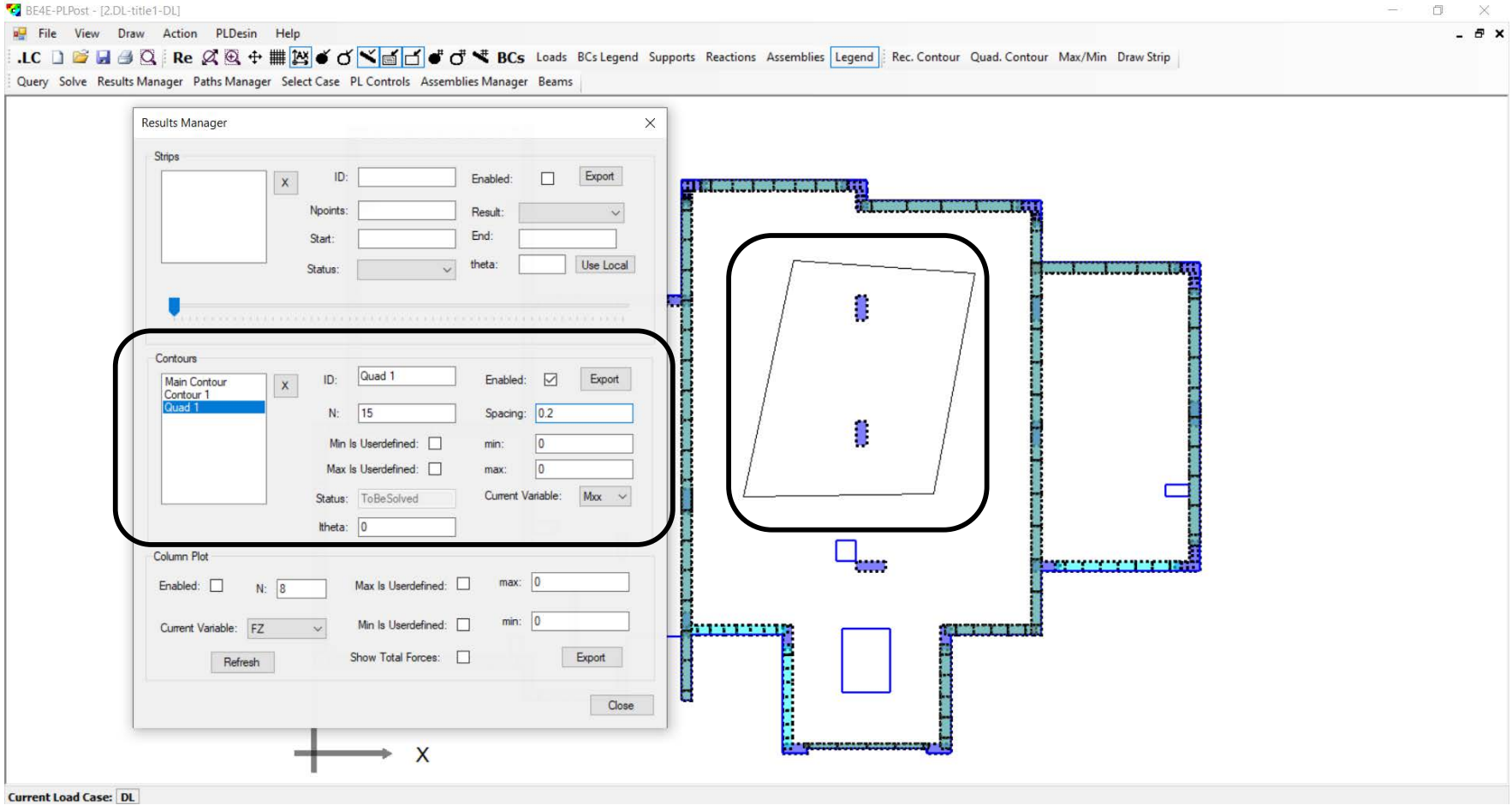
www.be4e.com

Cairo University

3. Slab results – contour results

Straining action for quadratic contour using result manager:

- Draw the quadratic contour.
- The results manager consists of three parts at the middle part (Contours), it has the Main Contour in addition to Contour 1, and quad 1.
- Quad 1 is created and it's automatically enabled.
- Insert the spacing between grids.
- Insert number of colors (N).
- Choose the Current Variable
- Edit the min/max value for user define (if exist).
- Press on Close.
- Solve the contour.



CUFE-BE

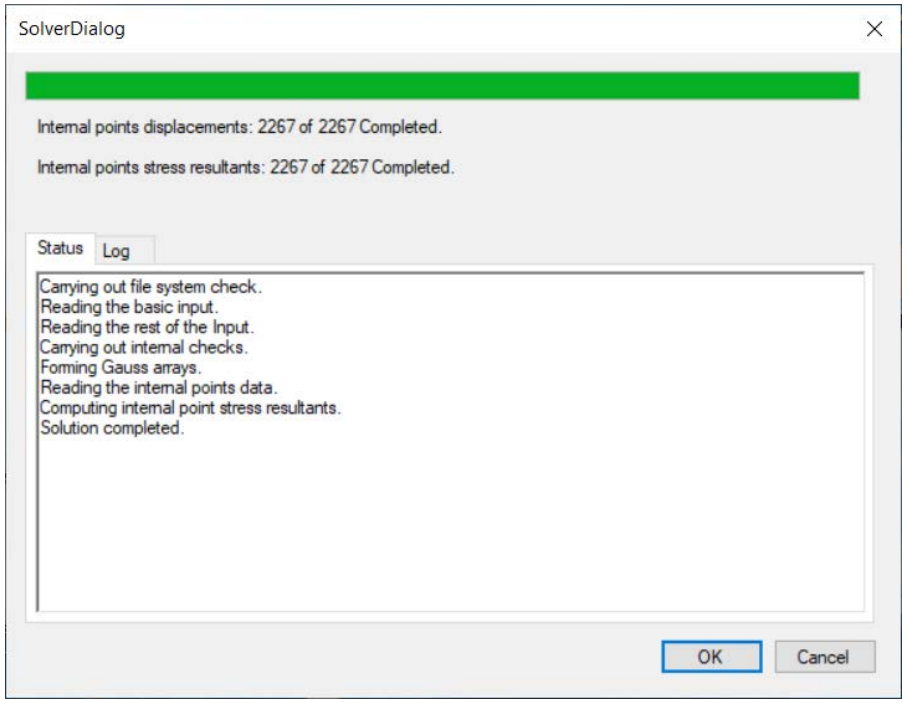
www.be4e.com

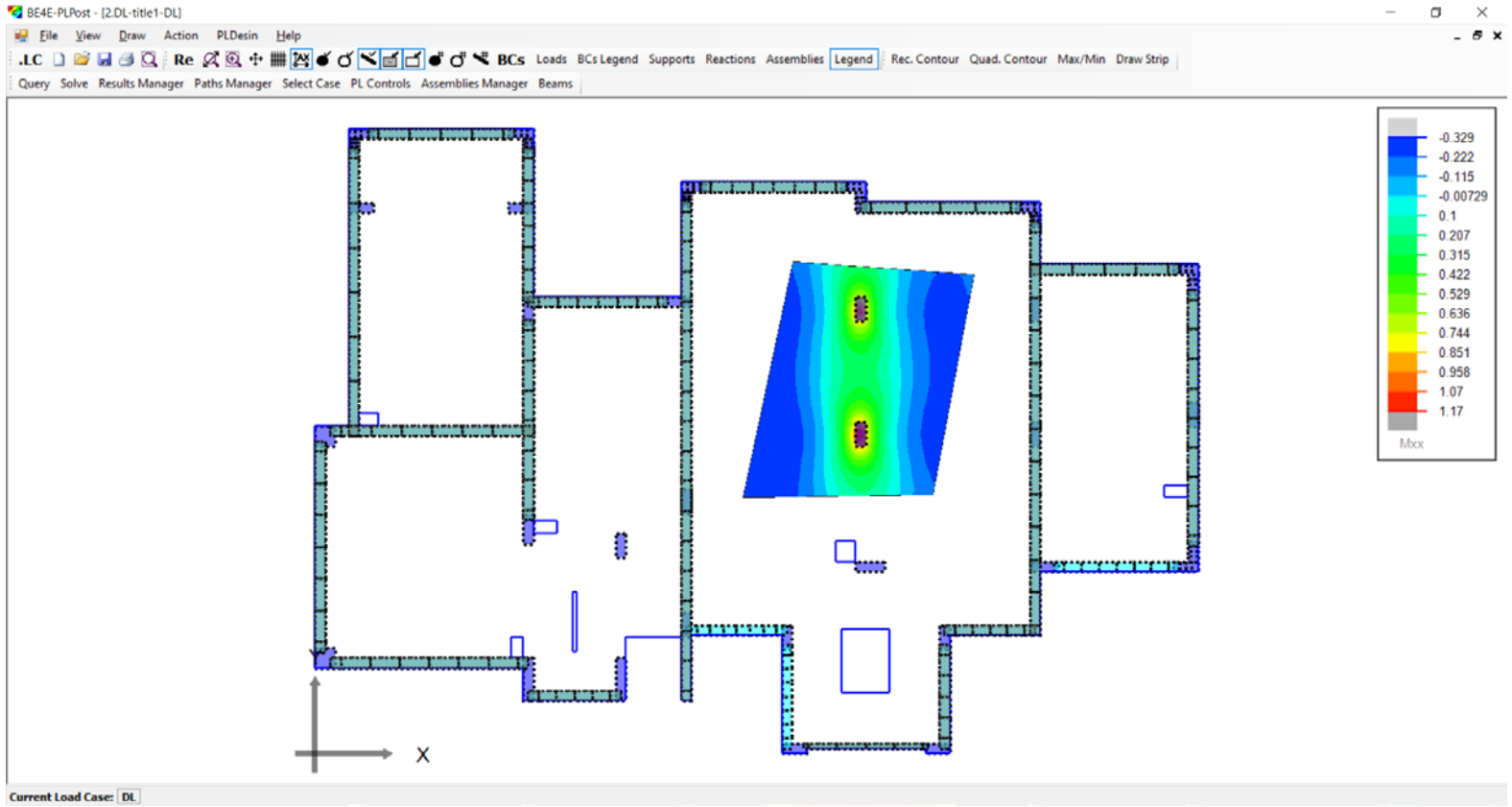
Cairo University

3. Slab results – contour results

Straining action for quadratic contour using result manager:

- Solve the main contour.
- Solver dialog will appear and after solving press on (F3) or refresh.
- The user can show/hide the legend.

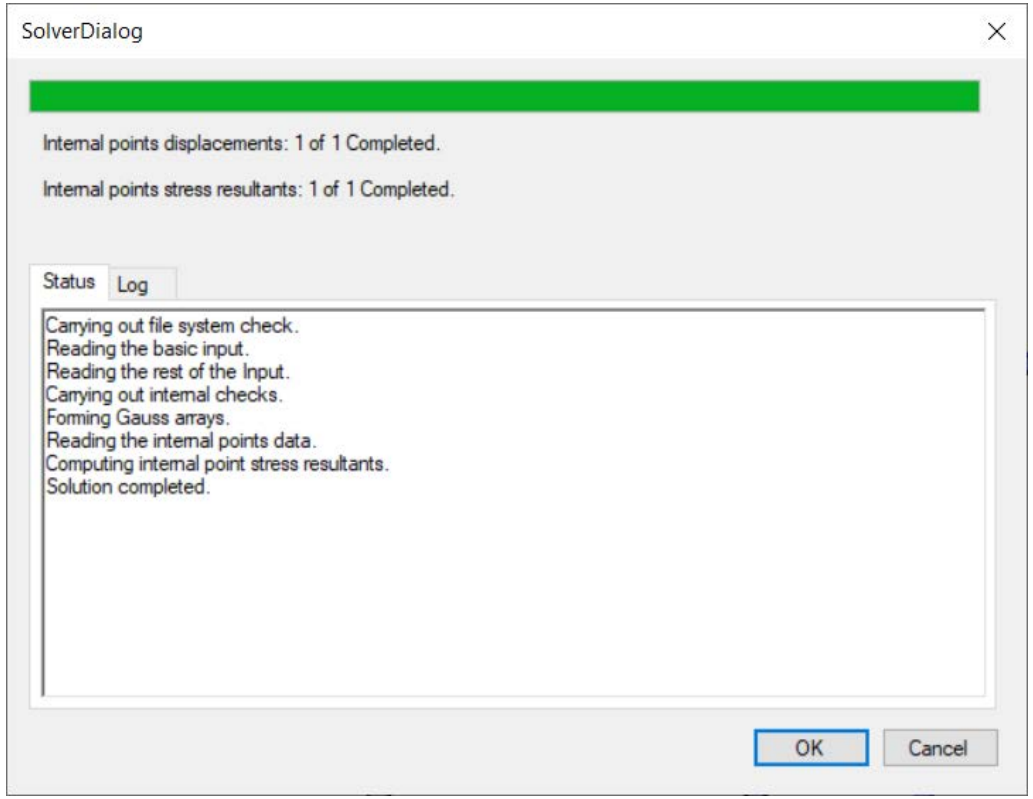


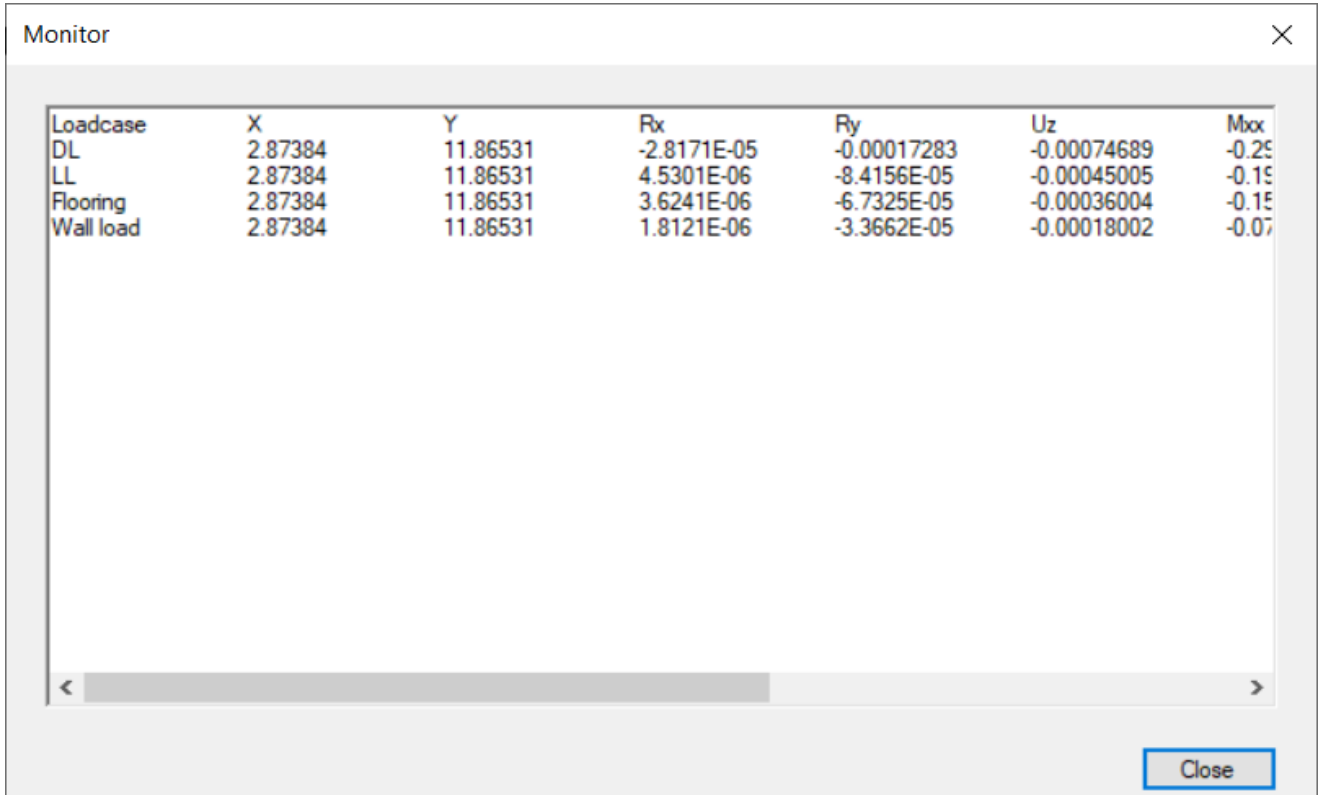


3. Slab results – query result

The user can see the straining action at any point by using Query tab:

- After pressing on Query, choose any point to view its straining actions in all cases & their combinations.
- The user doesn't need to go to Result Manager as any previous Contour.





CUFE-BE

www.be4e.com

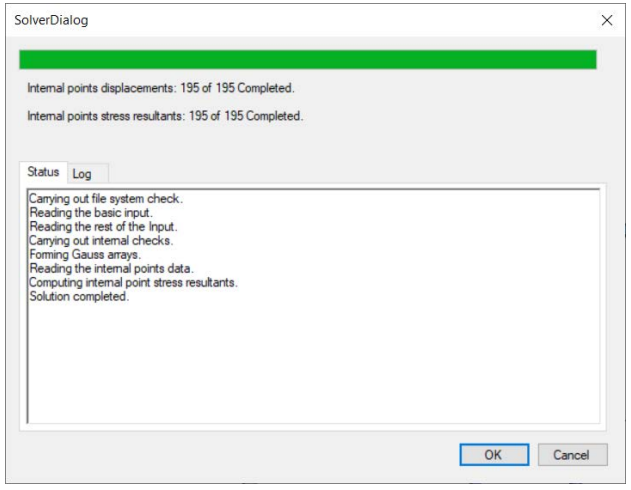
Cairo University

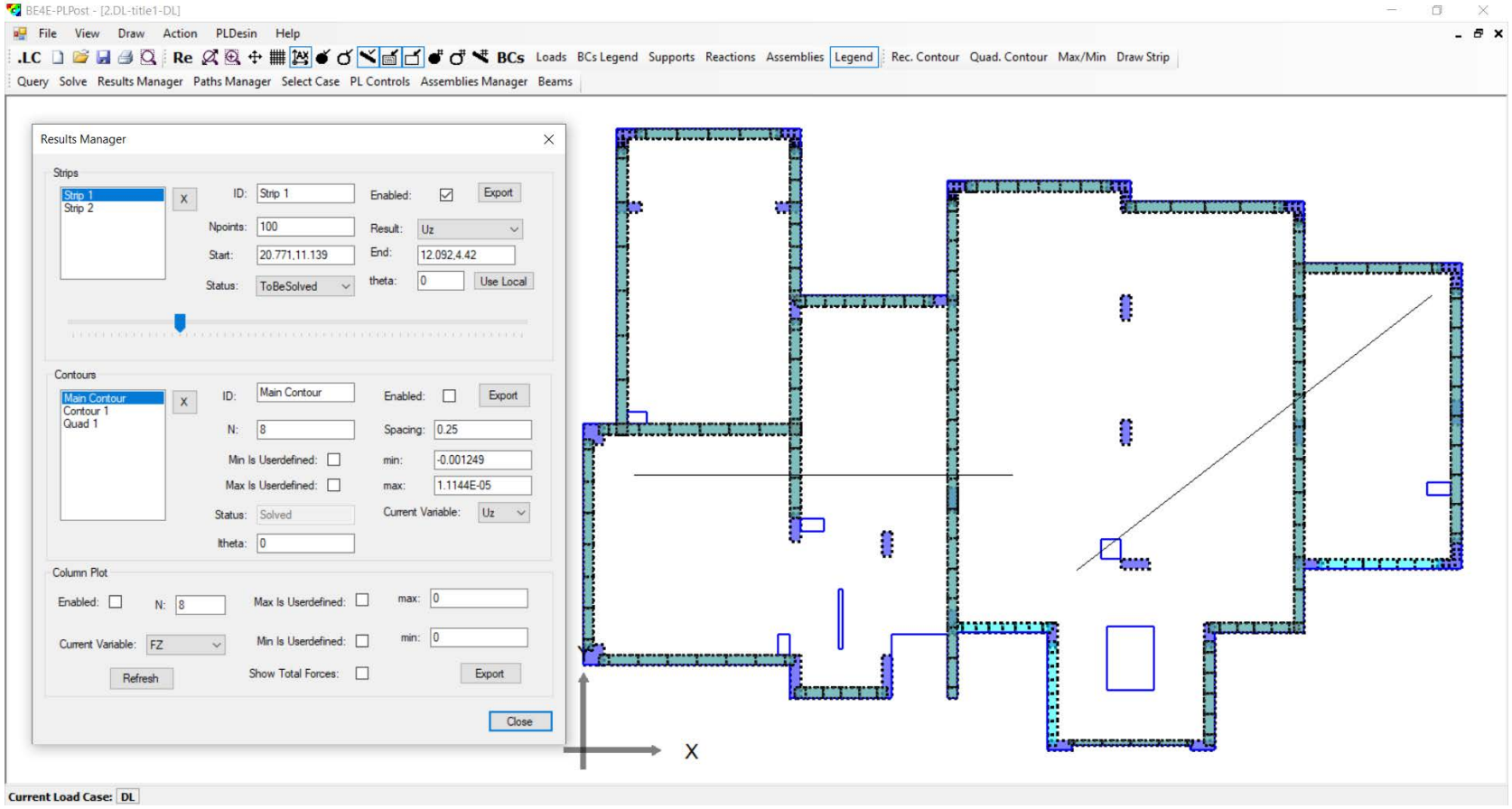
3. Slab results - strip result

The user can see the straining action on strip:

- The user can draw inclined line by clicking the two points, or straight line by pressing shift during drawing.
- Then open the result manager to modify the strip.

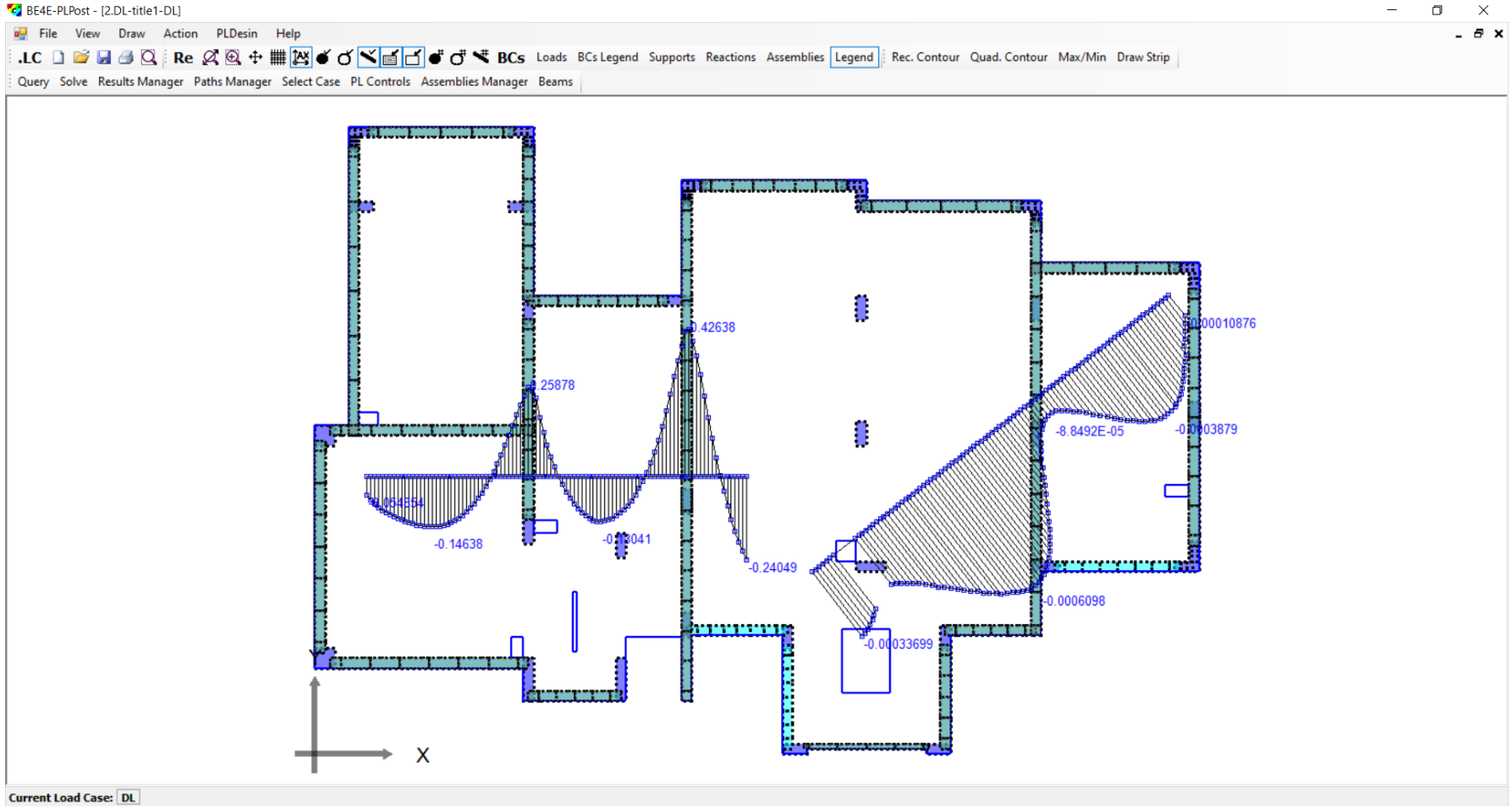
• The user can insert number of points.
• The user can change the Start & the End points of the strip.
• Choose the result need to be shown in the strip.
• The user can export the result on text file after running the analysis.





3. Slab results - strip result

- After solving, press refresh or (F3) to show results.
- The user can change the Straining action need to be shown on strip by changing results in Result Manager.



CUFE-BE

www.be4e.com

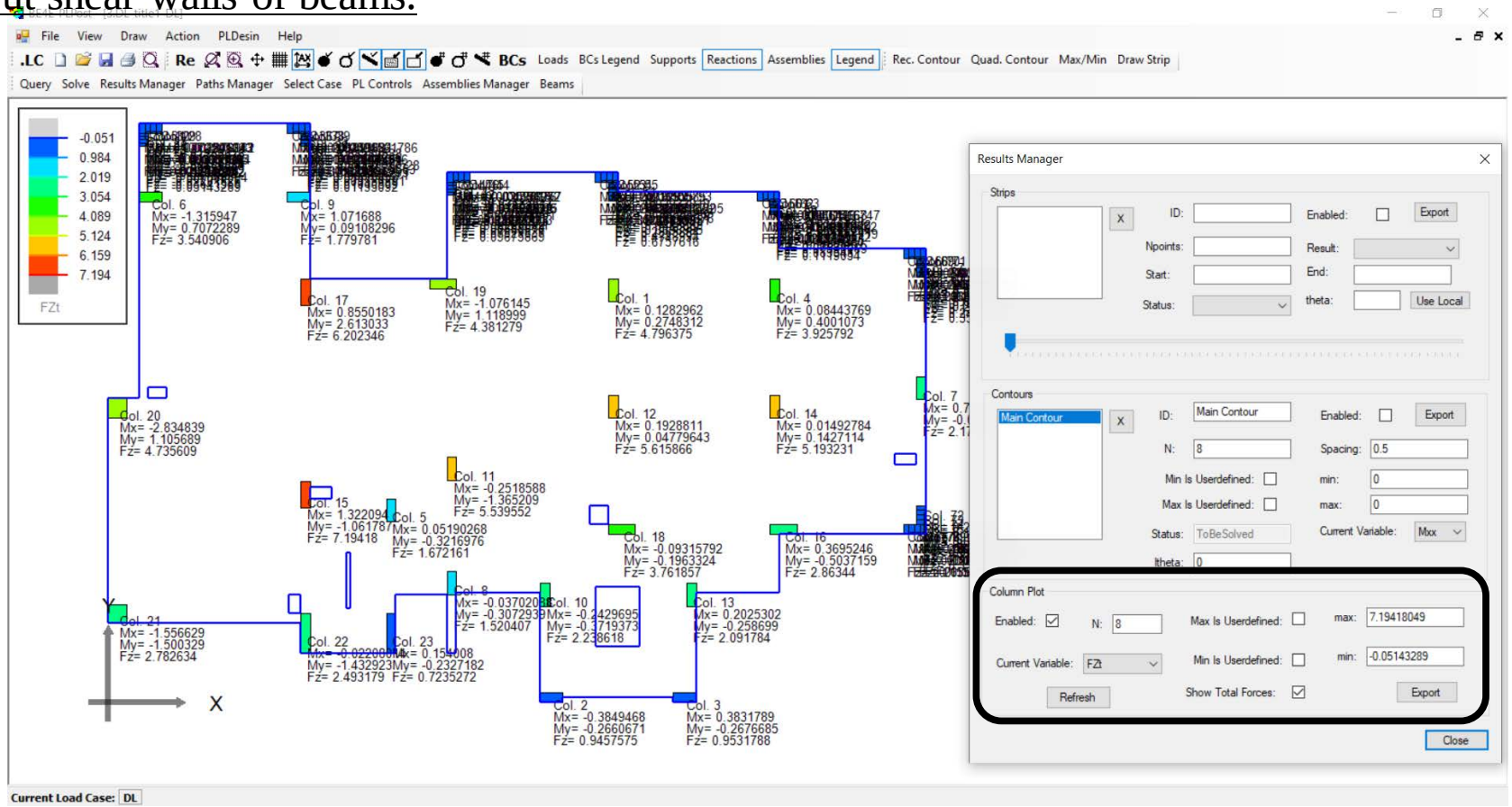
Cairo University

3. Slab results - supporting elements results

The user can show column analysis by two ways according to the type of model:

- In case of quadratic columns and without shear walls or beams.

- Open the Result Manager, the last part is for column plot.
- The user mark on the check box (Enable).
- Mark on the check box (Show Total Force).
- Choose the Current Variable.
- The user can export the column straining
- actions on text file.
- Unlike slabs, the columns don't have to run.

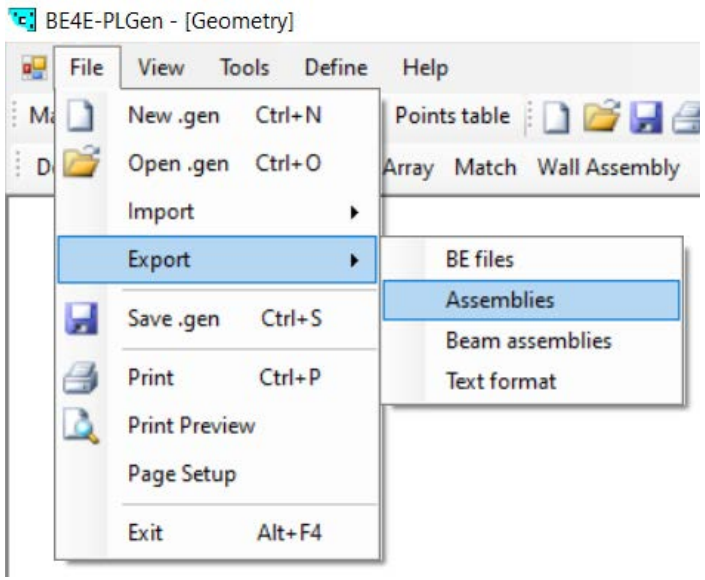


3. Slab results - supporting elements results

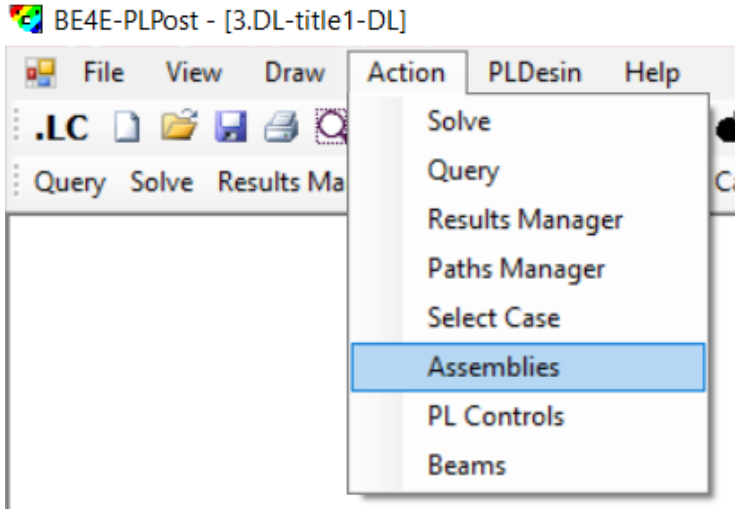
The user can show column analysis by two ways according to the type of model:

- In case of columns more than four sides or slab with shear walls or beams.

- In this case the user should export Assembly file from generator file.
- Then load the assembly file from Assemblies Manager tab.
- From load tab select the assembly file (.asm) for loading all support elements calculating all geometric properties of the element.
- Open the Result Manager then check mark on (Enable) box and check mark on (Show Total Force) box.



OR



CUFE-BE

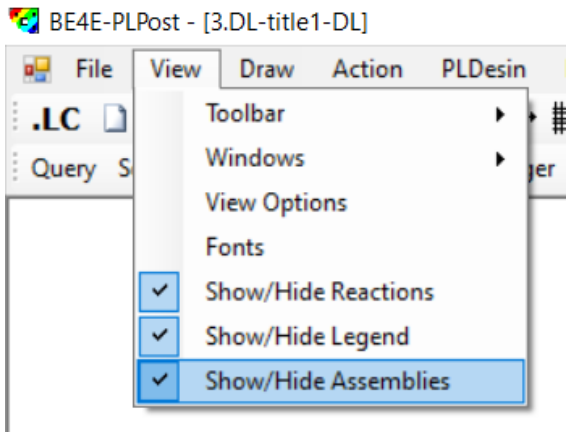
www.be4e.com

Cairo University

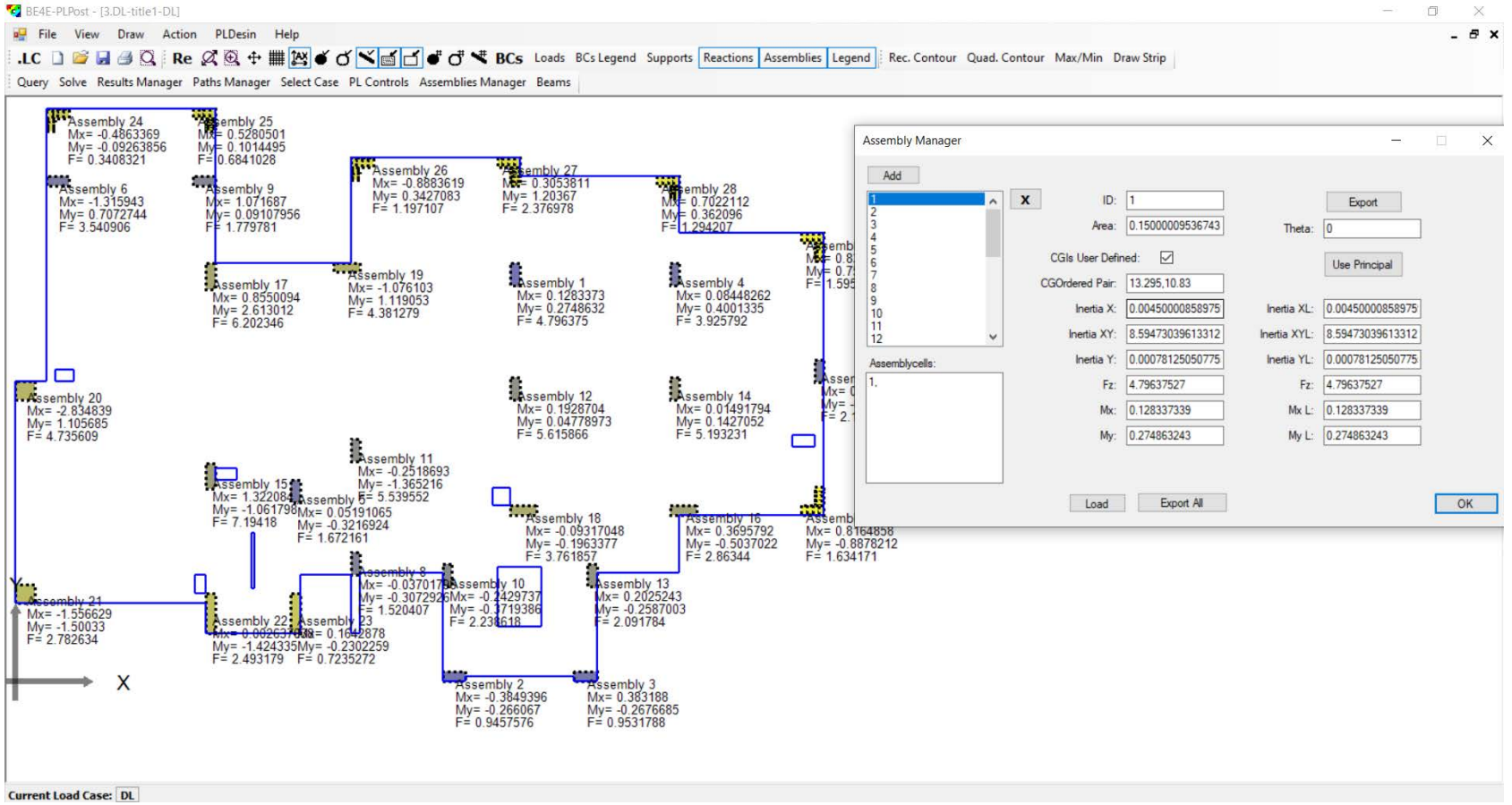
3. Slab results - supporting elements results

The user can show column analysis by two ways according to the type of model:

- In case of columns more than four sides or slab with shear walls or beams.
- From Show/Hide Assemblies then refresh, the user can show the straining actions on columns or shear walls.



OR



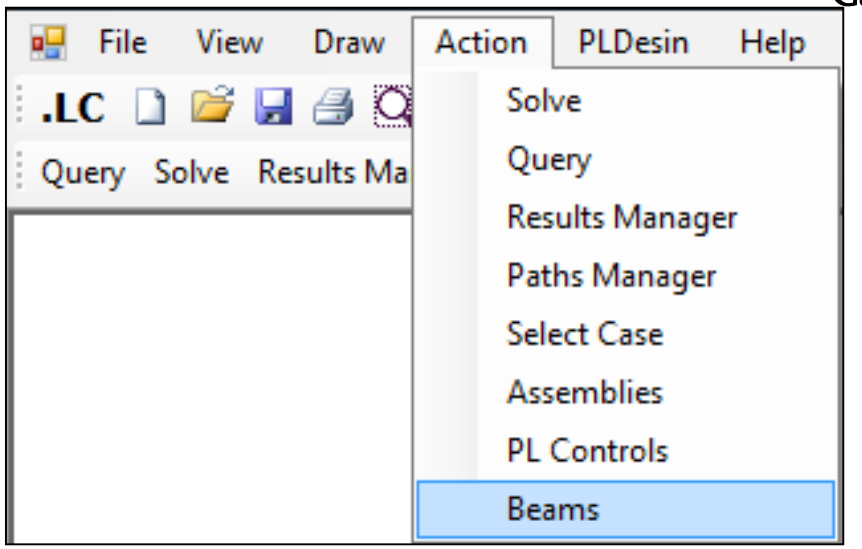
CUFE-BE

www.be4e.com

Cairo University

4. Beam results

- Beams analysis is very simple just open Beams Manager tab.
- Press on Read Beam Geometry.
- Press on Read Beams Results.
- Check mark on Show Result box.
- Check mark on Result Value box.
- Choose the Straining action need to be shown.
- Like column analysis, beams don't need to run.



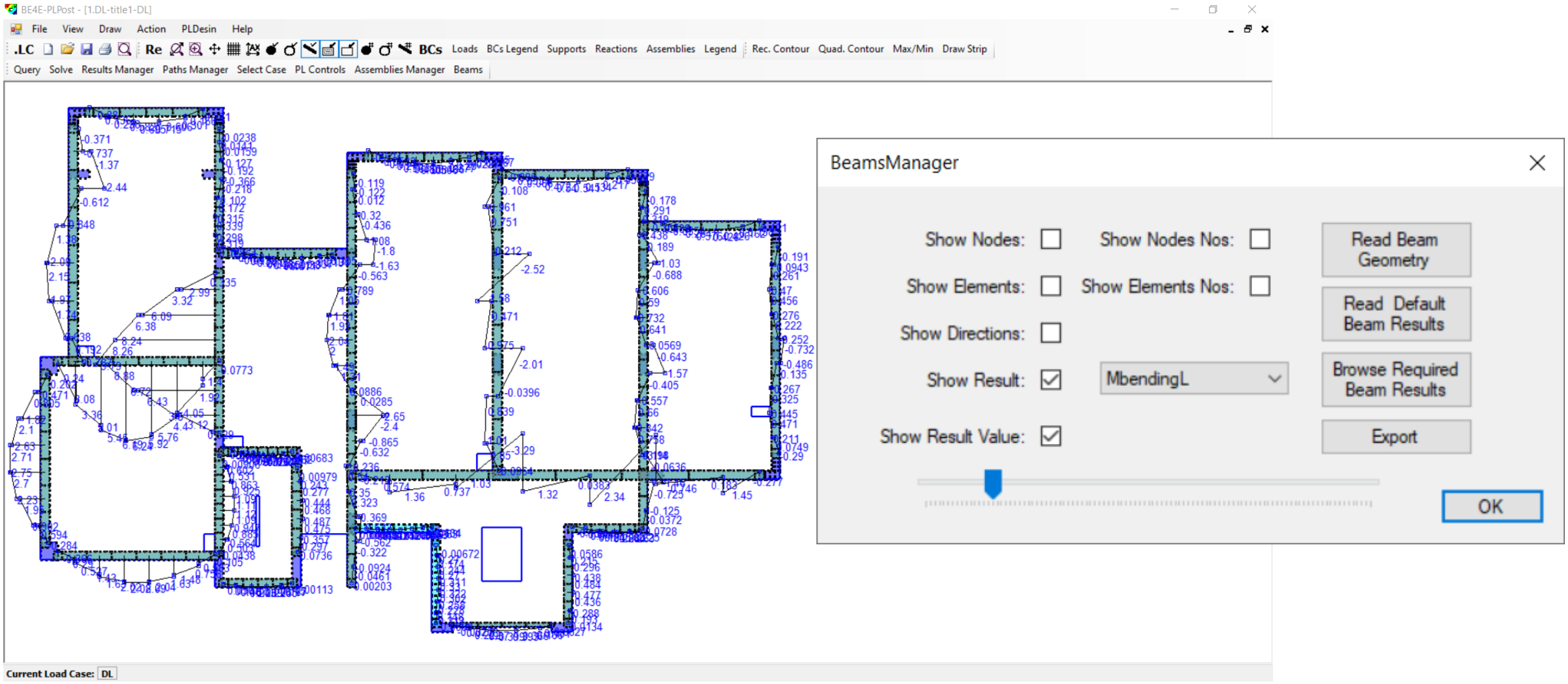
OR

CUFE-BE

www.be4e.com

Cairo University

4. Beam results



CUFE-BE

www.be4e.com

Cairo University

A. PLGen – Model generator ✓

B. PLView – Numerical model ✓

C. PLCoreMan – Manager and solver ✓

D. PLPost – Post processing ✓

E. PLDesign – Design tool

F. PLPAK modelling capabilities

CUFE-BE

www.be4e.com

Cairo University

A. PLGen – Model generator

B. PLView – Numerical model

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

CUFE-BE

www.be4e.com

Cairo University

What is the PLDesign?

- PLDesign (Plate design package) is a structural design tool package for plate bending structures based on the boundary element method for shear deformable plate bending theory, using different codes like (ACI, EC, and ECP).
- The PLDesign is a added to the PLPAK-Basic package to design reinforced concrete building slabs and foundations.
- The PLDesign is not only consider about design, but also about detailing and calculation sheet forming.
- In the PLDesign the user can check the reinforcement of section under any stresses (Bending, Shear and Torsion).
- In the PLDesign the user can check deflection and punching of slabs.
- In the PLDesign the calculation is not only for load combination, but also for envelopes.

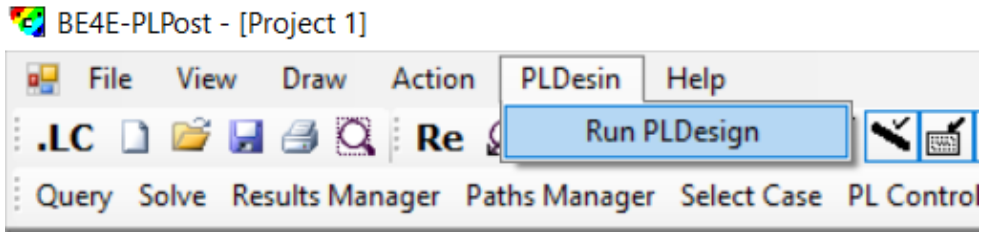
CUFE-BE

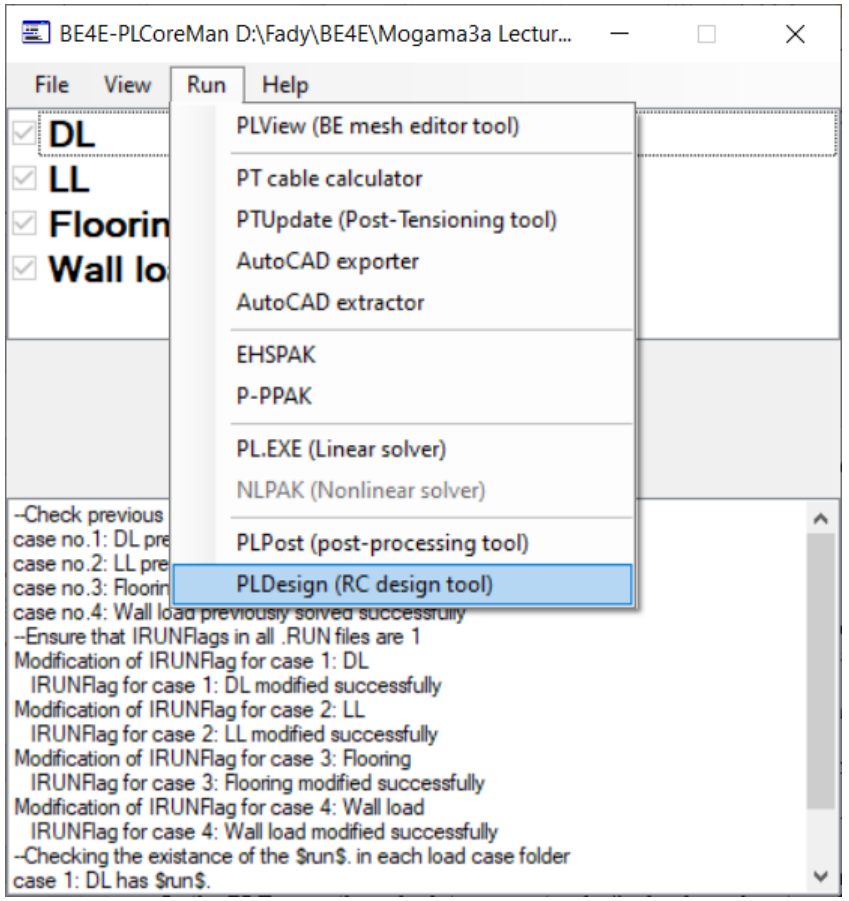
www.be4e.com

Cairo University

What is the PLDesign?

- The user can go to PLDesign by two ways either by using PLPost or PLCoreMan as follows:





CUFE-BE

www.be4e.com

Cairo University

PLDesign Package

CUFE-BE

www.be4e.com

Cairo University

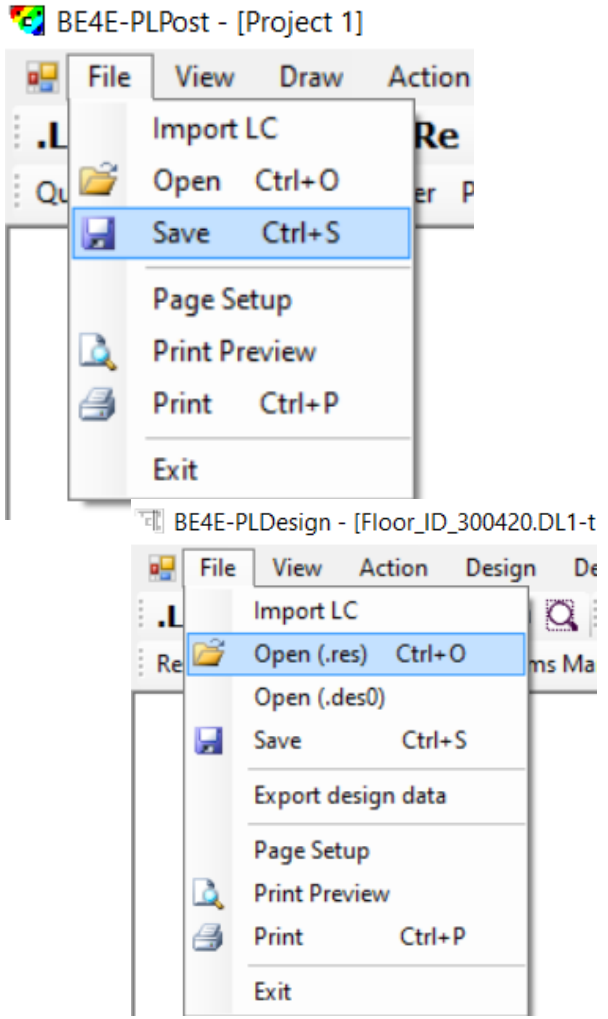
1. File needed to be exported before using PLDesign

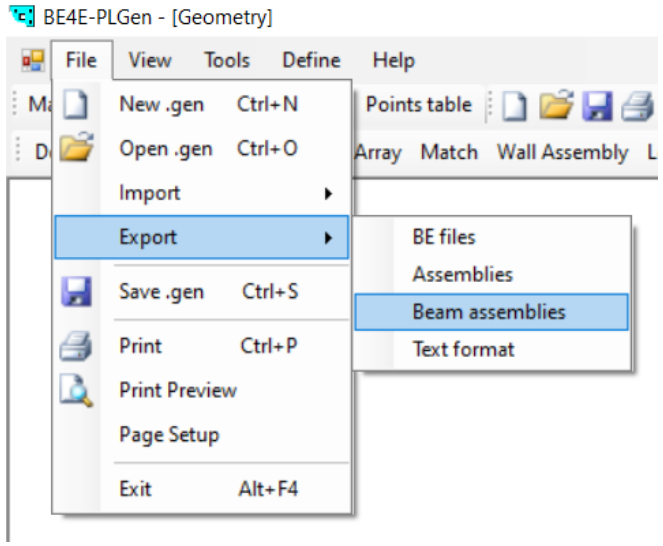
There are cases that user have to export file from PLGen and PLPost before using PLDesign:

- Export beam assemblies: this case is used to design the beams.
- Save the PLPost results: this case is used to design the slab.
- Export assemblies file: this case is used to check punching of the columns.

The previous cases can be restored in the PLDesign as follows:

- Import beam assemblies: this case is used to design the beams (will be demonstrated in beam design section).
- Open the PLPost results: this case is used to design the slab.
- Import assemblies file: this case is used to check punching of the columns.





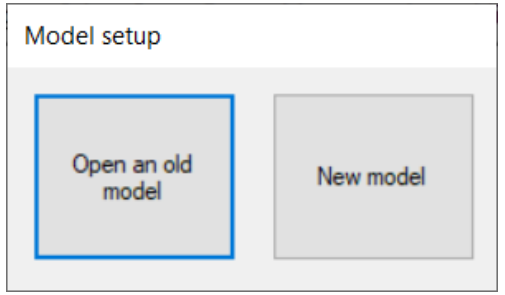
CUFE-BE

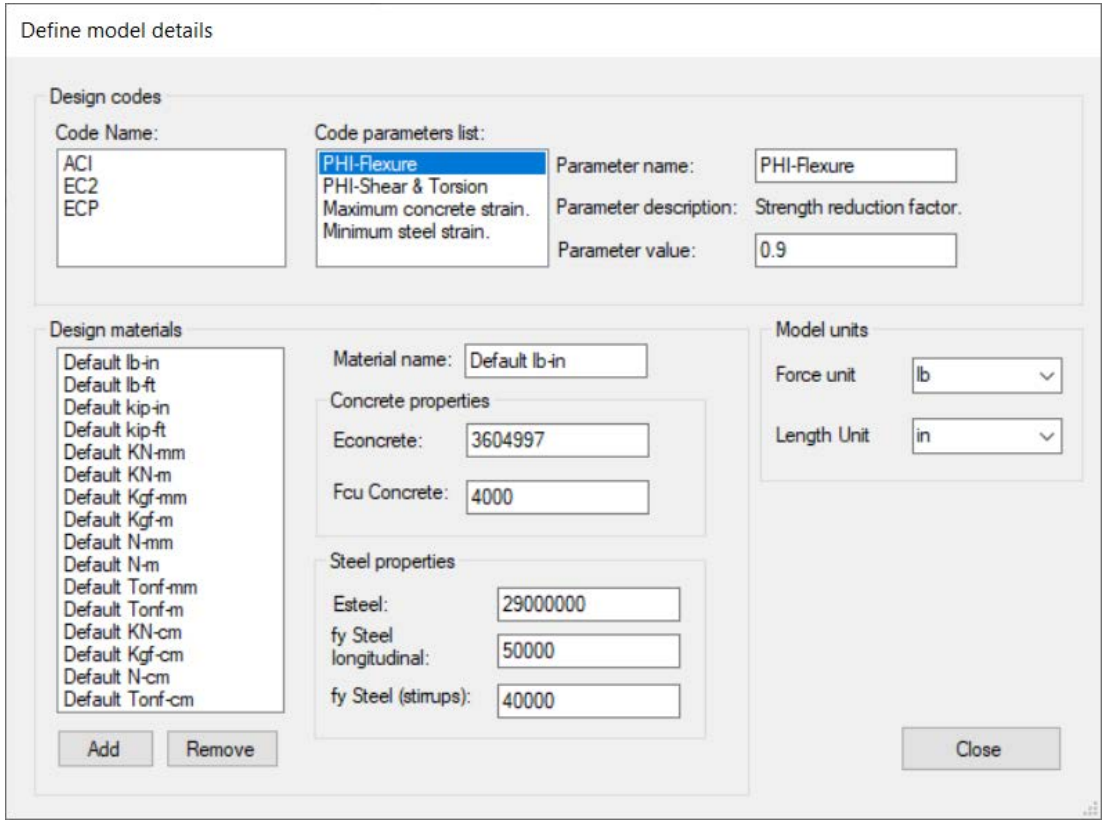
www.be4e.com

Cairo University

2. Starting PLDesign

- Once the user open the PLDesign, a model setup window is open and ask if the model is a new model or an old model.
- As it is start in PLDesign we will click on New model.
- In case of using PLDesign before, the user can click on open an old model.
- After clicking on New model, the user should define model details.
- The model details are the code name and the code parameter, design material units and modify it if any, choosing model units.
- To save click close then choose (.LC) file need to be designed, it has to be noted that it will be opened automatically if open from PLCoreMan.





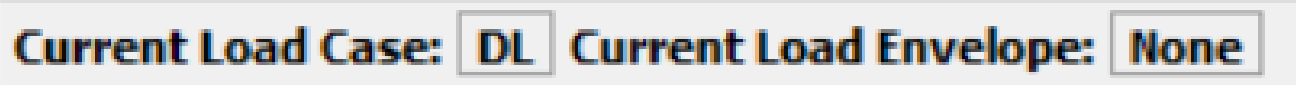
CUFE-BE

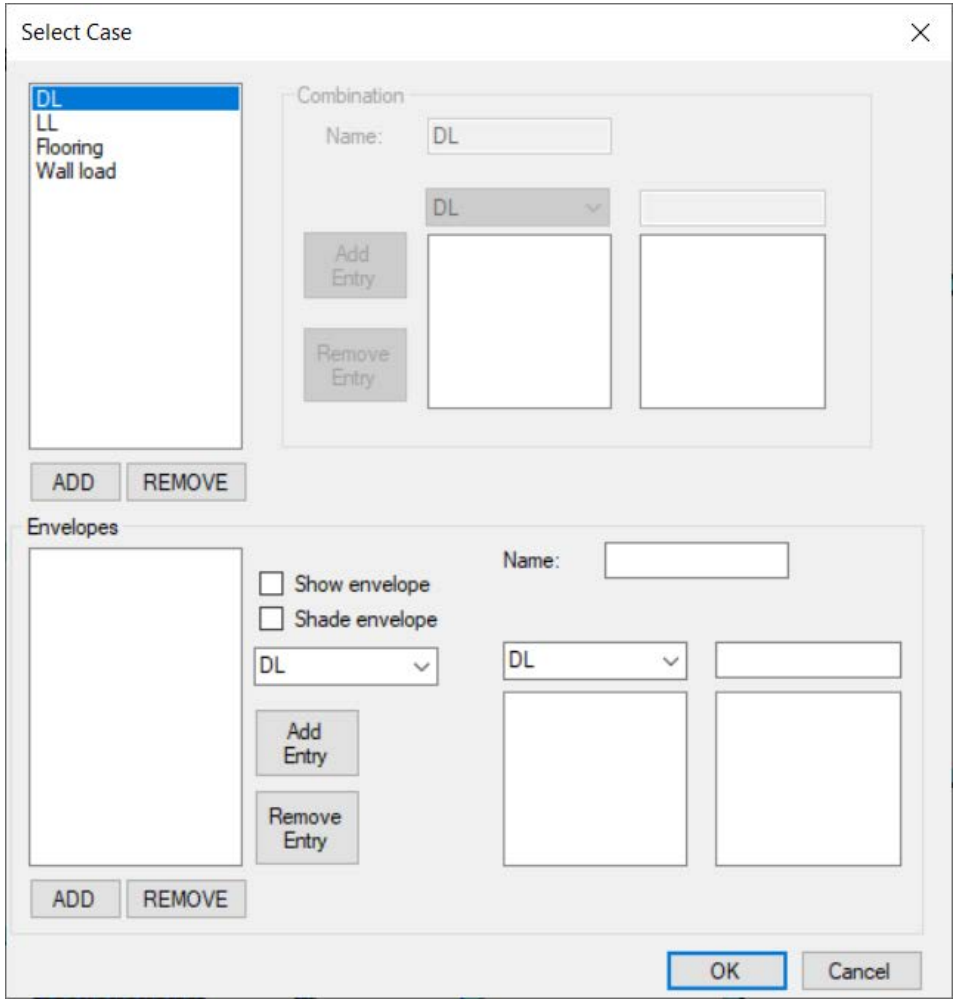
www.be4e.com

Cairo University

3. Load combinations & load envelopes

- The lower tabs of the PLDesign contain by default current load case is dead and current envelope is none.
- If the user press double click on dead load combinations window will open.
- The user can add cases like ultimate, working cases, each case contains combination between load cases inserted from PLGen and if there are any envelopes between them the user can insert also the envelope between combinations to achieve max. straining actions.



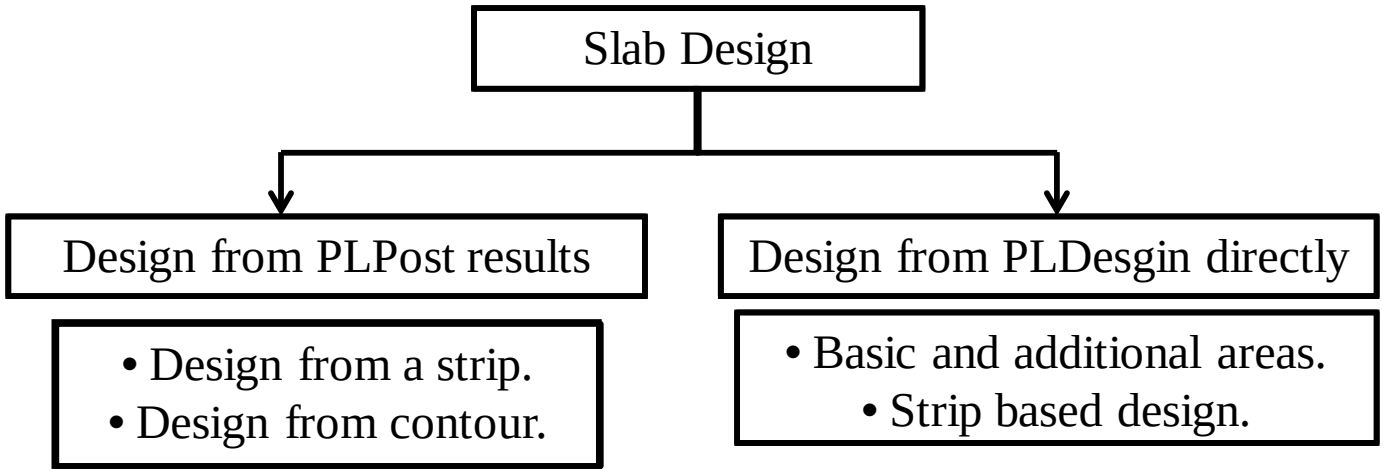


4. Slab design

The user have many options to design slabs, these options are according to the purpose of design or what are the details that user need from PLDesign:

<u>Purpose of design</u>
- Design a Strip.
- Design a part of slab.
- Design the slab totally.

<u>Reinforcement details</u>
- Basic and additional reinforcement.
- top and bottom reinforcement.



CUFE-BE

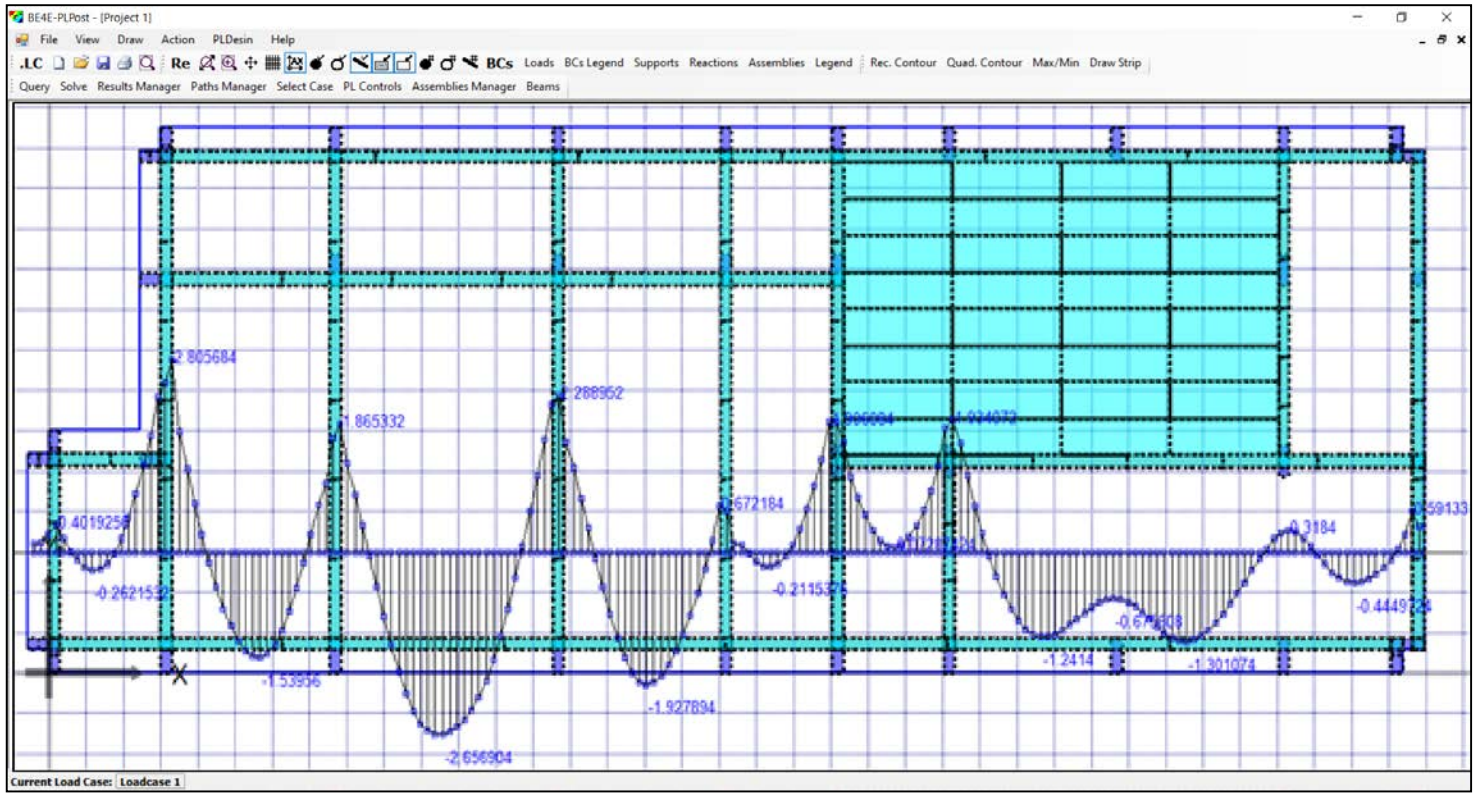
www.be4e.com

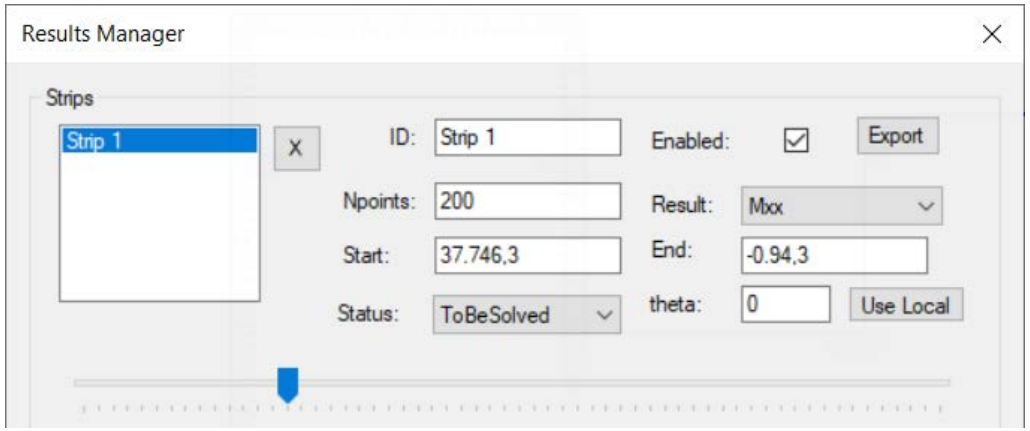
Cairo University

4.1. Design from PLPost results (strip design)

Design a certain strip with specific coordinates is one of the advantages of the PLDesign.

First the user have to save a strip from PLPost (a strip at y = 3.00m) as (.res) file.





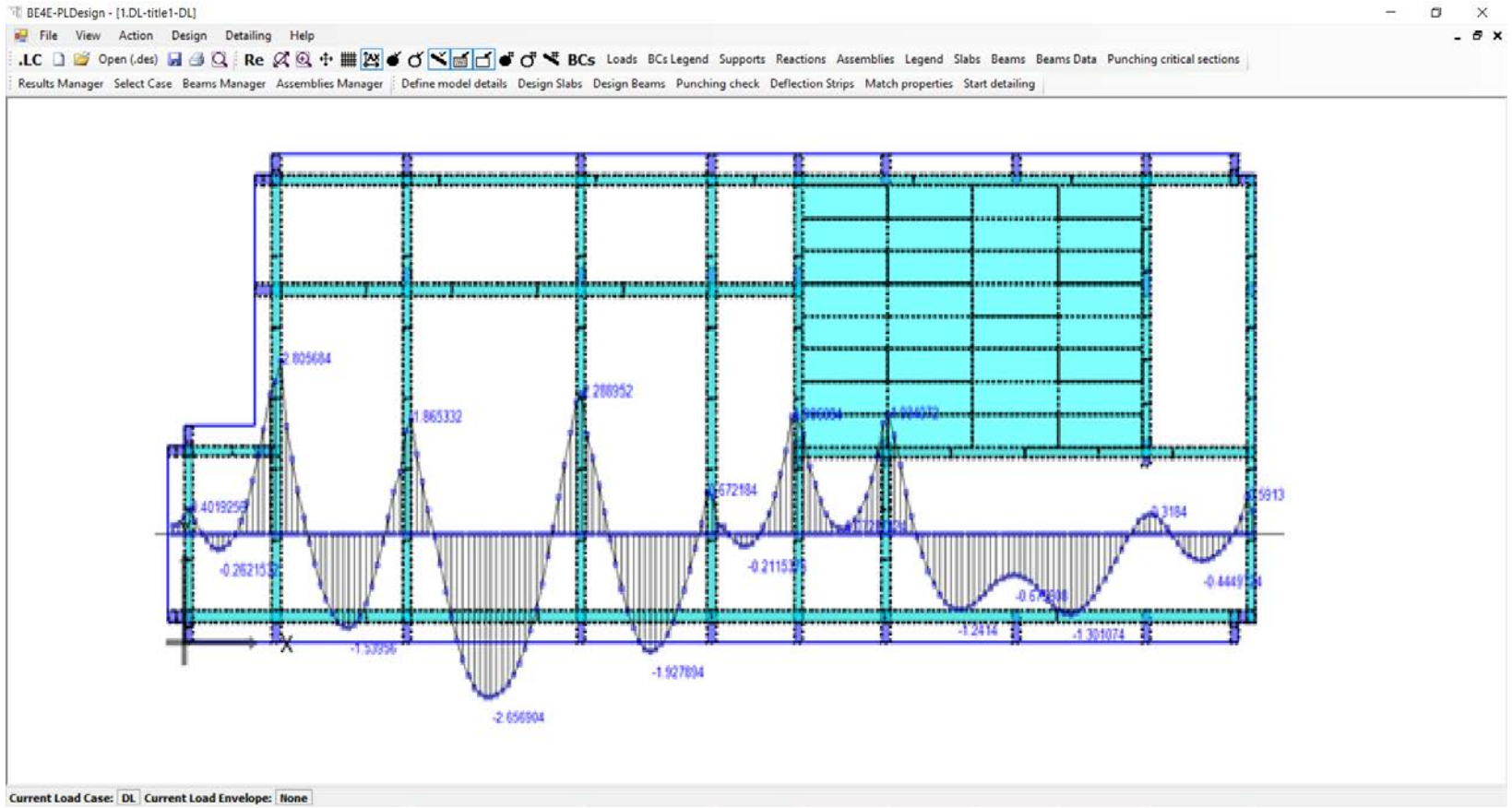
CUFE-BE

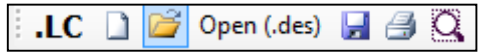
www.be4e.com

Cairo University

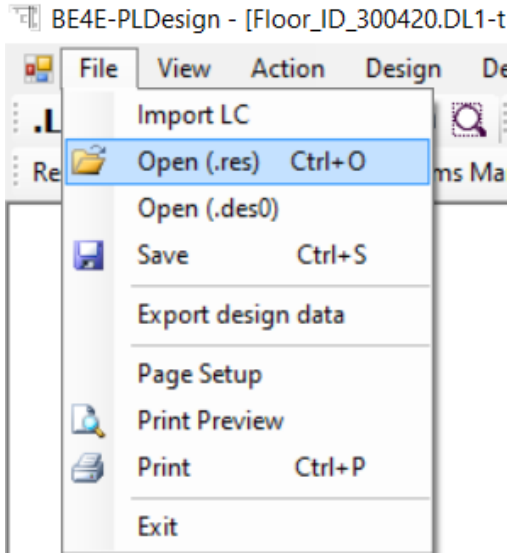
4.1. Design from PLPost results (strip design)

- Load the saved (.res) file in PLDesign.





OR



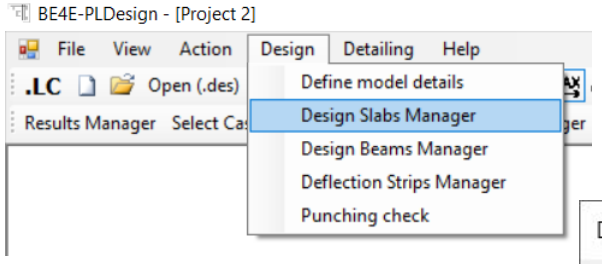
CUFE-BE

www.be4e.com

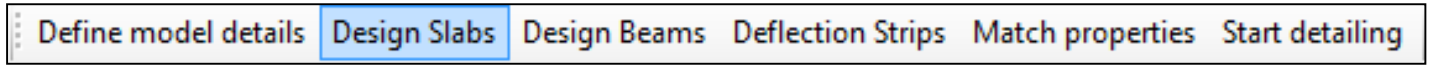
Cairo University

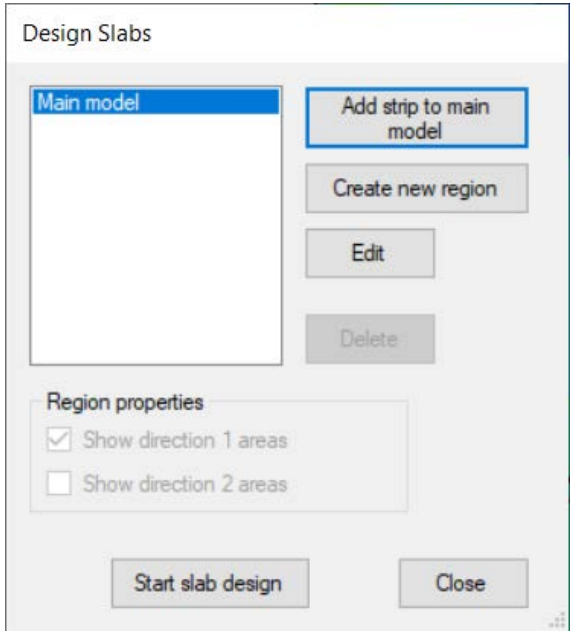
4.1. Design from PLPost results (strip design)

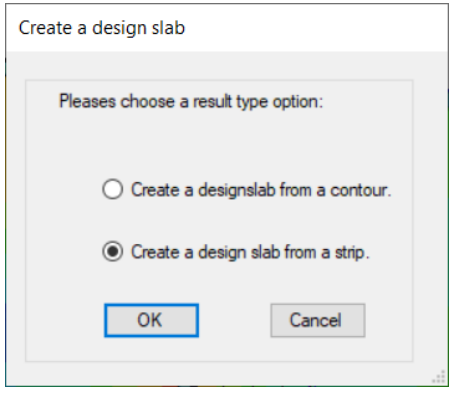
- Open Design Slabs Manager, then press on add strip to main model tab.
- Choose a design slab from a strip which will open a strip list to choose from them, then determine the width of the strip.

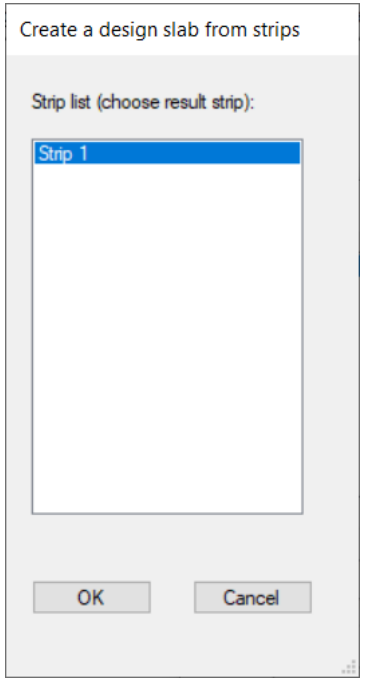


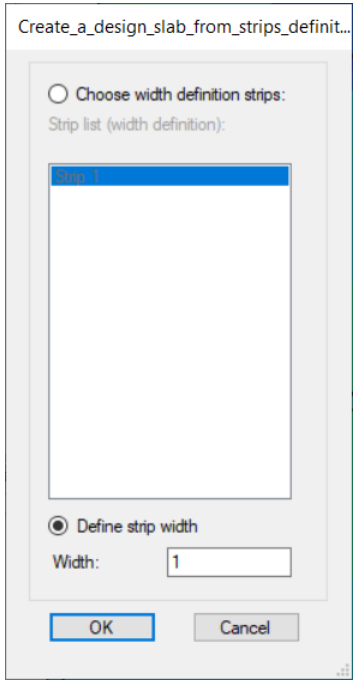
OR











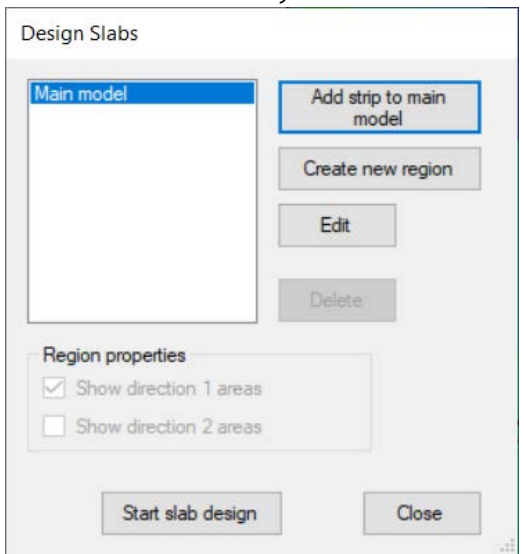
CUFE-BE

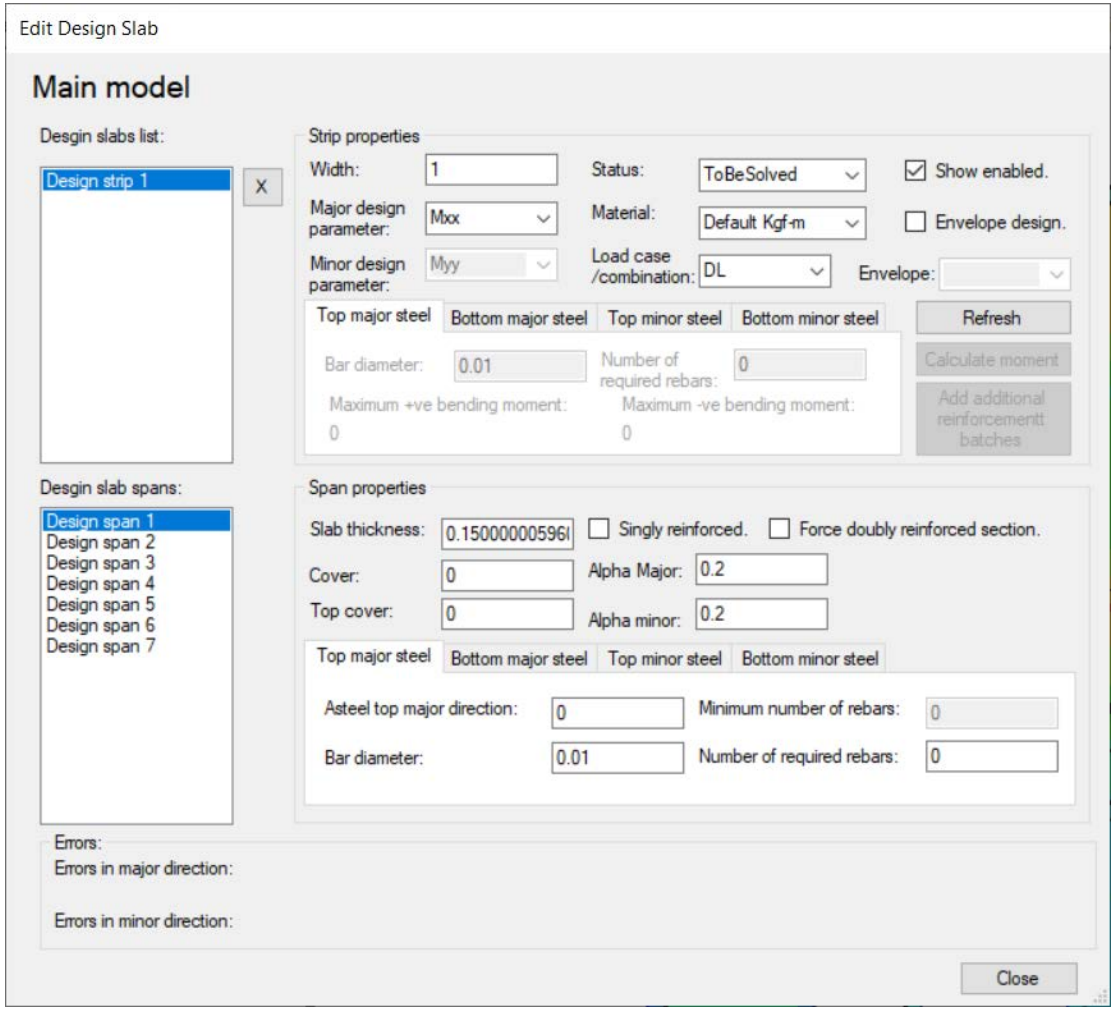
www.be4e.com

Cairo University

4.1. Design from PLPost results (strip design)

- Press on Edit to open Design Slab Manager.
- The main model is divided into two parts: Strip properties and Span properties.
  - The strip properties contains information for the strip like width, Major design parameter, Material units, Load cases/combinations.
  - While span properties contains information for the section like thickness, cover, bar diameter, number of rebars, number of required rebars.





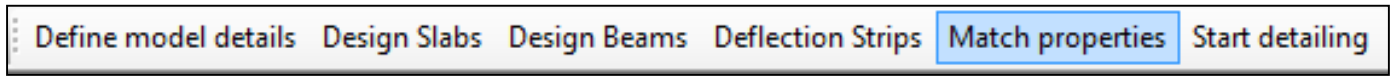
CUFE-BE

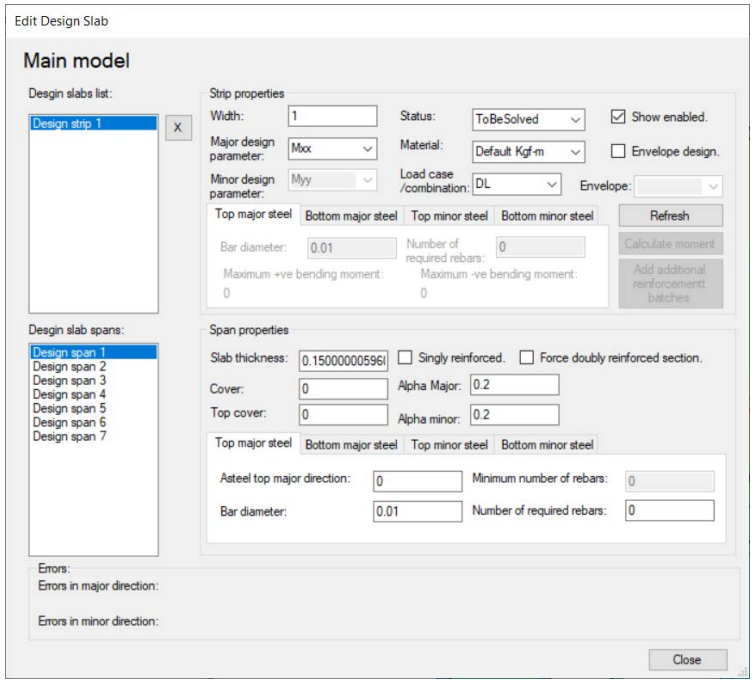
www.be4e.com

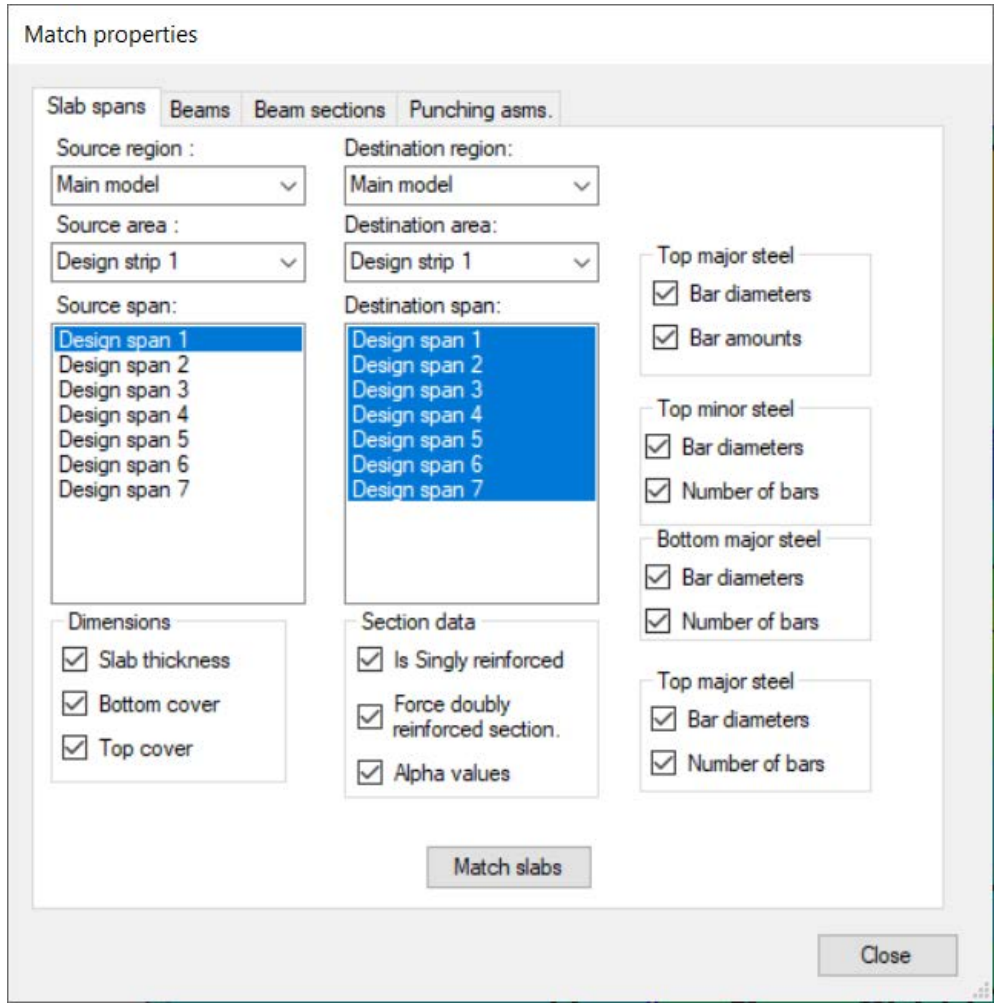
Cairo University

4.1. Design from PLPost results (strip design)

- Adjust the main model by choosing the design parameter and inserting all information (cover, bar diameter and number of bars) for one span.
- User do not need to adjust all spans, user can match the spans with the same properties.







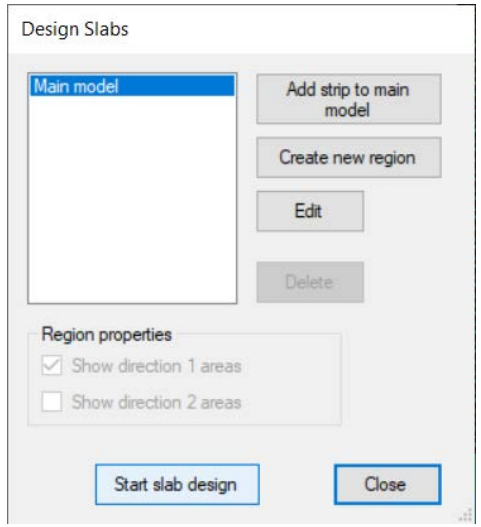
CUFE-BE

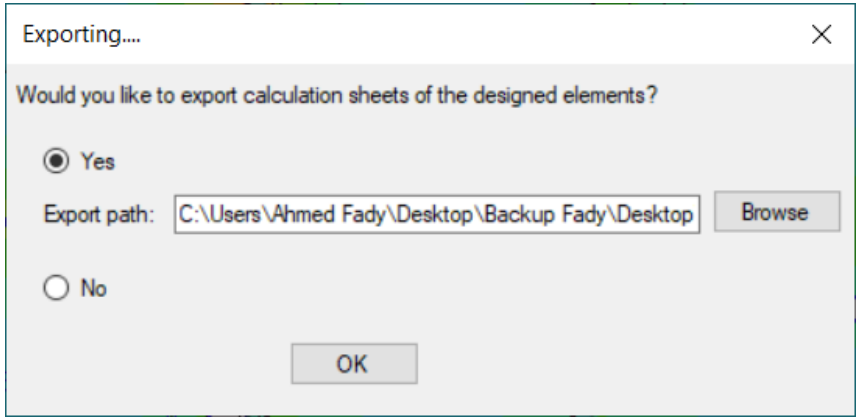
www.be4e.com

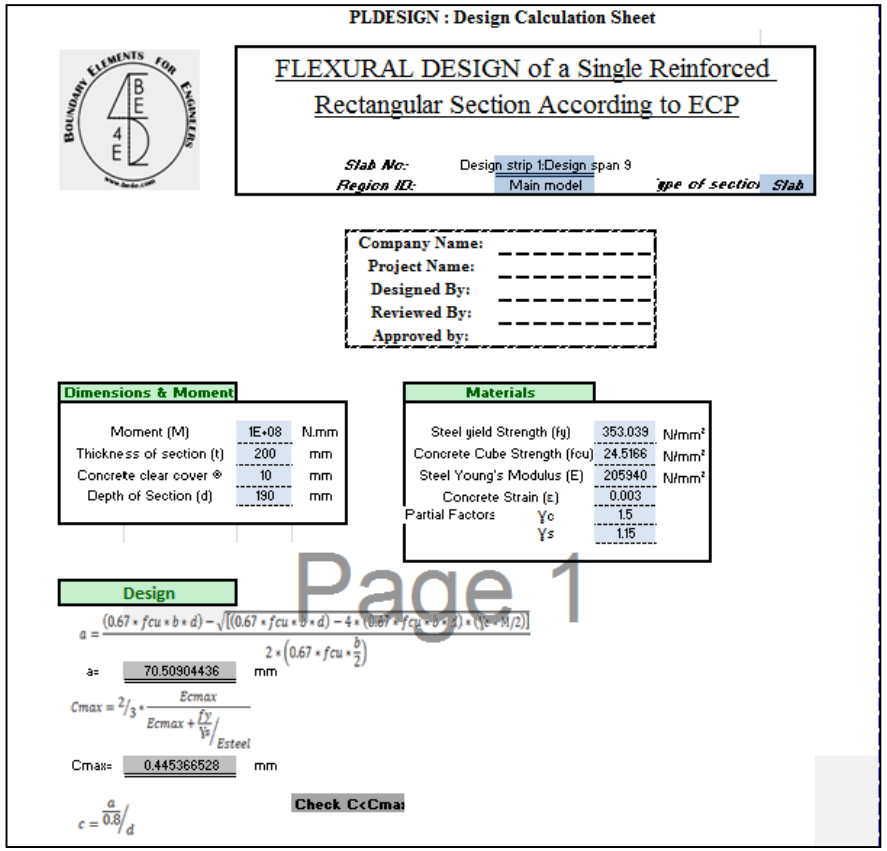
Cairo University

4.1. Design from PLPost results (strip design)

- Check that all spans are matched then start slab design.
- The PLDesign is automatically export the calculation sheet for slab every section has two files one for moment in X-direction and the other for Y-direction.







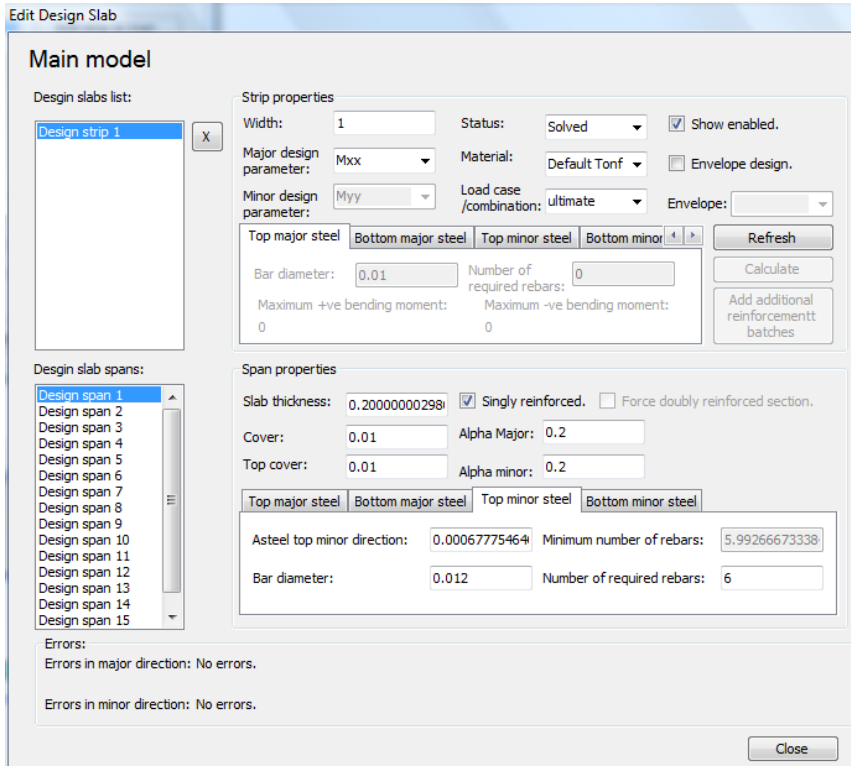
CUFE-BE

www.be4e.com

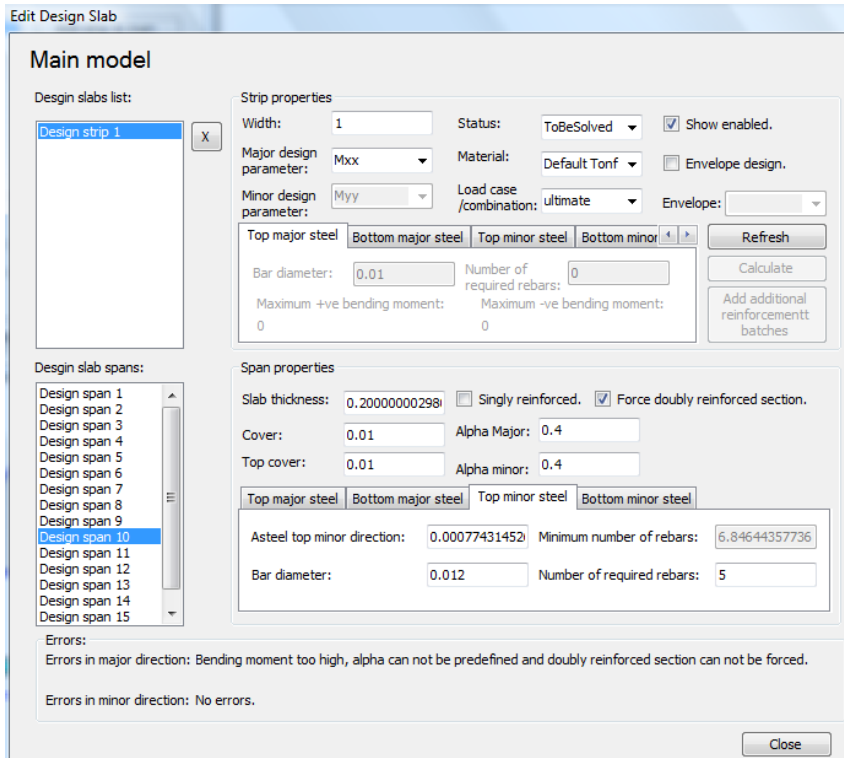
Cairo University

4.1. Design from PLPost results (strip design)

- Check that all spans are safe and modify the number of bars and bar diameter if needed.



Case of safe section



Case of unsafe section

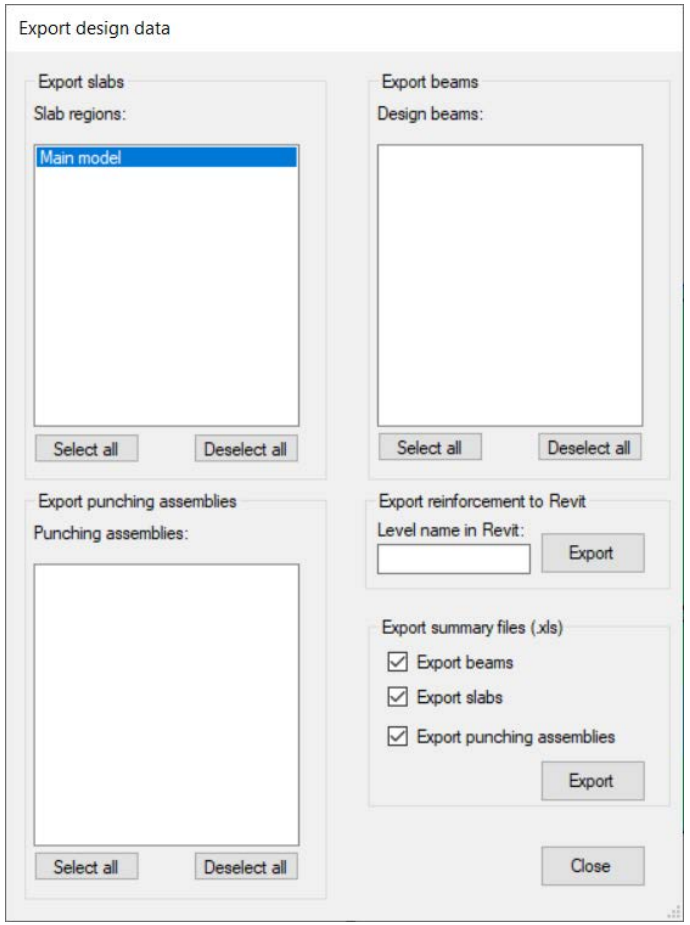
CUFE-BE

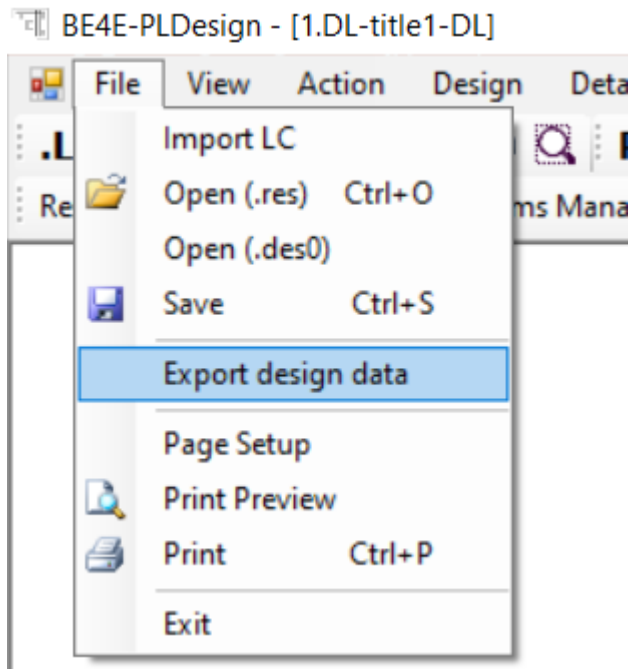
www.be4e.com

Cairo University

4.1. Design from PLPost results (strip design)

- Instead of every strip contains two excel files, the user can export a summary for slab reinforcement.





Region name	Area name	Major design moment	Strip name	Top major rft.	Bot. major rft.	Top minor rft.	Bot minor rft.
Main model	Design strip 1	Mxx	Design span 1	5 Φ 0.012	6 Φ 0.012	**6 Φ 0.012**	5 Φ 0.012
			Design span 2	5 Φ 0.012	5 Φ 0.012	**10 Φ 0.016**	5 Φ 0.012
			Design span 3	5 Φ 0.012	6 Φ 0.012	10 Φ 0.016	5 Φ 0.012
			Design span 4	6 Φ 0.016	5 Φ 0.012	9 Φ 0.018	5 Φ 0.012
			Design span 5	5 Φ 0.012	9 Φ 0.018	5 Φ 0.012	7 Φ 0.012
			Design span 6	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
			Design span 7	5 Φ 0.012	7 Φ 0.012	7 Φ 0.012	5 Φ 0.012
			Design span 8	9 Φ 0.016	5 Φ 0.012	7 Φ 0.016	5 Φ 0.012
			Design span 9	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012
			Design span 10	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012
			Design span 11	5 Φ 0.012	8 Φ 0.018	7 Φ 0.016	5 Φ 0.012
			Design span 12	7 Φ 0.016	5 Φ 0.012	9 Φ 0.012	5 Φ 0.012
			Design span 13	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012
			Design span 14	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
			Design span 15	5 Φ 0.012	6 Φ 0.012	6 Φ 0.012	5 Φ 0.012
			Design span 16	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012	5 Φ 0.012

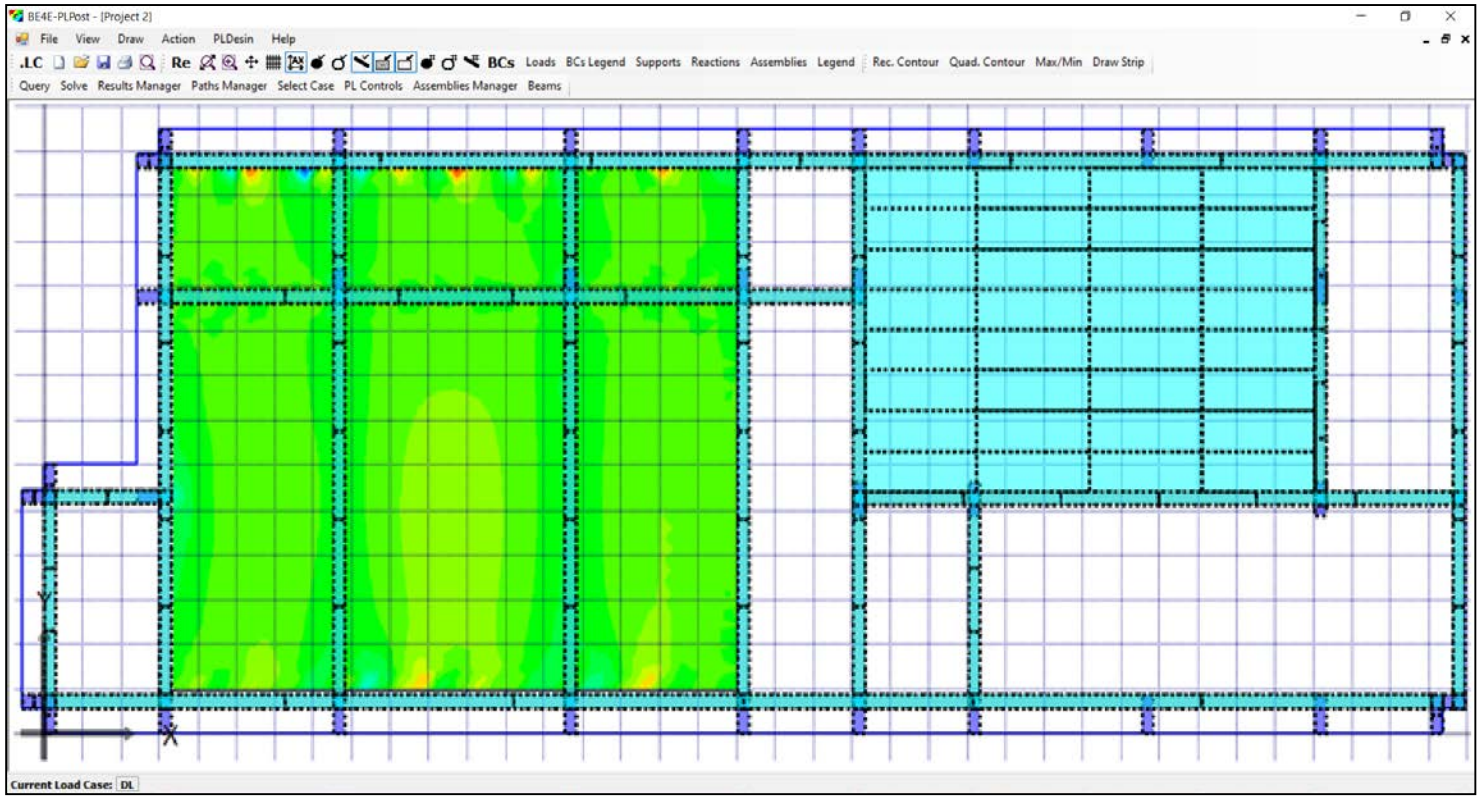
CUFE-BE

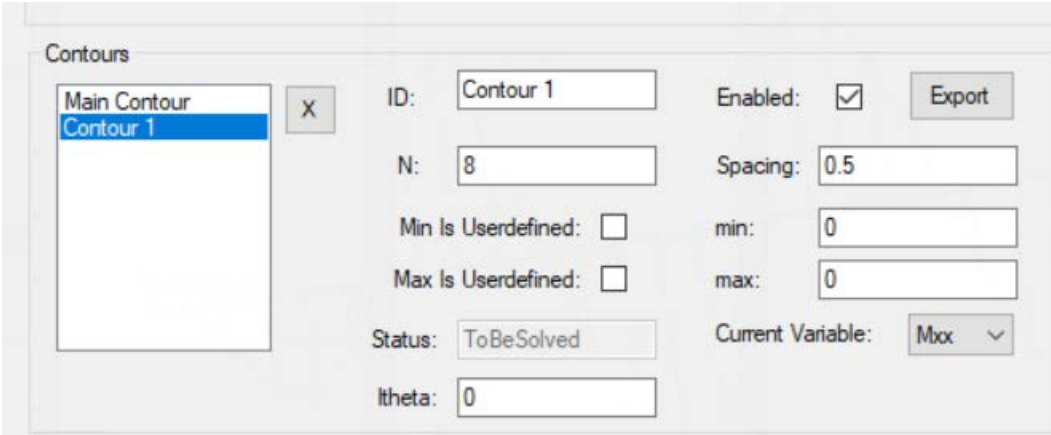
www.be4e.com

Cairo University

4.2. Design from PLPost results (contour design)

- Similarly as Strip design the user should save results in PLPost then load it again in PLDesign.





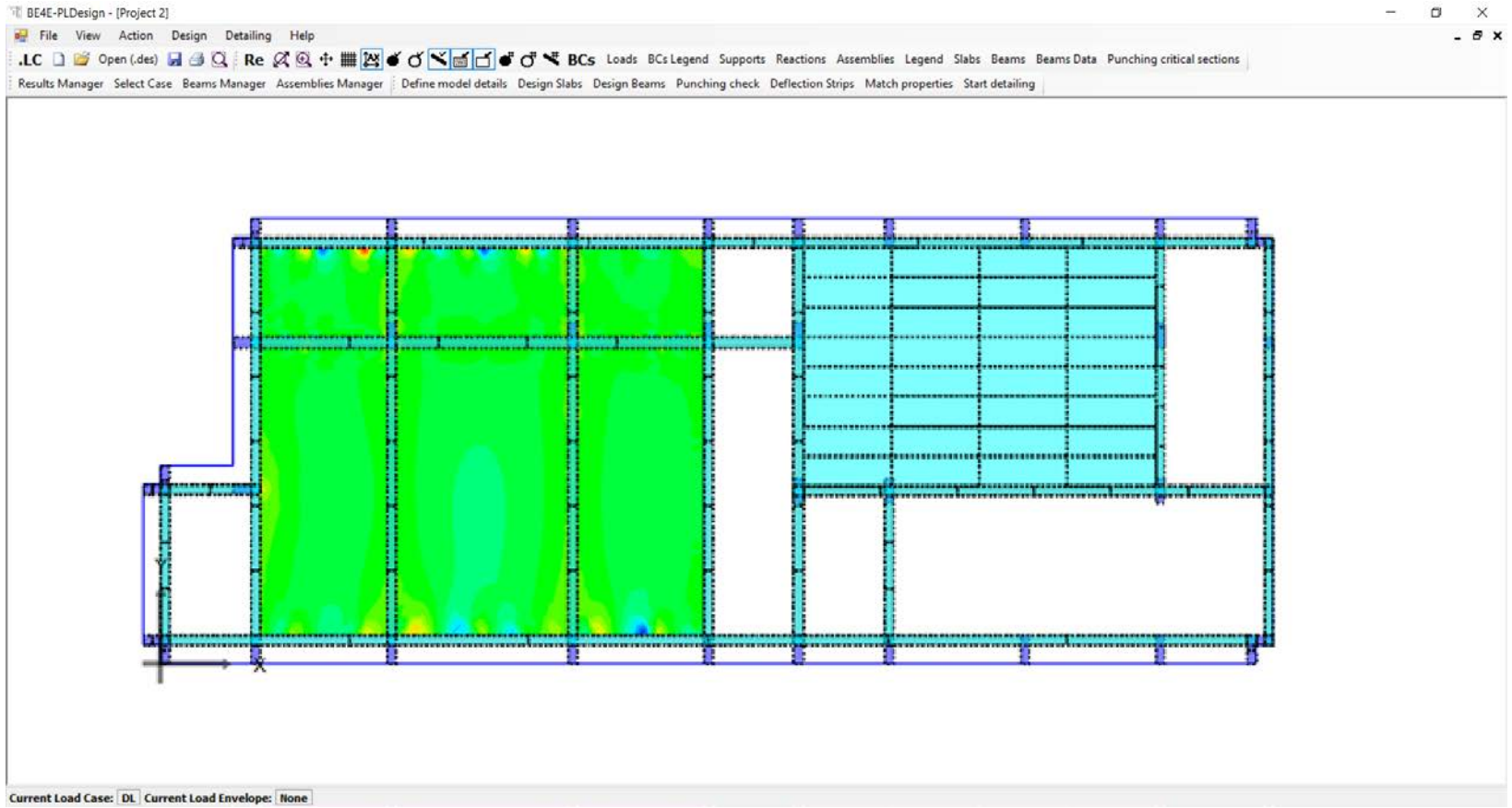
CUFE-BE

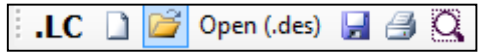
www.be4e.com

Cairo University

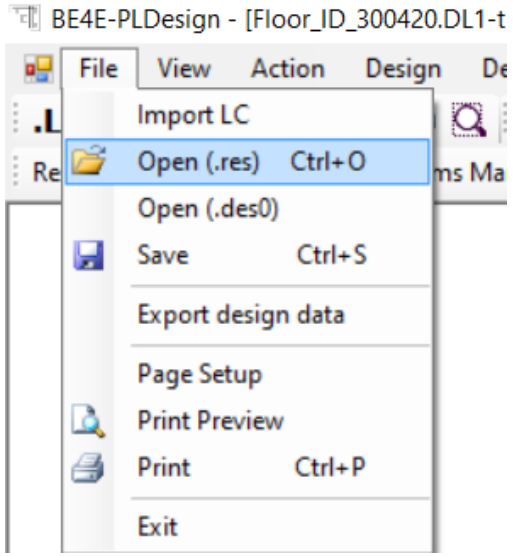
4.2. Design from PLPost results (contour design)

- Load the saved (.res) file in PLDesign.





OR



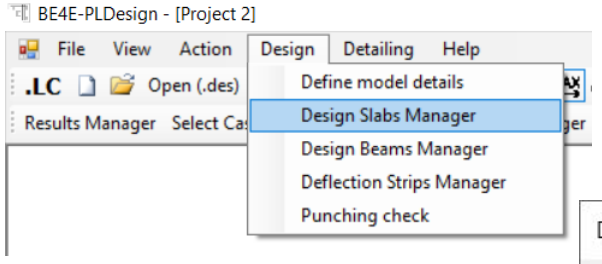
CUFE-BE

www.be4e.com

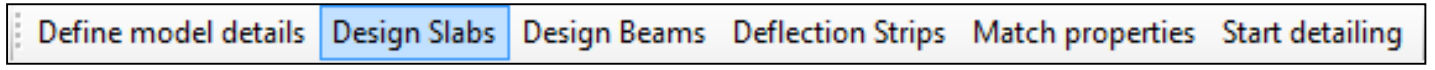
Cairo University

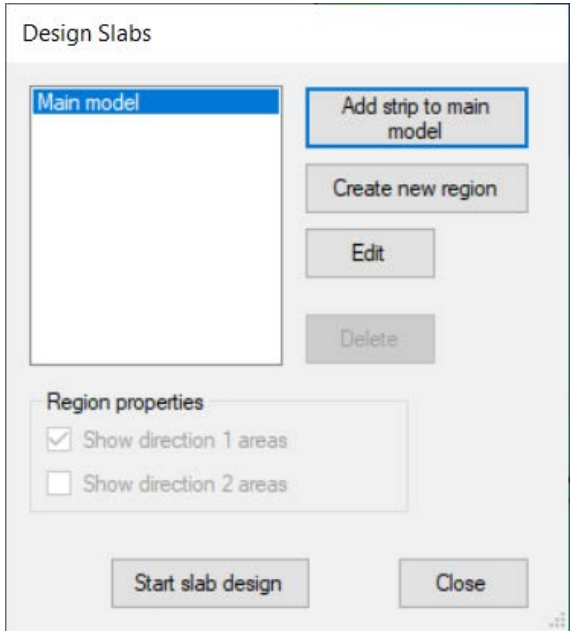
4.2. Design from PLPost results (contour design)

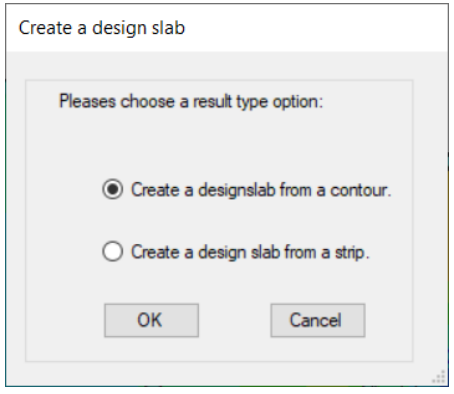
- Open Design Slabs Manager, then press on add strip to main model tab.
- Choose a design slab from a contour which will open a contour list to determine the contour area needed to be designed.

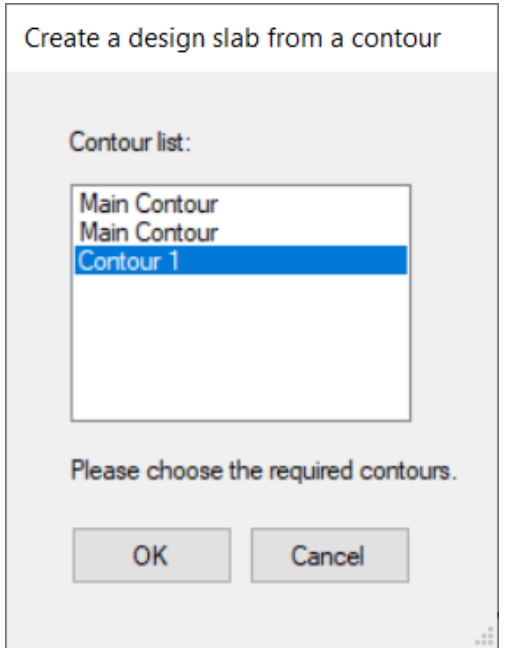


OR









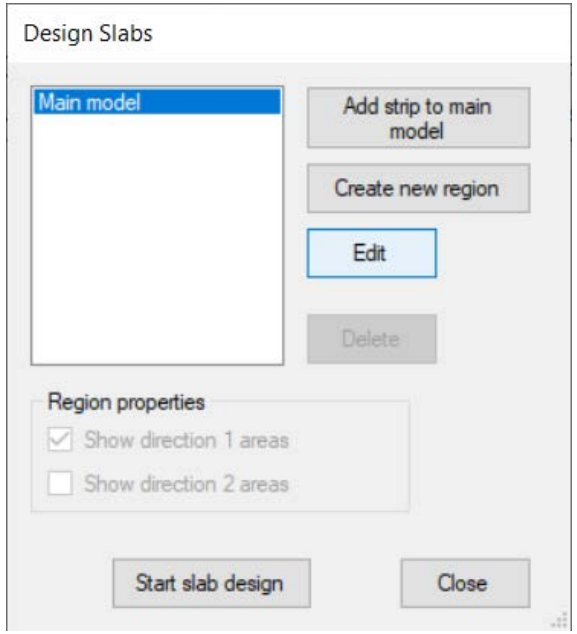
CUFE-BE

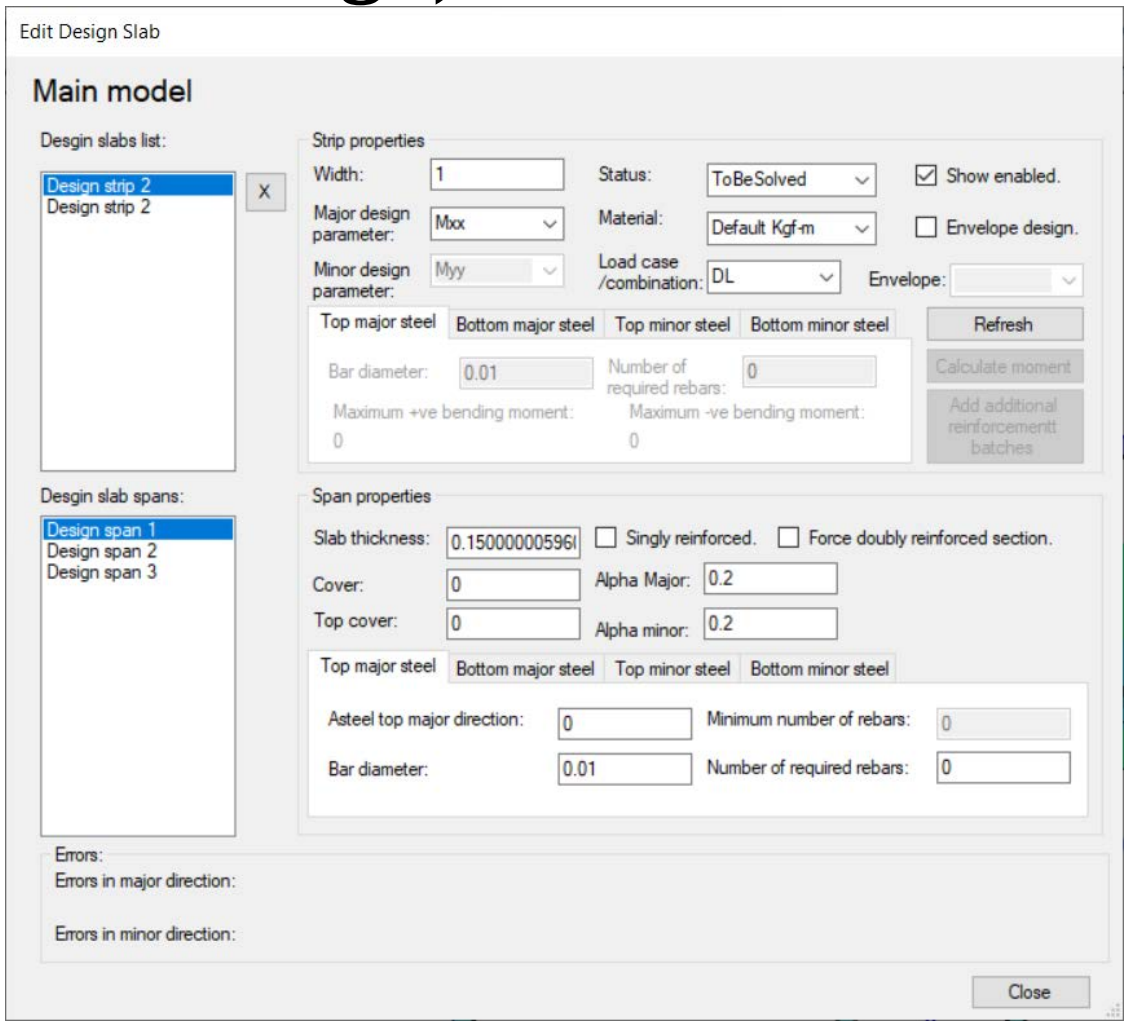
www.be4e.com

Cairo University

4.2. Design from PLPost results (contour design)

- Press on Edit to open Design Slab Manager.
- Similarly as strip design, the user should adjust the design slab list and design span list.
- But in contour design we note that there are 2 design strips one of them is vertical (strip 1) and the other is horizontal (strip 2) each strip should adjust it’s properties.





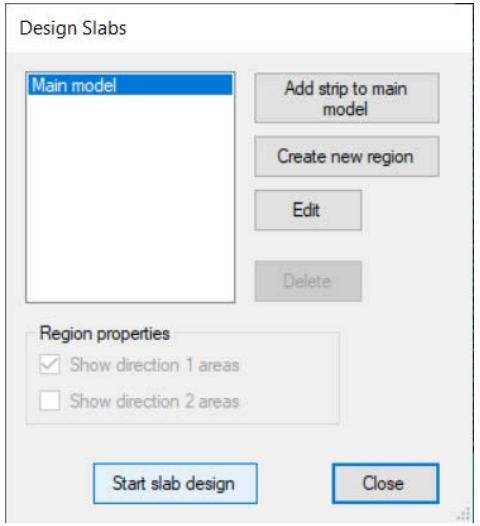
CUFE-BE

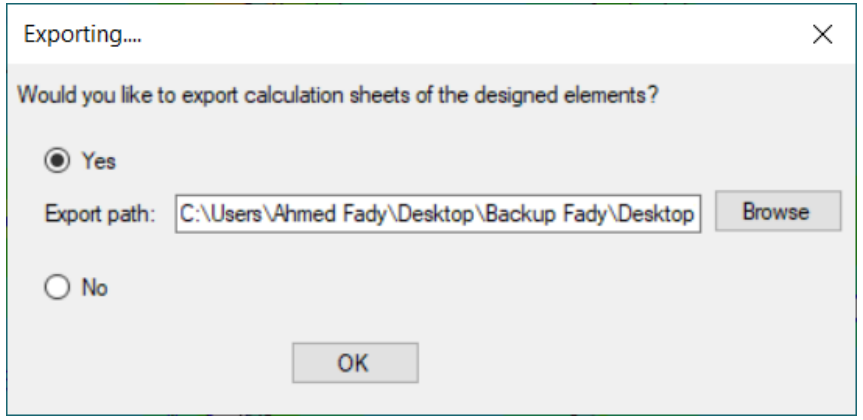
www.be4e.com

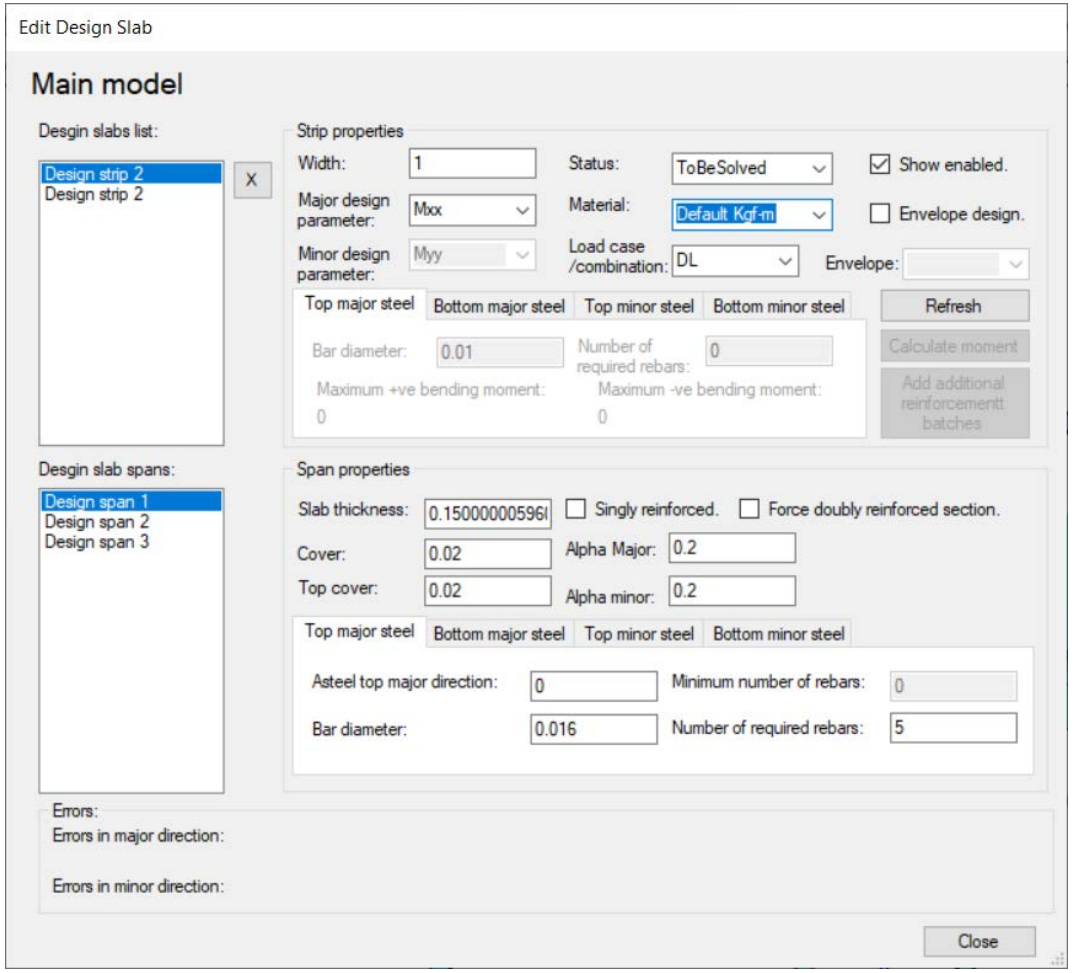
Cairo University

4.2. Design from PLPost results (contour design)

- After adjusting the main model, it is time for solving the slab by pressing start slab design.
- Export the design calculation sheet.







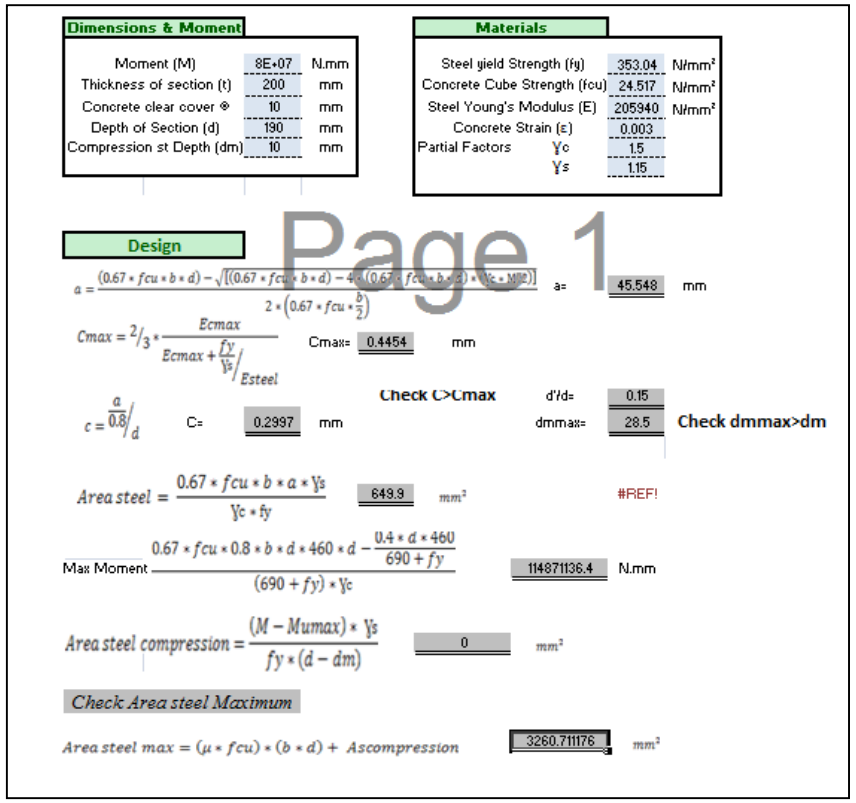
CUFE-BE

www.be4e.com

Cairo University

4.2. Design from PLPost results (contour design)

- Check that all spans are safe and modify the number of bars and bar diameter if needed.
- The PLDesign is automatically export the calculation sheet for slab every section has two files one for moment in X-direction and the other for Y-direction.



Dimensions & Moment

Moment (M)	8E+07	N.mm
Thickness of section (t)	200	mm
Concrete clear cover ⊗	10	mm
Depth of Section (d)	190	mm
Compression st Depth (dm)	10	mm

Materials

Steel yield Strength (fy)	353.04	N/mm²
Concrete Cube Strength (fcu)	24.517	N/mm²
Steel Young's Modulus (E)	205940	N/mm²
Concrete Strain (ε)	0.003	
Partial Factors γc	1.5	
γs	1.15	

Design

$$a = \frac{(0.67 \times fcu \times b \times d) - \sqrt{[(0.67 \times fcu \times b \times d) - 4 \times (0.67 \times fcu \times b \times d) \times \gamma c \times M]}}{2 \times \left(0.67 \times fcu \times \frac{b}{2}\right)}$$ a= 45.548 mm

$$Cmax = \frac{2}{3} \times \frac{Ecmax}{Ecmax + \frac{fy}{\gamma s}/Esteel}$$ Cmax= 0.4454 mm

$$c = \frac{a}{0.8}/d$$ C= 0.2997 mm

Check C>Cmax d'/d= 0.15

dmmax= 28.5 Check dmmax>dm

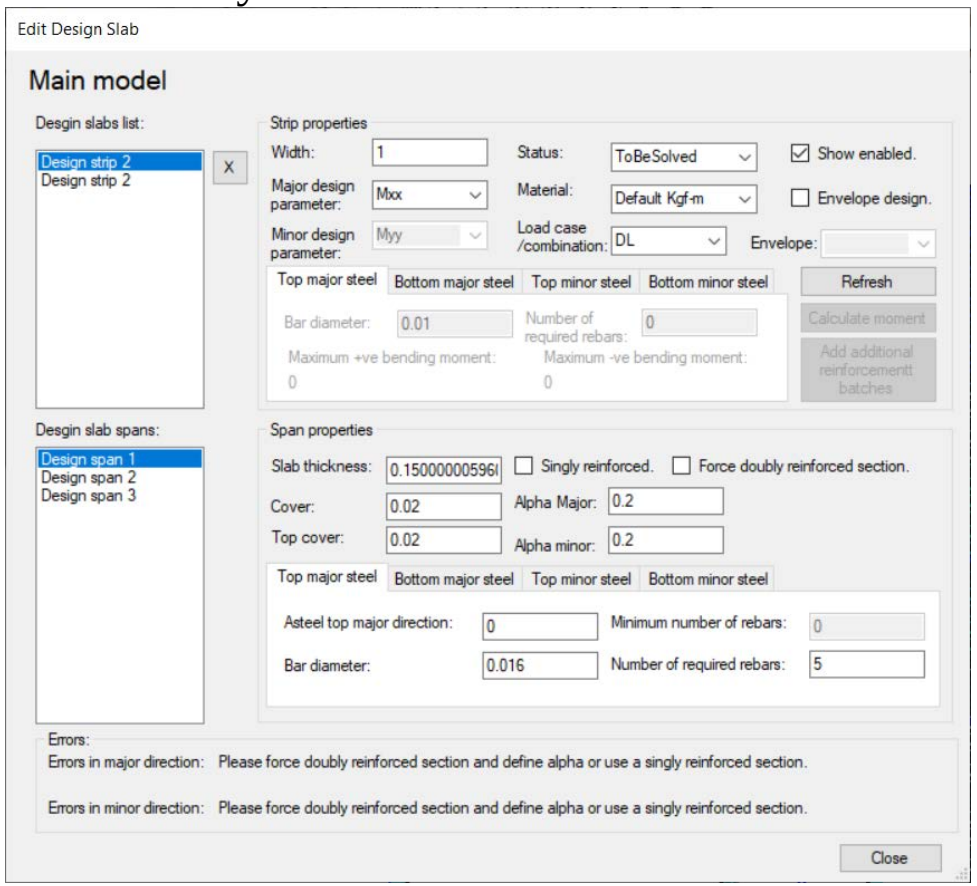
$$Area\ steel = \frac{0.67 \times fcu \times b \times a \times \gamma s}{\gamma c \times fy}$$ 649.9 mm² #REF!

Max Moment $\frac{0.67 \times fcu \times 0.8 \times b \times d \times 460 \times d - \frac{0.4 \times d \times 460}{690 + fy}}{(690 + fy) \times \gamma c}$ 114871136.4 N.mm

$$Area\ steel\ compression = \frac{(M - Mumax) \times \gamma s}{fy \times (d - dm)}$$ 0 mm²

Check Area steel Maximum

$$Area\ steel\ max = (\mu \times fcu) \times (b \times d) + Ascompression$$ 3260.711176 mm²



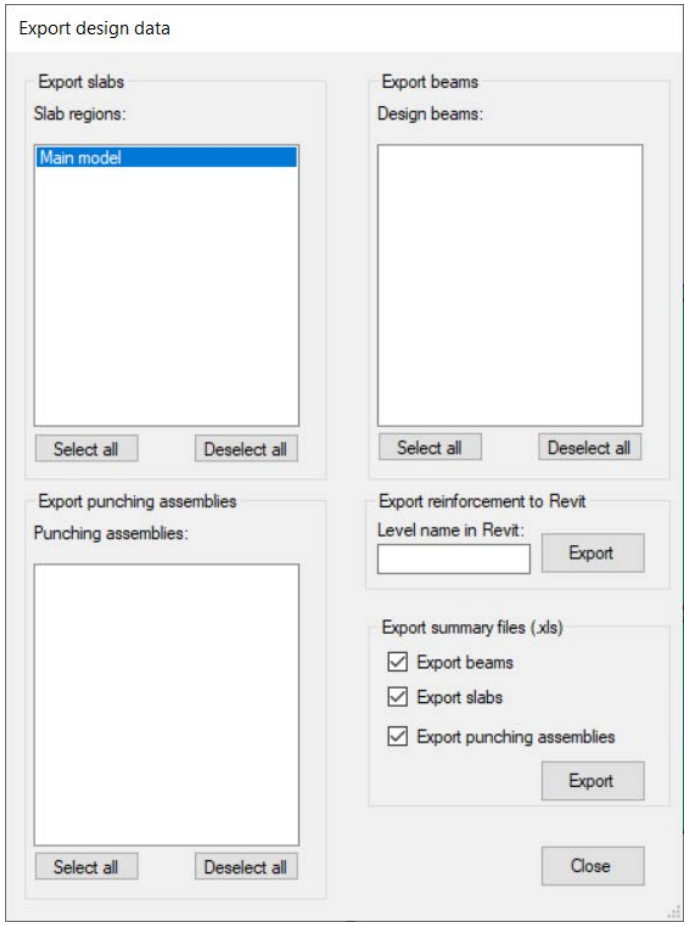
CUFE-BE

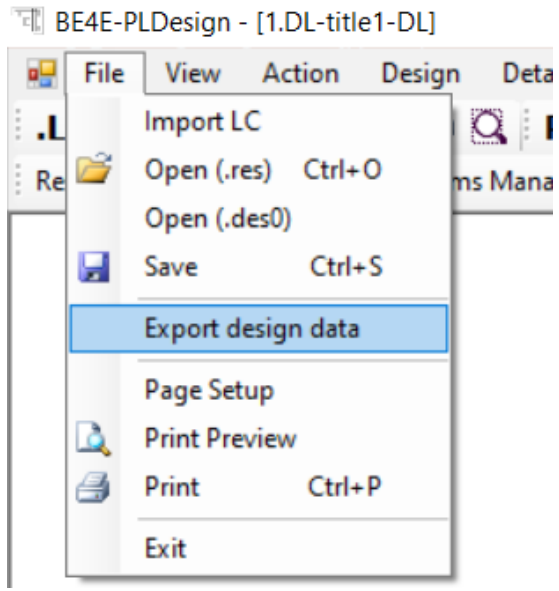
www.be4e.com

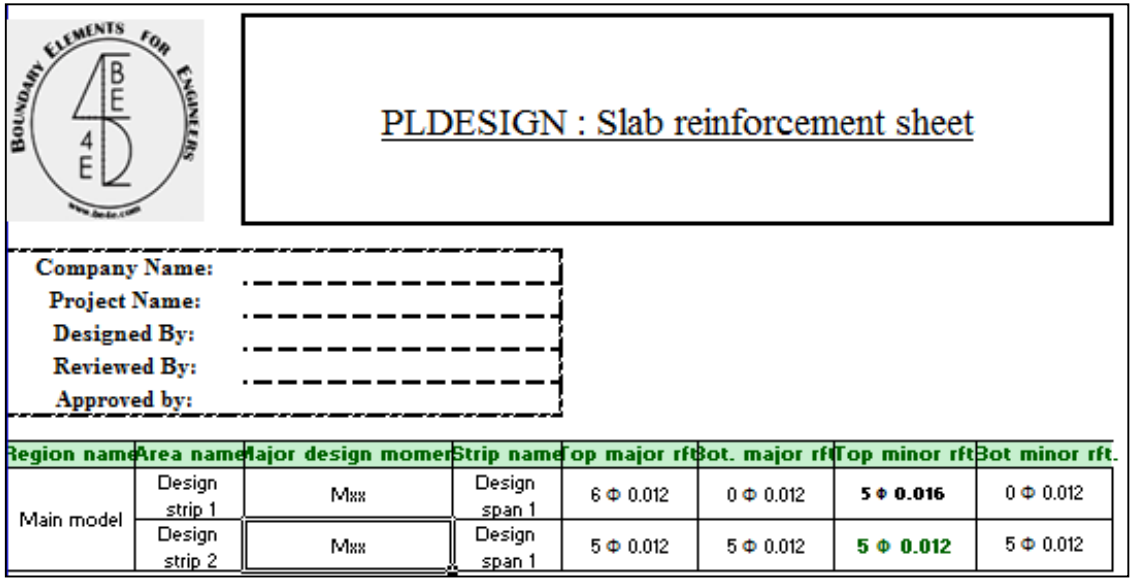
Cairo University

4.2. Design from PLPost results (contour design)

- Instead of every strip contains two excel files, the user can export a summary for slab reinforcement.







PLDESIGN : Slab reinforcement sheet

Company Name:
Project Name:
Designed By:
Reviewed By:
Approved by:

Region name	Area name	Major design momen	Strip name	Top major rft	Bot. major rft	Top minor rft	Bot minor rft.
Main model	Design strip 1	Mxx	Design span 1	6 Φ 0.012	0 Φ 0.012	**5 Φ 0.016**	0 Φ 0.012
	Design strip 2	Mxx	Design span 1	5 Φ 0.012	5 Φ 0.012	**5 Φ 0.012**	5 Φ 0.012

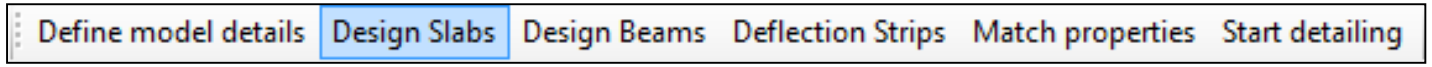
CUFE-BE

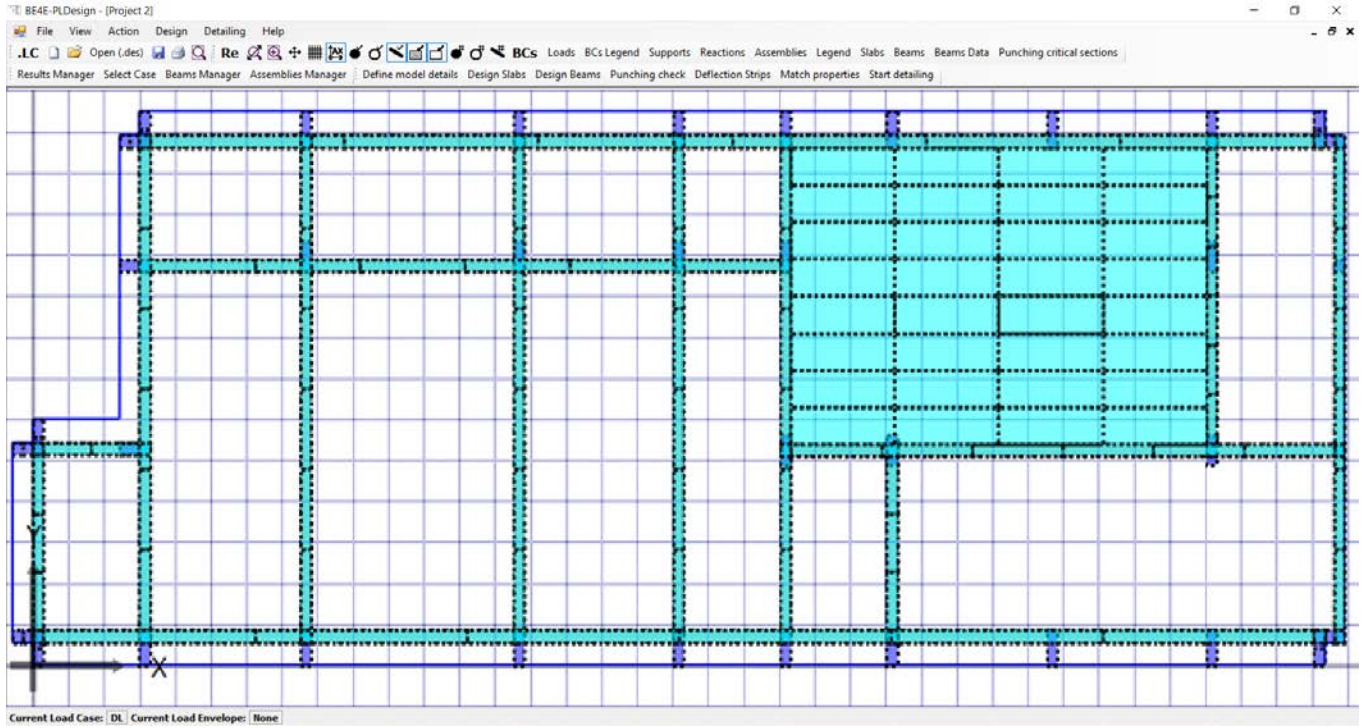
www.be4e.com

Cairo University

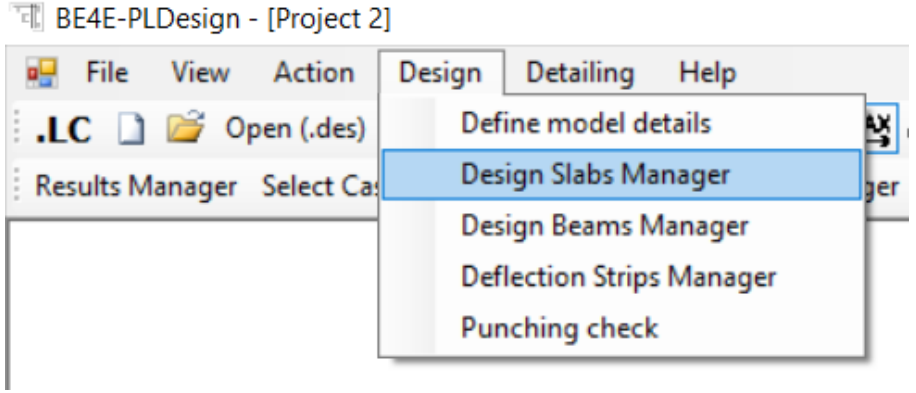
4.3. Design from PLDesign directly (strip based region)

- The user has no need to use PLPost, he could use PLDesign directly.
- Design based region's idea is dividing the selected slab into number of horizontal and vertical strips, these numbers are selected by the user and could be changed according to the dimension of slab, then the PLDesign calculate automatically the straining action for the selected part and design it.





OR



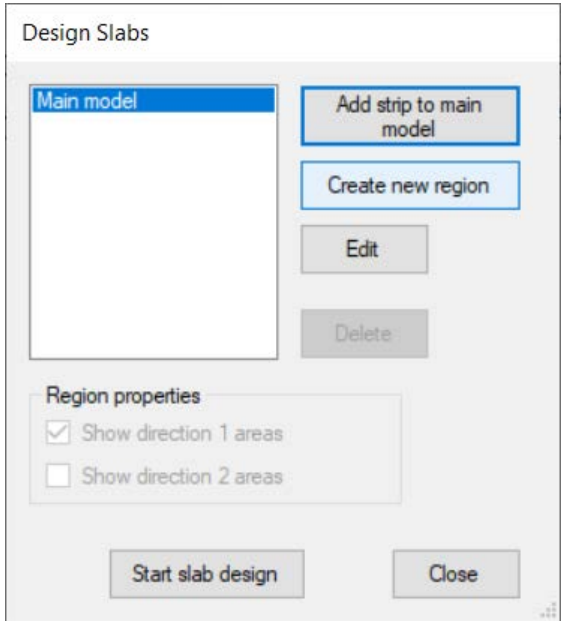
CUFE-BE

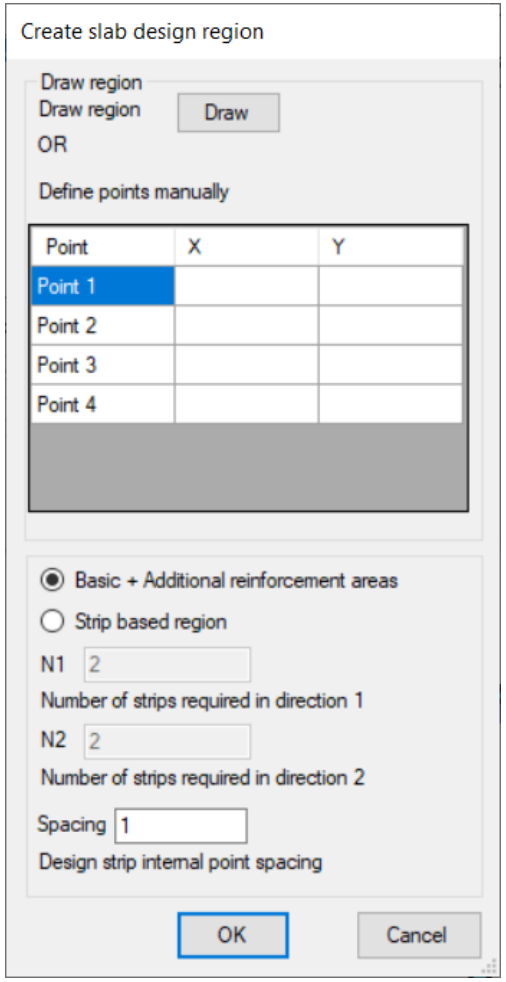
www.be4e.com

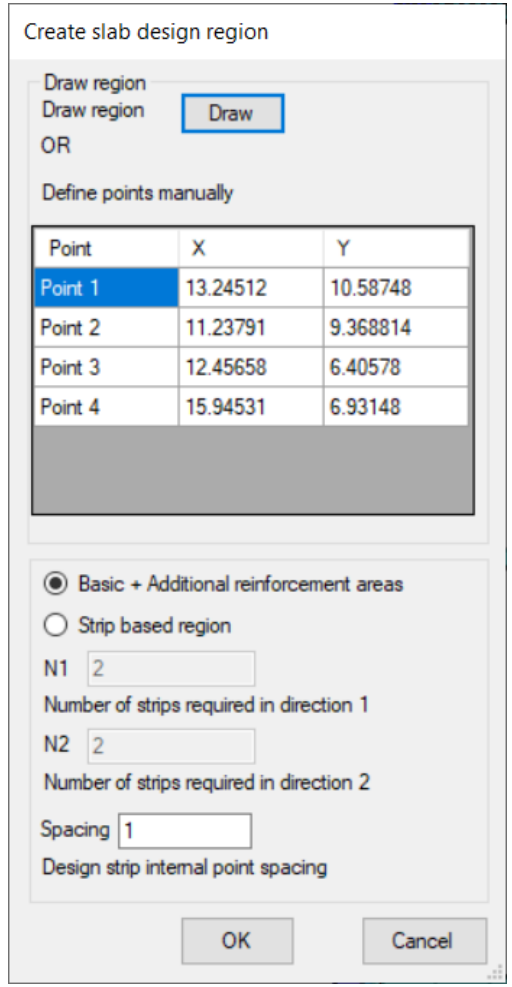
Cairo University

4.3. Design from PLDesign directly (strip based region)

- The two previous methods, the user use add strip to main model tab now he should use create new region as far there is no previous analysis.
- The user should draw the area needed to be designed by Draw tab, then choose Strip based region, and select the number of horizontal /vertical strips and select the spacing.







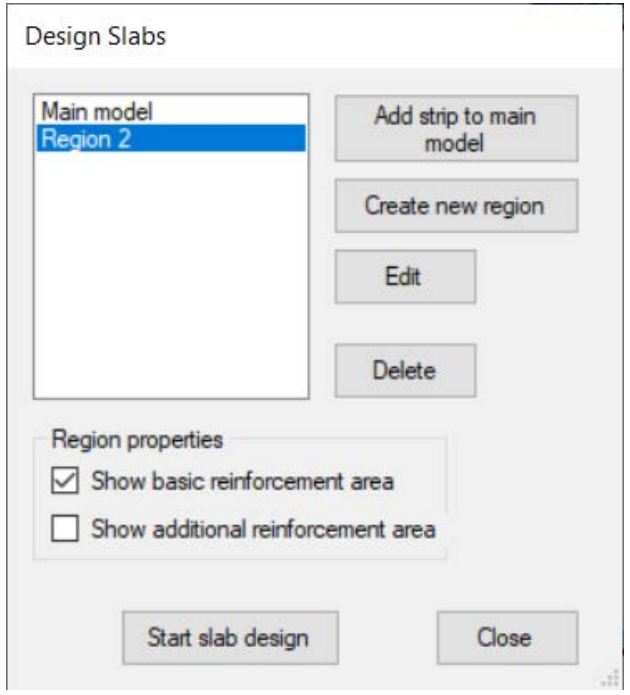
CUFE-BE

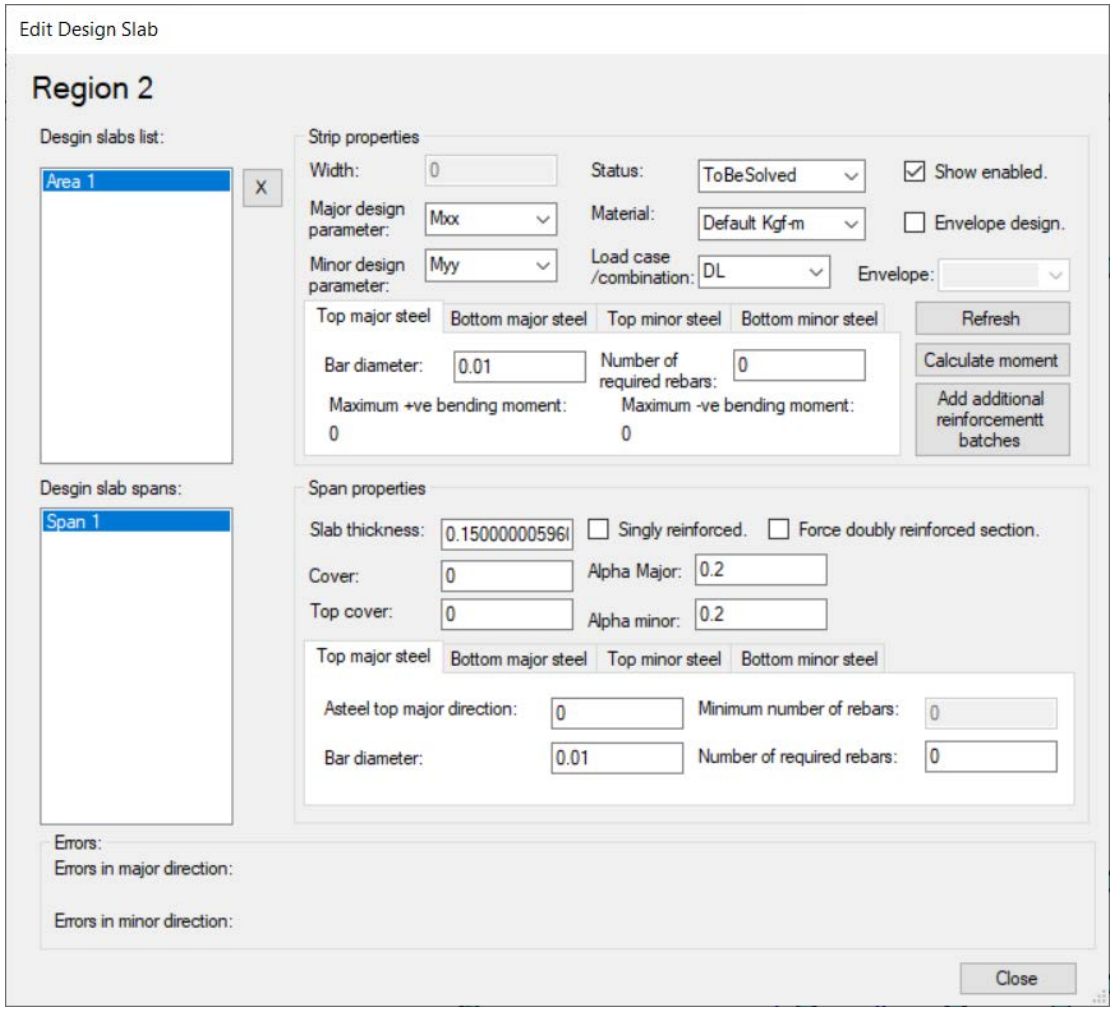
www.be4e.com

Cairo University

4.3. Design from PLDesign directly (strip based region)

- The PLDesign starts the analysis similarly as PLPost.
- Press on Design slab manager to see that a new region has been created.
- Go to Edit slab design to see that the slab is divided into 12 areas (8 horizontal and 4 vertical) each area divided into a number of spans.





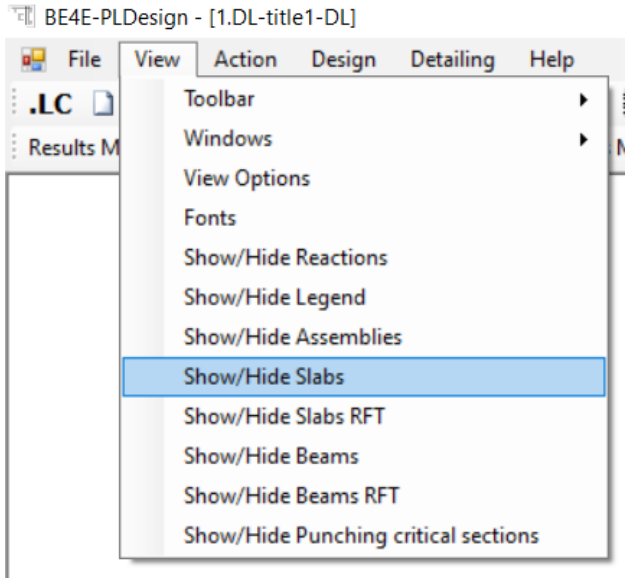
CUFE-BE

www.be4e.com

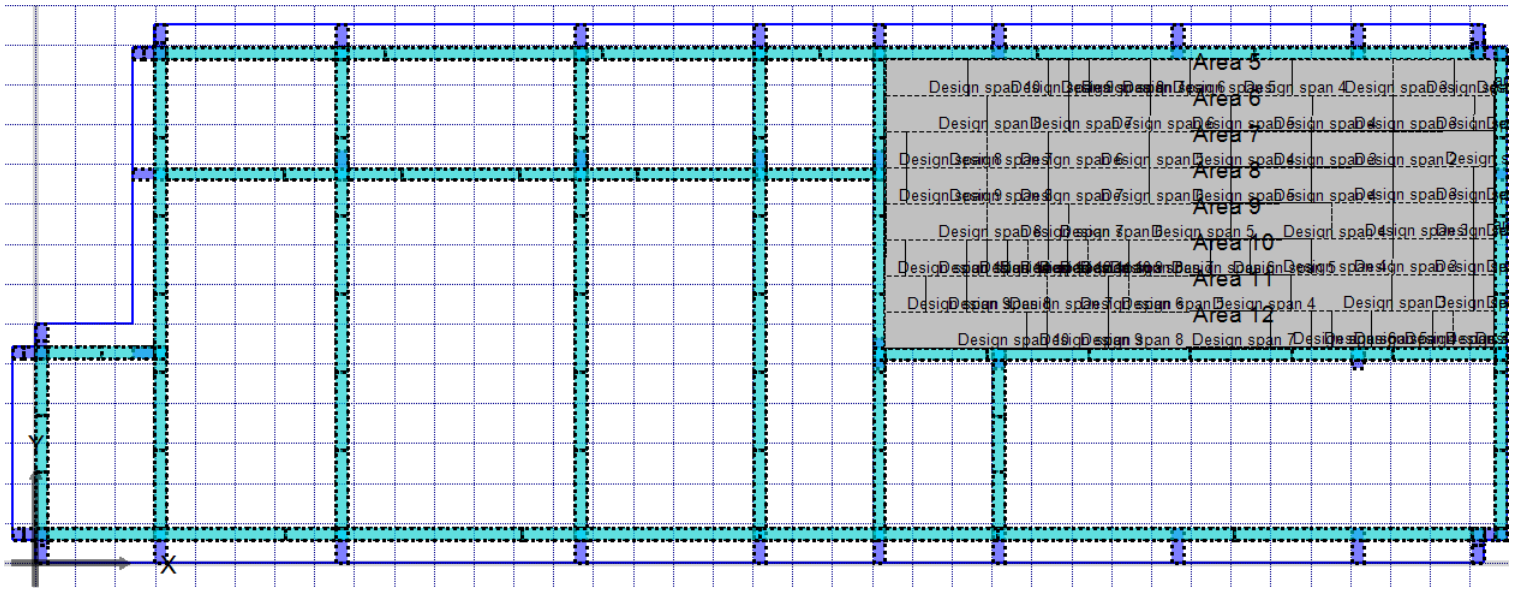
Cairo University

4.3. Design from PLDesign directly (strip based region)

- The horizontal areas should be designed on moment in x-direction and the vertical areas on moment in y-direction.
- The user will recognize the area and the spans in each area.



OR



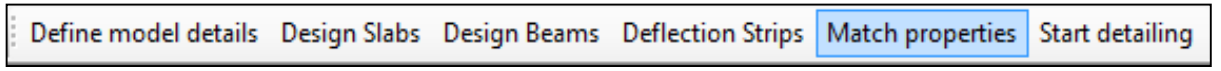
CUFE-BE

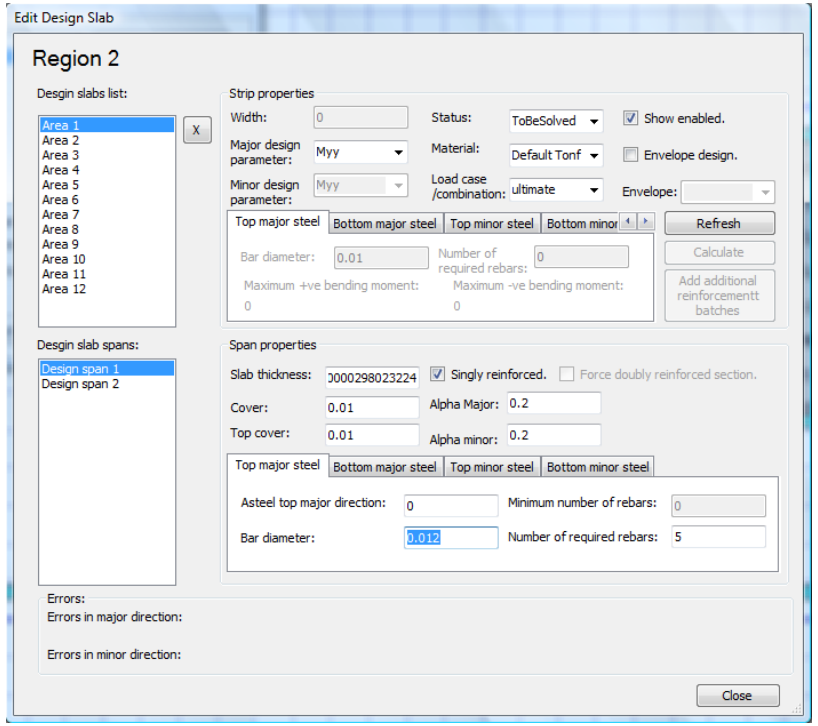
www.be4e.com

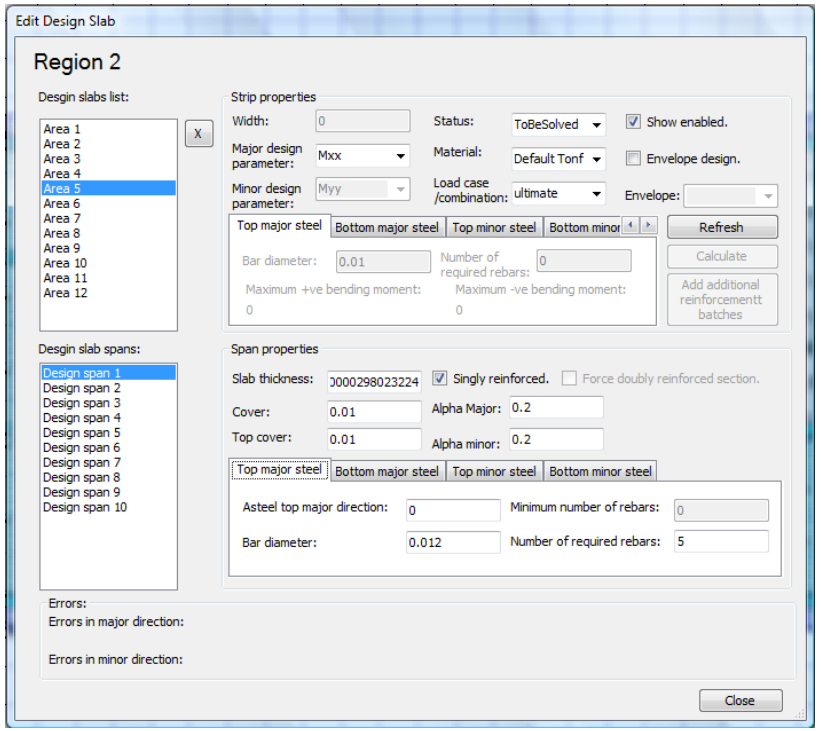
Cairo University

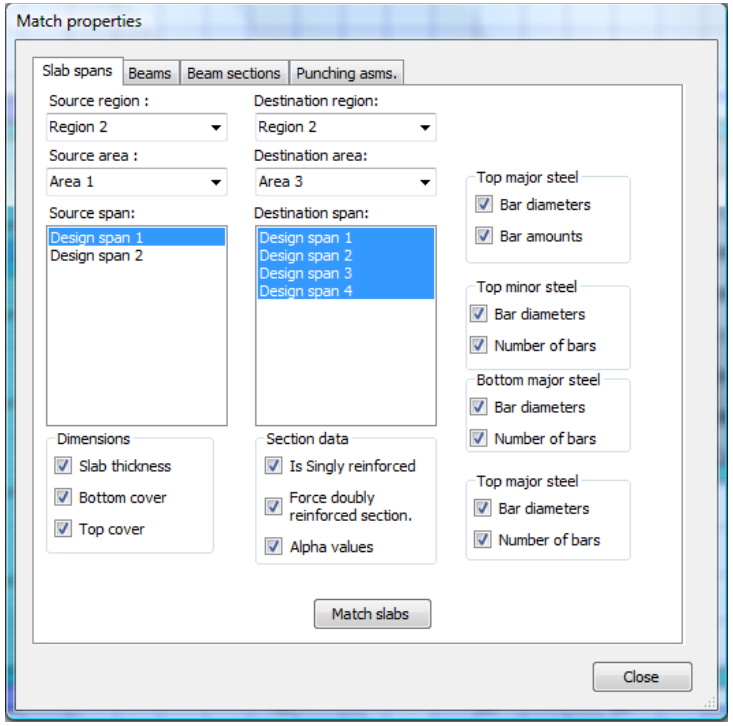
4.3. Design from PLDesign directly (strip based region)

- Edit one Span in one area then match the properties for all spans.
- The user match properties twice one for areas in y-direction and the other of the spans in x-directions, then he has to check the sections before starting slab design.









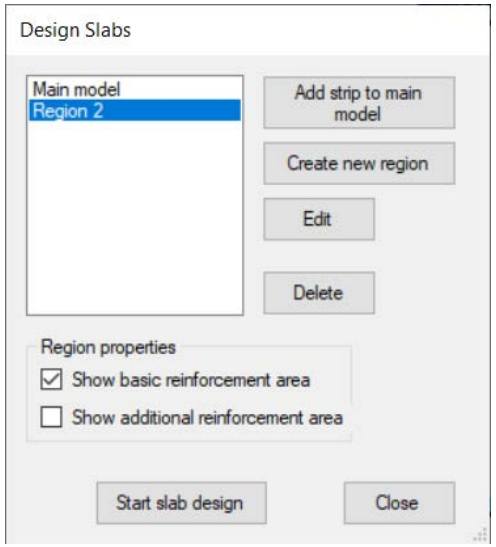
CUFE-BE

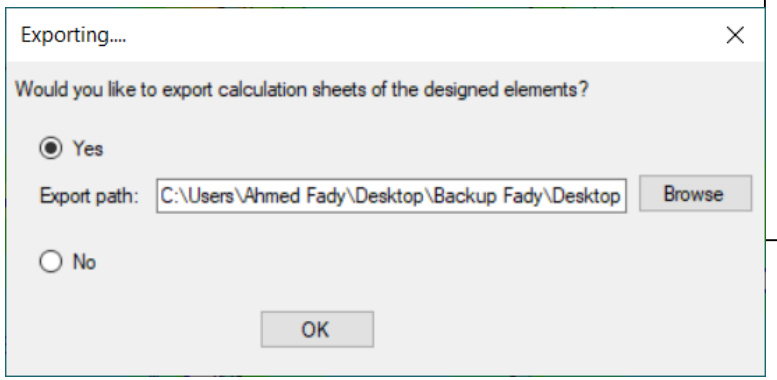
www.be4e.com

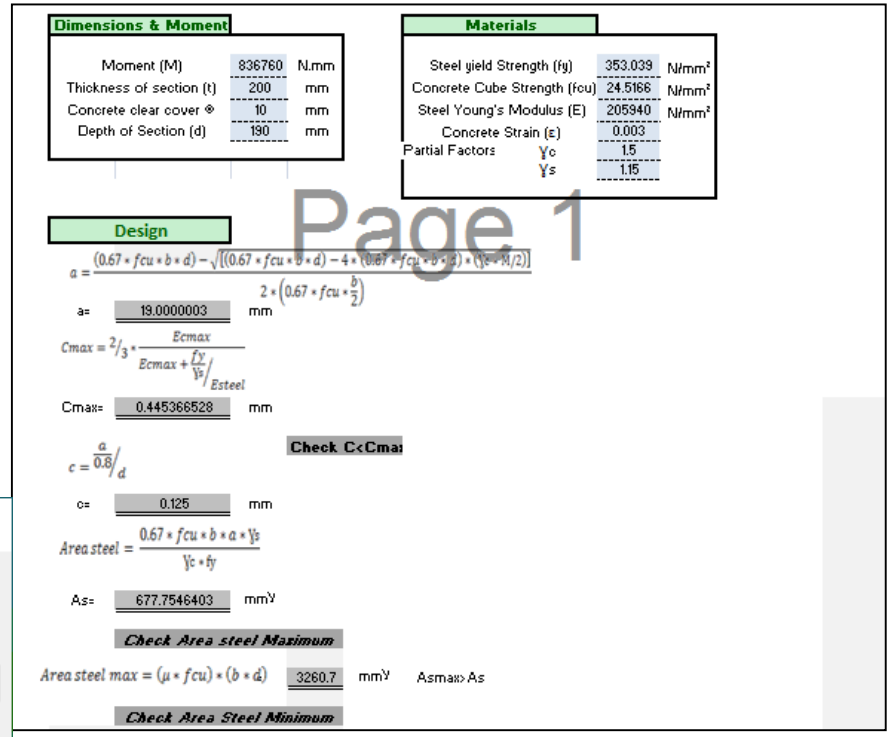
Cairo University

4.3. Design from PLDesign directly (strip based region)

- Before starting slab design, the user should check mark on show direction 2 areas.







Area 5	Mxx	Design span 1	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 2	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 3	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 4	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 5	7 Φ 0.012	5 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 6	5 Φ 0.012	7 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 7	5 Φ 0.012	6 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 8	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 9	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 10	6 Φ 0.012	5 Φ 0.012	5 Φ 0.012	6 Φ 0.012
Area 6	Mxx	Design span 1	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 2	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 3	6 Φ 0.012	5 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 4	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 5	6 Φ 0.012	5 Φ 0.012	5 Φ 0.012	6 Φ 0.012
		Design span 6	5 Φ 0.012	6 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 7	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012
		Design span 8	5 Φ 0.012	6 Φ 0.012	5 Φ 0.012	6 Φ 0.012

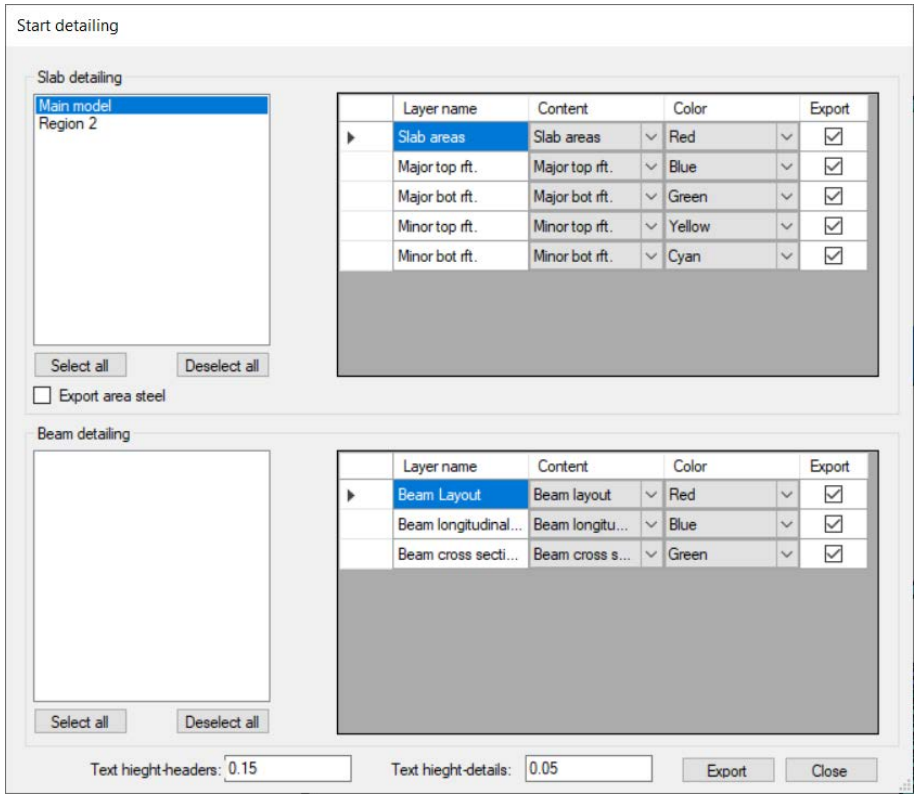
CUFE-BE

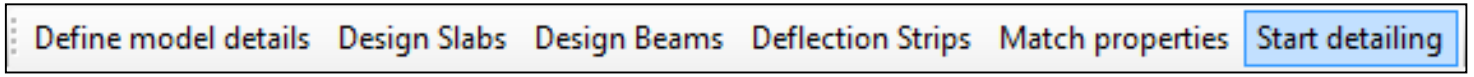
www.be4e.com

Cairo University

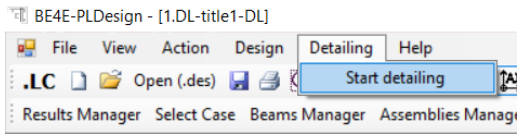
4.3. Design from PLDesign directly (strip based region)

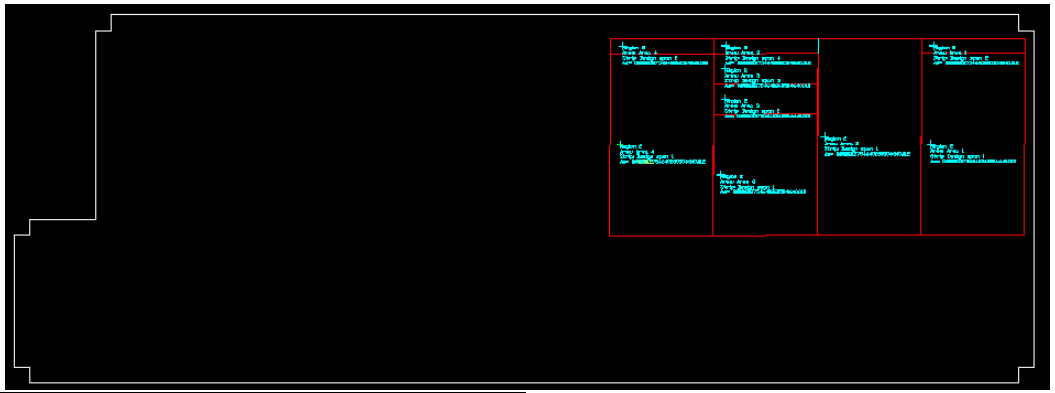
- One of PLDesign advantages is the detailing where the user after finishing the design, he can see slab detailing.
- The user will have (.Dxf) file, the file contain two drawings one for horizontal areas and the other for vertical areas.

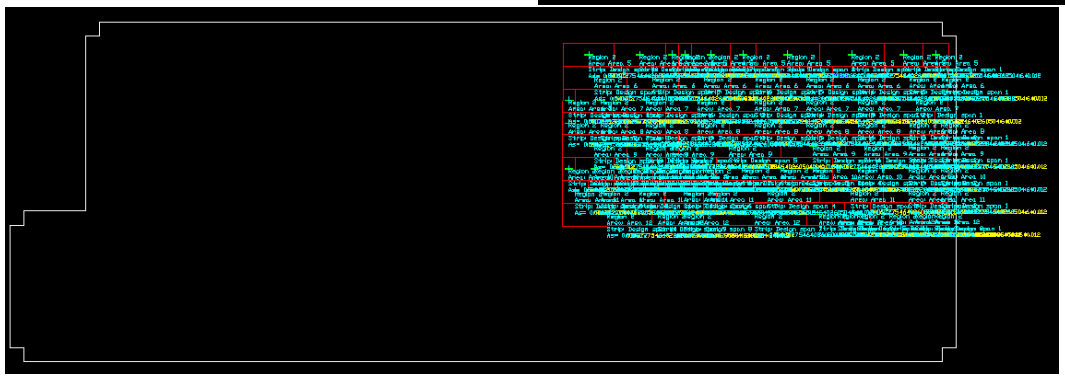




OR







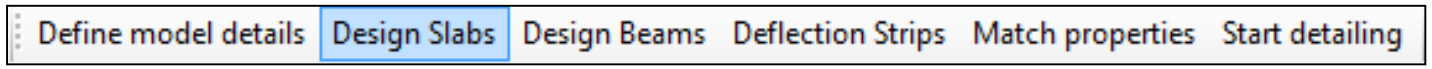
CUFE-BE

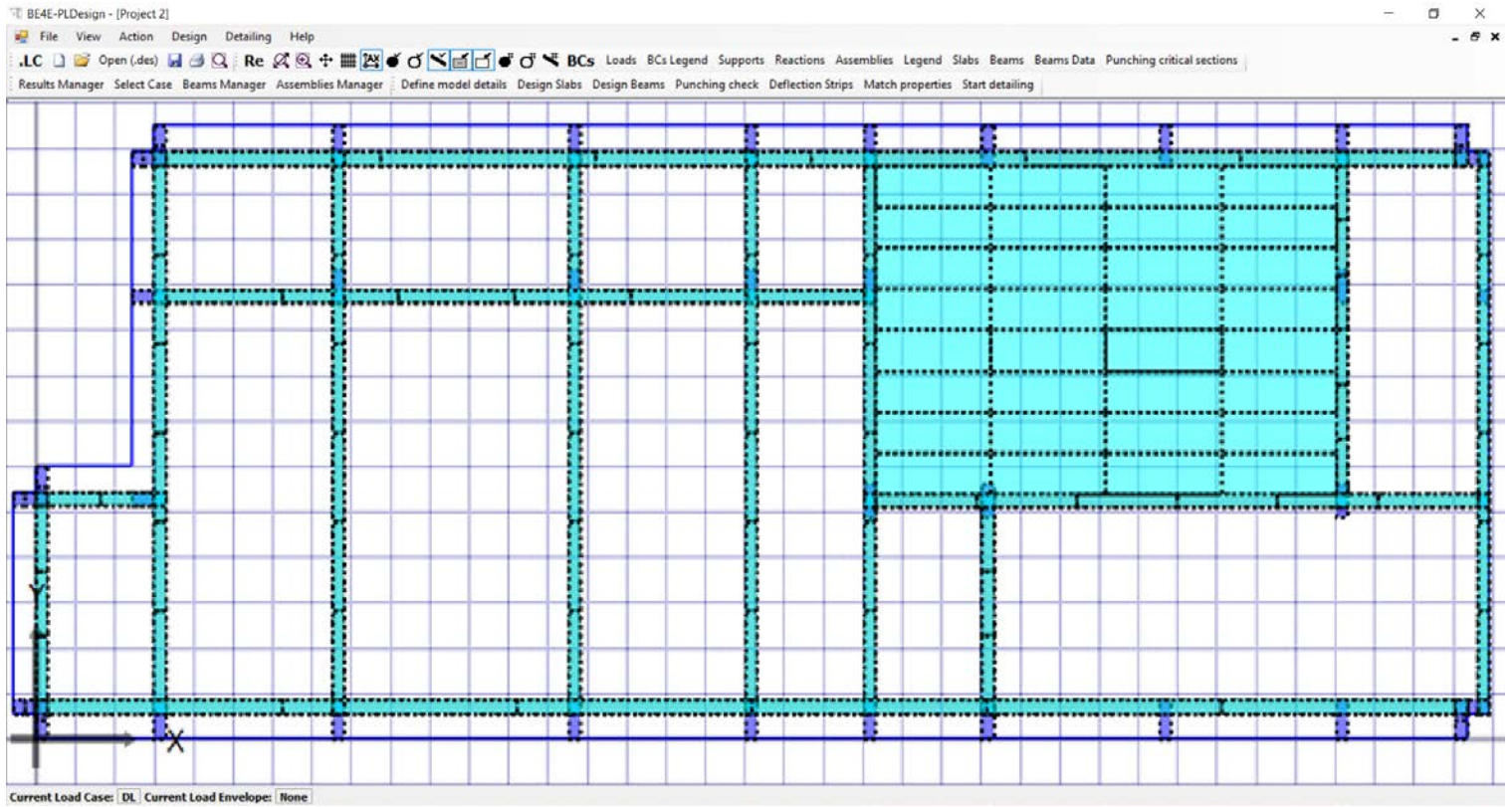
www.be4e.com

Cairo University

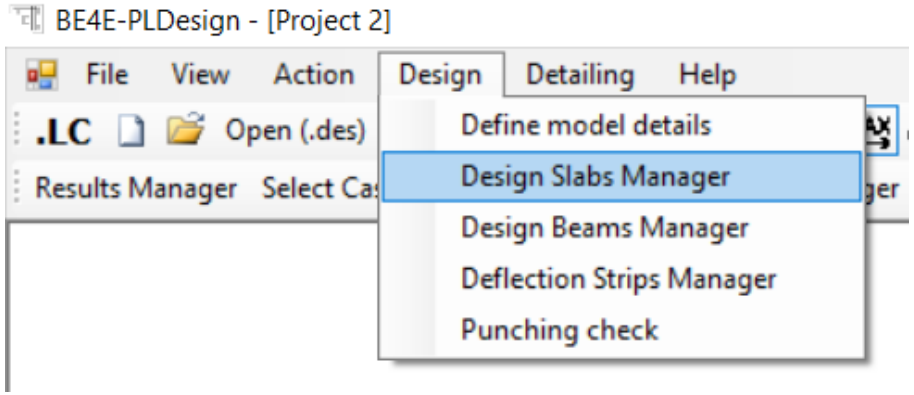
4.4 Design from PLDesign directly (basic and additional RFT)

- This method is very famous in flat slabs and can be shown very simply.





OR



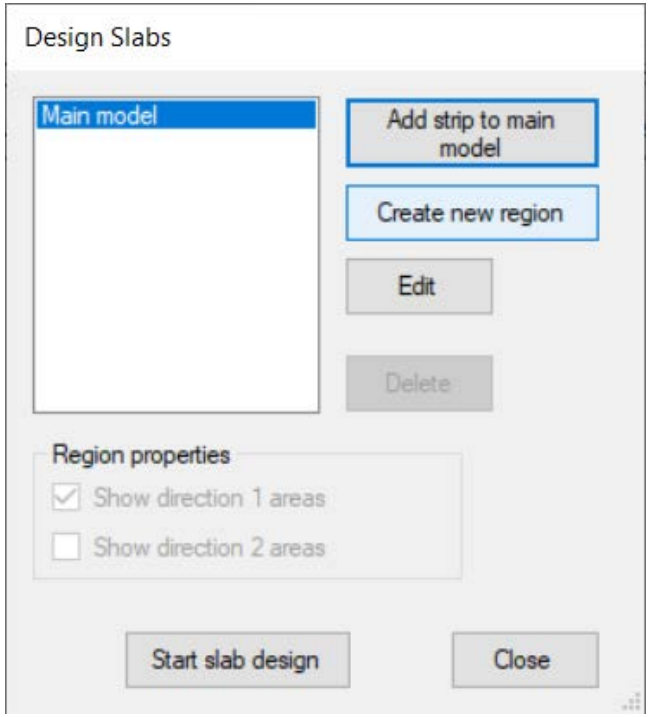
CUFE-BE

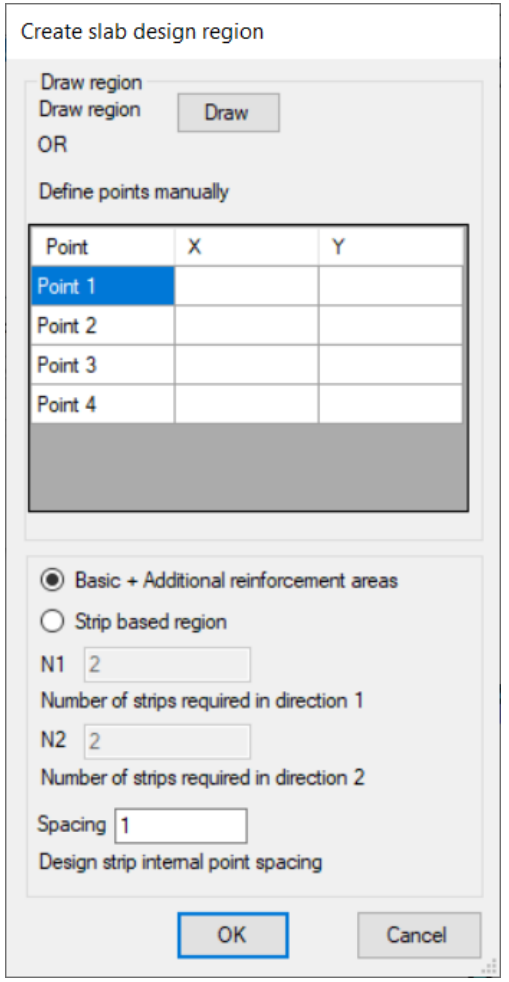
www.be4e.com

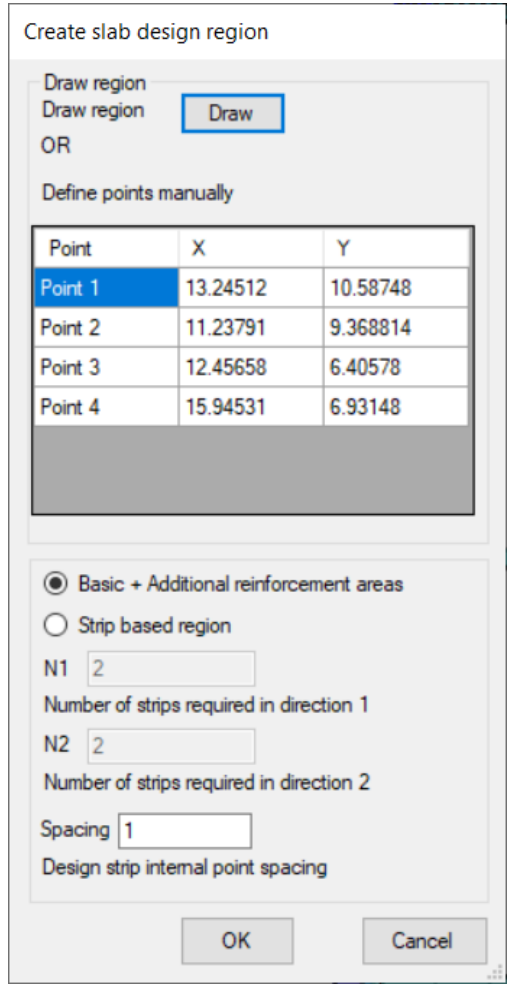
Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

- We are also going to use Create new region.
- The user should draw the area needed to be designed by Draw tab, then select the spacing for the analysis.







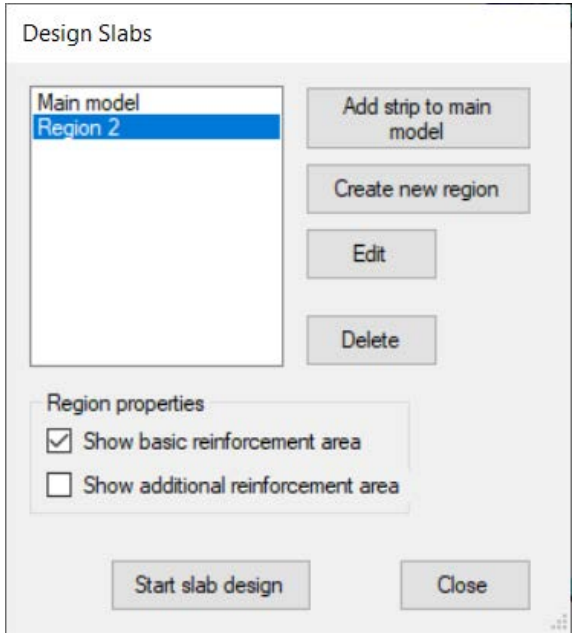
CUFE-BE

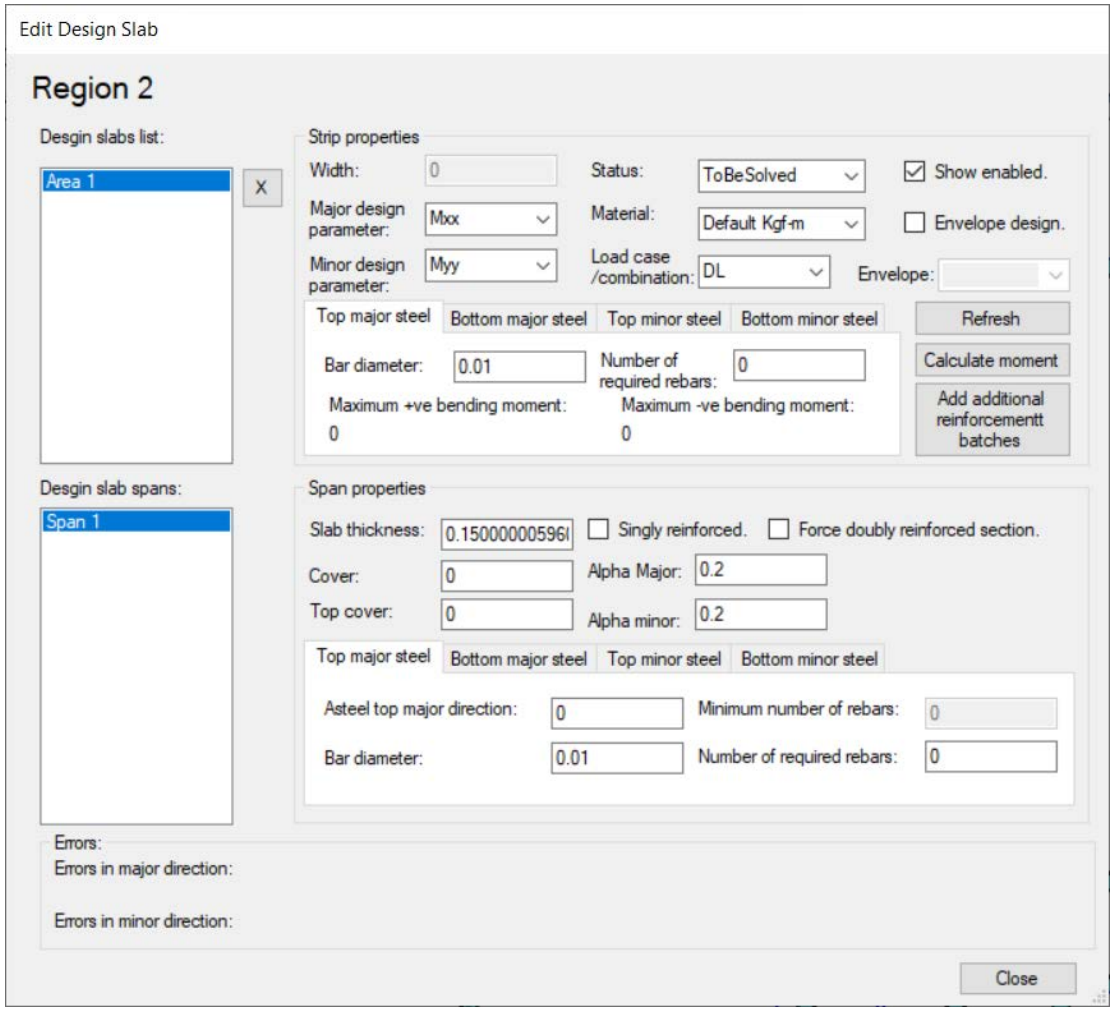
www.be4e.com

Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

- The PLDesign starts the analysis similarly as PLPost.
- Press on Design slab manager to see that a new region has been created.
- Go to Edit slab design to see that the slab is one area.
- The upper section of strip properties is for the basic reinforcement and the lower is for additional reinforcement.





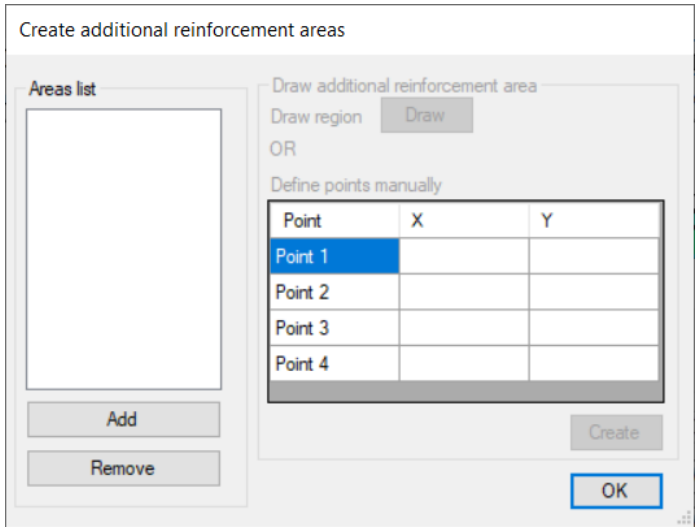
CUFE-BE

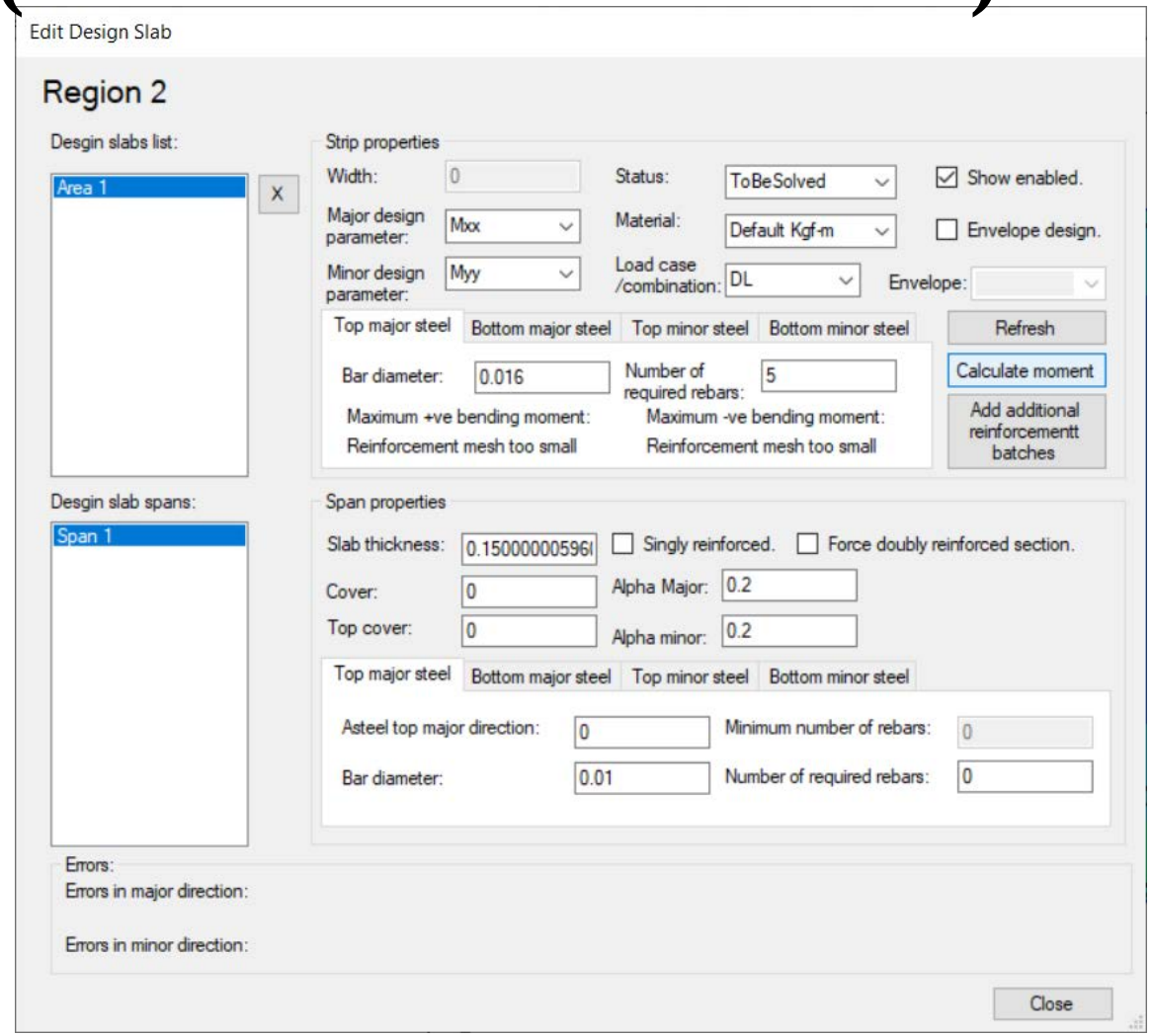
www.be4e.com

Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

- The user has to insert the major/minor design parameter, Load case/combination, material units, Bar diameter and number of bars, then press calculate and refresh.
- The PLDesign calculate the maximum +ve and –ve moments.
- Click on add additional reinforcement batches to show areas for additional reinforcement.
- Press on add additional areas then draw to show parts of slab need additional reinforcement.





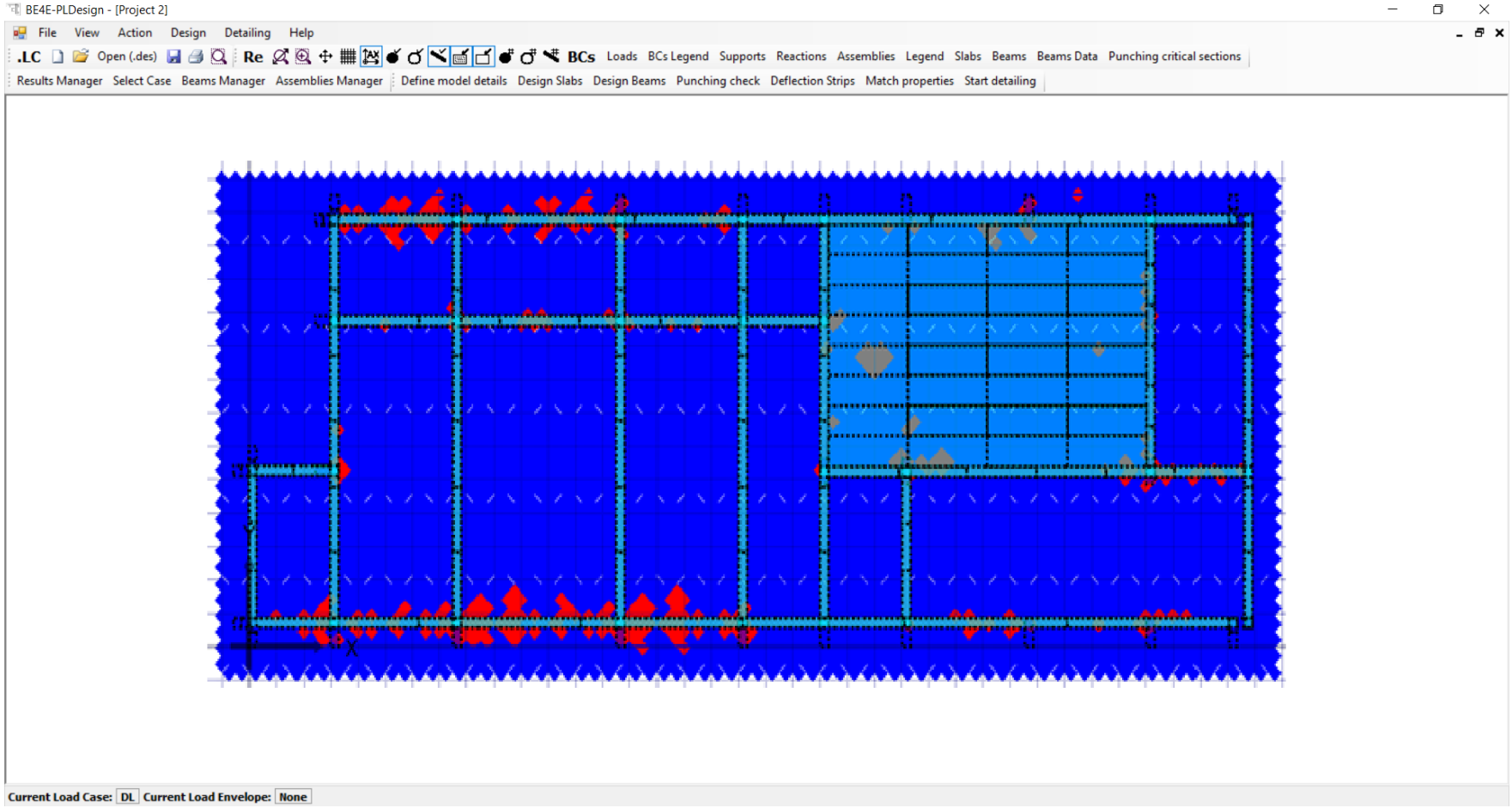
CUFE-BE

www.be4e.com

Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

- The blue area is safe for the basic reinforcement, but the red areas are not safe.



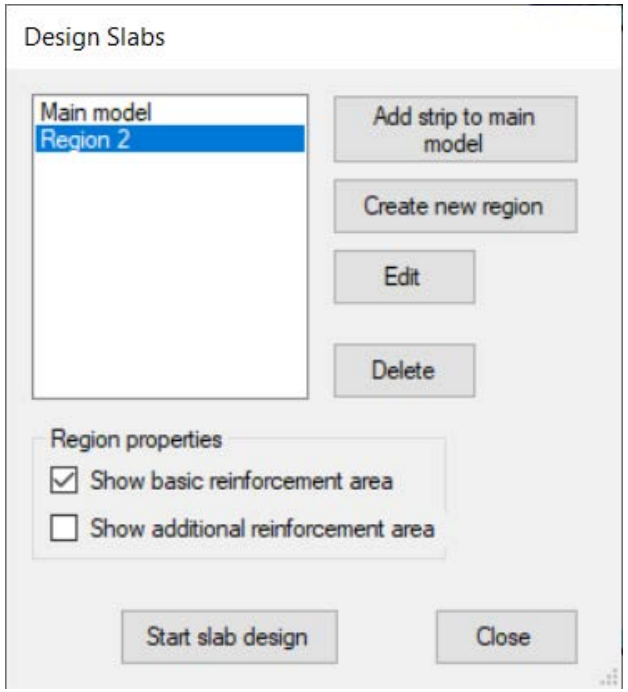
CUFE-BE

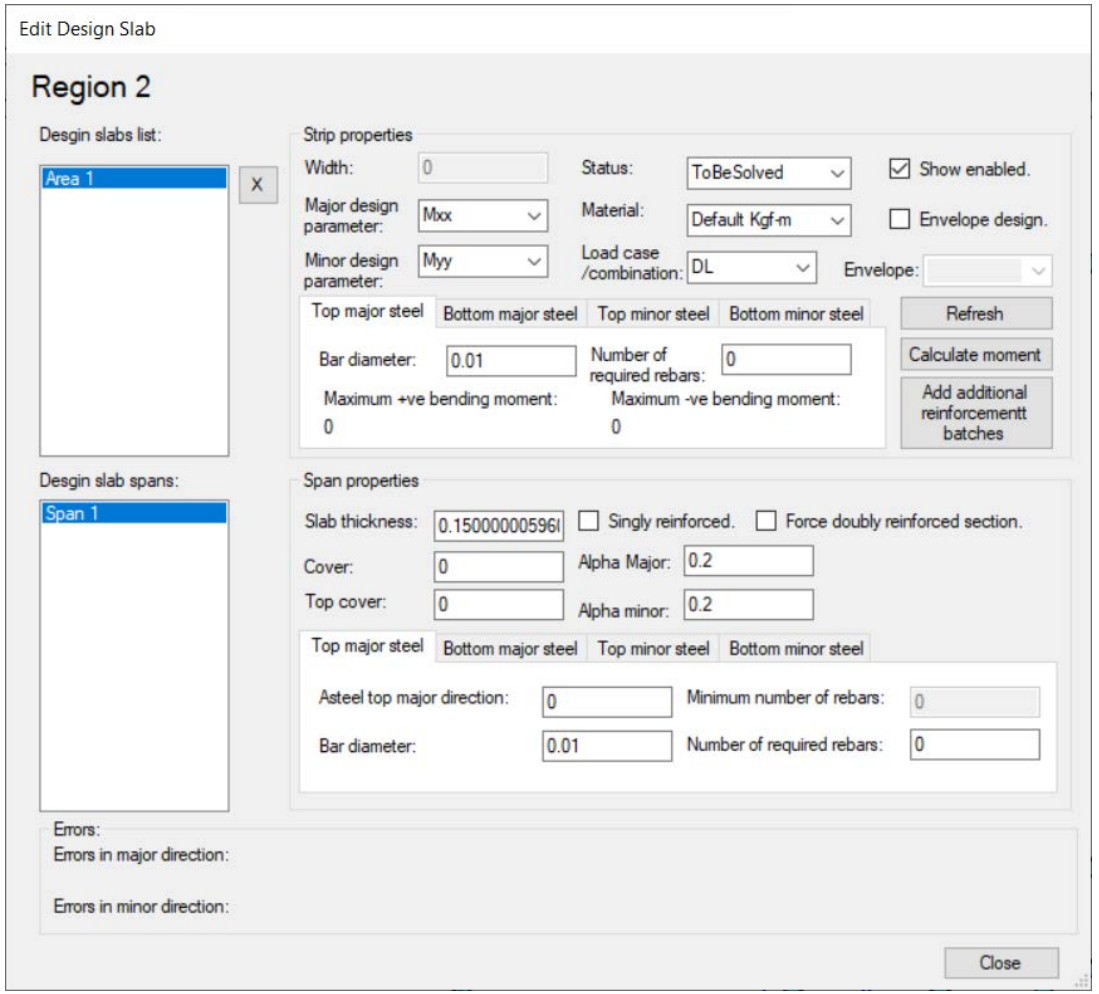
www.be4e.com

Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

- After drawing the additional areas, the user should select cover, bar diameter and number of required bars in span properties.
- Check the mark box of show additional reinforcement area, then Start slab design.





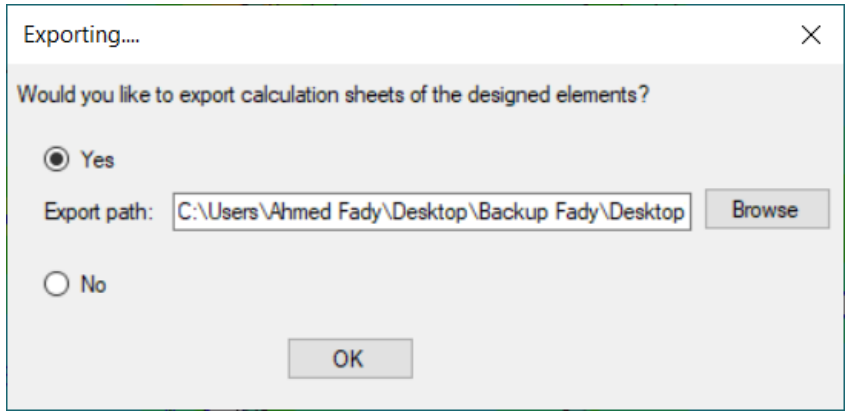
CUFE-BE

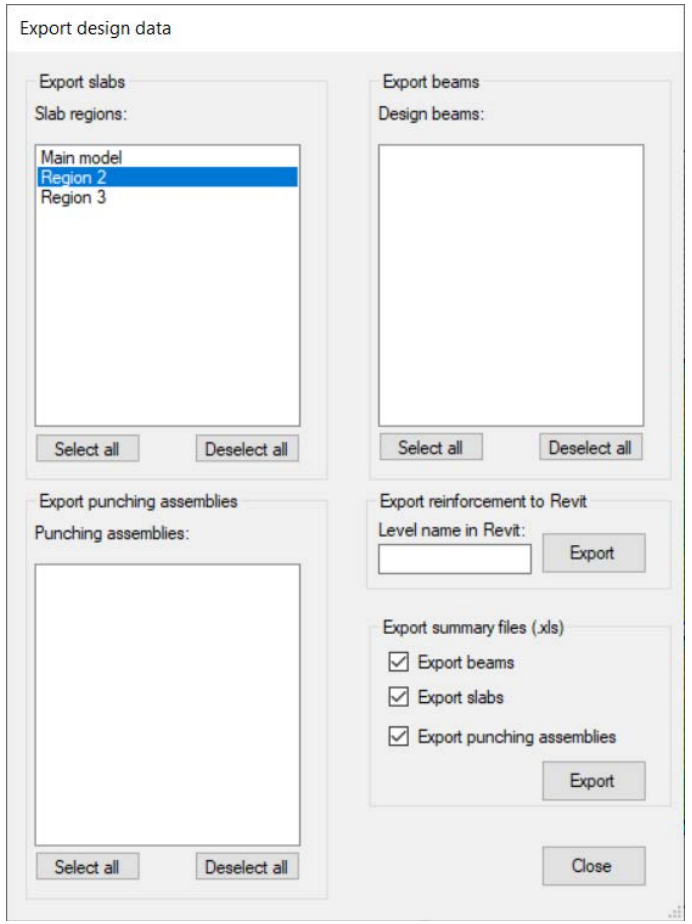
www.be4e.com

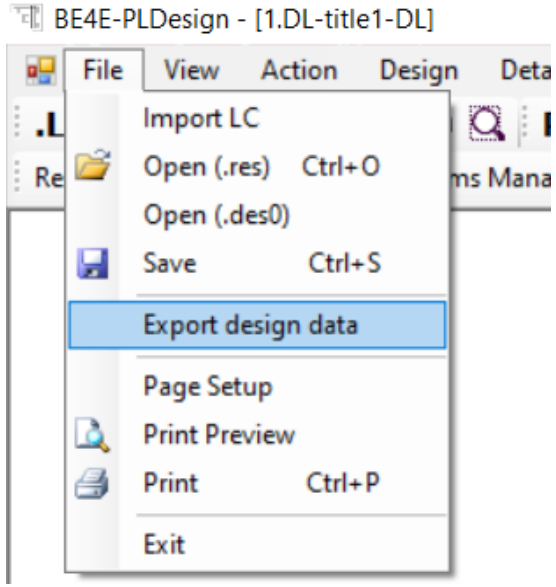
Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

- Export the calculation sheet files, then check the reinforcement and export the data sheet summary.







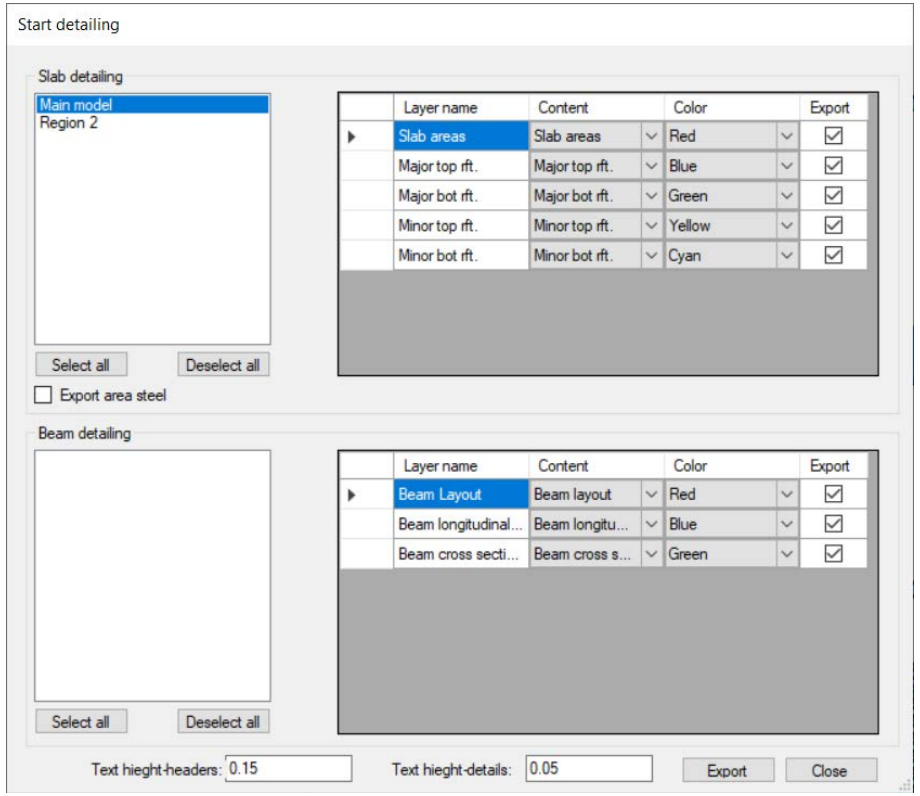
CUFE-BE

www.be4e.com

Cairo University

4.4 Design from PLDesign directly (basic and additional RFT)

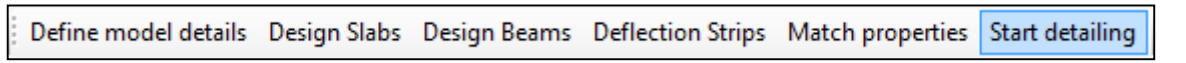
- Now the user can also see slab detailing as strip based region.



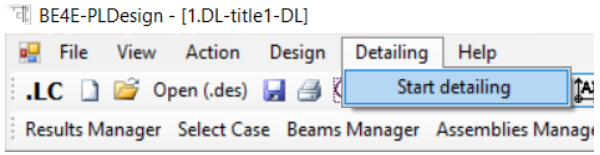
PLDESIGN : Slab reinforcement sheet

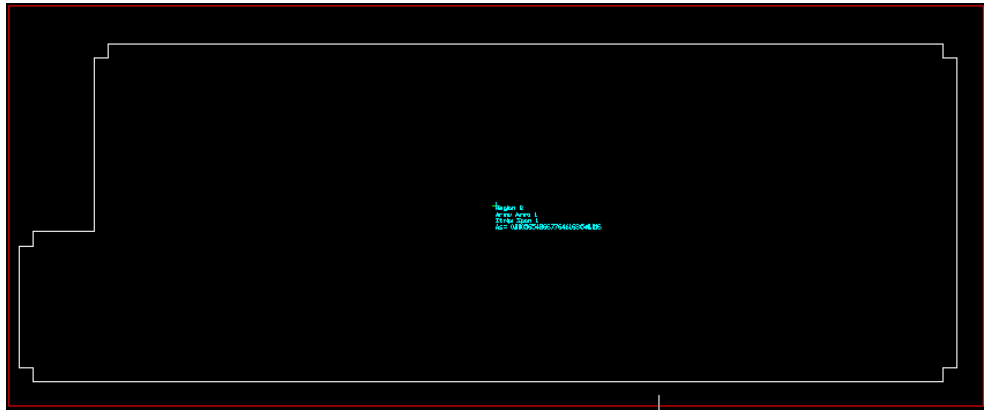
Company Name:
Project Name:
Designed By:
Reviewed By:
Approved by:

Region name	Area name	Major design moment	Strip name	Top major rft.	Bot. major rft.	Top minor rft.	Bot minor rft.
Region 2	Area 1	Mxx	Span 1	5 Φ 0.016	5 Φ 0.016	**5 Φ 0.016**	5 Φ 0.016



OR





CUFE-BE

www.be4e.com

Cairo University

PLDesign Package

2.1. File needed to be exported before using PLDesign ✓

2.2. Starting PLDesign ✓

2.3. Load combinations & load envelopes ✓

2.4. Slab design ✓

2.4.1. Design from PLPost results (strip design) ✓

2.4.2. Design from PLPost results (contour design) ✓

2.4.3. Design from PLDesign directly (strip based region) ✓

2.4.4 Design from PLDesign directly (basic and additional reinforcement) ✓

2.5 Check deflections of slab

2.6 Check punching

2.7 Beam design

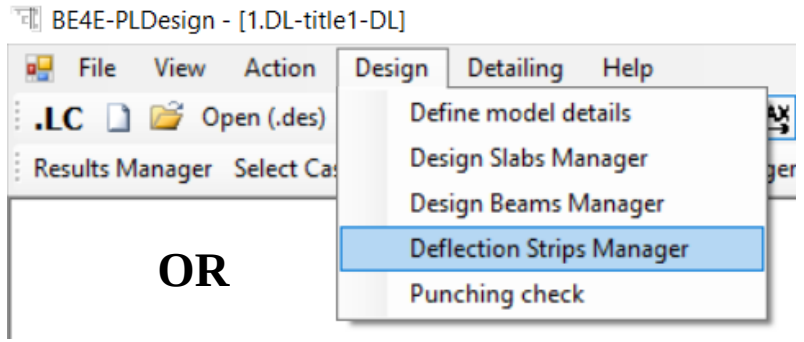
CUFE-BE

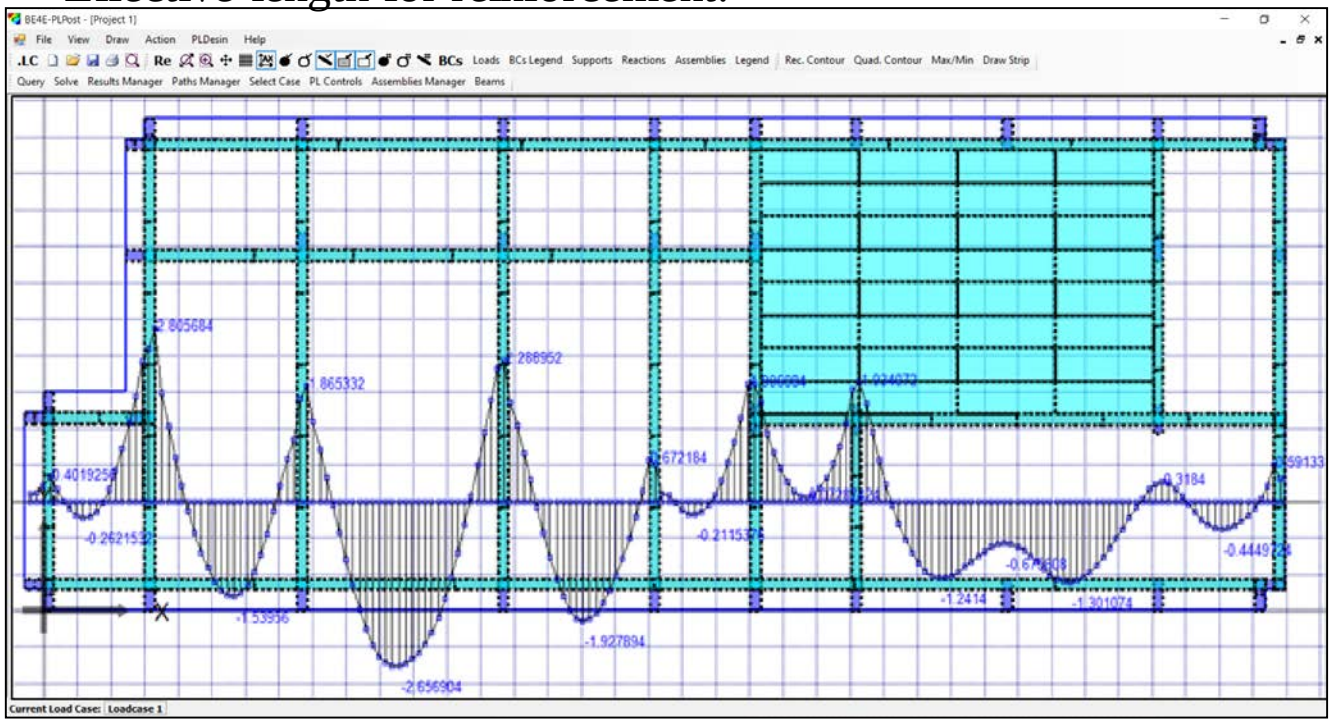
www.be4e.com

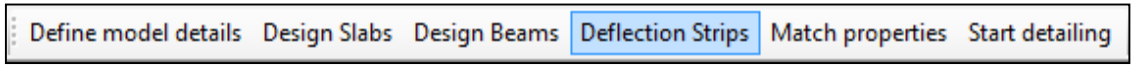
Cairo University

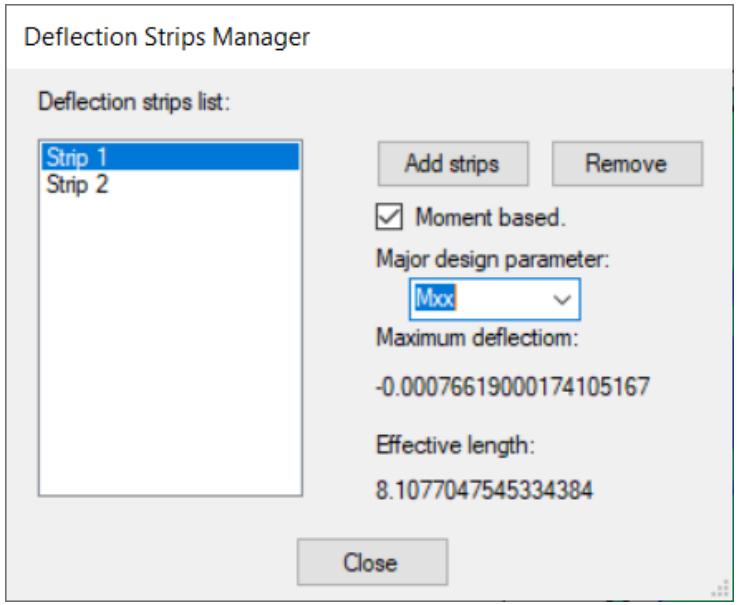
5 Check deflections of slab

- The user can check deflection only for striped slab either from PLDesign Directly or import PLPost results.
- Open Slab deflection strip manager then load the strips needed to be checked.
- Choose the Major design parameter to calculate both of Maximum deflection and Effective length for reinforcement.









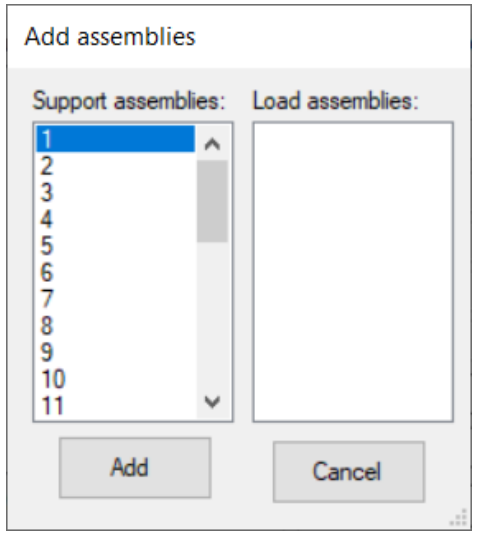
CUFE-BE

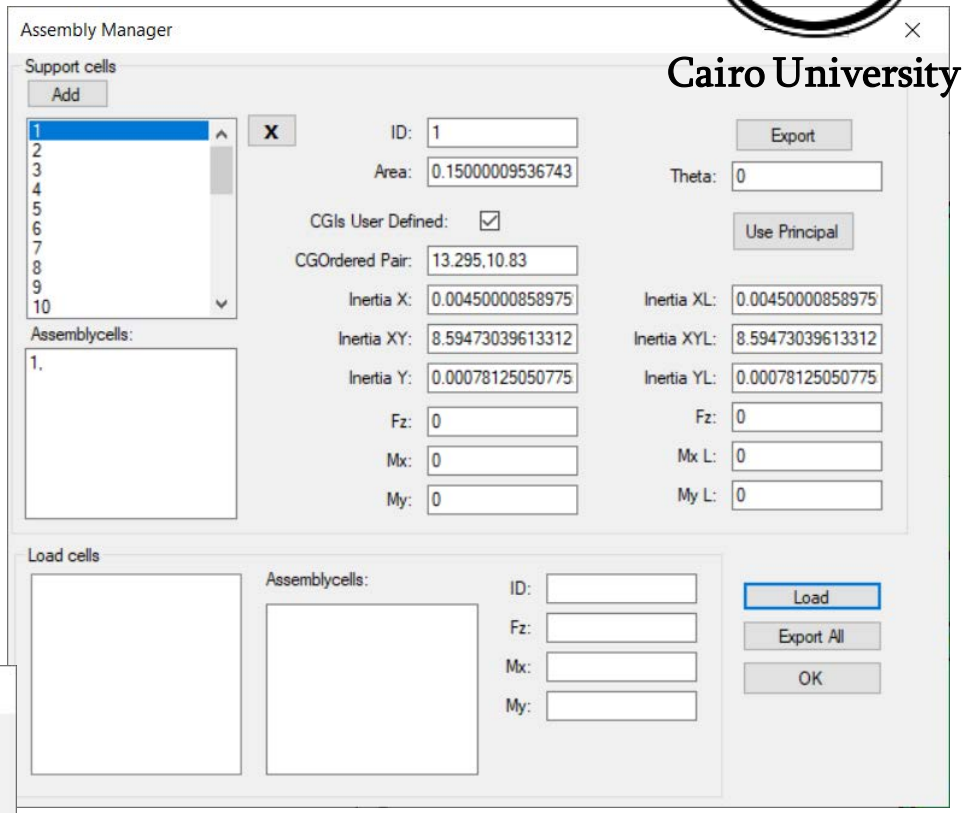
www.be4e.com

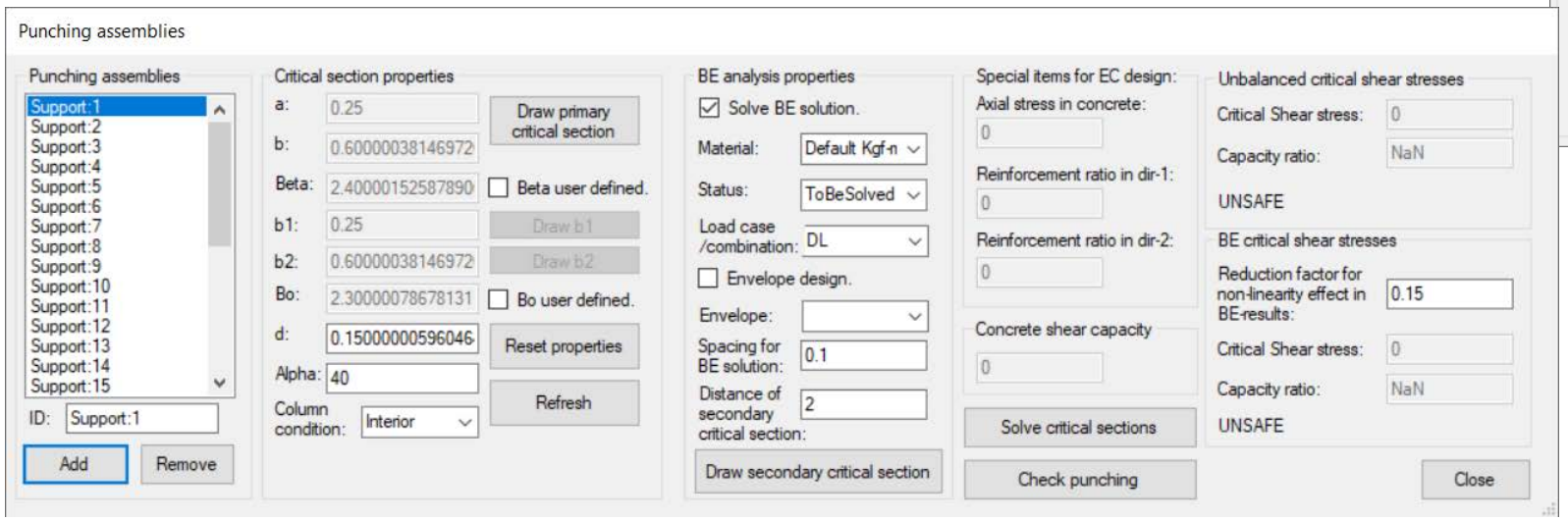
Cairo University

6 Check punching

- The user can check punching for column.
- Open assemblies manager and load .asm file.
- Add the required assemblies to be checked.
- Solve critical sections.
- Check punching.





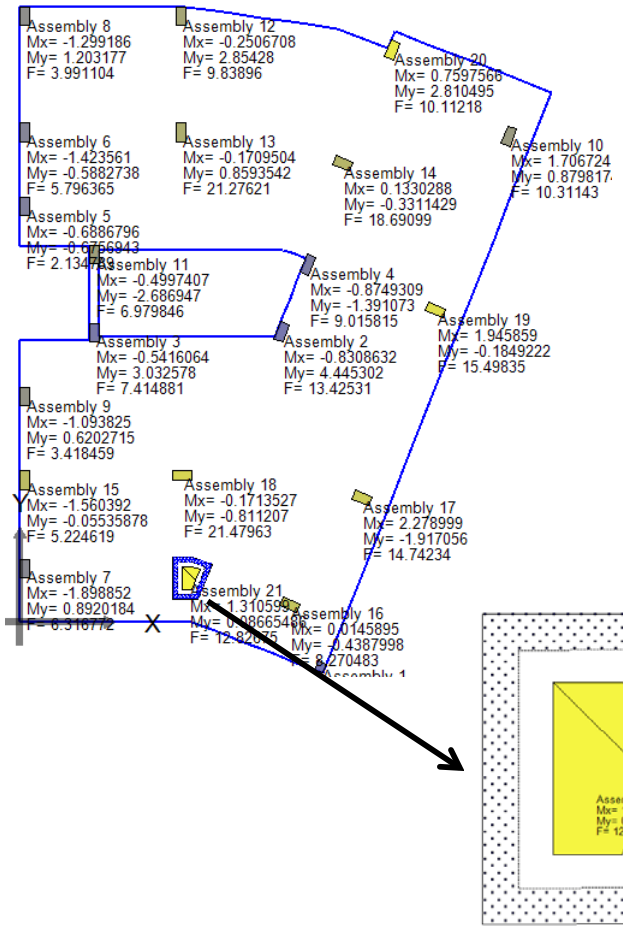


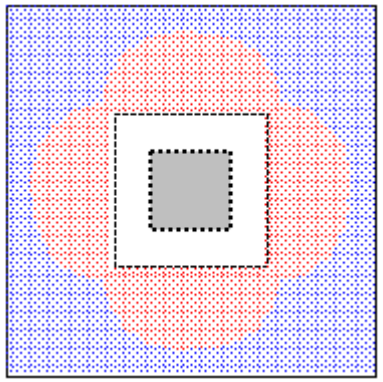
CUFE-BE

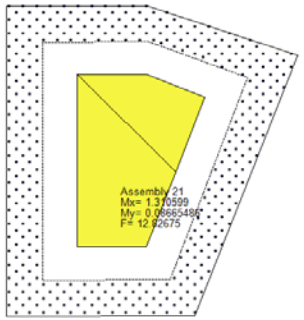
www.be4e.com

Cairo University

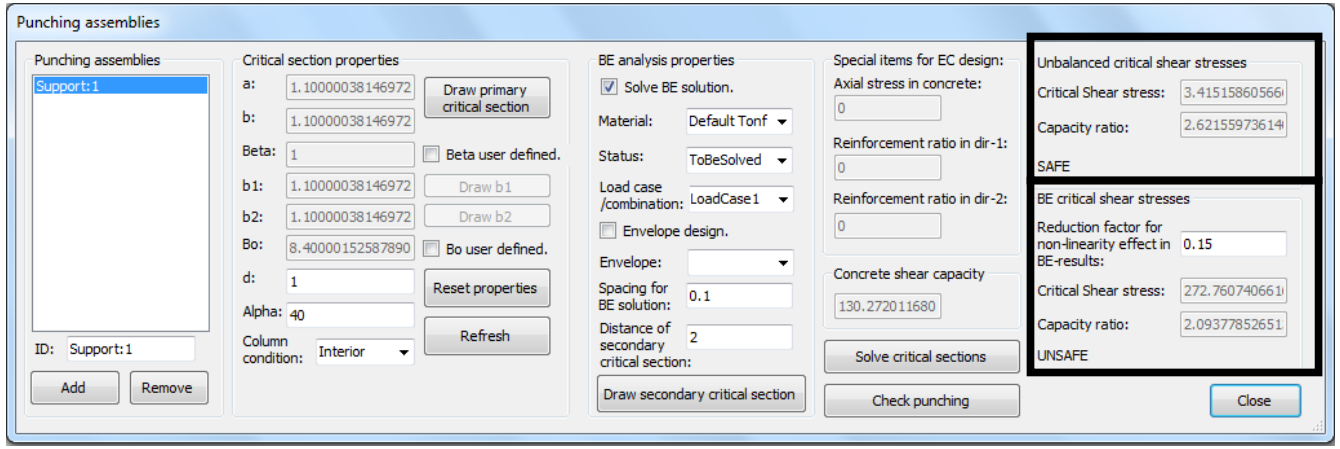
6 Check punching



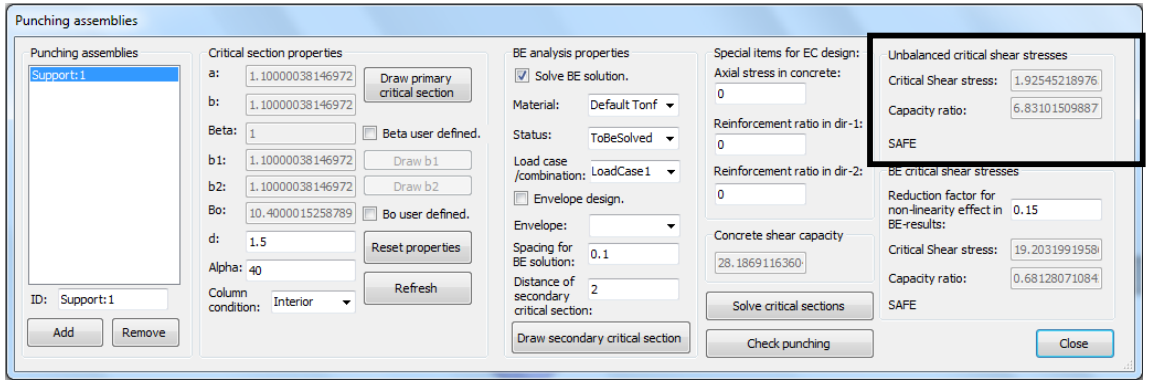


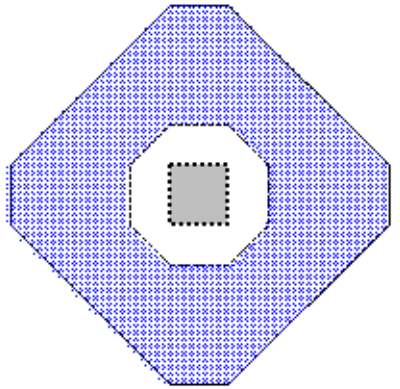


Punching Check According to ECP 2003 and ACI



Punching Check According to EC



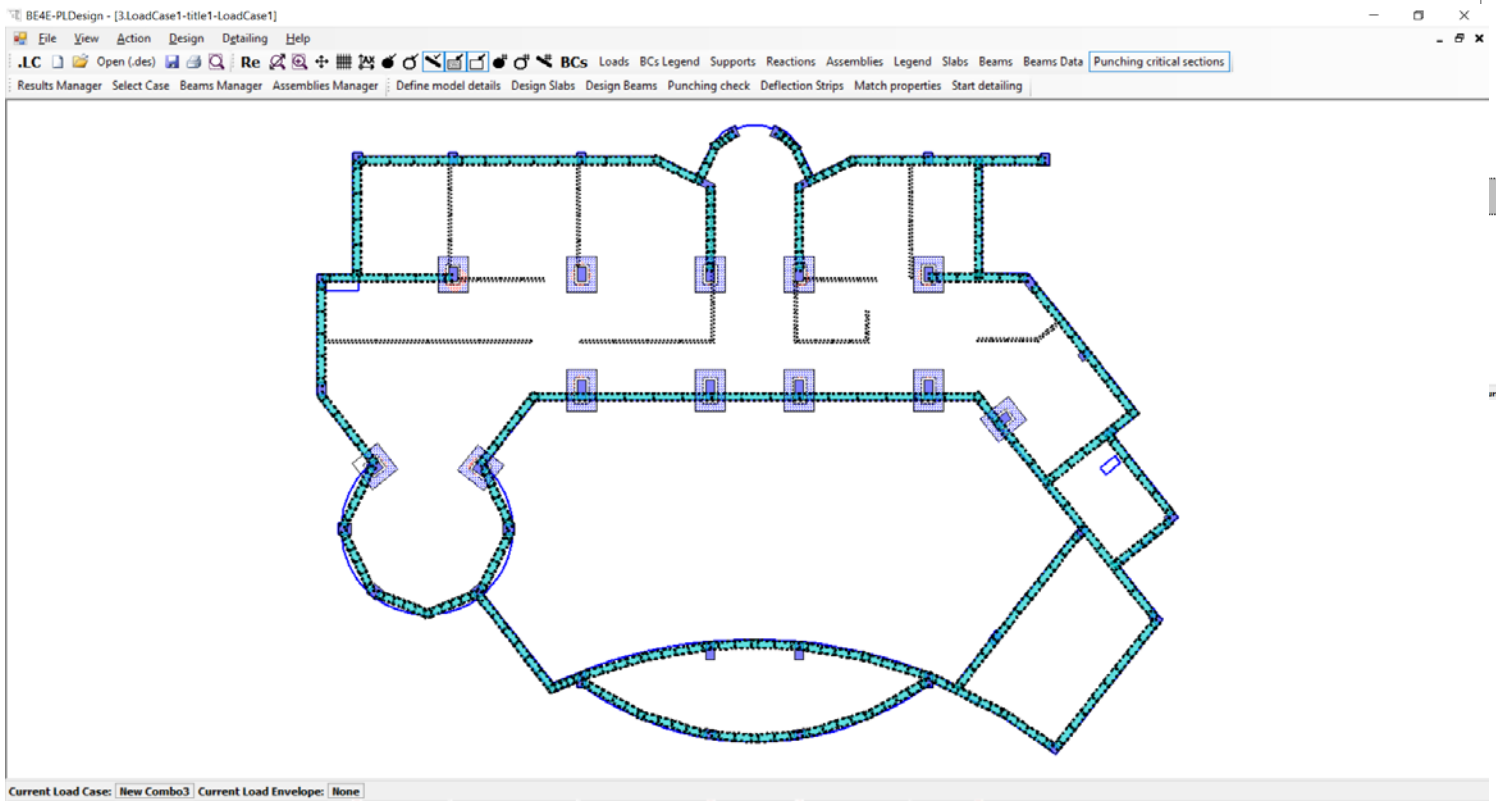


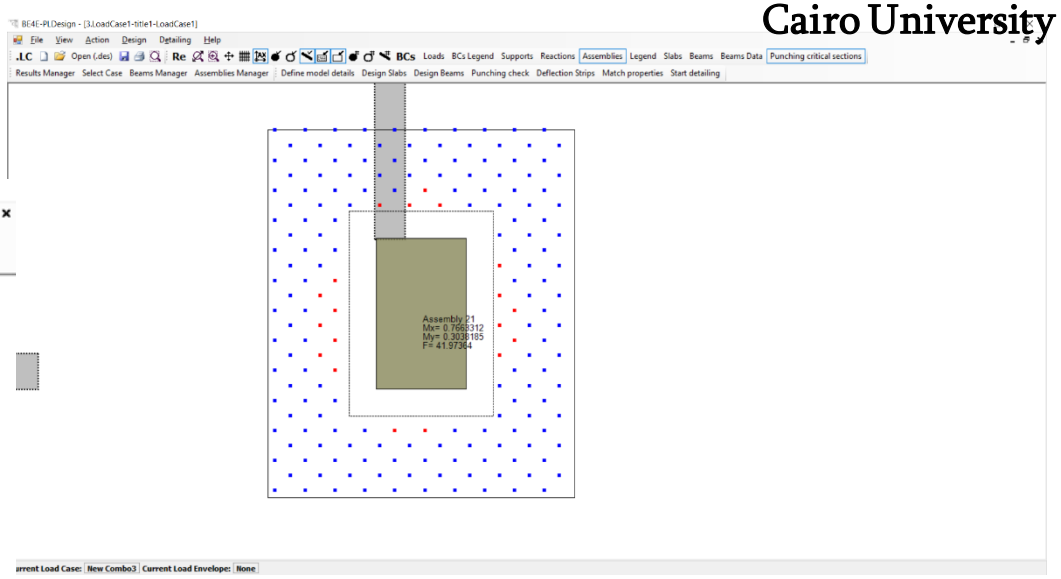
CUFE-BE

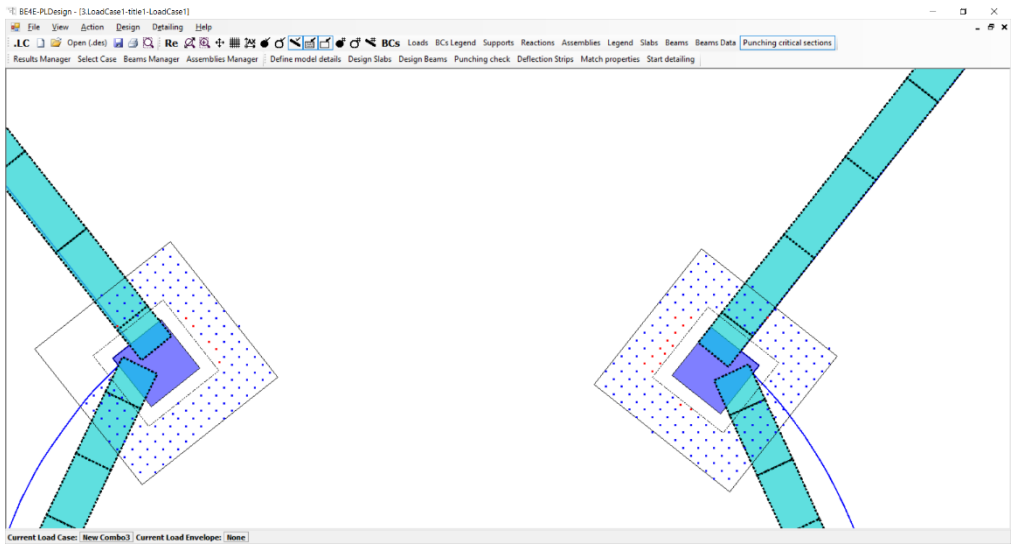
www.be4e.com

Cairo University

6 Check punching







CUFE-BE

www.be4e.com

Cairo University

PLDesign Package

2.1. File needed to be exported before using PLDesign

2.2. Starting PLDesign

2.3. Load combinations & load envelopes

2.4. Slab design

2.4.1. Design from PLPost results (strip design)

2.4.2. Design from PLPost results (contour design)

2.4.3. Design from PLDesign directly (strip based region)

2.4.4 Design from PLDesign directly (basic and additional reinforcement)

2.5 Check deflections of slab

2.6 Check punching

2.7 Beam design

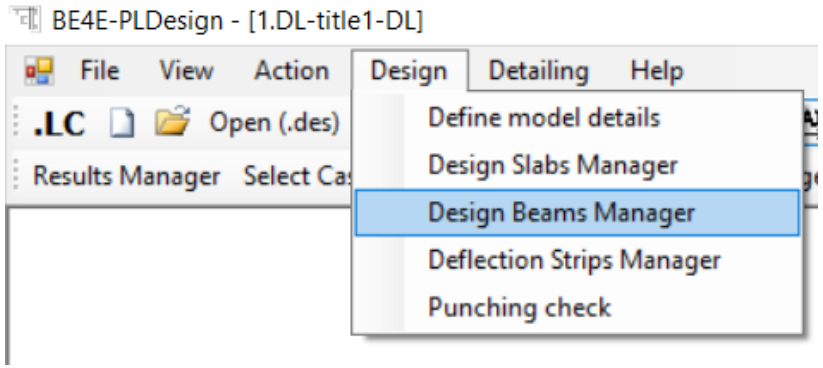
CUFE-BE

www.be4e.com

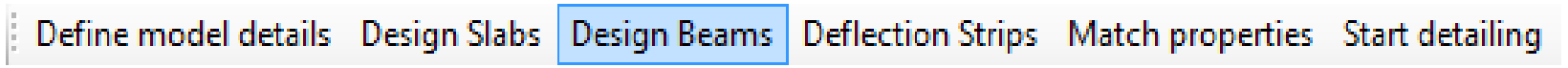
Cairo University

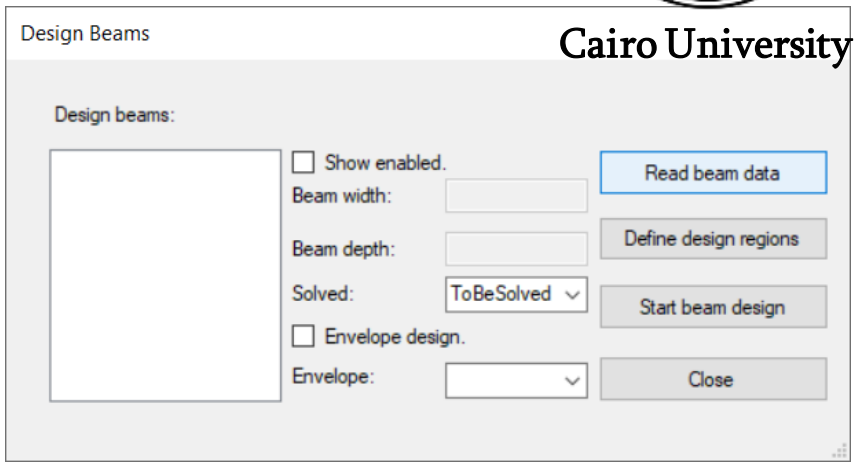
7 Beam design

- In PLDesign the user can design or check design on beam reinforcement.
- But the user should export beam assemblies from Gen file to read beam geometry.
- Open PLDesign Manager then load beam data (.basm) to read beams geometry.
- Now the user should define the design regions in beams.

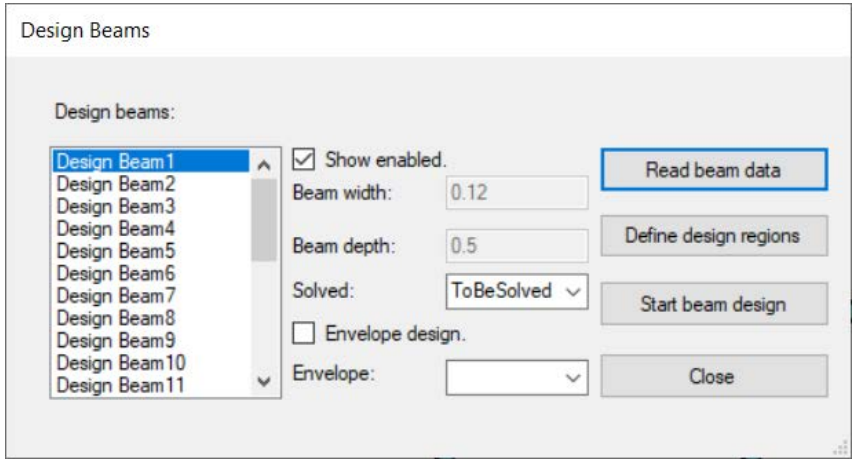


OR





Before loading beam assembly file.



After loading beam assembly file.

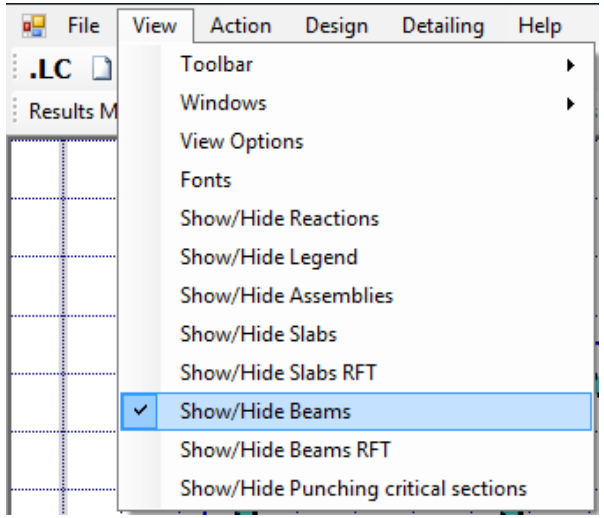
CUFE-BE

www.be4e.com

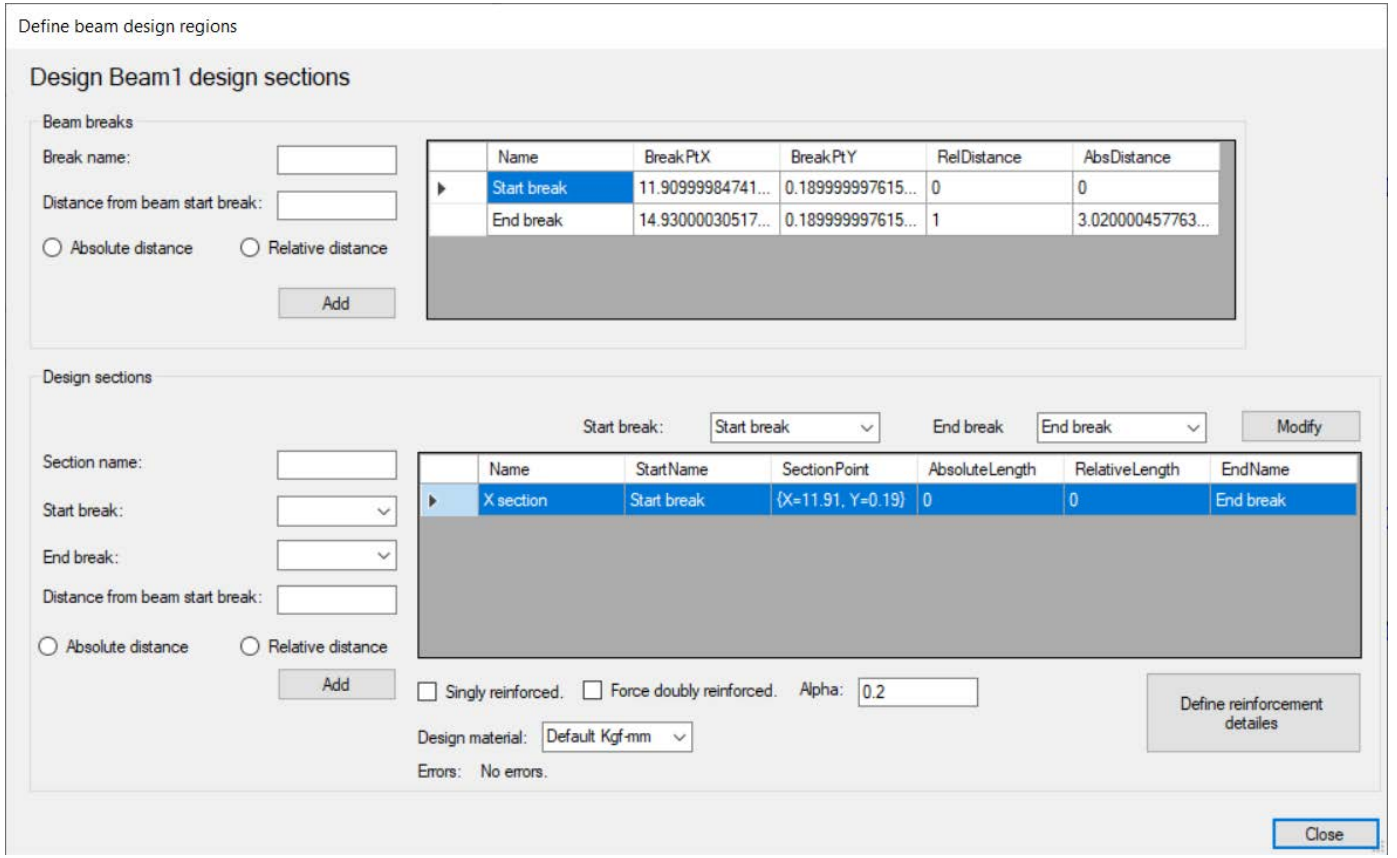
Cairo University

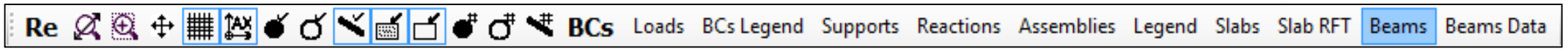
7 Beam design

- Open Define design region to show the design beam section.
- The user will notice that the design beam is divided into two parts, the first part is for the beam breaks (supports) and the other is for beam sections.
- Where is the beam that the user design?



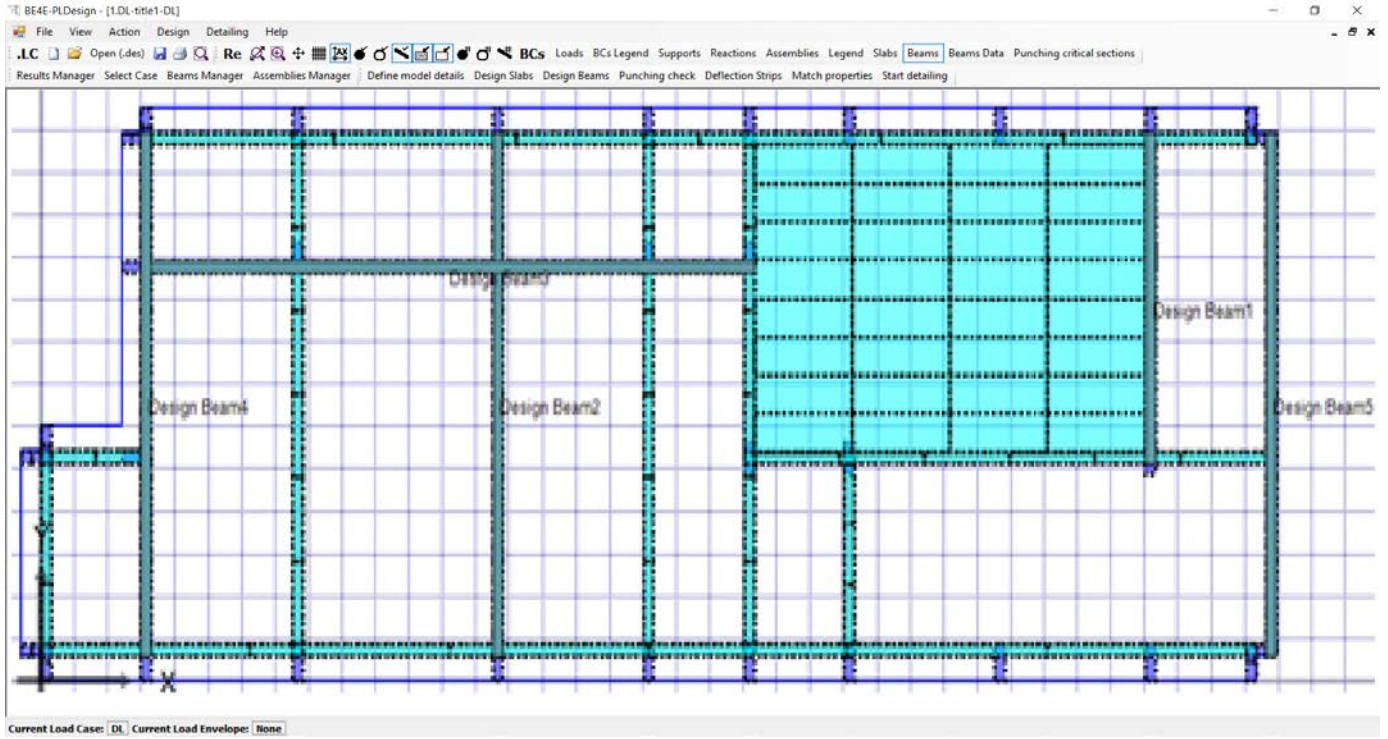
OR





7 Beam design

- Show/hide beams allow the user to see the beam to determine the section he needs.
- Every beam contain mark box (Show enabled), the default is all beams are enabled, but the user can open or close any beam he want.
- Once the user know the location of beams need for design, he could determine the sections and breaks.



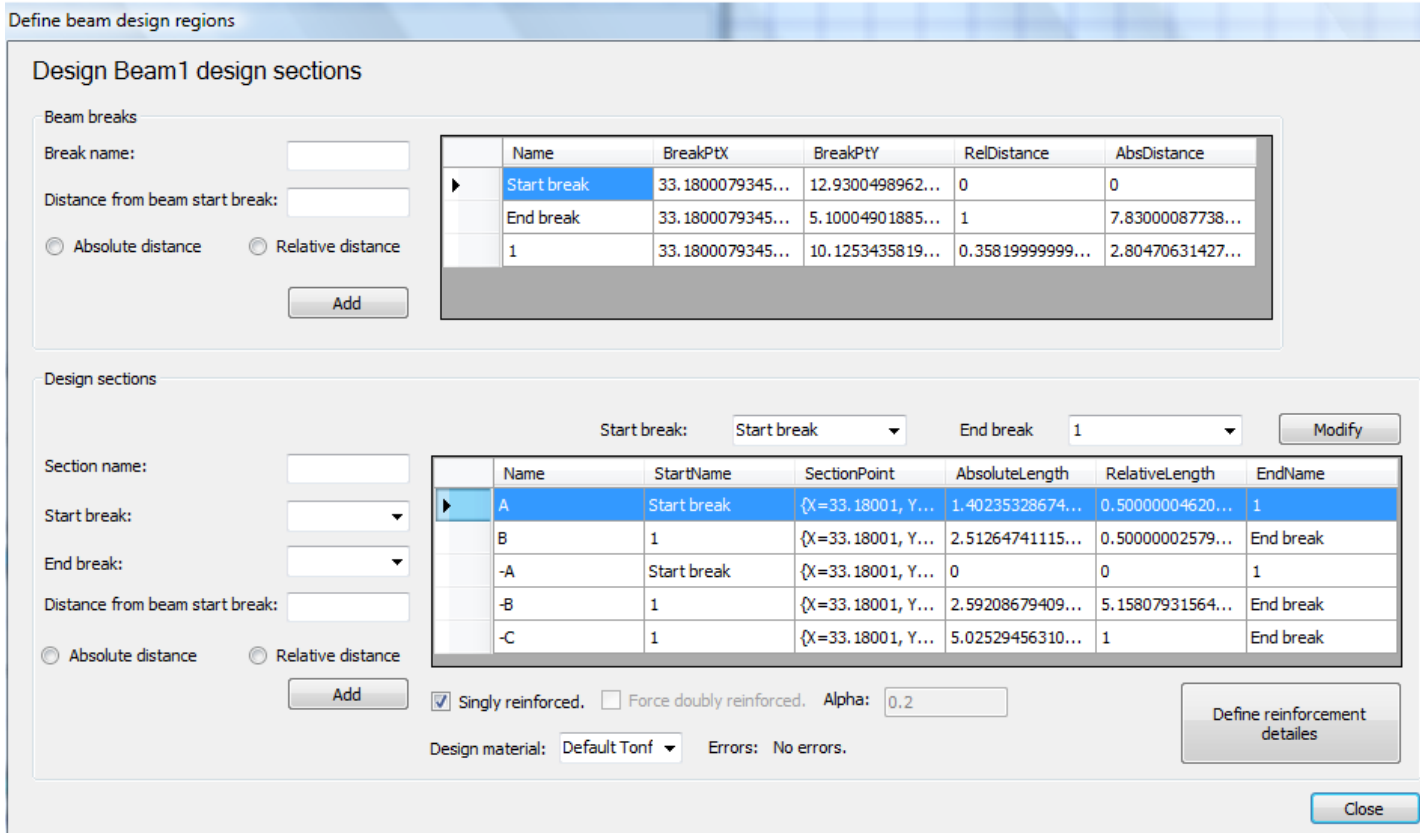
CUFE-BE

www.be4e.com

Cairo University

7 Beam design

- The user should connect between the AutoCAD drawing & the PLDesign to put the section accurately.
- In beam 1 contain 3 supports so the user should put section break and five sections (Two sections +ve and three sections –ve).



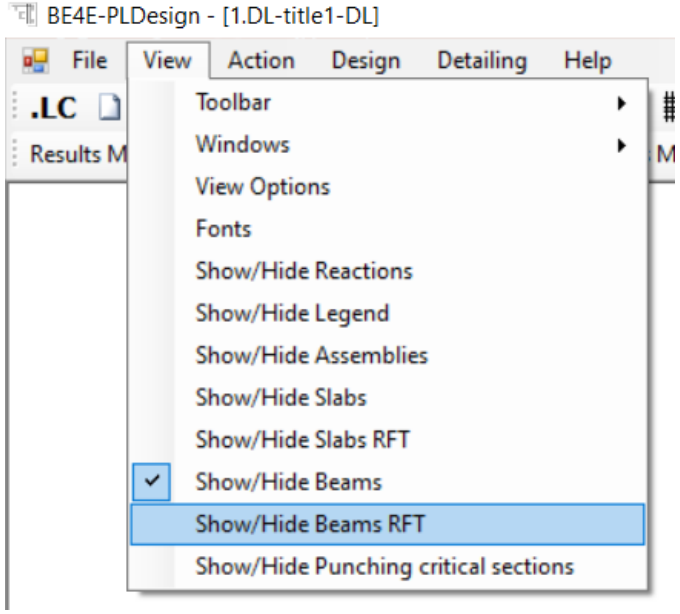
CUFE-BE

www.be4e.com

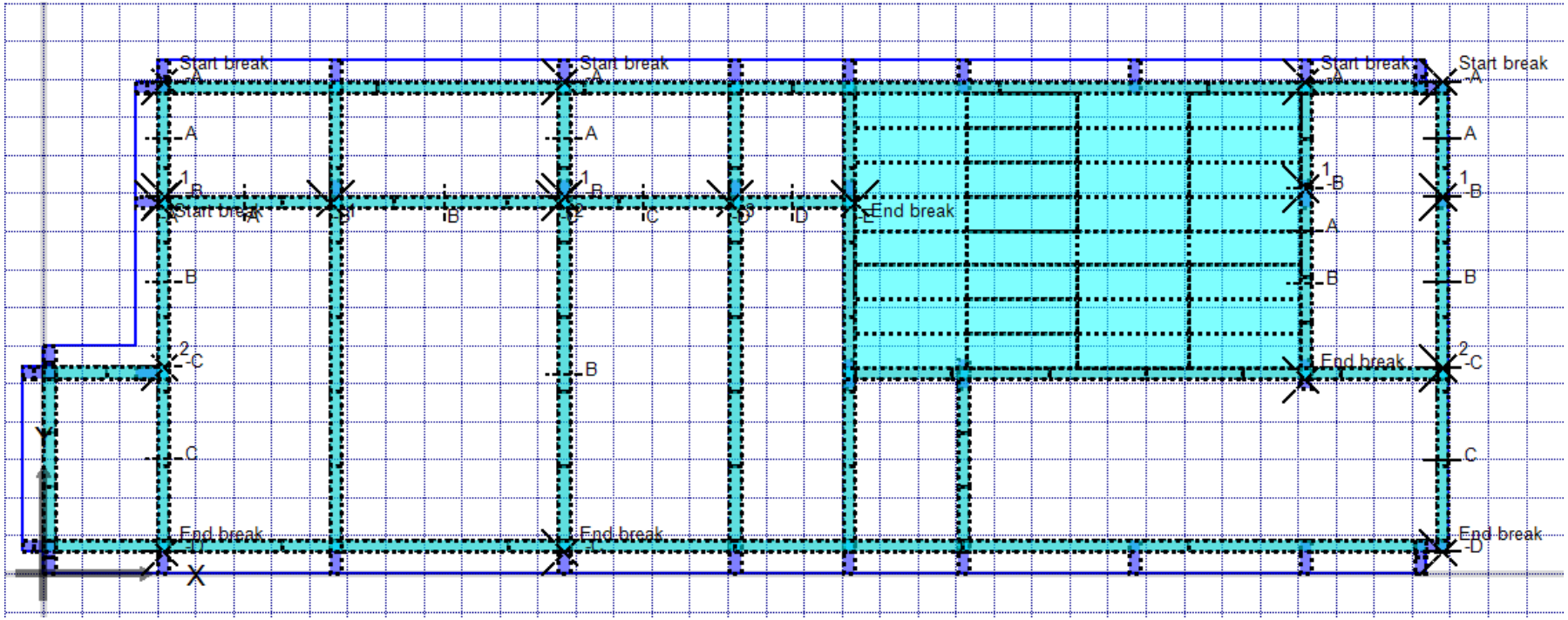
Cairo University

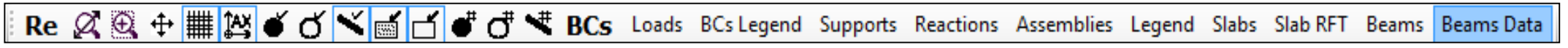
7 Beam design

- The user can check the location of sections that he constructed.



OR





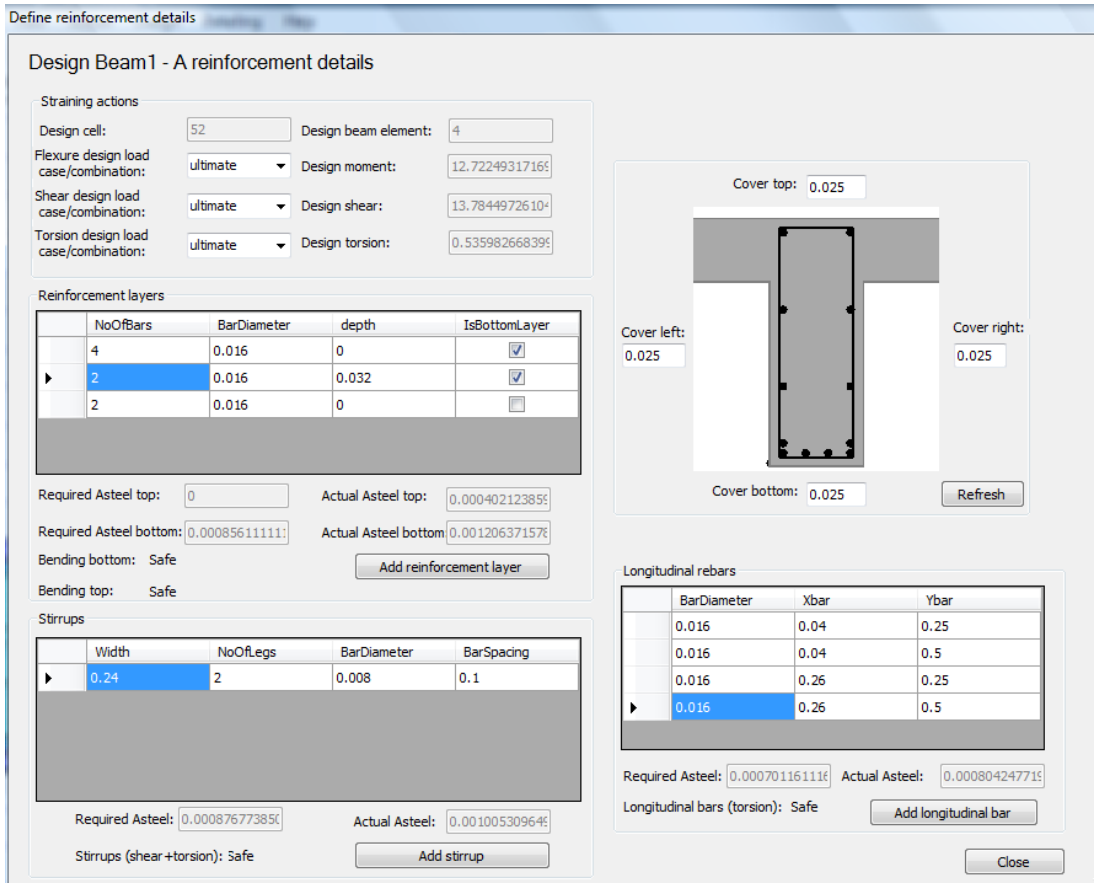
CUFE-BE

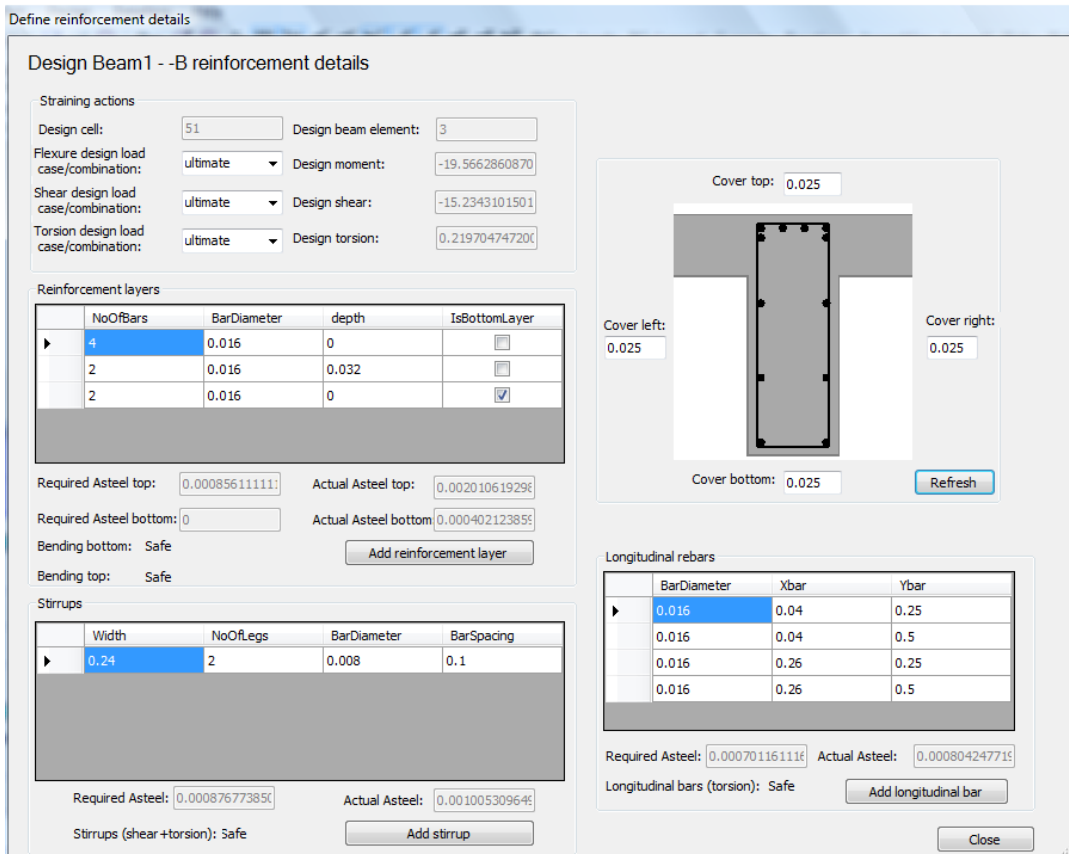
www.be4e.com

Cairo University

7 Beam design

- Open Define reinforcement details for +ve section and another for –ve section.





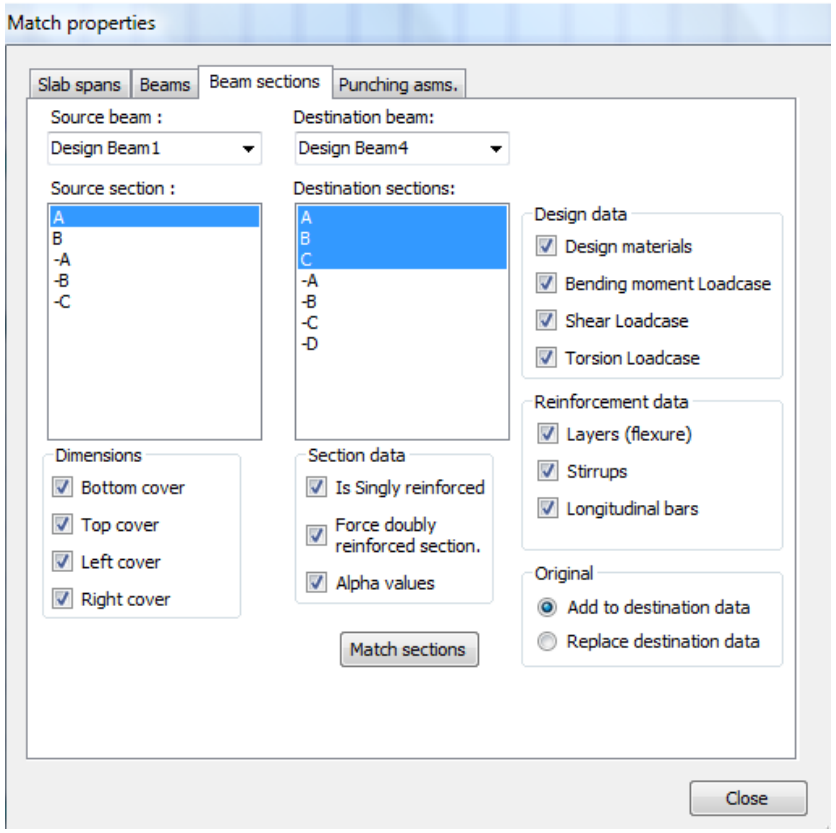
CUFE-BE

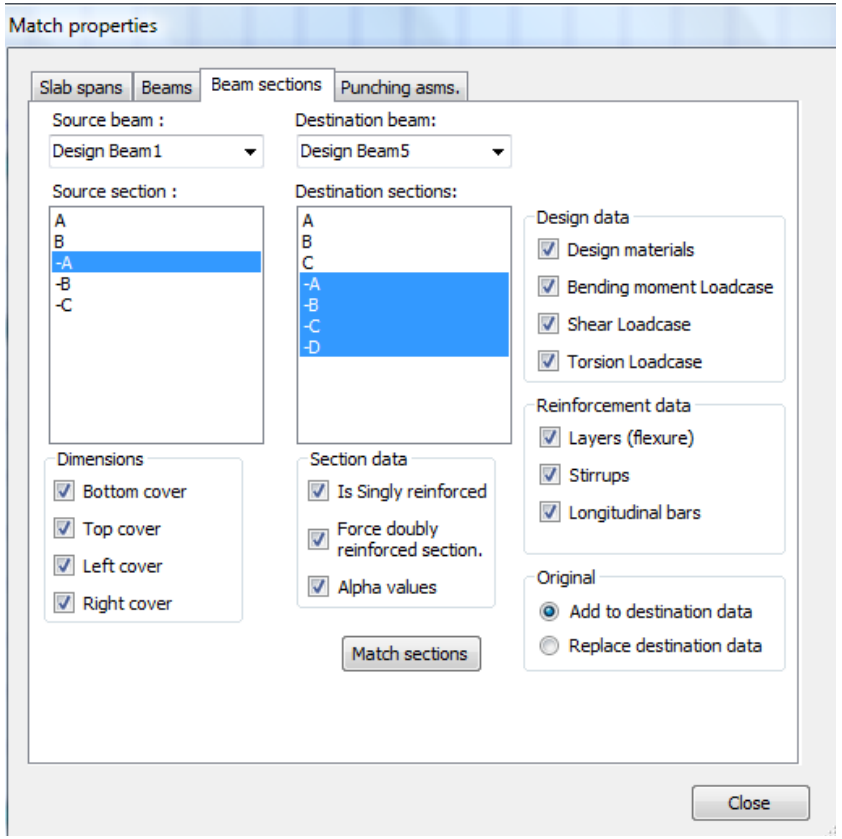
www.be4e.com

Cairo University

7 Beam design

- Match the reinforcement properties for all +ve/-ve sections.
- Check that the sections have been matched it’s properties.





CUFE-BE

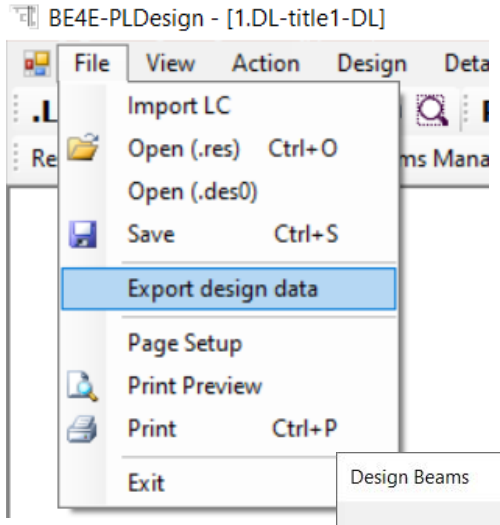
www.be4e.com

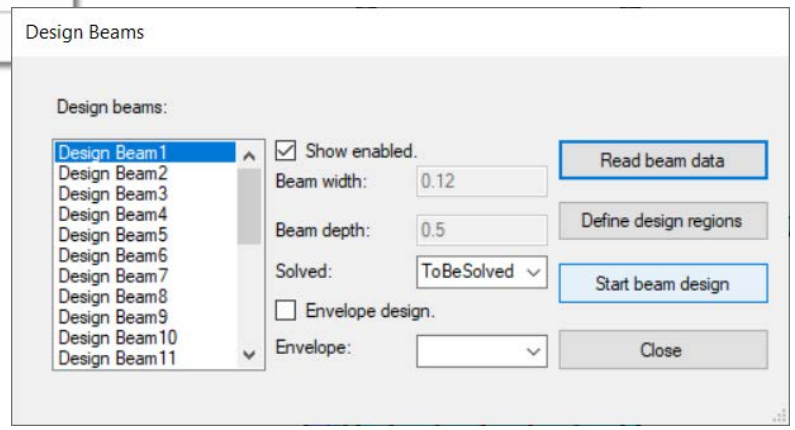
Cairo University

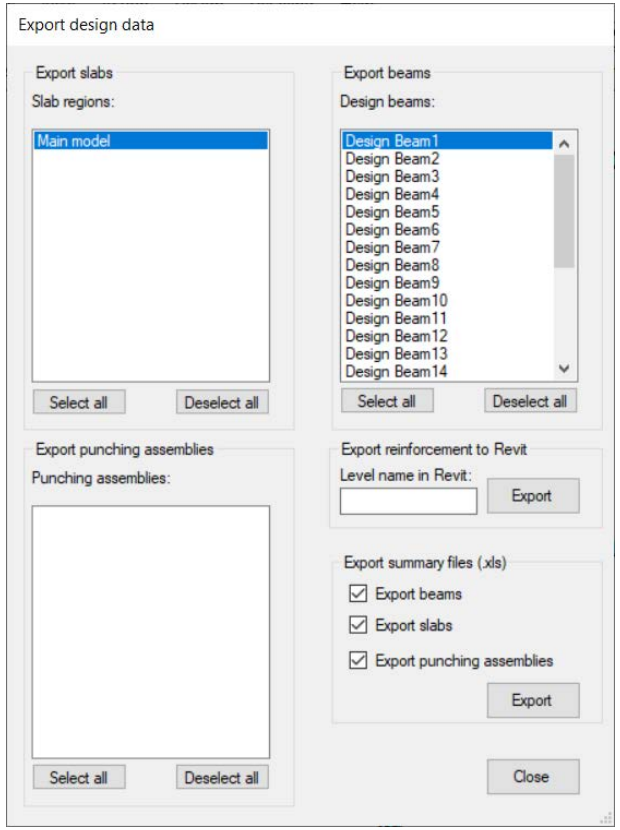
PLDESIGN : Beam reinforcement sheet

7 Beam design

- Start beam design then check the reinforcement that the user insert.







Company Name:
Project Name:
Designed By:
Reviewed By:
Approved by:

Beam name	Beam size	Beam section	Flexure reinforcement	Stirrups	Longitudinal steel
Design Beam1	0.3 X 0.8	A	Top (2 Φ 0.016) Bot (4 Φ 0.0162 Φ 0.016)	2L Φ 0.008 @ 0.1	Φ 0.016 @ (0.04,0.25) Φ 0.016 @ (0.04,0.5) Φ 0.016 @ (0.26,0.25) Φ 0.016 @ (0.26,0.5)
		B	Top () Bot ()		
		-A	Top () Bot (4 Φ 0.016)	0L Φ 0 @ 0	Φ 0 @ (0,0)
		-B	Top (4 Φ 0.0162 Φ 0.016) Bot (2 Φ 0.016)	2L Φ 0.008 @ 0.1	Φ 0.016 @ (0.04,0.25) Φ 0.016 @ (0.04,0.5) Φ 0.016 @ (0.26,0.25) Φ 0.016 @ (0.26,0.5)

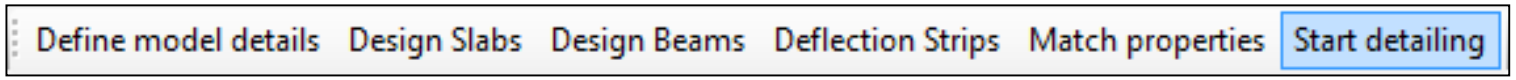
CUFE-BE

www.be4e.com

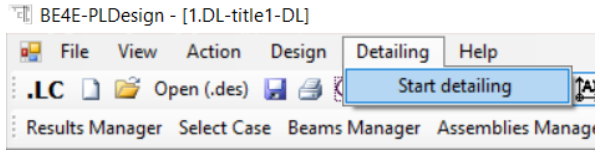
Cairo University

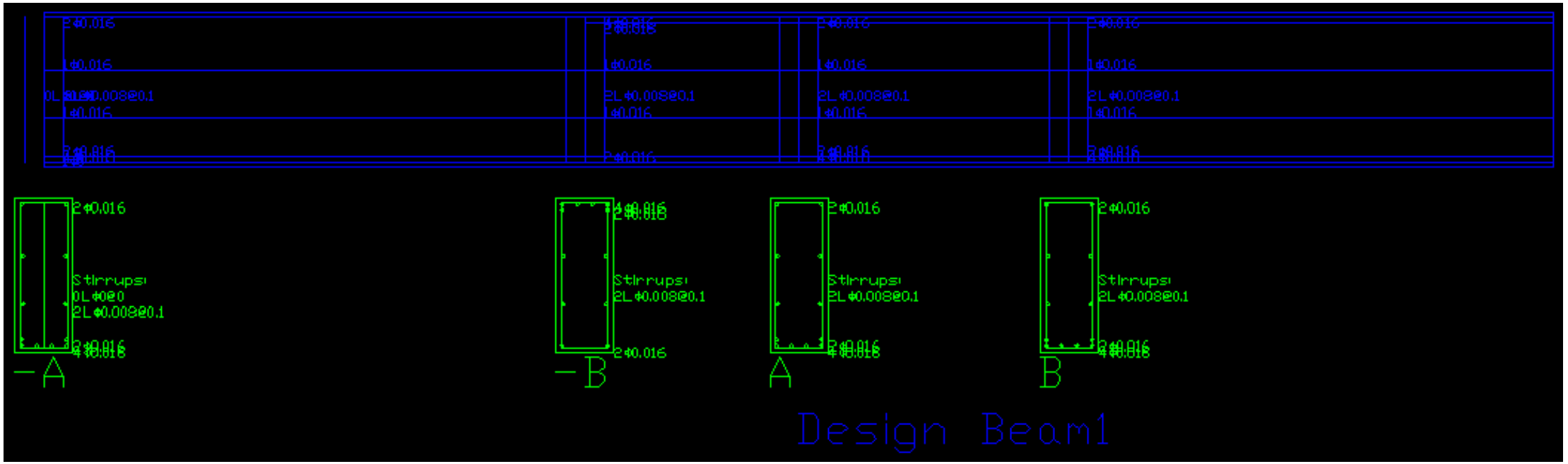
7 Beam design

- Now the user are going to Start detailing for the beams.
- This detailing shows the beam reinforcement and the reinforcement of the sections.



OR





CUFE-BE

www.be4e.com

Cairo University

PLDesign Package

2.1. File needed to be exported before using PLDesign

2.2. Starting PLDesign

2.3. Load combinations & load envelopes

2.4. Slab design

2.4.1. Design from PLPost results (strip design)

2.4.2. Design from PLPost results (contour design)

2.4.3. Design from PLDesign directly (strip based region)

2.4.4 Design from PLDesign directly (basic and additional reinforcement)

2.5 Check deflections of slab

2.6 Check punching

2.7 Beam design

CUFE-BE

www.be4e.com

Cairo University

A. PLGen – Model generator

B. PLView – Numerical model

C. PLCoreMan – Manager and solver

D. PLPost – Post processing

E. PLDesign – Design tool

F. PLPAK modelling capabilities

F. PLPAK modelling capabilities

- Structural members in the PLPAK are entered with their exact dimensions (geometry) e.g. columns and beams are no longer entered as nodes or lines, but represented with their actual proportions thus no peaking occurs on slab region contour results.
- Easy input in forms of:

  - Multiple exporting from DXF to the virtual model in the PLGen, makes life easy for engineers to account for any modification in design. This is done without re-meshing or re-building the numerical model.

  - Multiple level of "undo" in the PLPAK preprocessor.
- Capable of modeling fine details such as small duct openings.
- The PLPAK models beams with it's actual interaction area to the slab which make it unique in case of modeling slab with irregular beams supported not on the full beam width.

F. PLPAK modelling capabilities

- Easy drawing capabilities of the PLPAK.
- The soil springs in soil models are considered as continuous spring patches underneath the continuum foundation plate.
- Exporting and importing model as text files.
- Real time post-processing.
- Strip results and exporting it to excel.
- Post-processing for certain part of the slab in huge practical problems.
- Direct assemblies reactions (walls / Cores).
- Real and easy assigning of assembly loads (walls / Cores).
- Save and restore the results in PLPost.

CUFE-BE

www.be4e.com

Cairo University

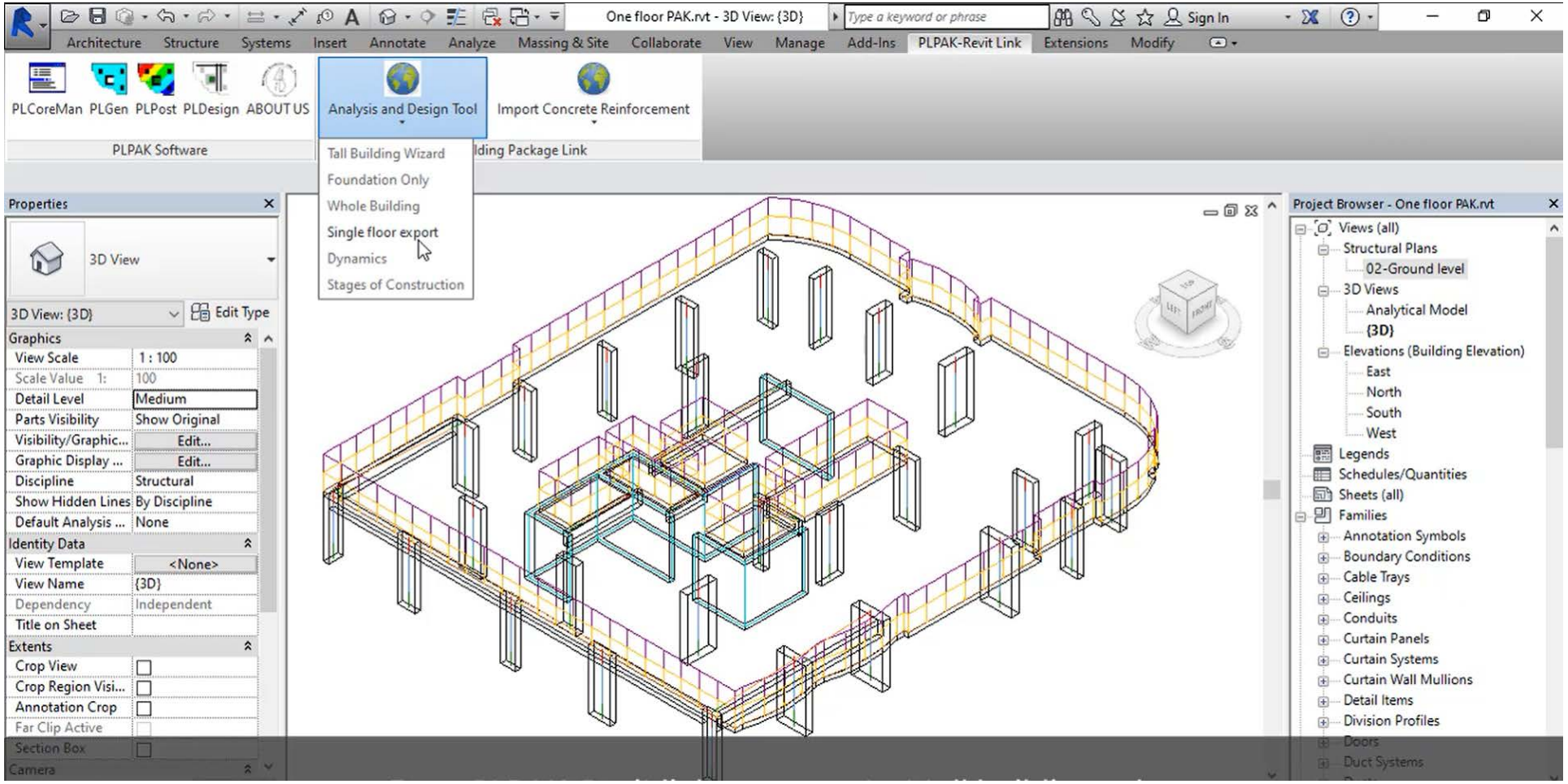
Table of contents

CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

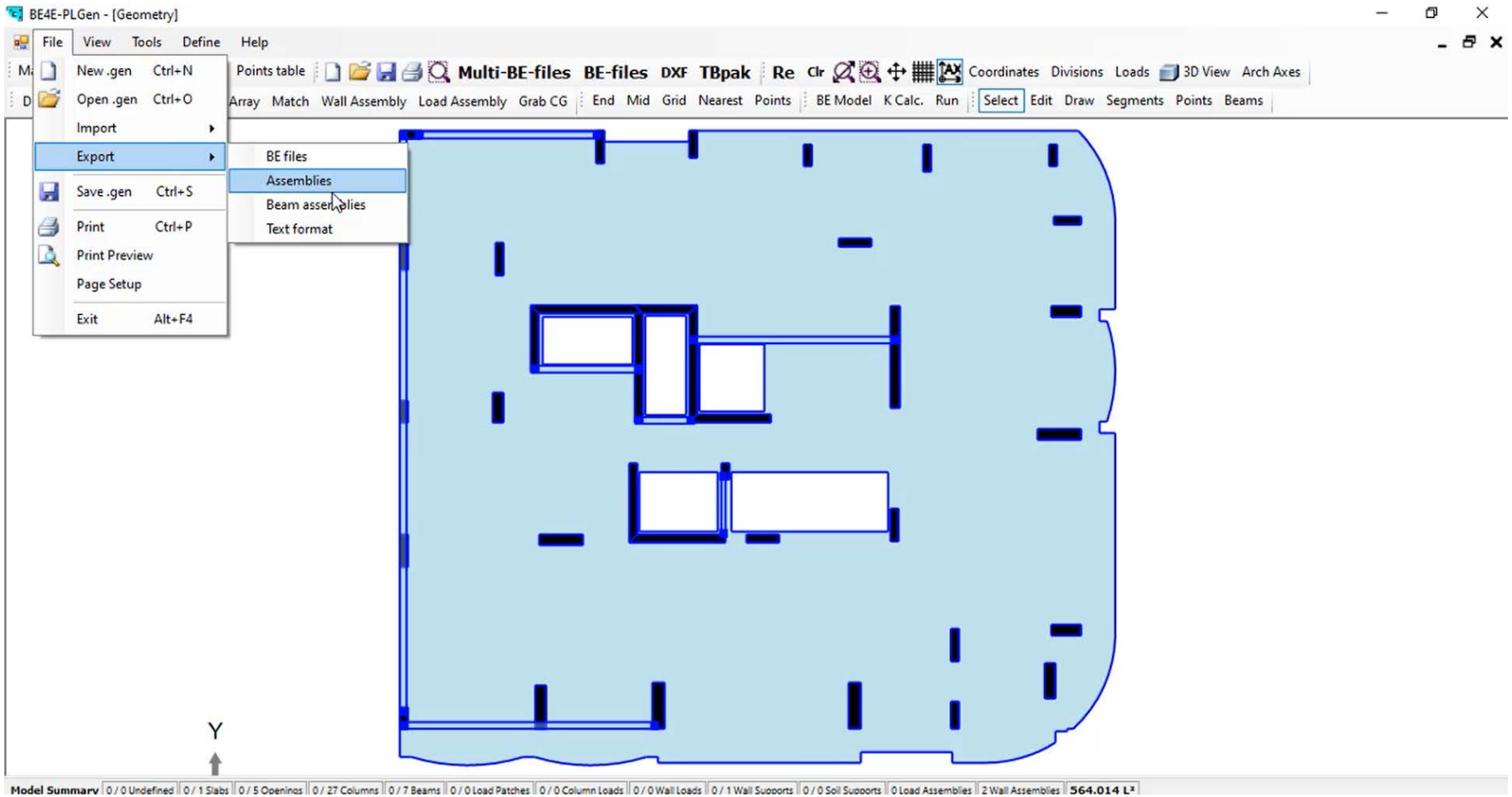


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

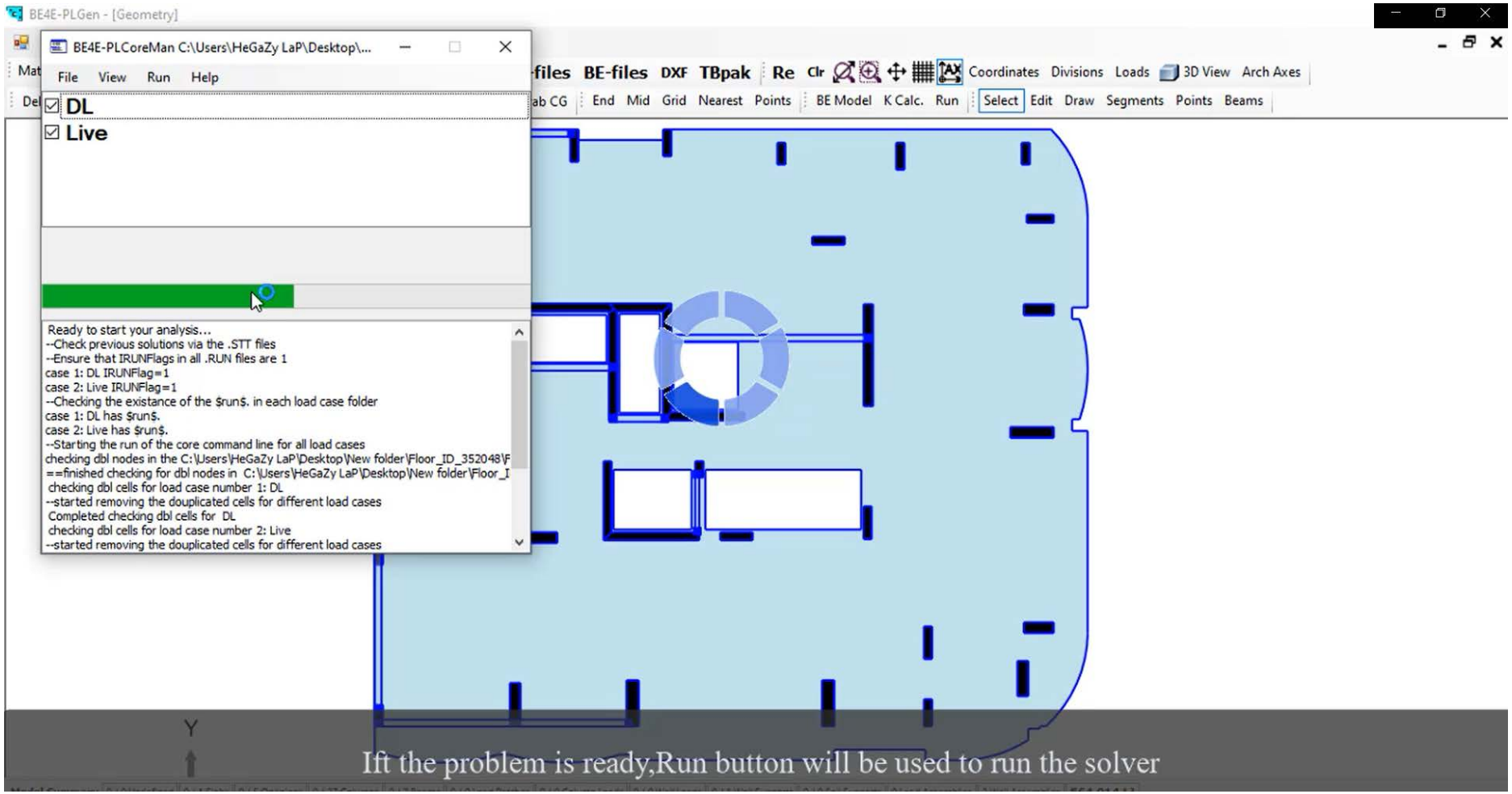


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

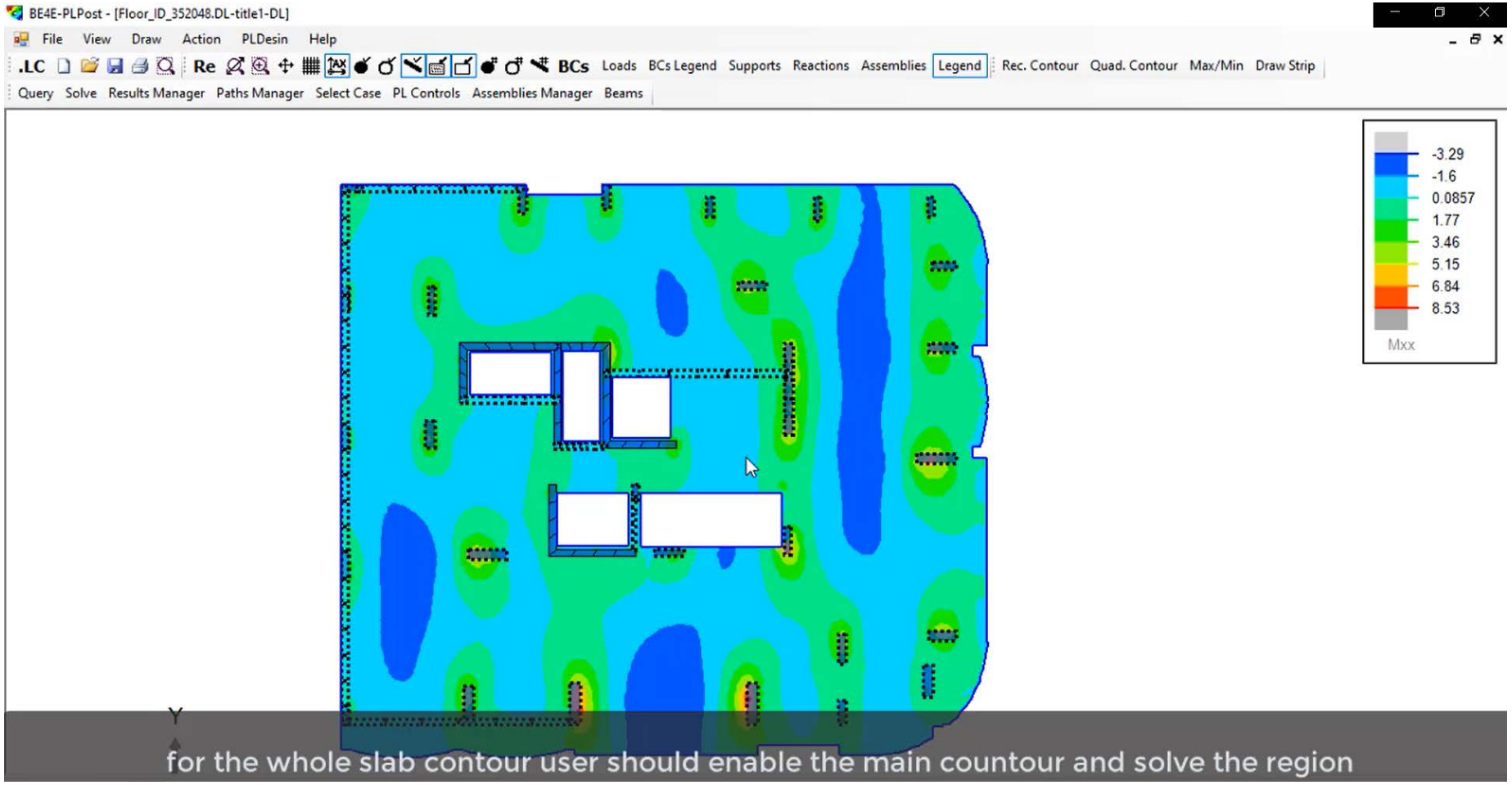


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

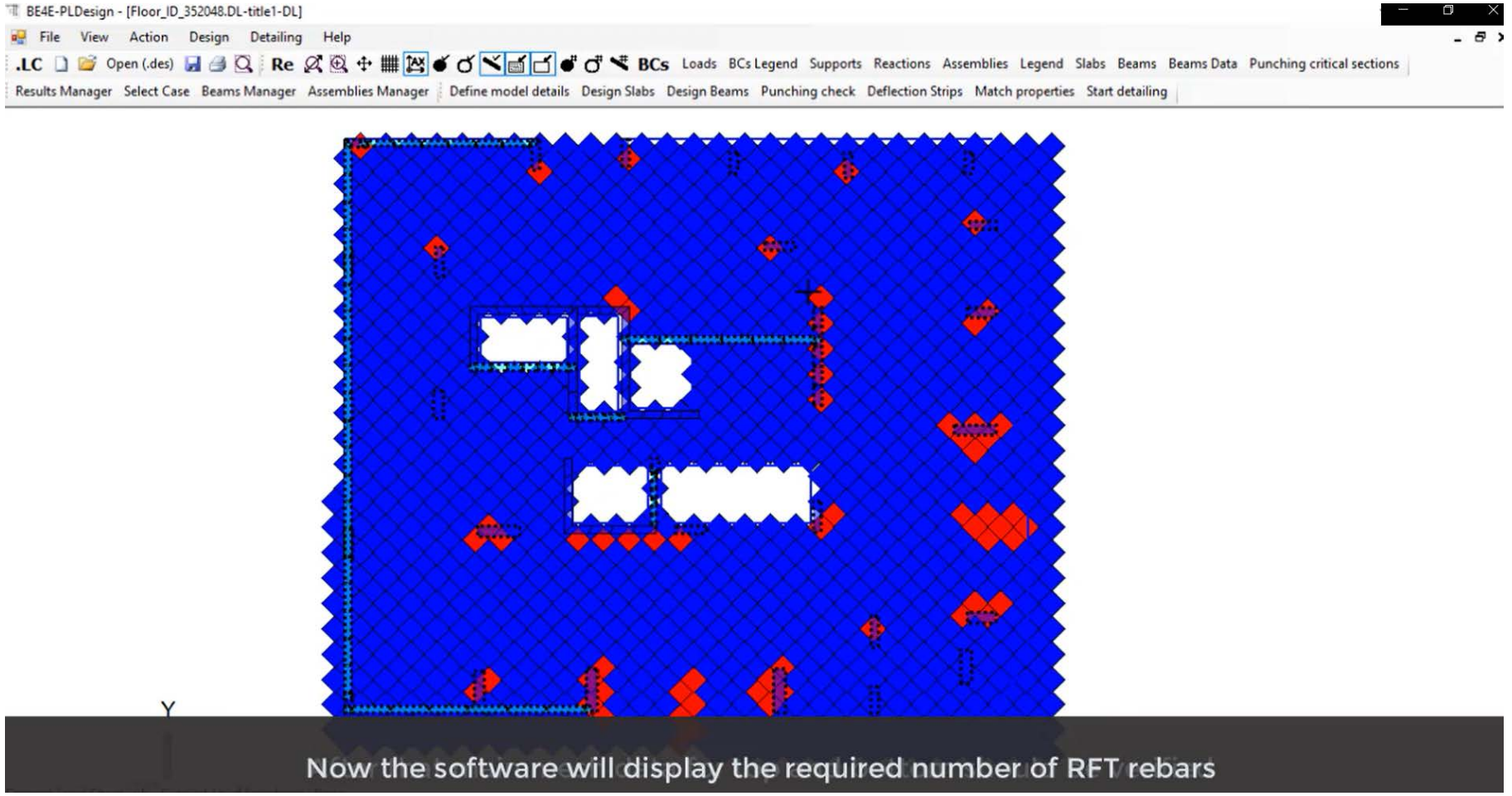


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

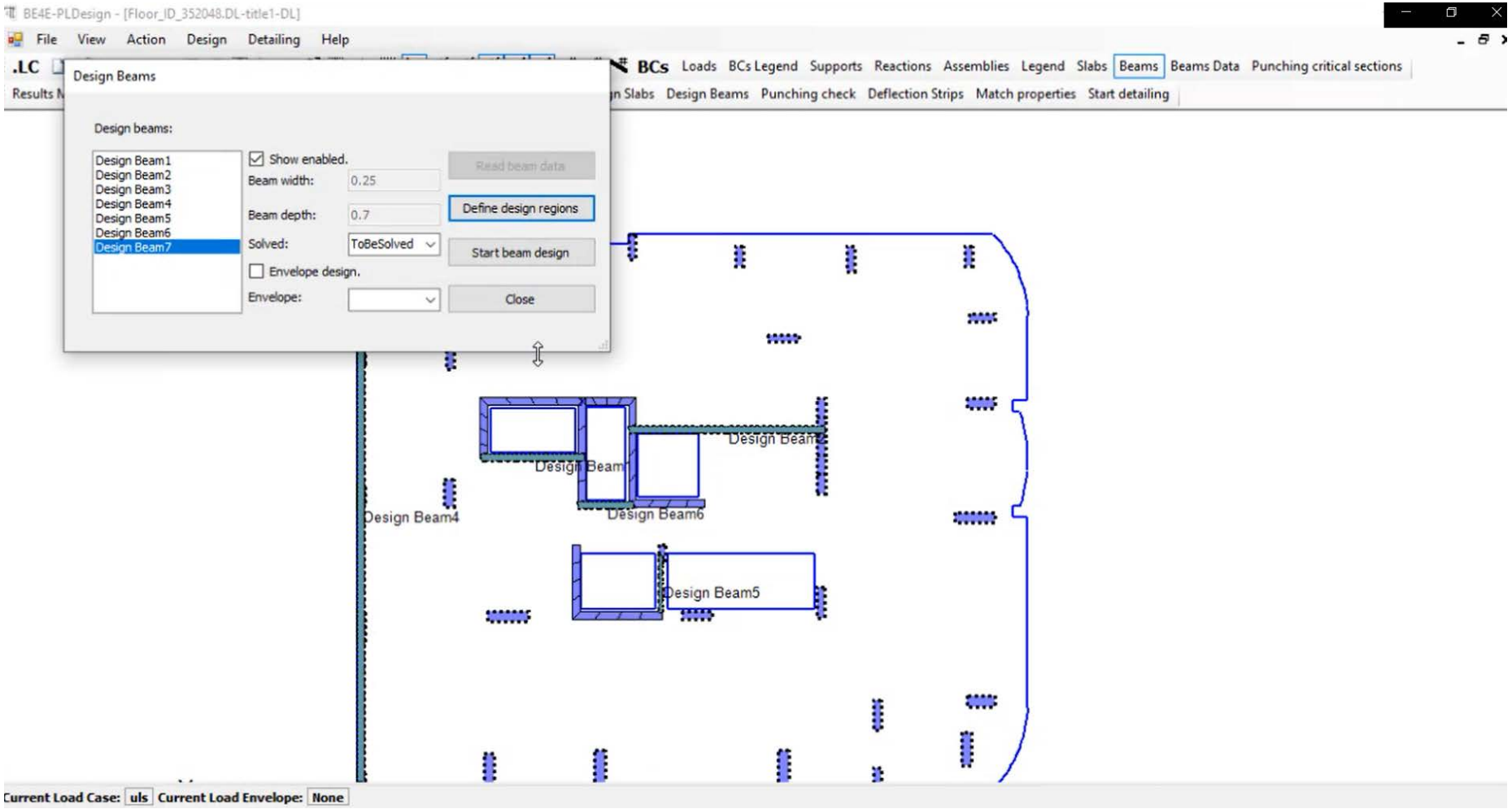


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

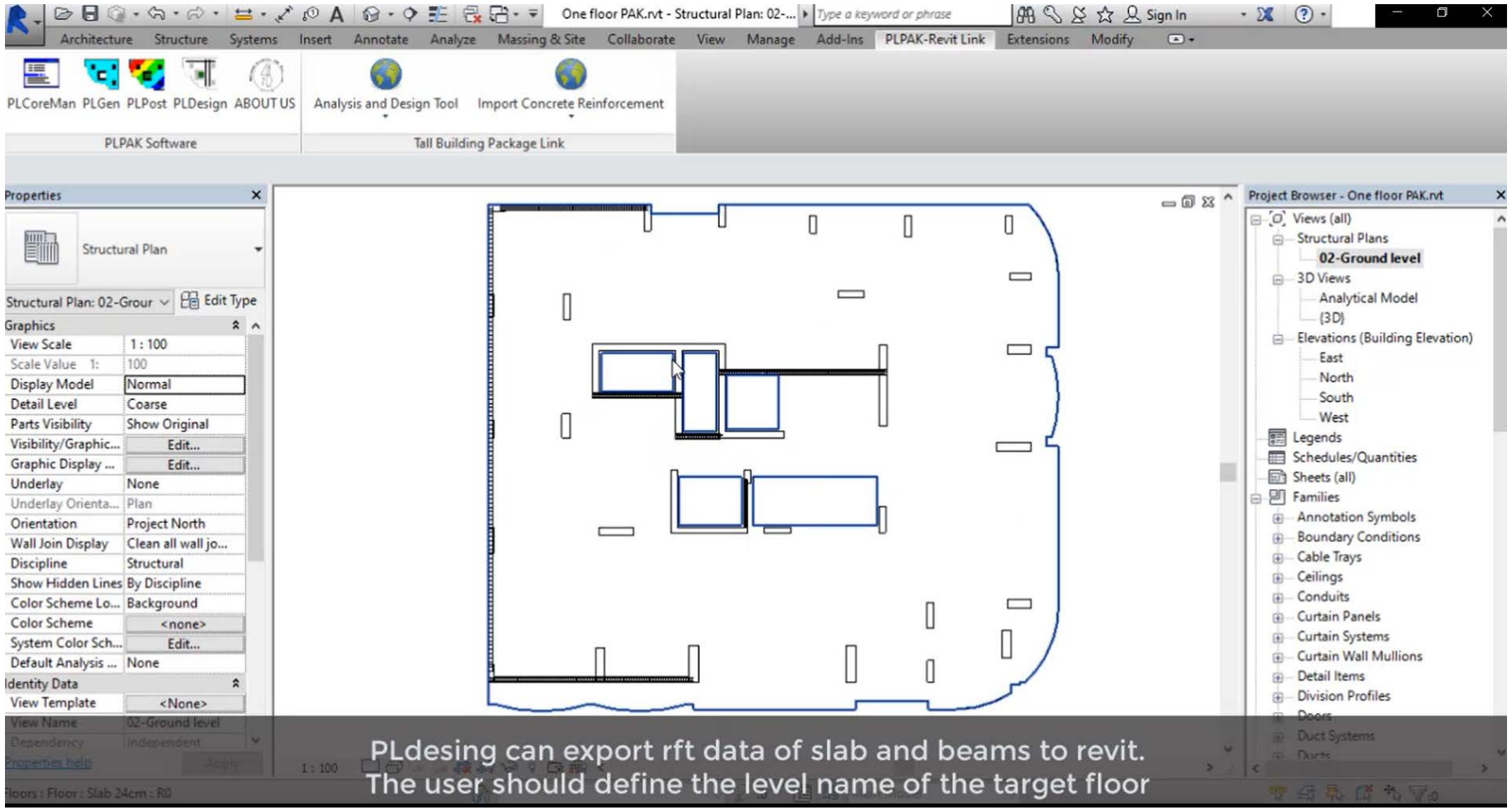


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)

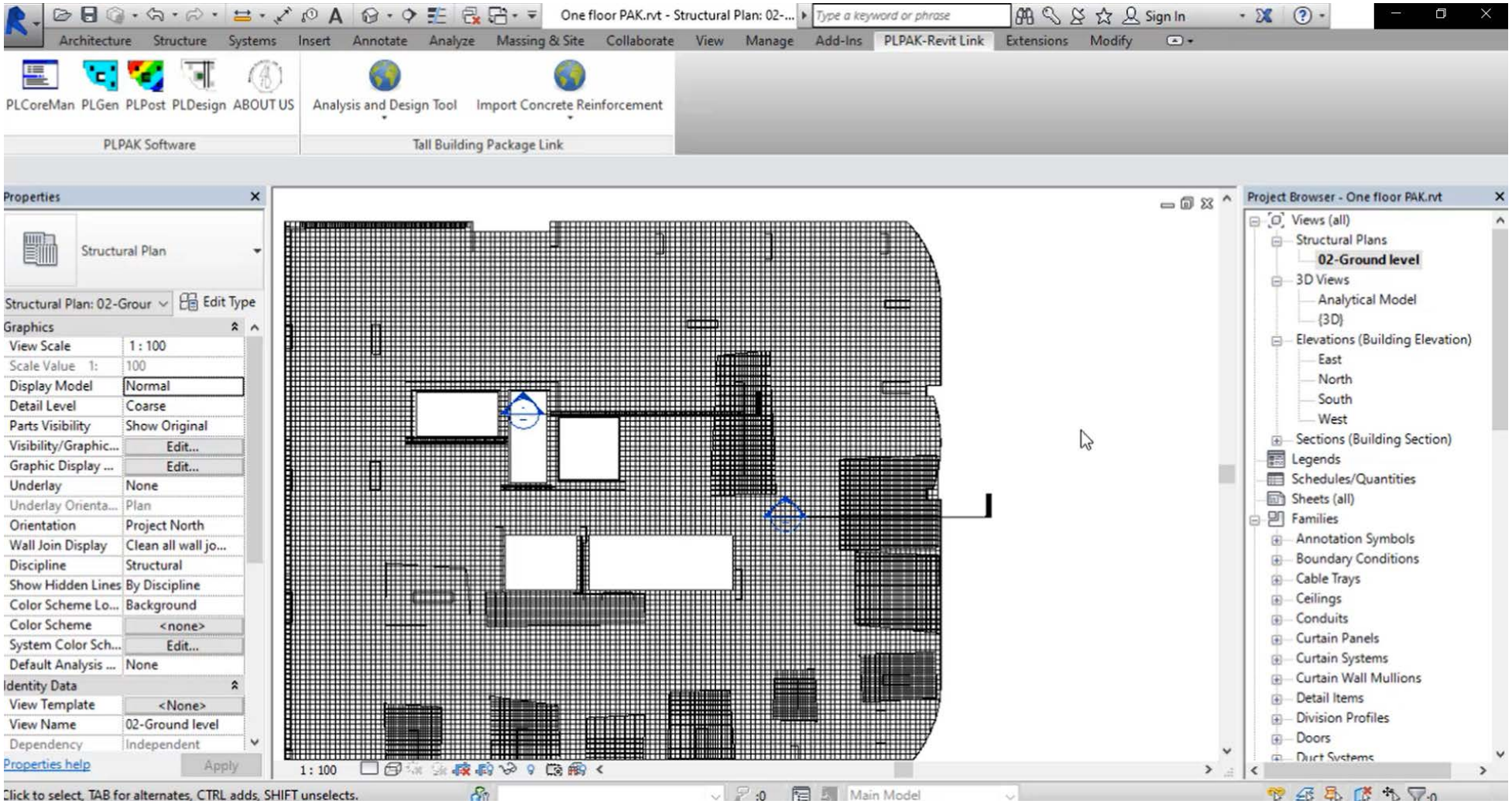


CUFE-BE

www.be4e.com

Cairo University

3. One floor package (BIM-PLPAK)



CUFE-BE

www.be4e.com

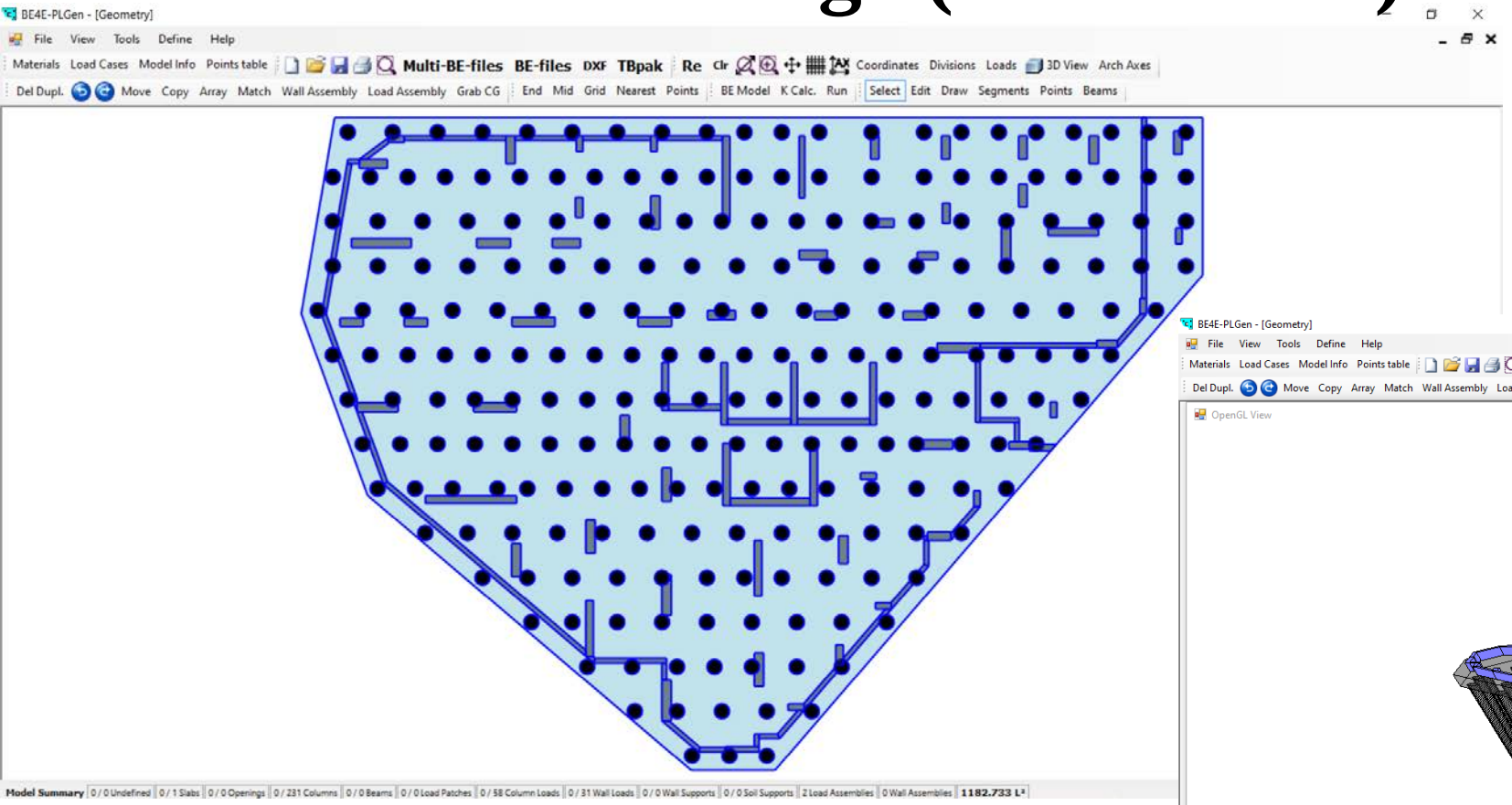
Cairo University

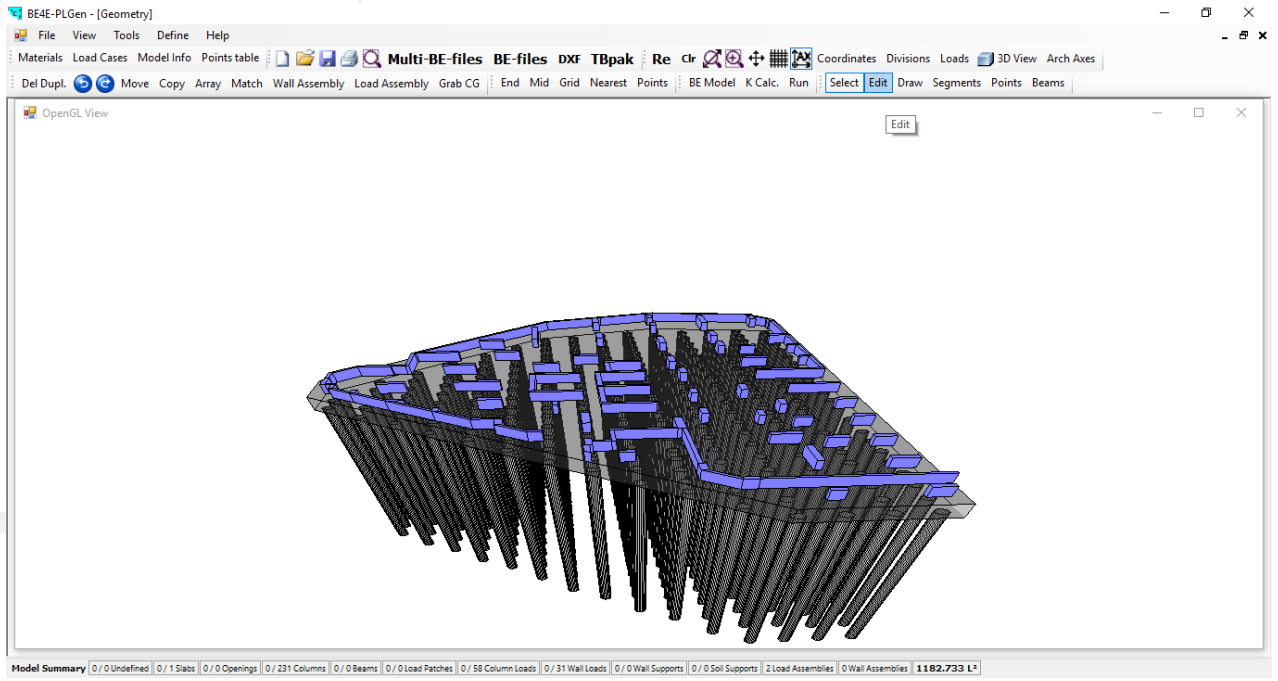
Table of contents

CUFE-BE

Cairo University

4. Foundation Package (Foundation)



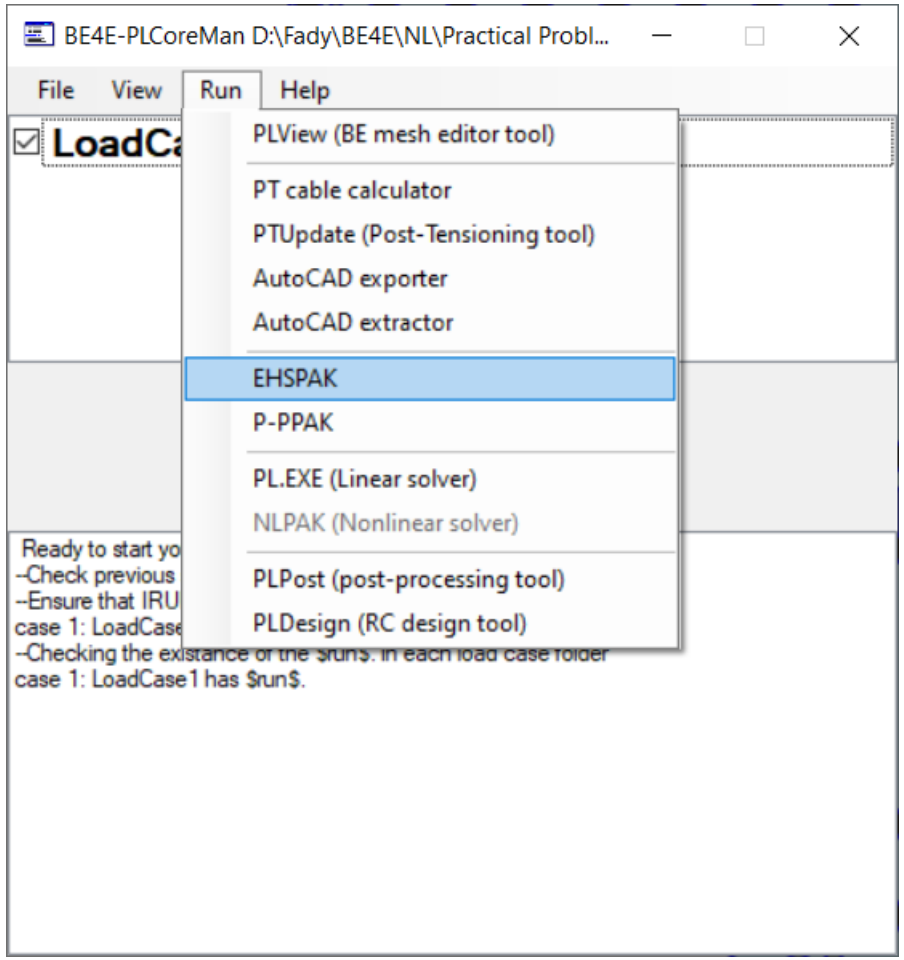


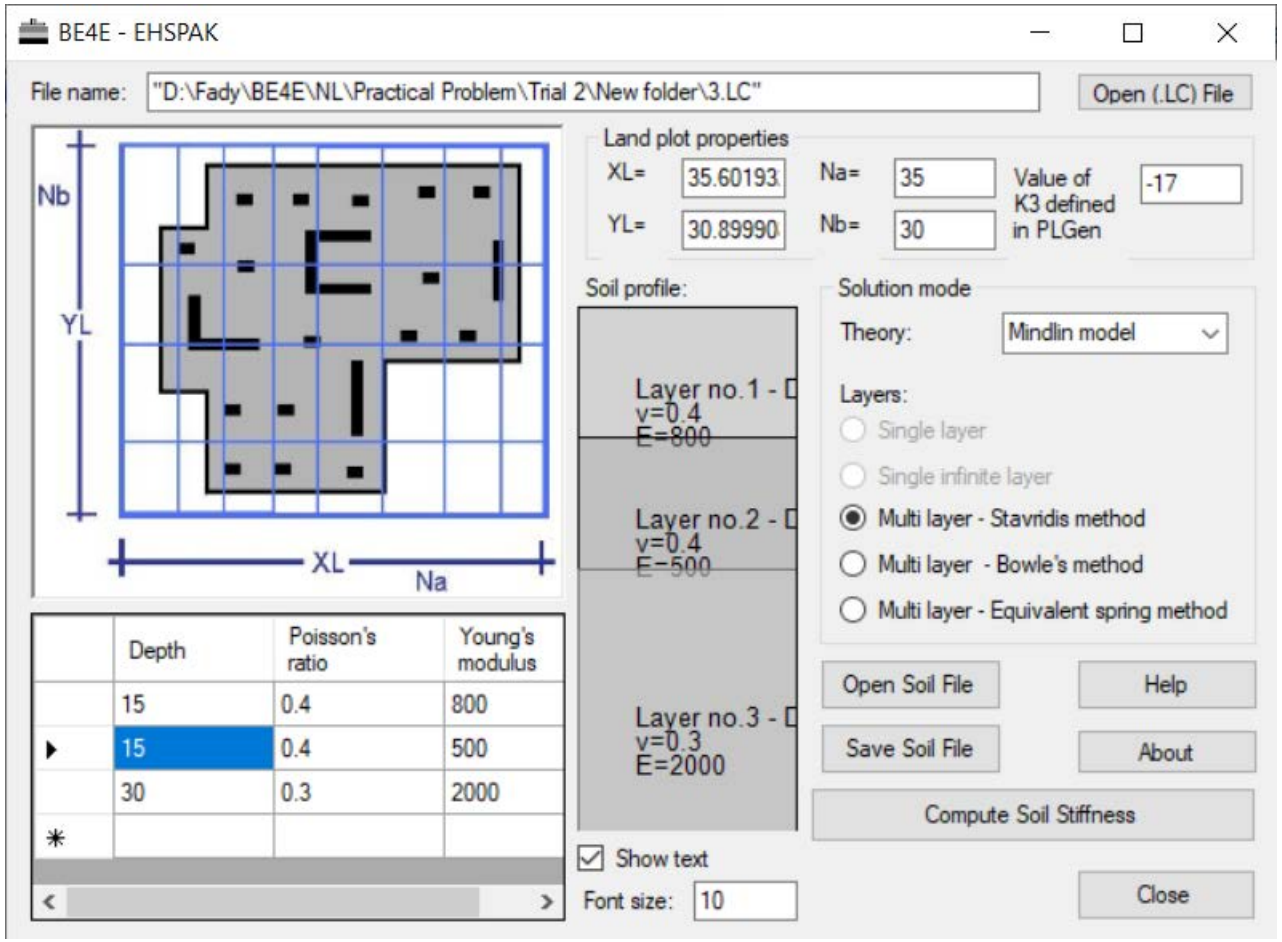
1- Generate Gen model of the piled raft defined piles as below only columns.

CUFE-BE

Cairo University

4. Foundation Package (Found-PAK)





2- Run the PLCoreMan	3- Run the EHSPAK if soil exist

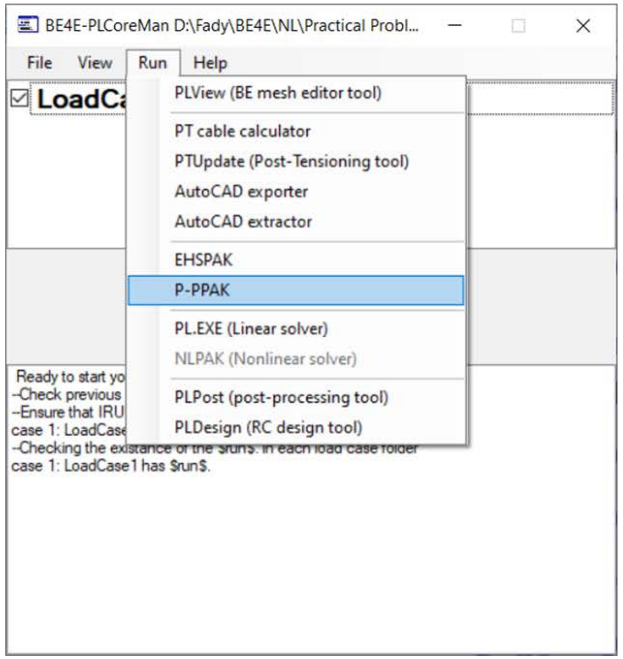
CUFE-BE

www.be4e.com

Cairo University

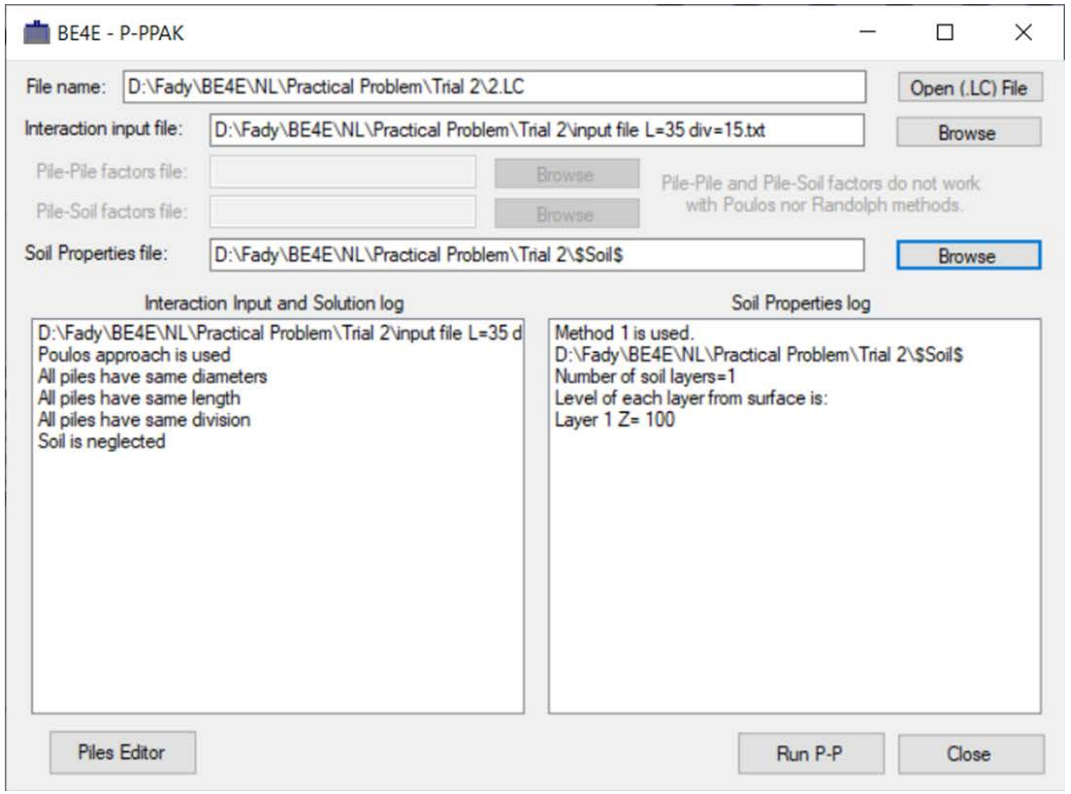
4. Foundation Package (Foundation)

4- Run the P-PPAK from PLCoreMan



5- Load interaction effects input file that can be created by:

- User write it manually using the format presented in P-PPAK manual
- Create automatically from Revit model



6- Load $Soil$ file that can be created by:

- Save it from EHSPAK
- User write it manually using the format presented in EHSPAK manual
- Create automatically from Revit model

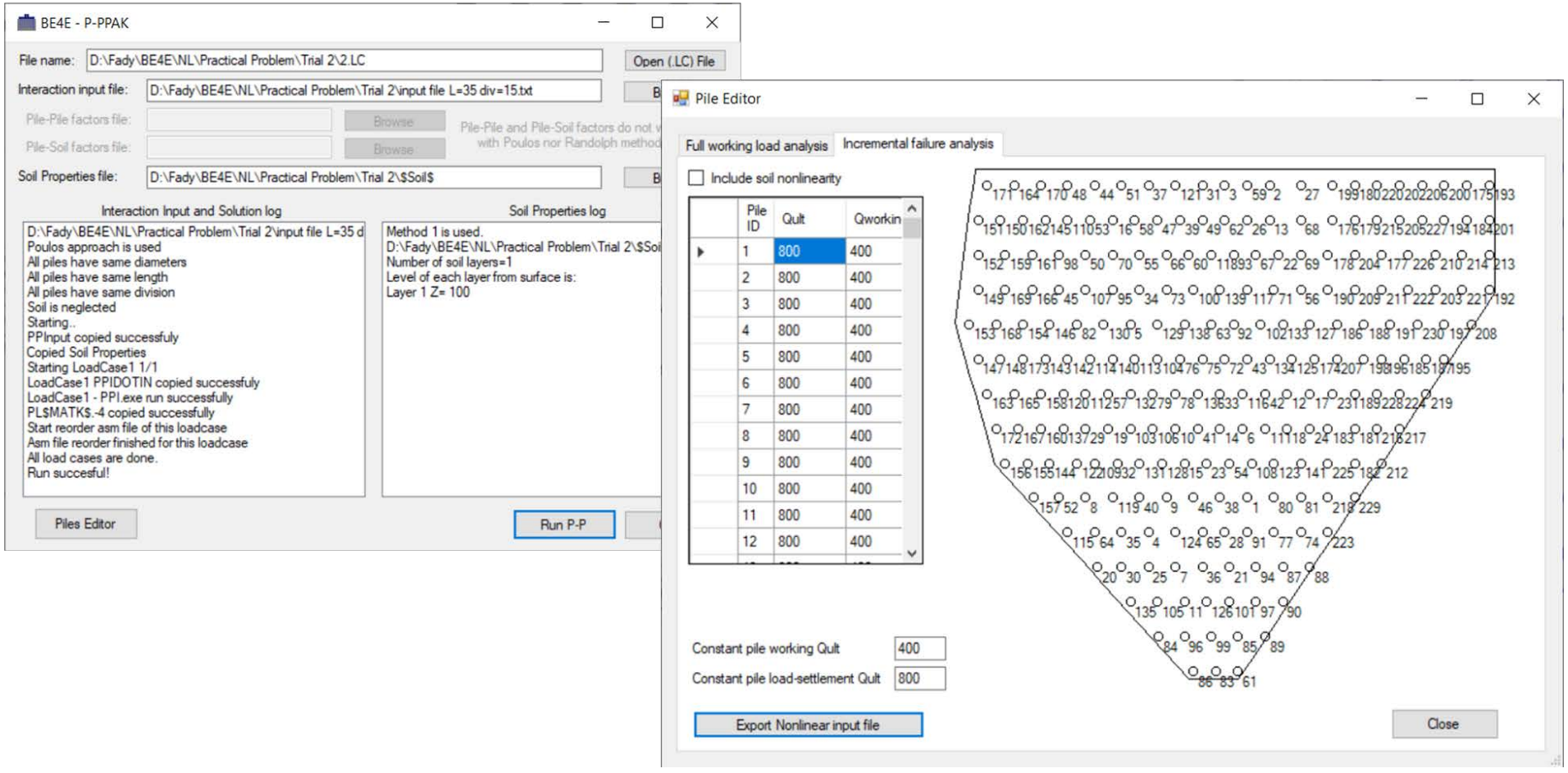
CUFE-BE

Boundary Elements for Engineers
www.be4e.com

Cairo University

4. Foundation Package (FoundPAK)

8- After finishing the P-PPAK run, open the pile editor to create the NLinput file
(If the nonlinear analysis will be performed)
Structure of the NLInput file is presented in NLPAK user manual

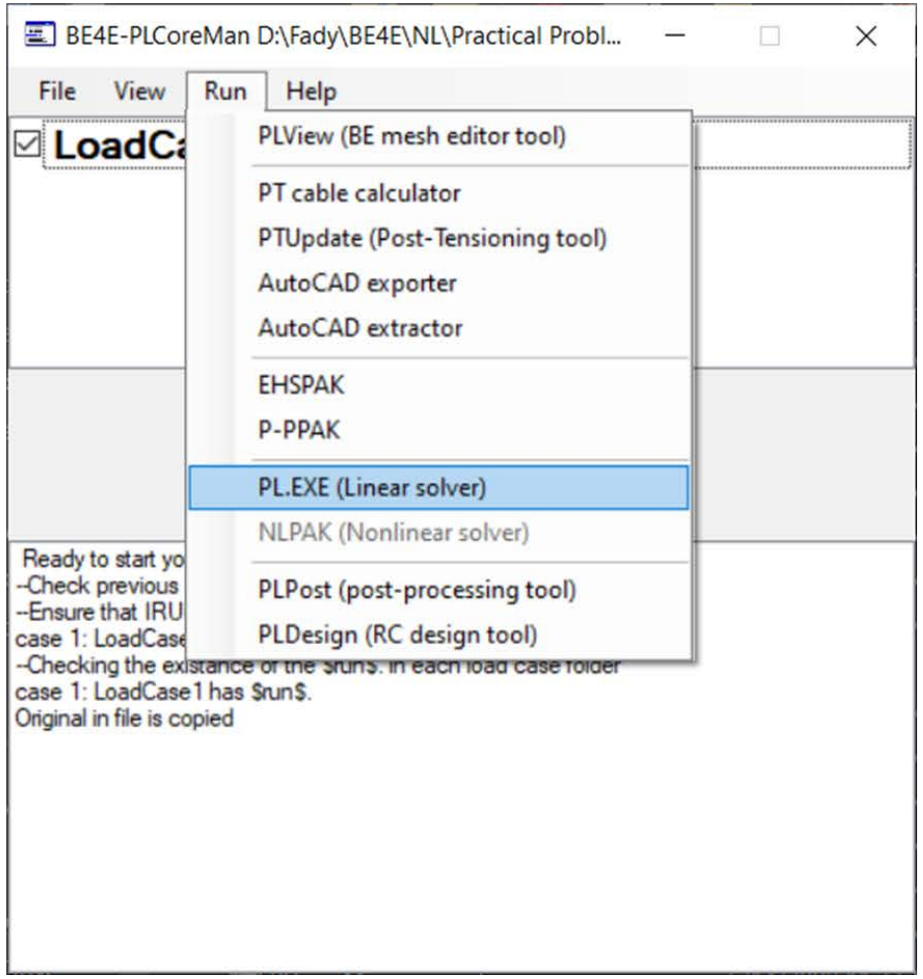


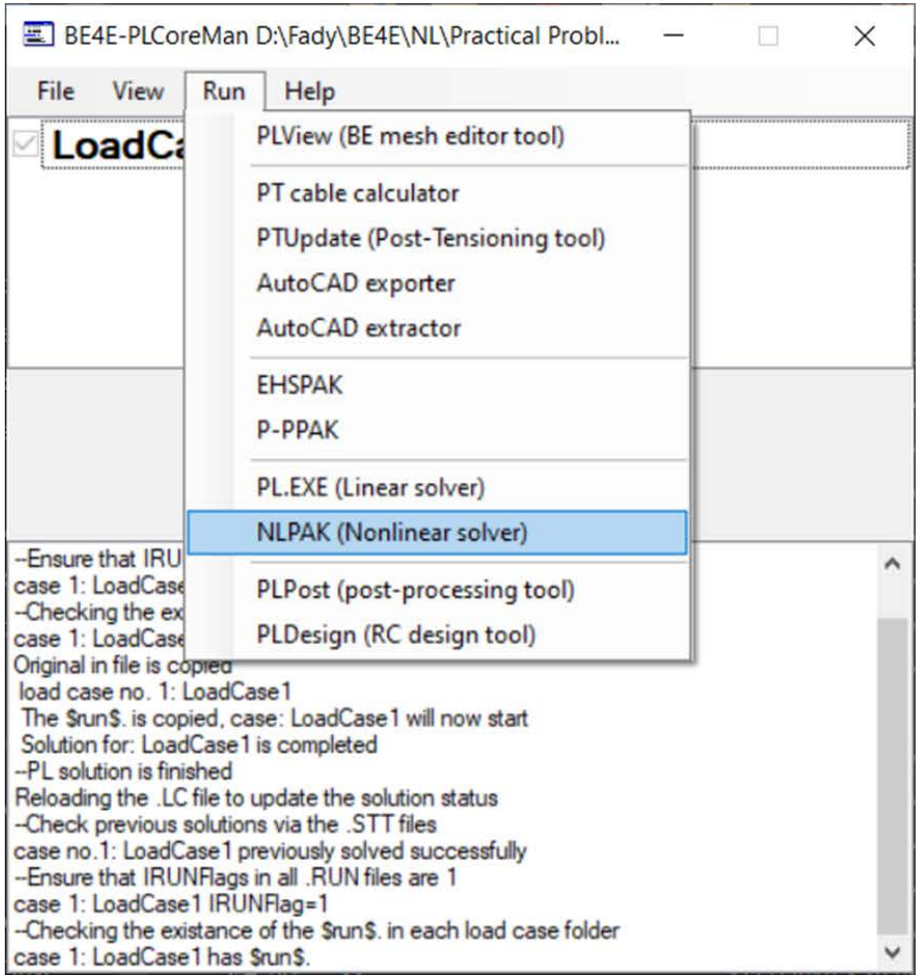
CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

9- Run the linear solver PL.exe	10- Run the nonlinear solver NLPAK





CUFE-BE

Boundary Elements for Engineers — www.be4e.com

Cairo University

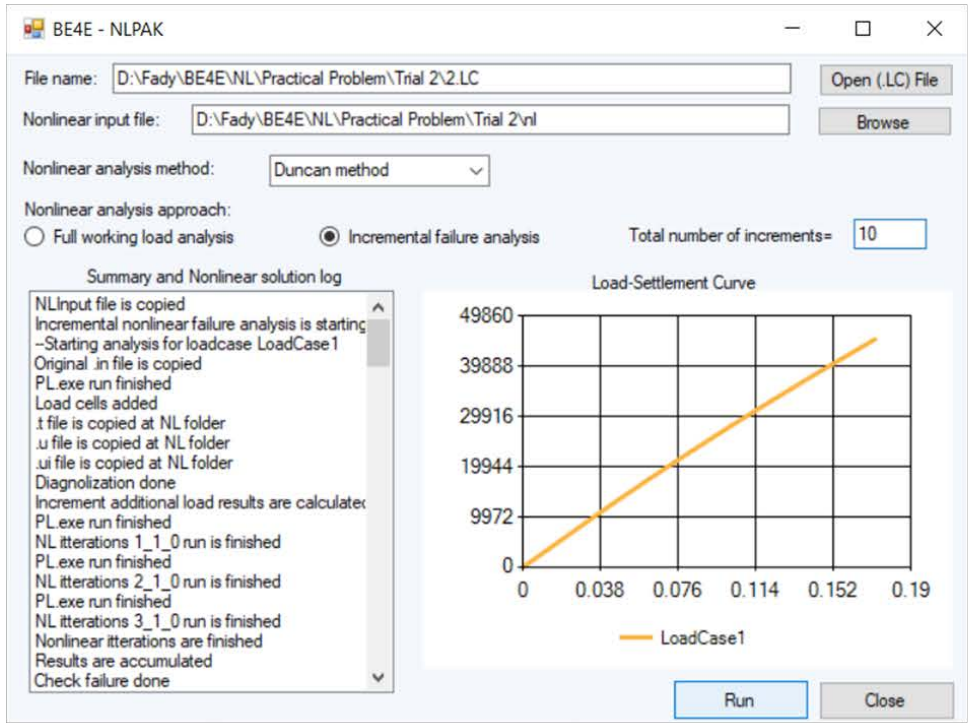
4. Foundation Package (FoundaPAK)

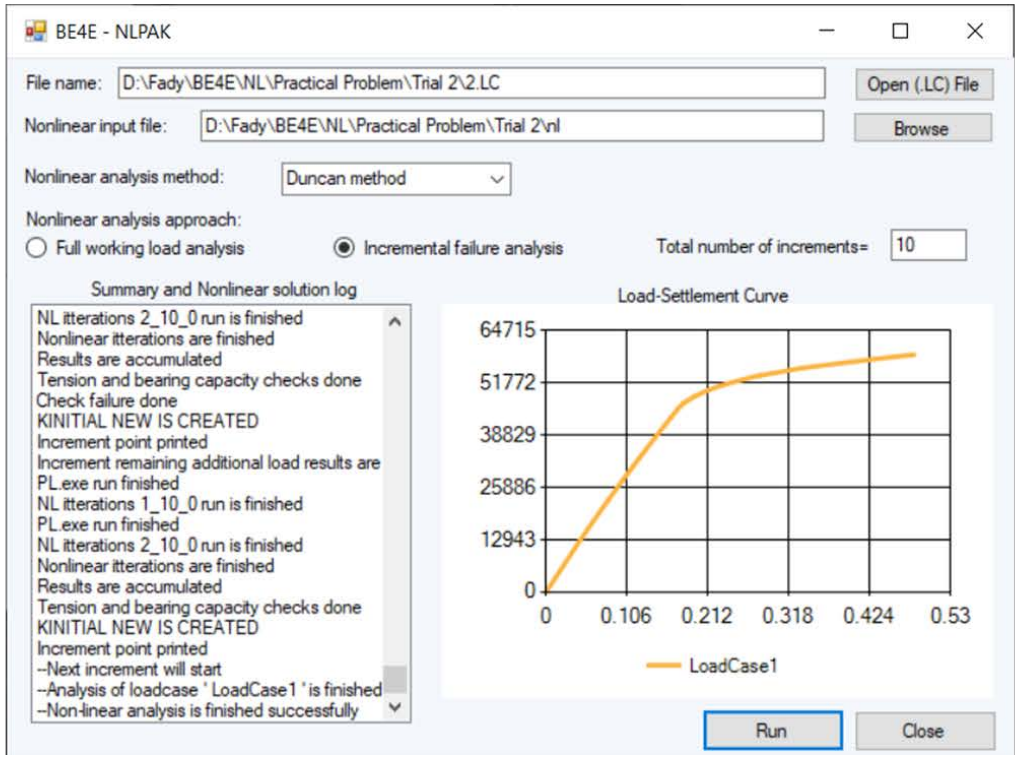
11- Load the nonlinear input file

- Already created by pile editor, or
- User write it manually using the format presented in NLPAK user manual

12- Choose your nonlinear approach:

- Full working load, or
- Incremental failure analysis (Input number of increments)





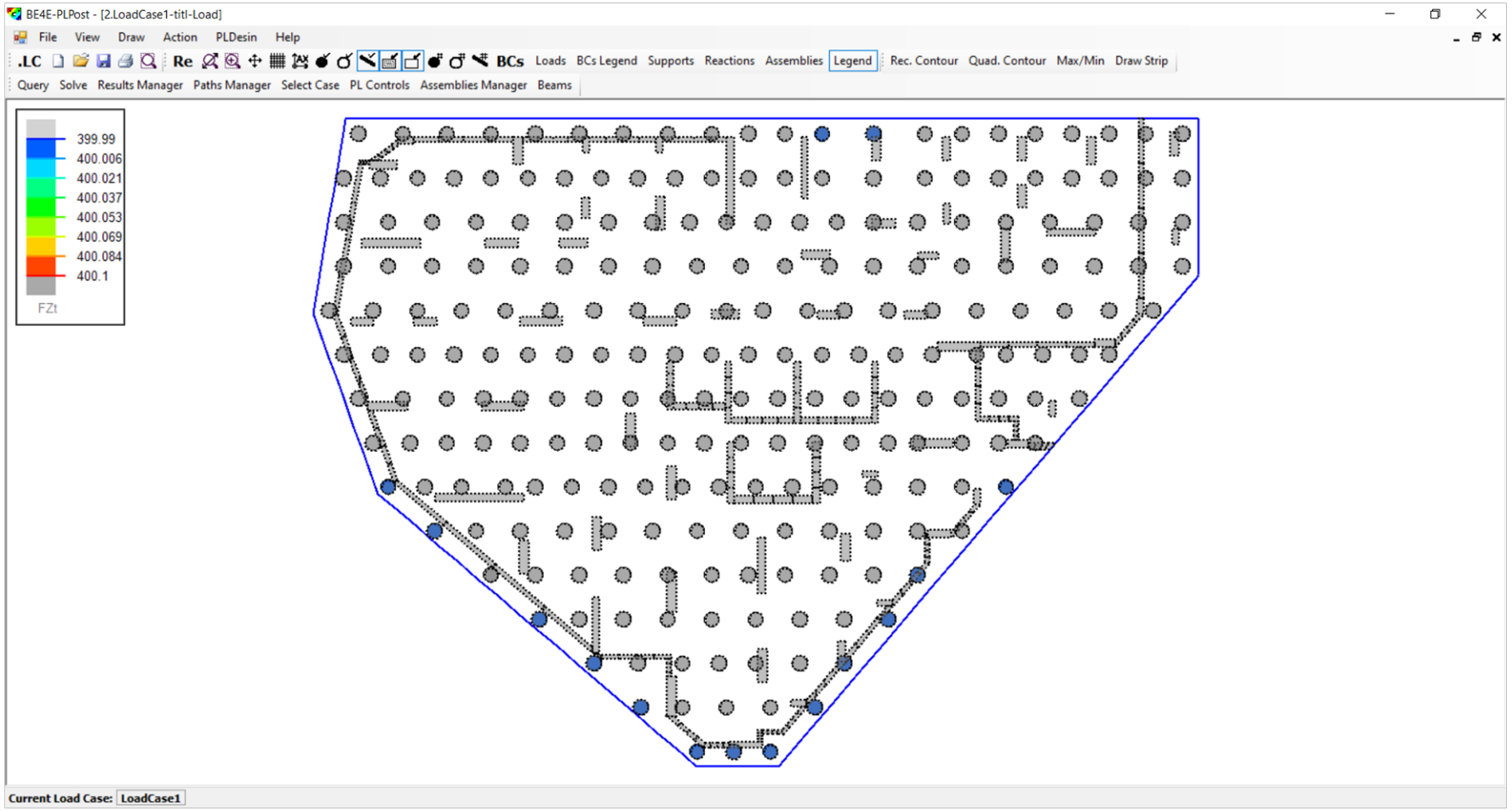
CUFE-BE

Boundary Elements for Engineers
www.be4e.com

Cairo University

4. Foundation Package (Foundation)

13- Run PLPost to see your results



Piles failed in blue color

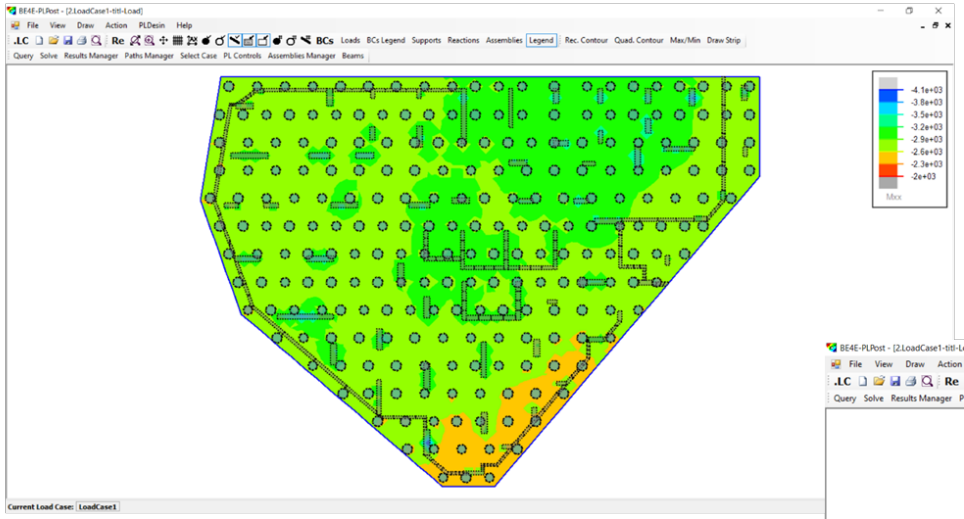
CUFE-BE

www.be4e.com

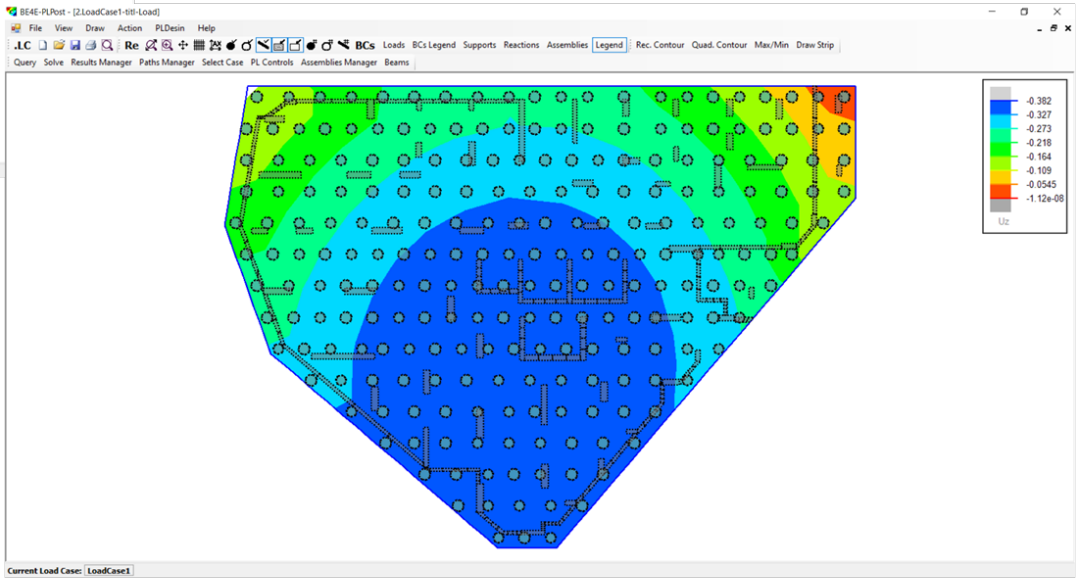
Cairo University

4. Foundation Package (Foundation)

13- Run PLPost to see your results



Nonlinear bending moment M_{xx} contours



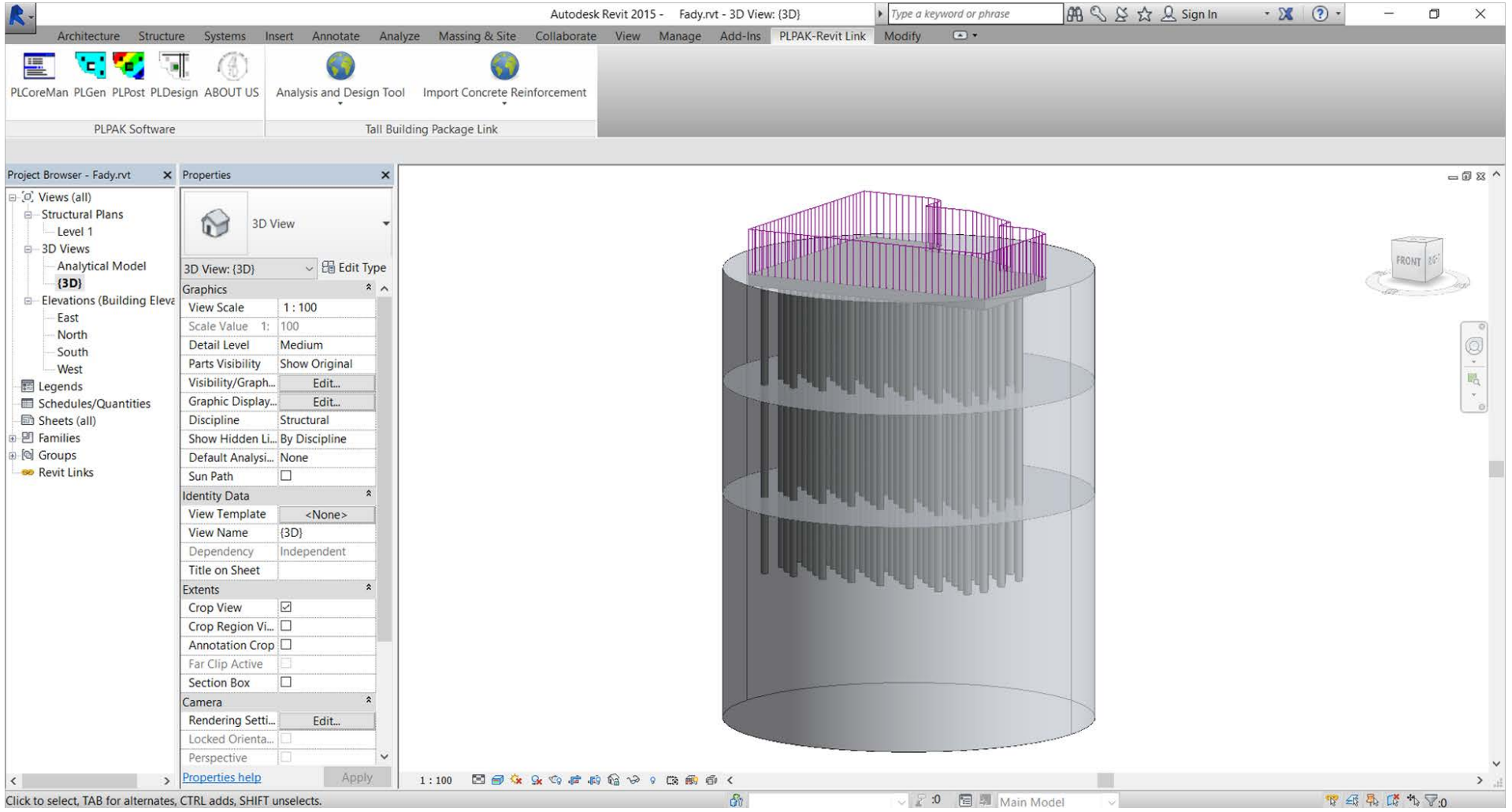
Nonlinear settlement contours

CUFE-BE

Cairo University

4. Foundation Package (Foundation)

1- Generate piled raft model using Revit

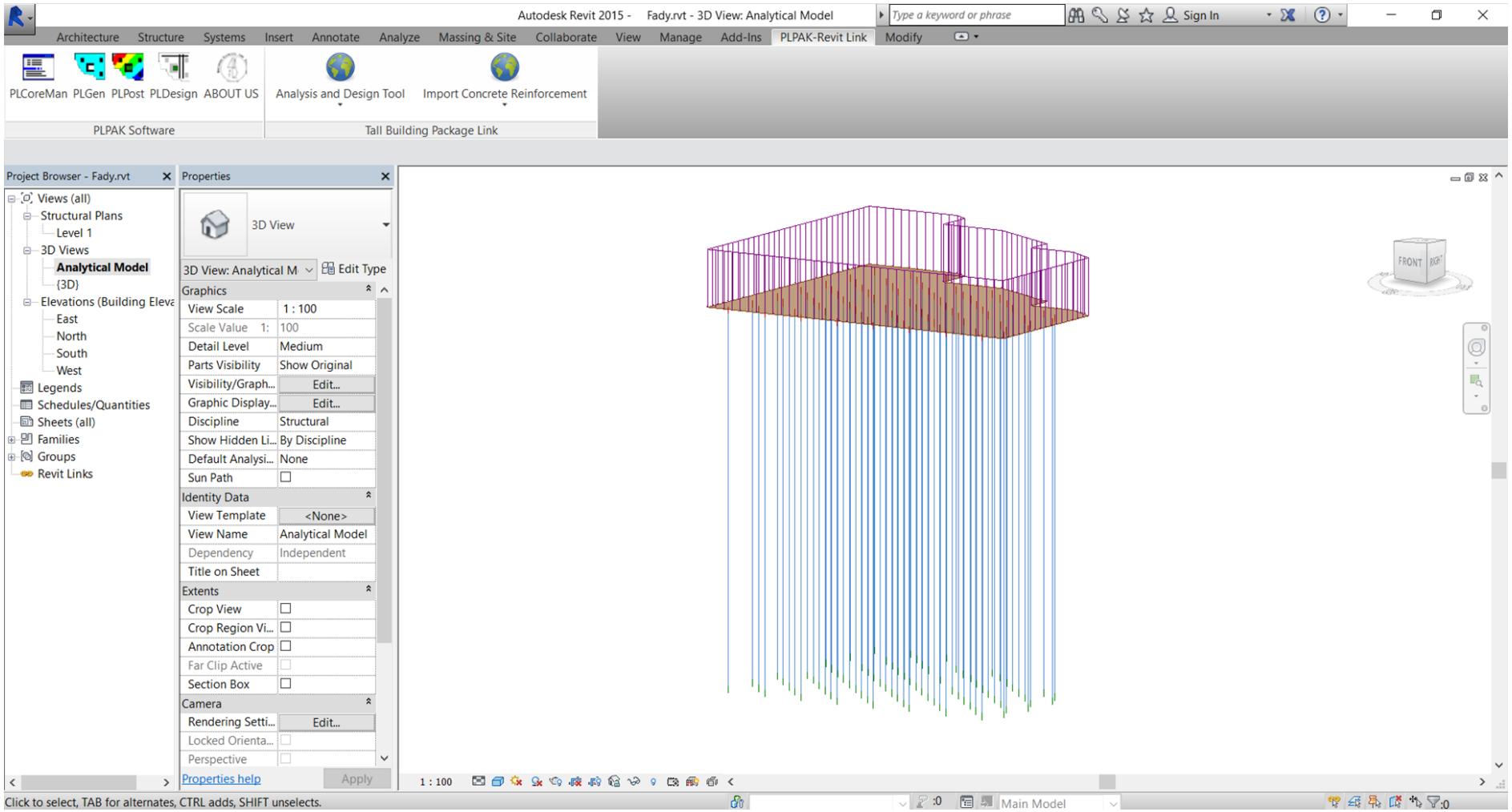


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

Revit analytical model



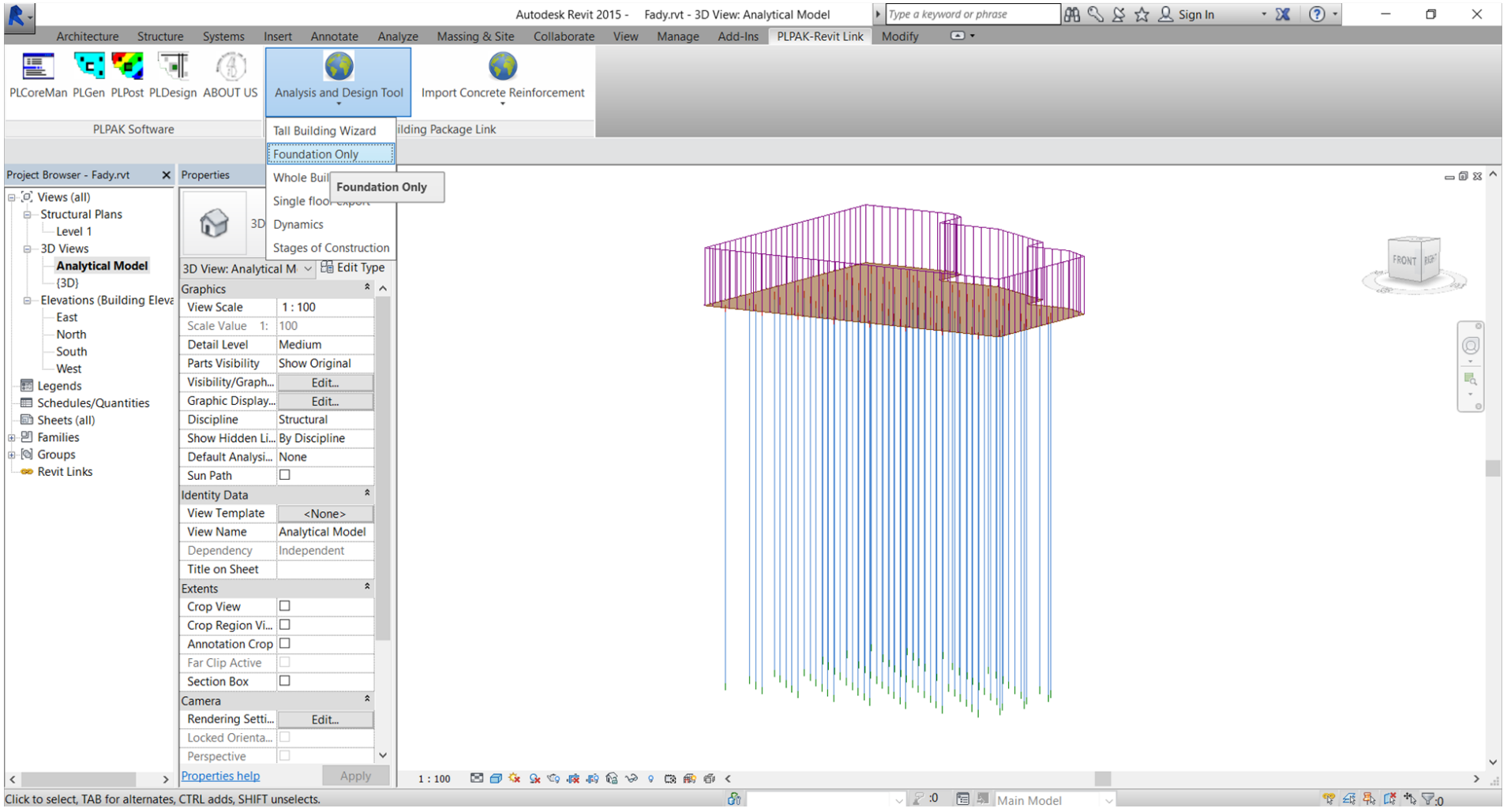
CUFE-BE

BOUNDARY ELEMENTS FOR ENGINEERS
www.be4e.com

Cairo University

4. Foundation Package (Foundation)

2- Open foundation only wizard from analysis and design PLPAK tool add-ins



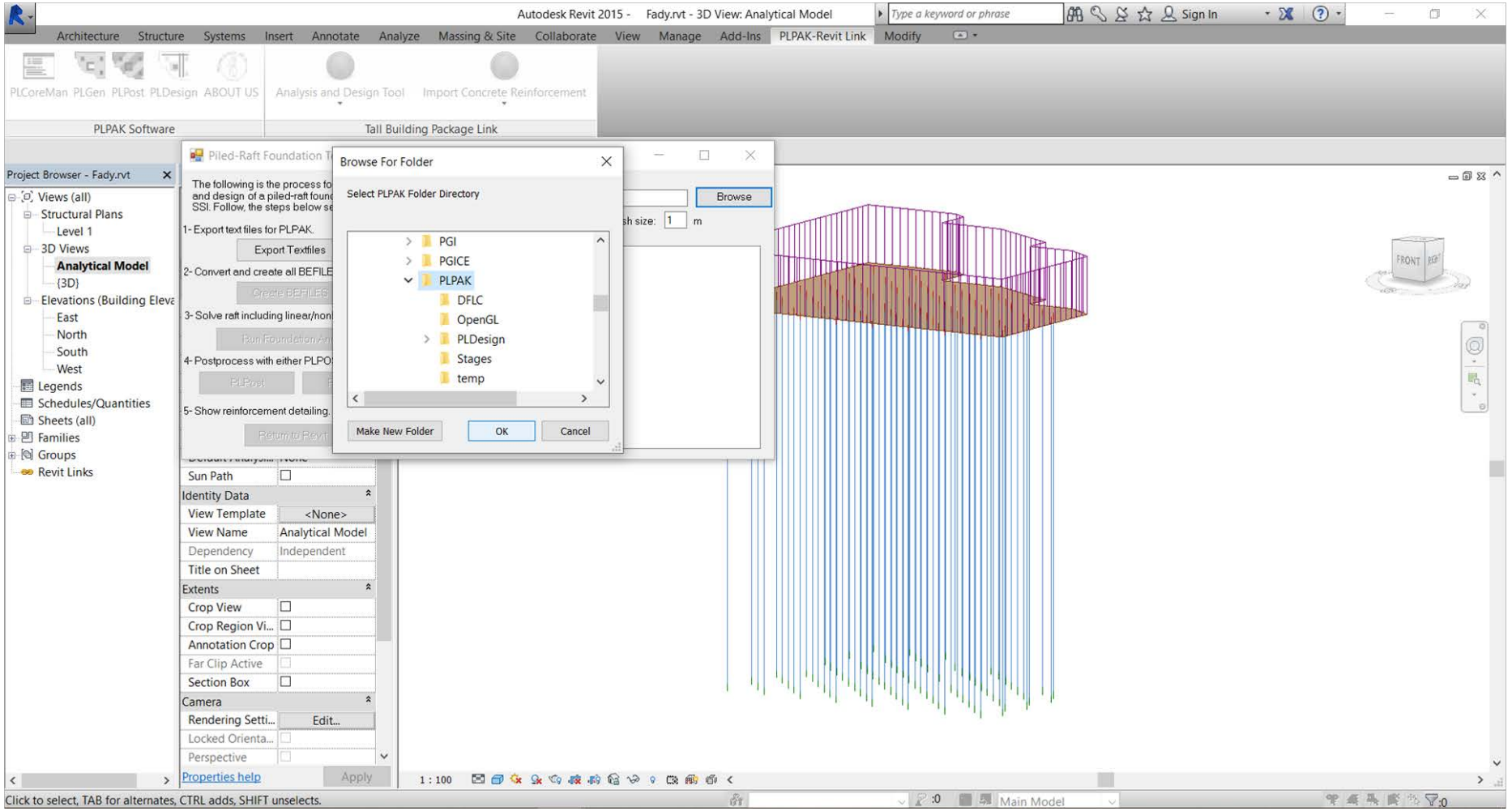
CUFE-BE

Boundary Elements for Engineers
www.be4e.com

Cairo University

4. Foundation Package (FoundPAK)

3- Browse the PLPAK folder path (if not the default C:\program files\PLPAK)

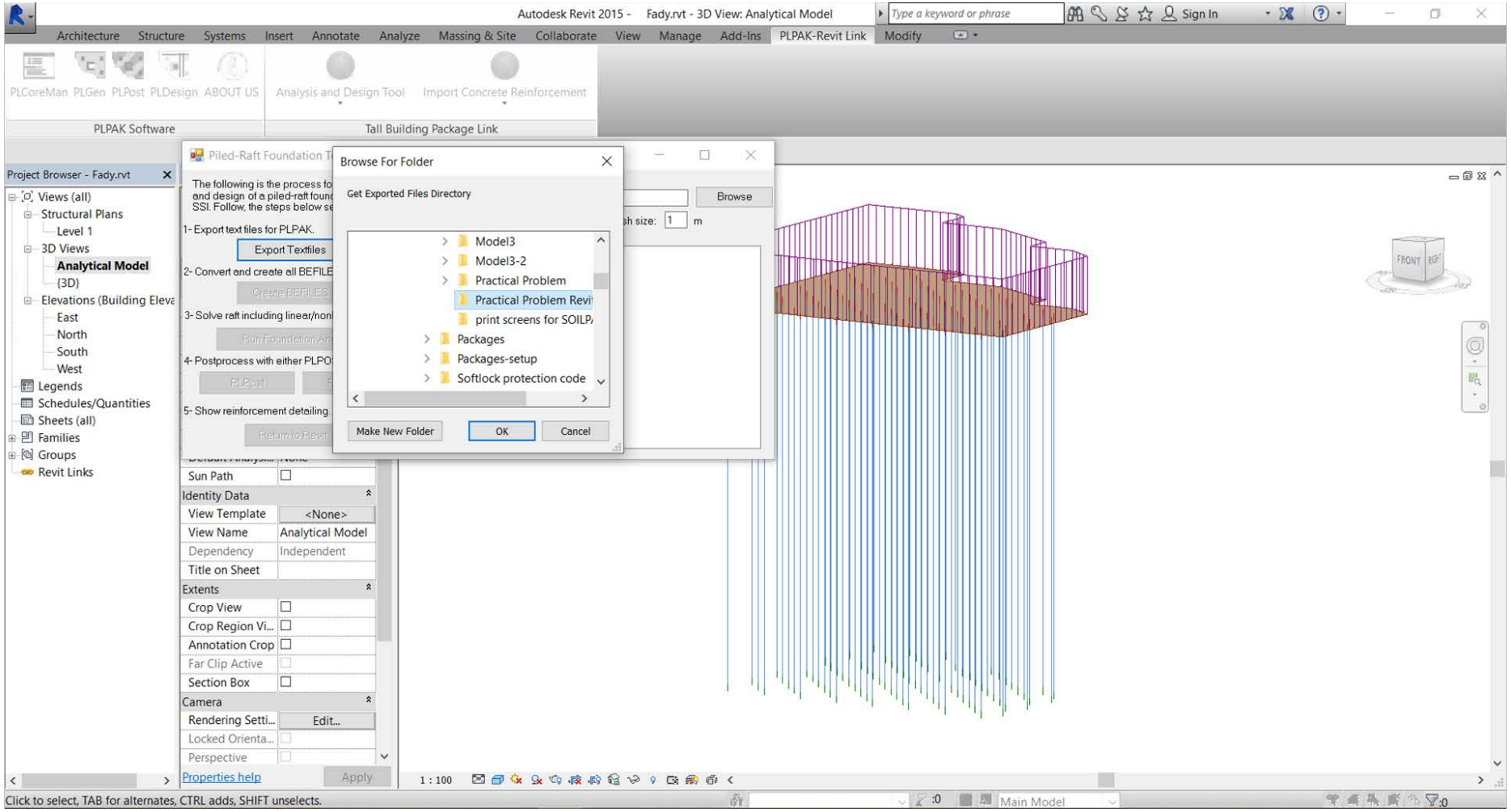


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

4- Export text files, and browse the problem folder (after defined the piles and soil divisions)

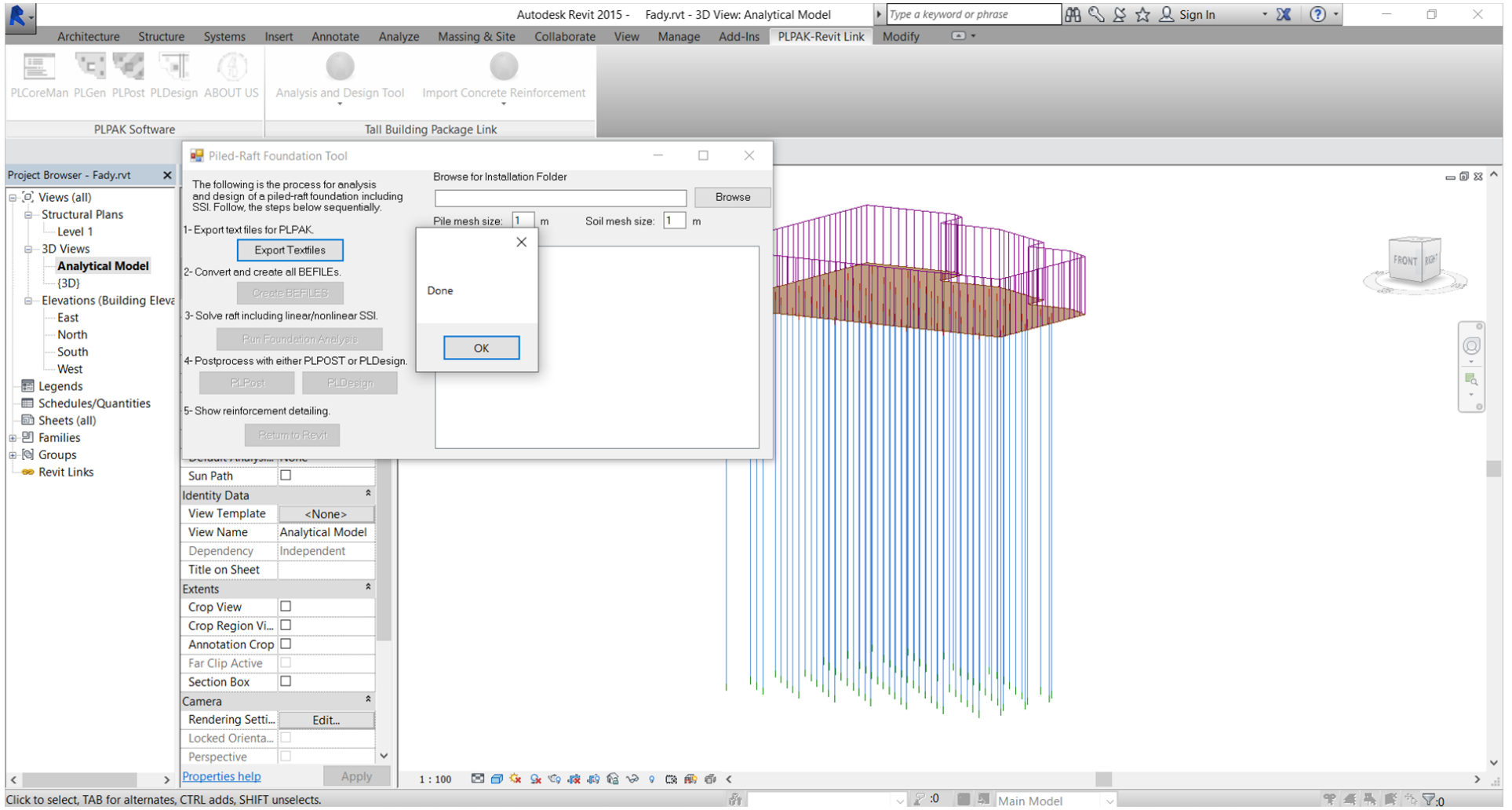


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

Exporting text files done

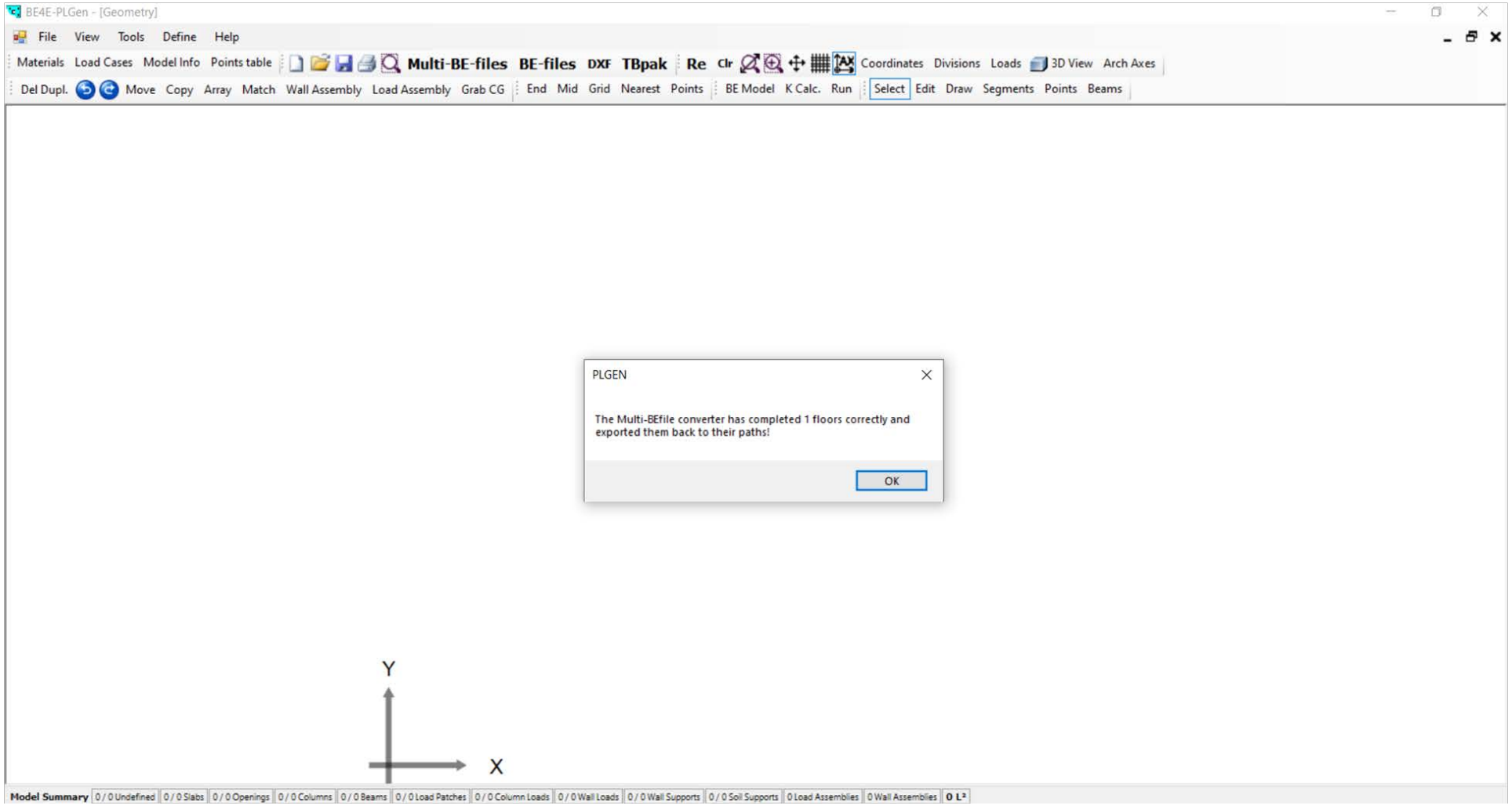


CUFE-BE

Cairo University

4. Foundation Package (FoundaPAK)

5- Create BEFiles



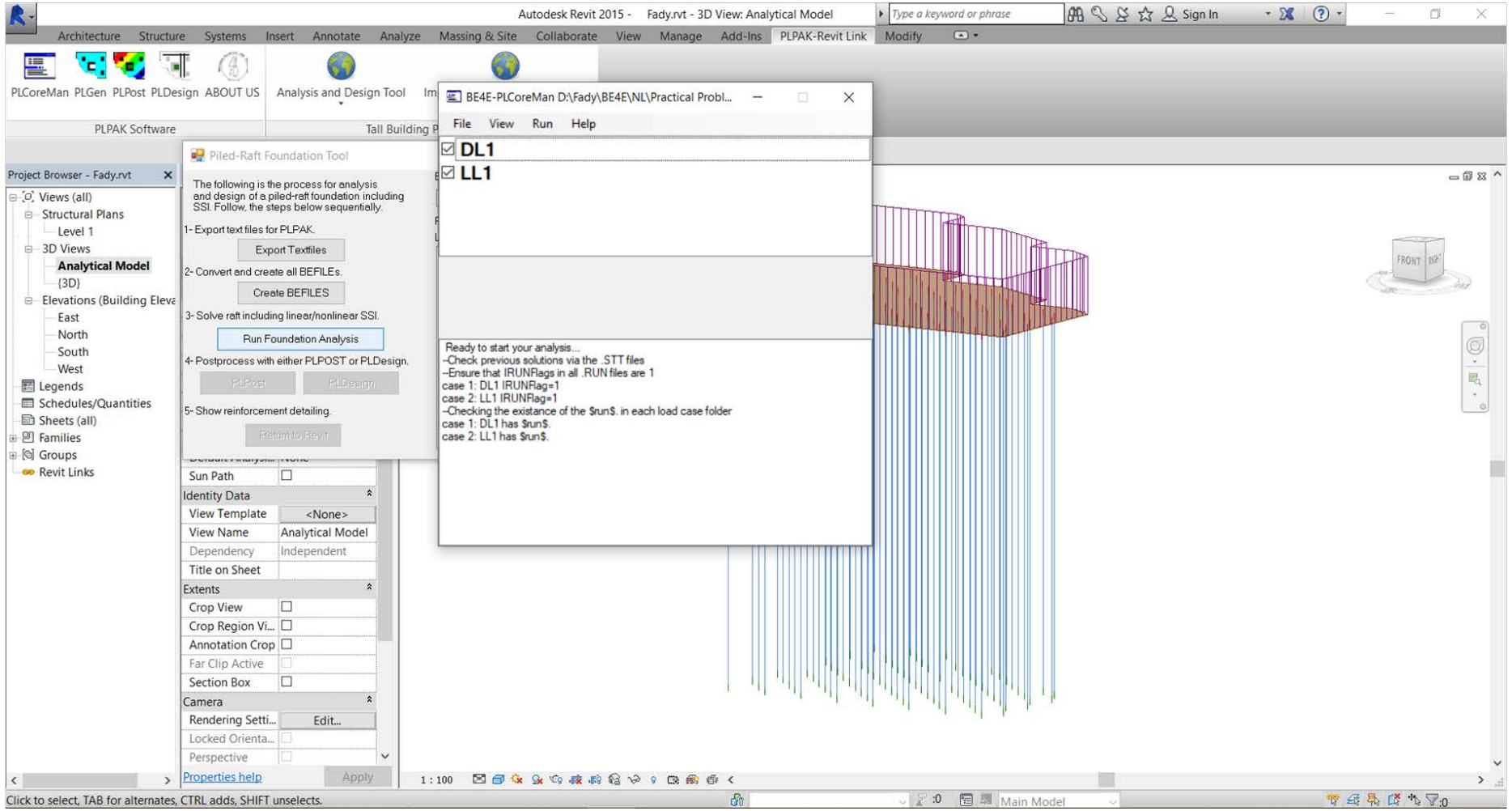
CUFE-BE

www.be4e.com

Cairo University

4. Foundation Package (FoundPAK)

6- Run foundation analysis (open the PLCoreMan automatically)



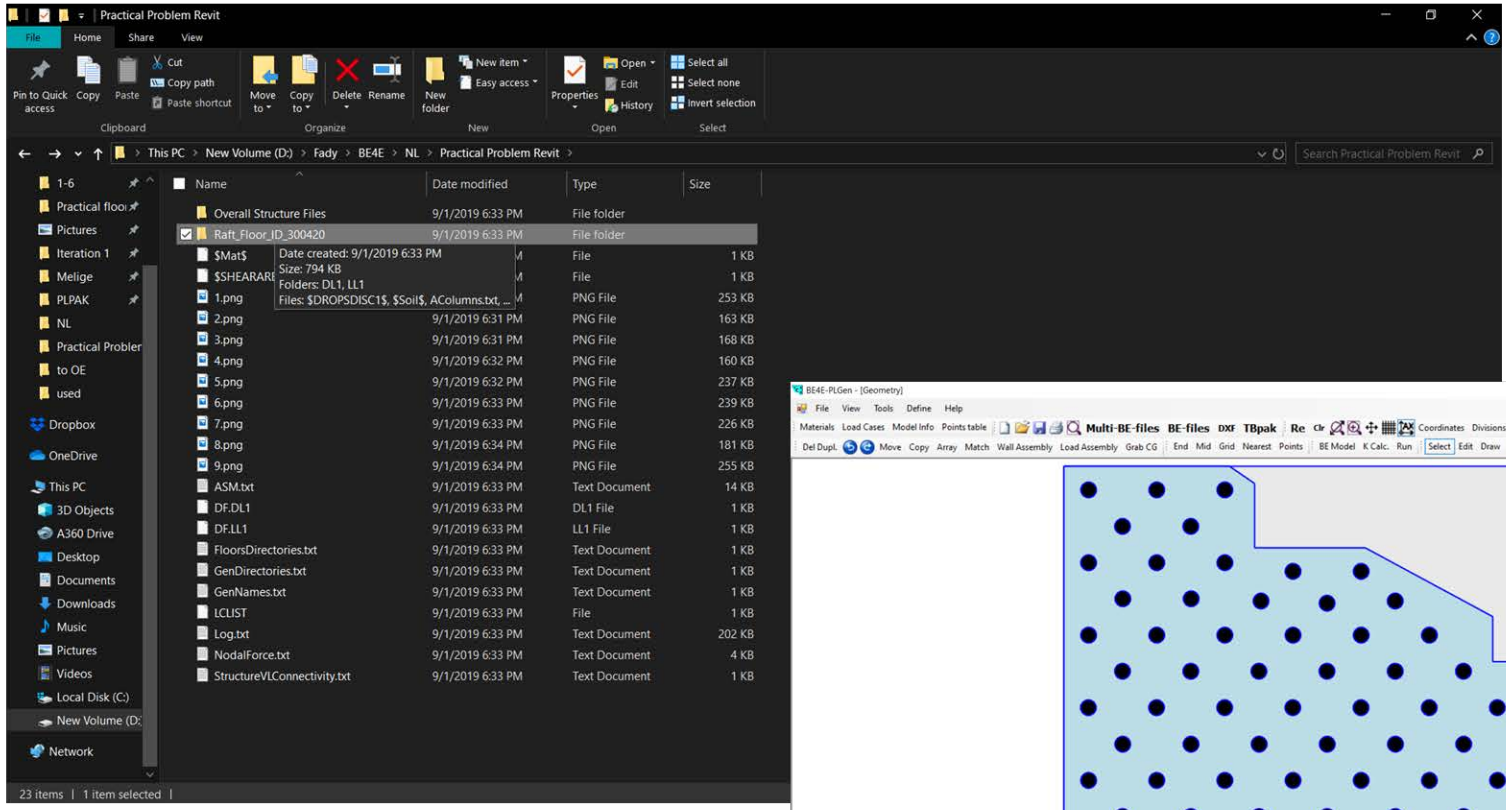
CUFE-BE

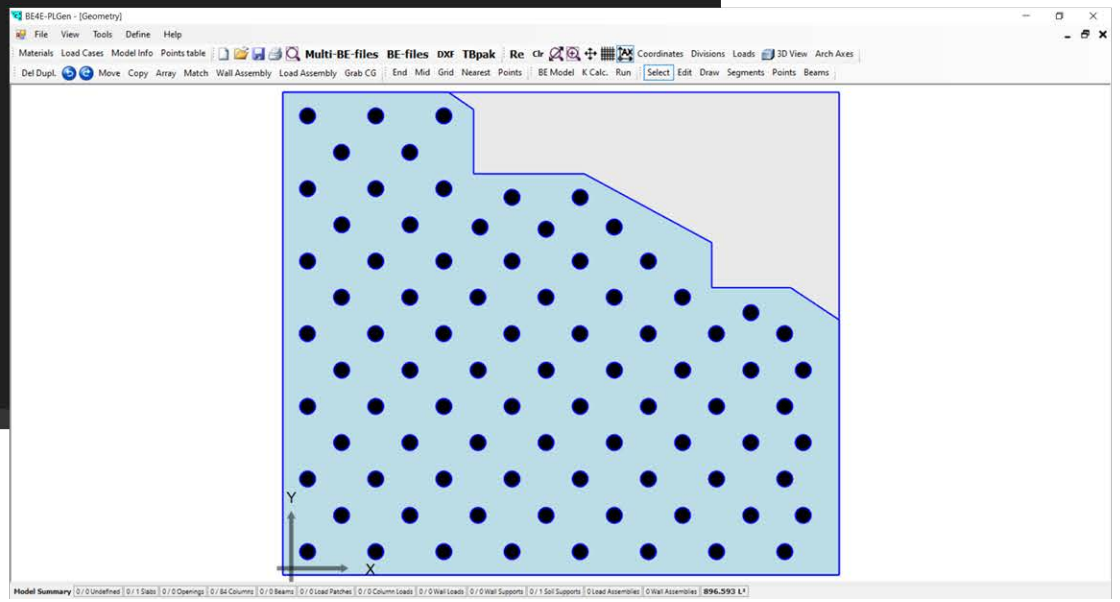
BOUNDARY ELEMENTS FOR ENGINEERS
www.be4e.com

Cairo University

4. Foundation Package (Foundation)

Can open the Gen model of the piled raft from the raft folder (extracted from Revit)



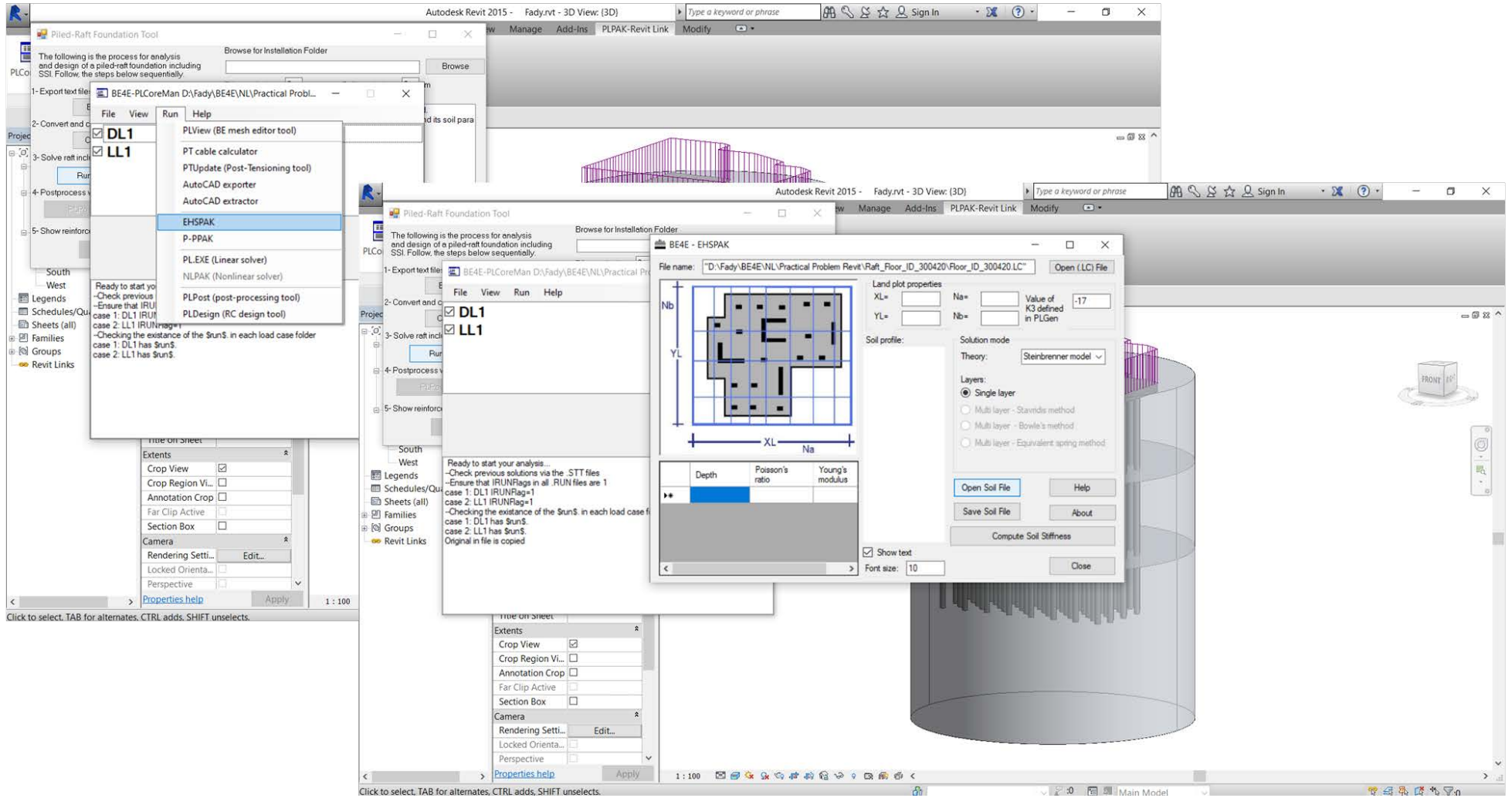


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

7- Run EHSPAK

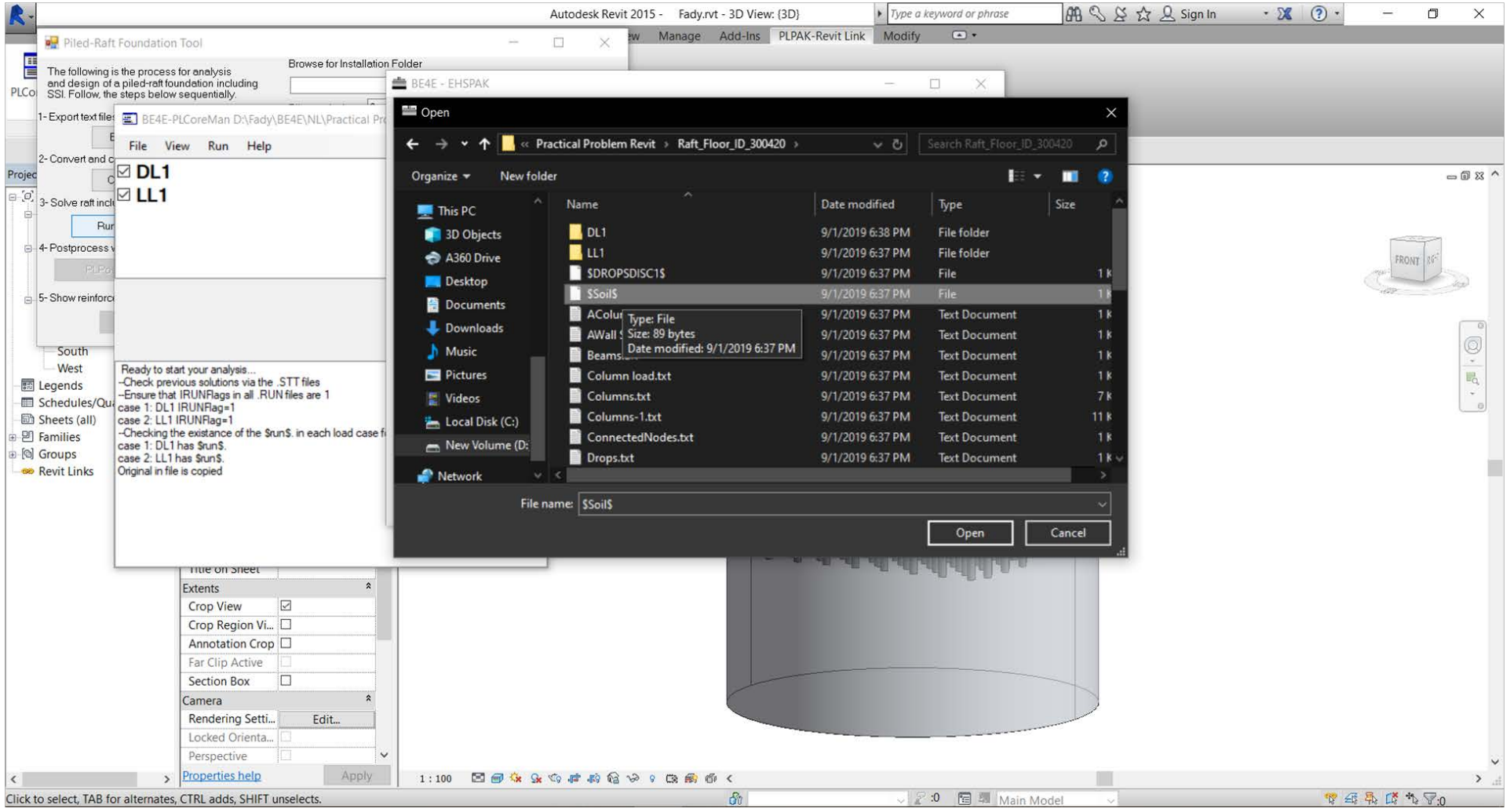


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

Browse $Soil$ in piled raft folder (automatically extracted from Revit)

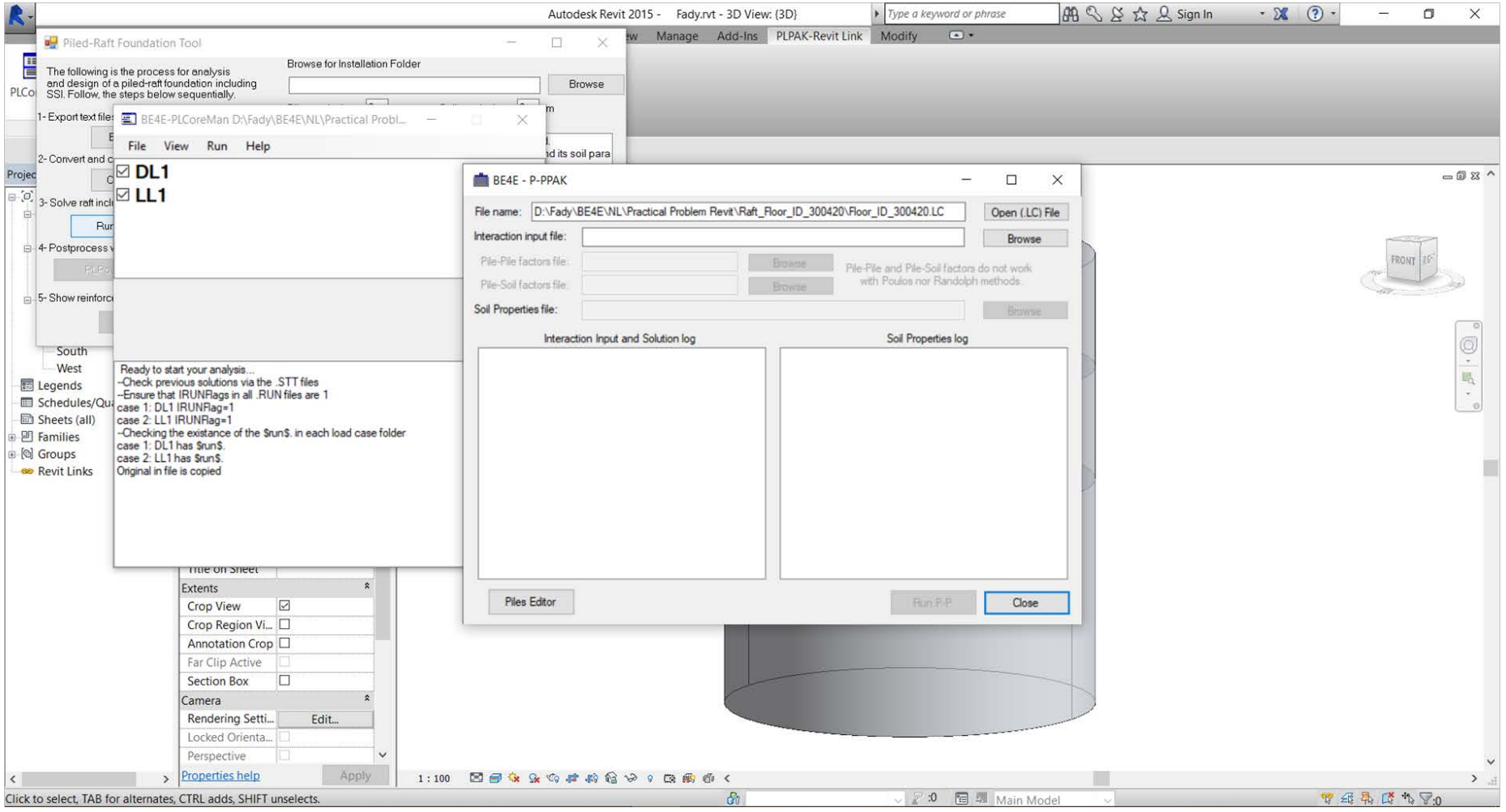


CUFE-BE

Cairo University

4. Foundation Package (Found-PAK)

8- Run P-PPAK

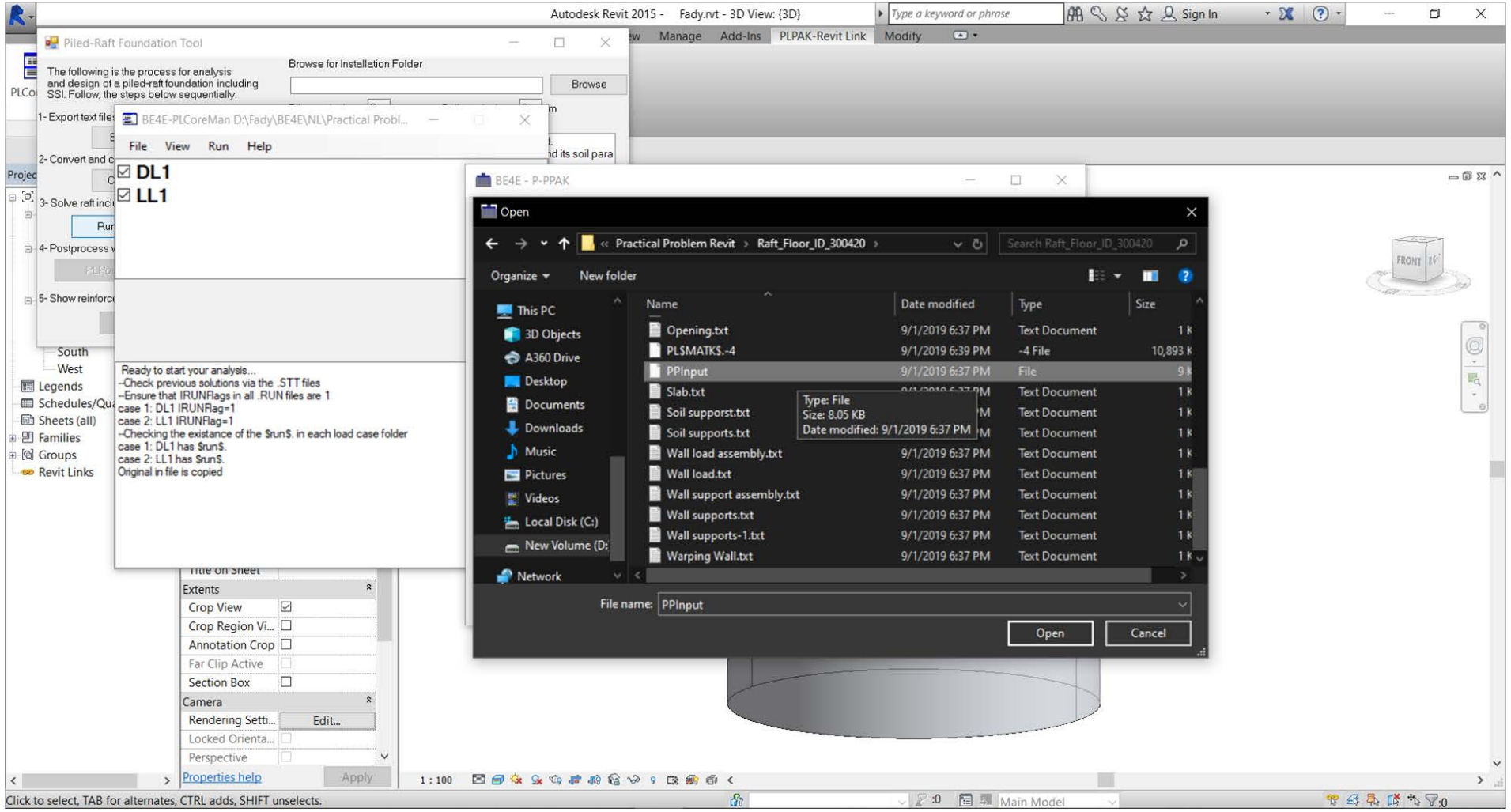


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

Browse PPInput and $Soil$ in piled raft folder (automatically extracted from Revit)



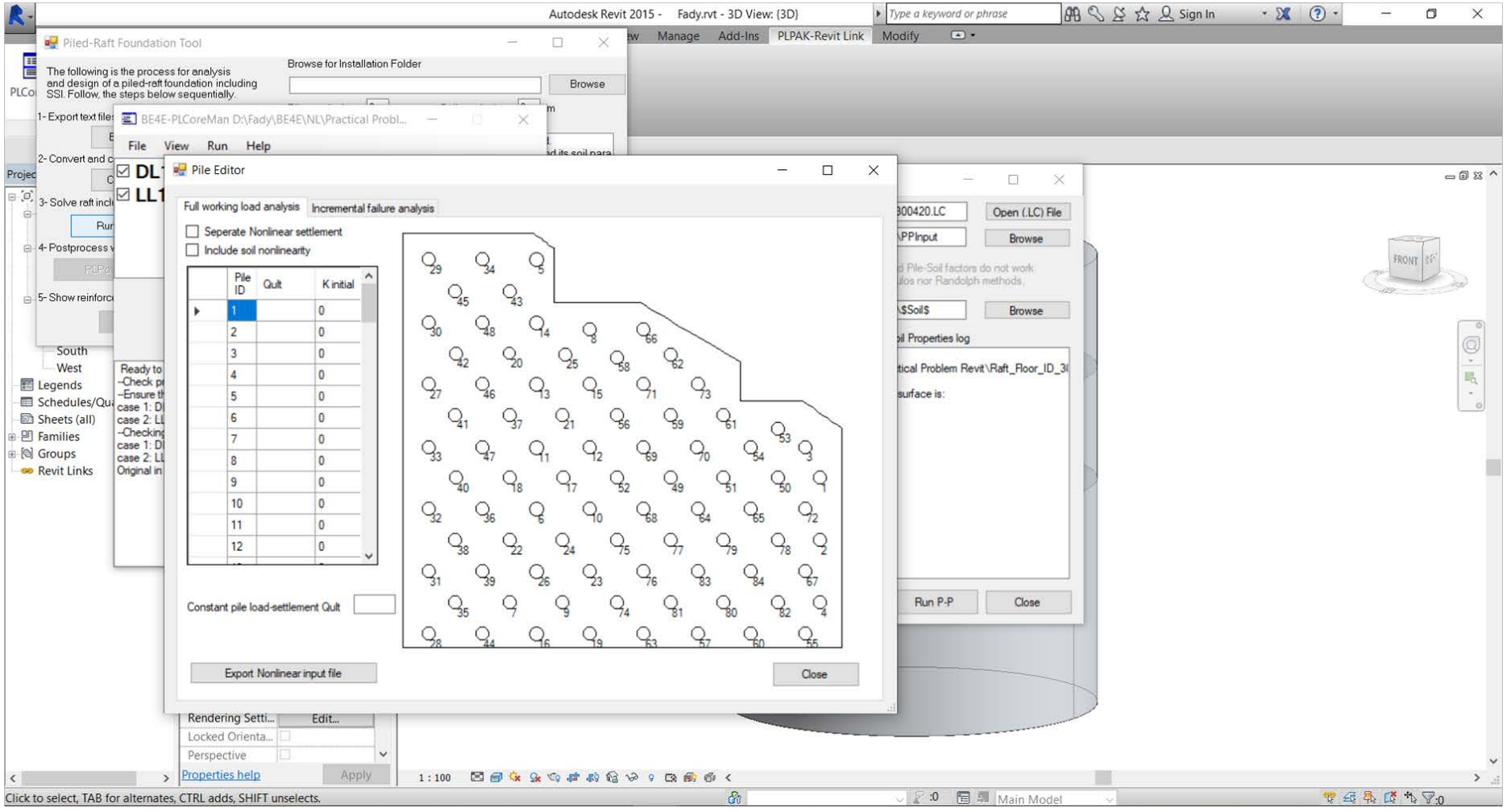
CUFE-BE

BOUNDARY ELEMENTS FOR ENGINEERS
BE 4 E
www.be4e.com

Cairo University

4. Foundation Package (Foundation)

9- Open the pile editor

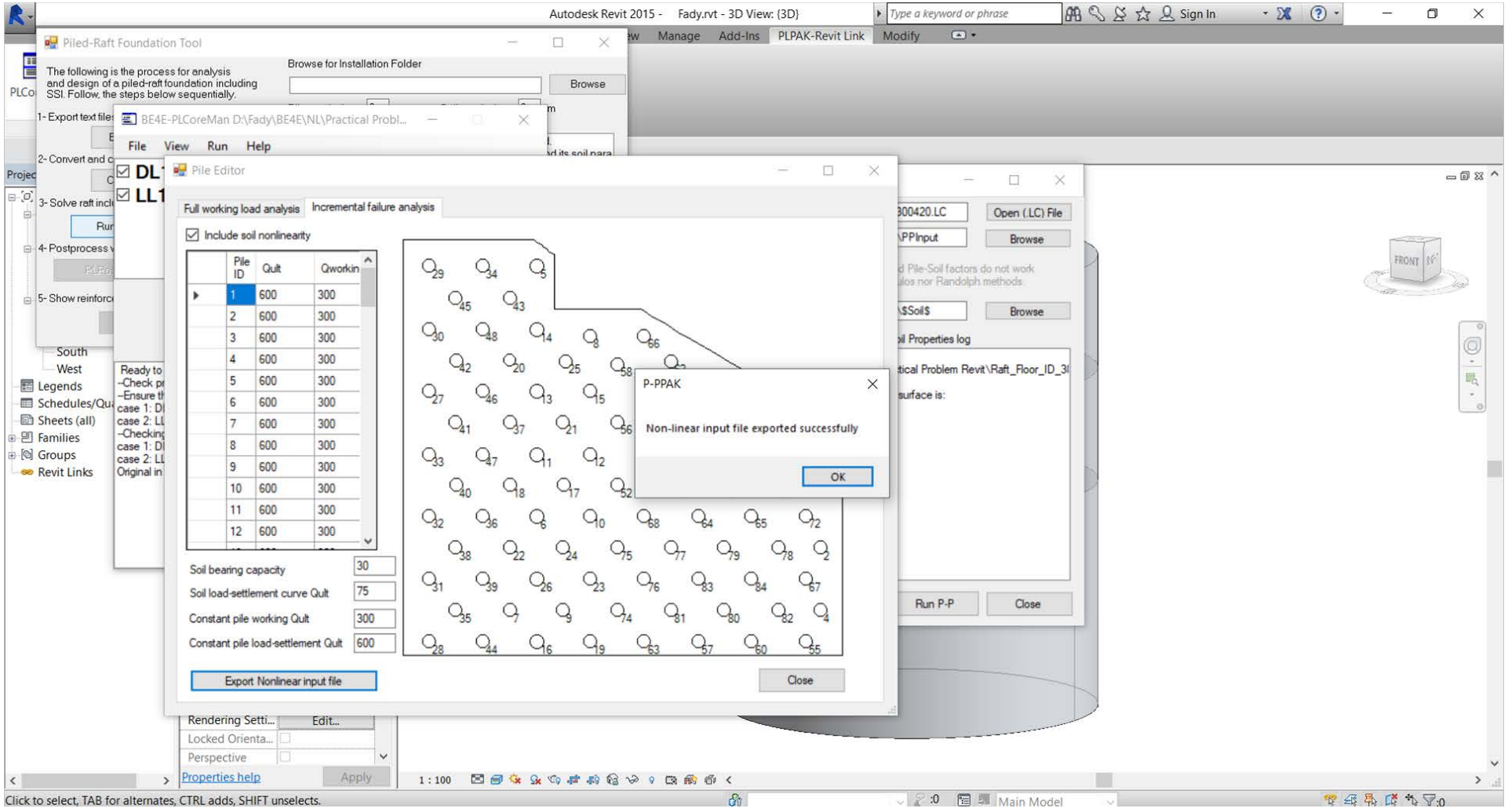


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

Extract the NLinput file



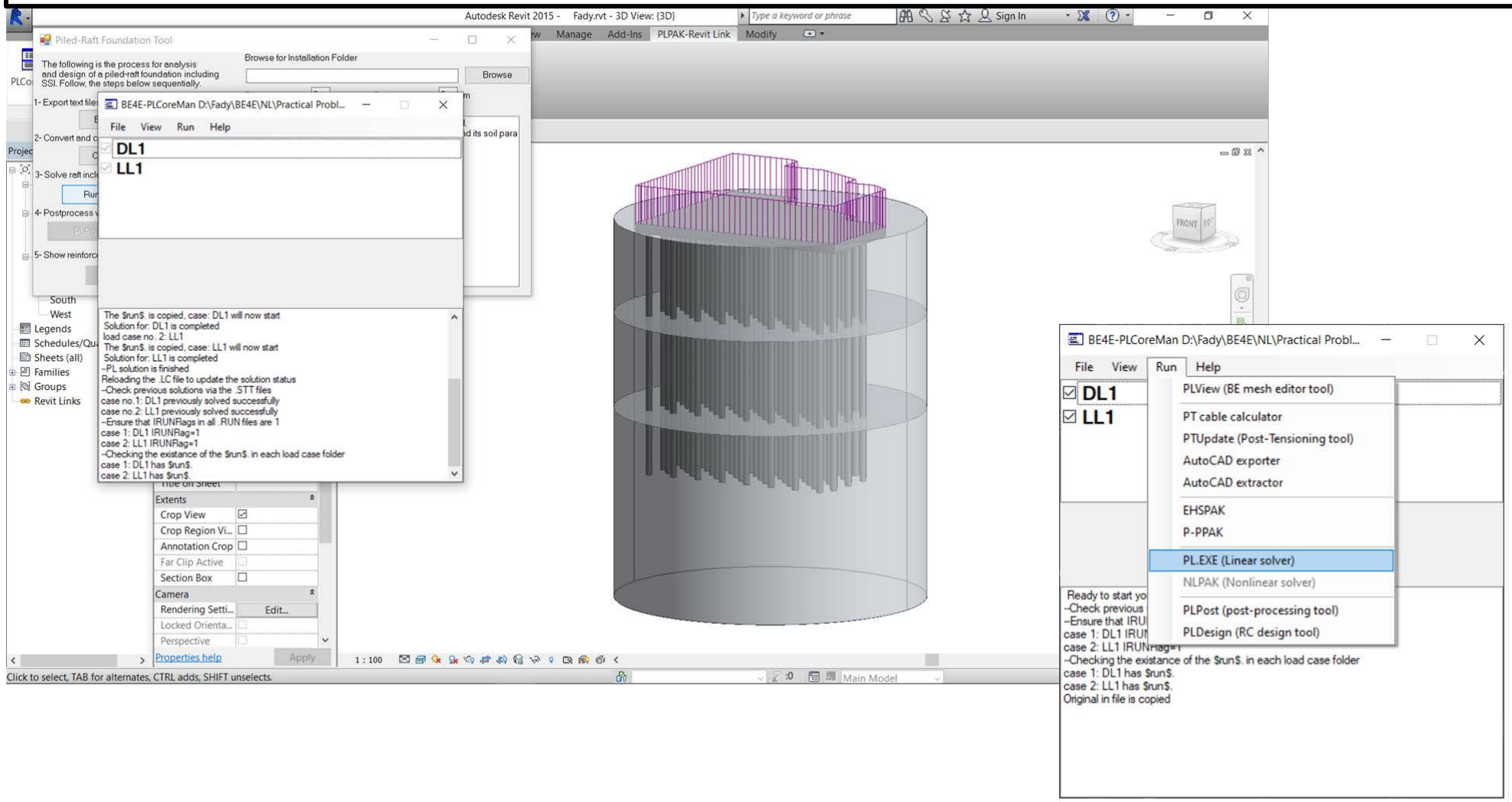
CUFE-BE

Boundary Elements for Engineers — www.be4e.com

Cairo University

4. Foundation Package (Foundation)

10- Run the linear solver PL.exe

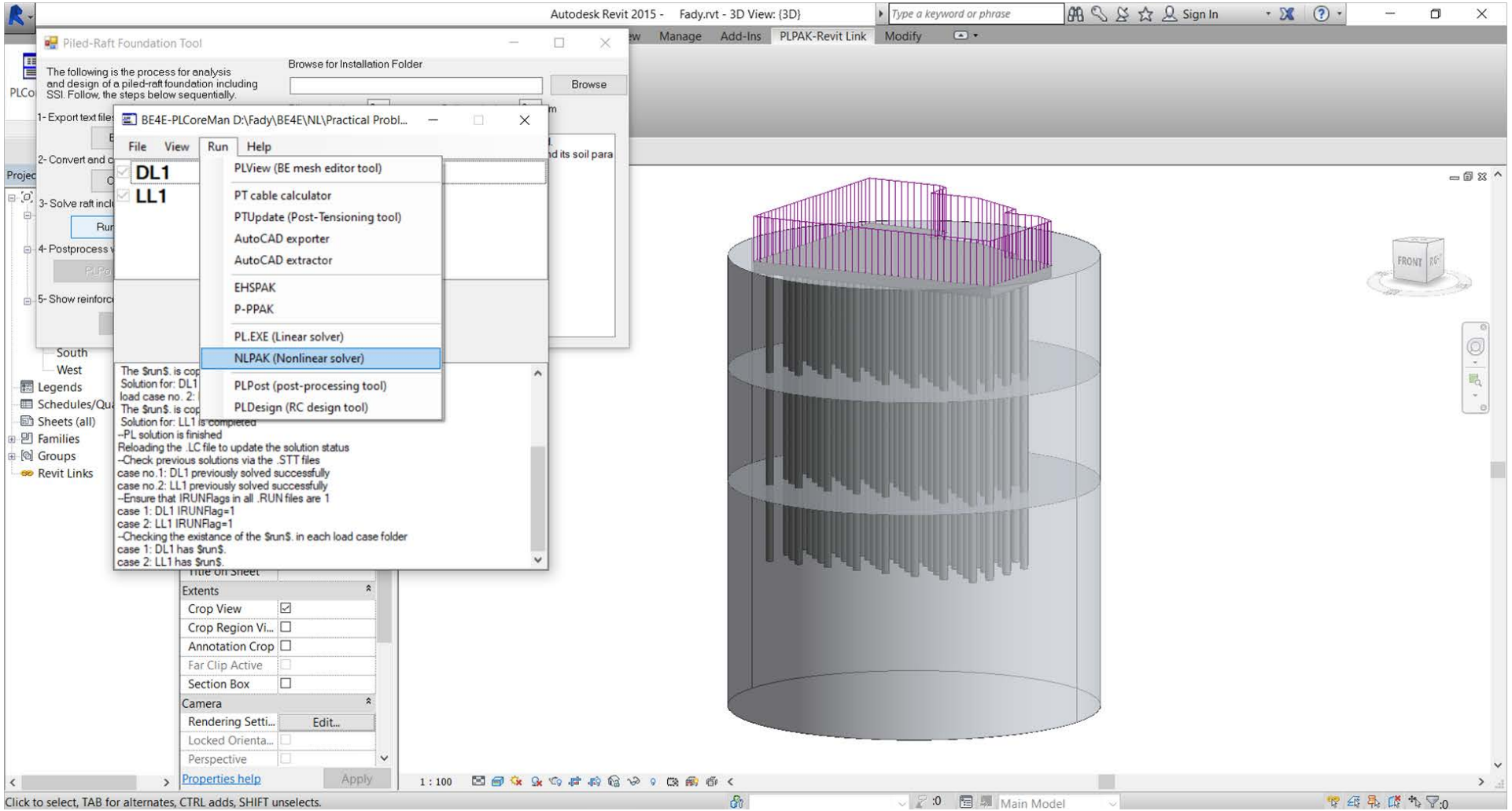


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

11- Run the nonlinear solver NLPAK

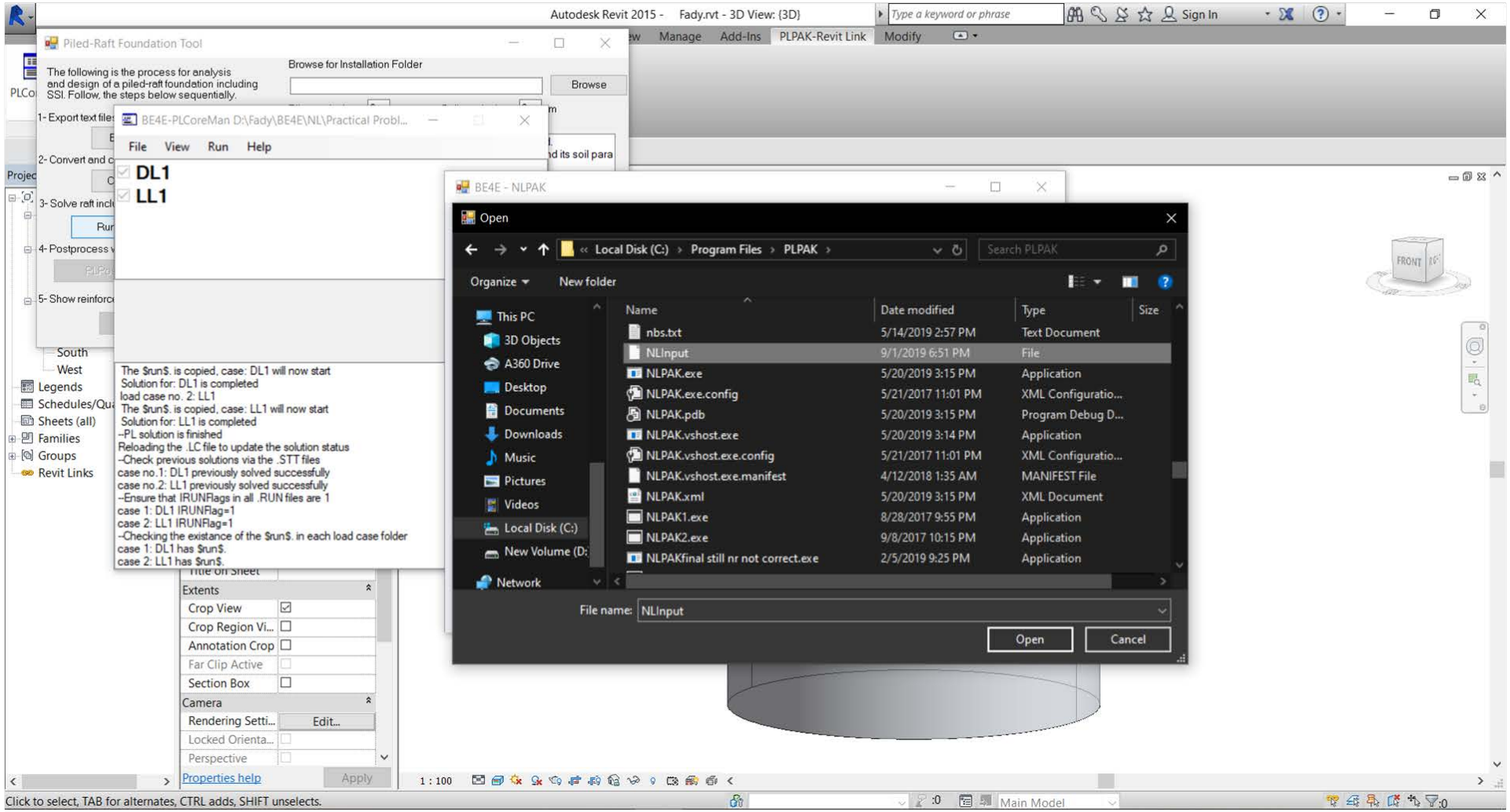


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

Browse NLinput in PLPAK folder (extracted from pile editor)



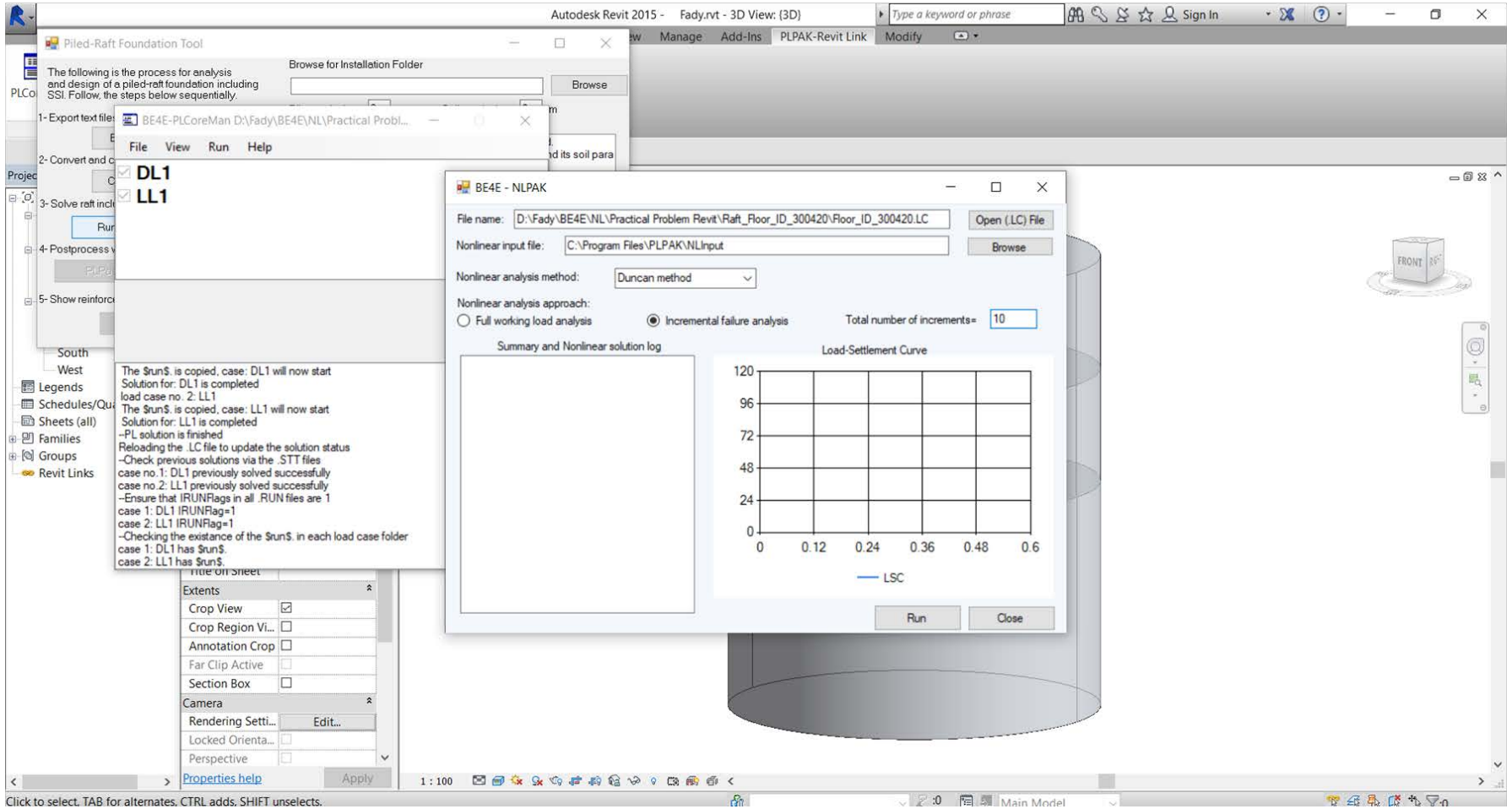
CUFE-BE

www.be4e.com

Cairo University

4. Foundation Package (FoundPAK)

12- Choose your nonlinear approach: Full working load, or Incremental failure analysis (Input number of increments)

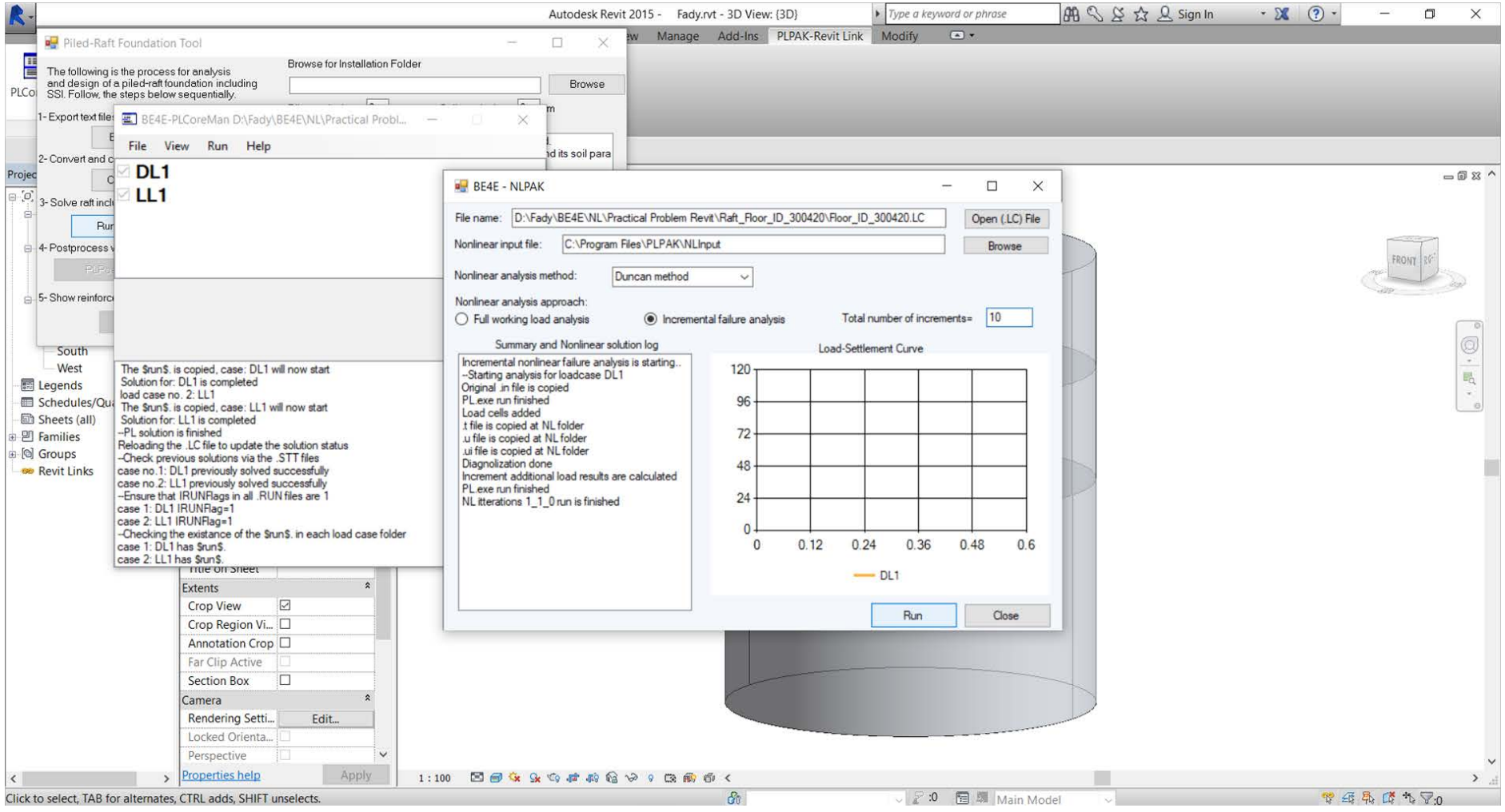


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

13- Run the solver

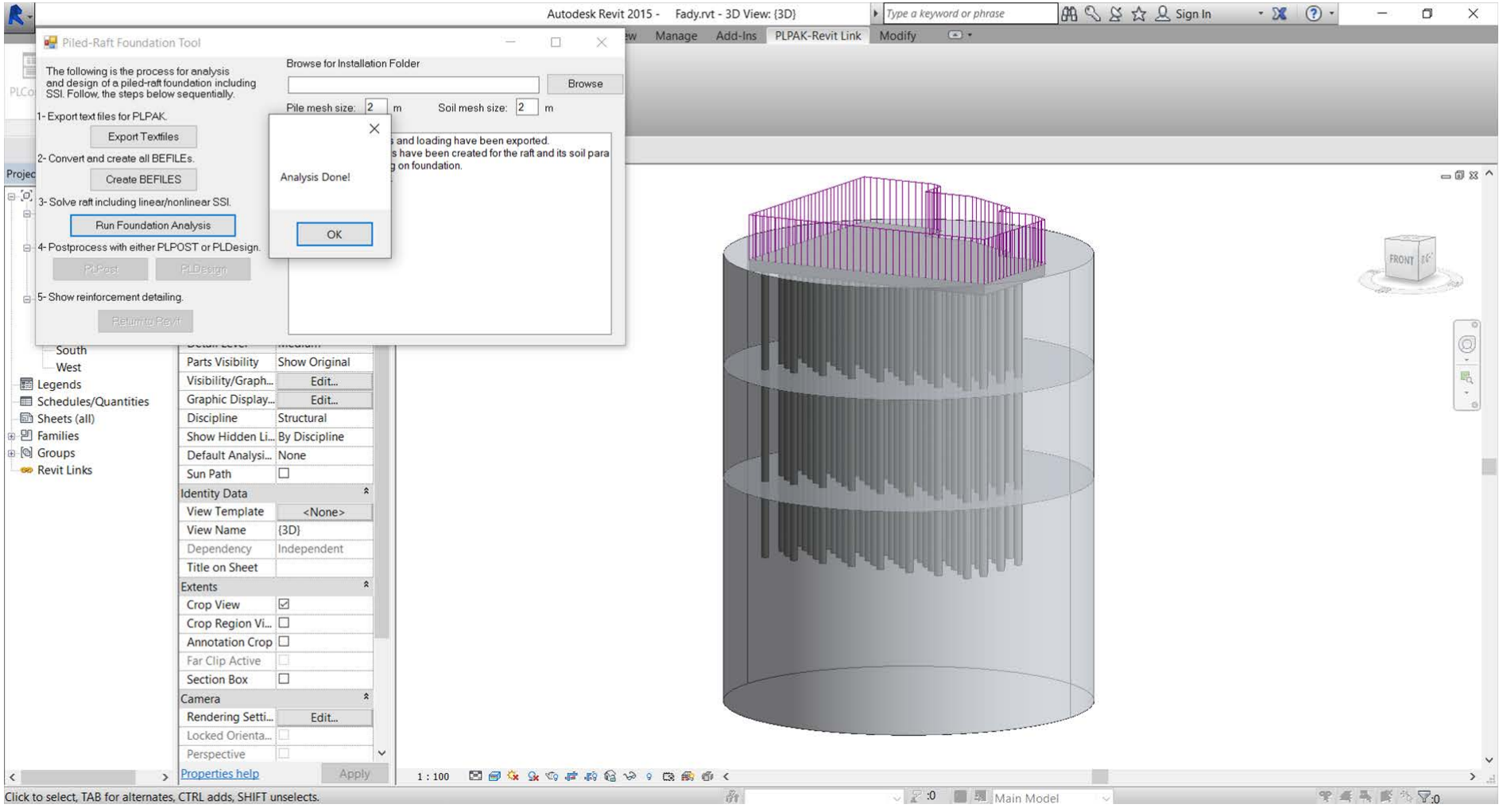


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

14- Close PLCoreMan and go back to the wizard (Analysis done!)

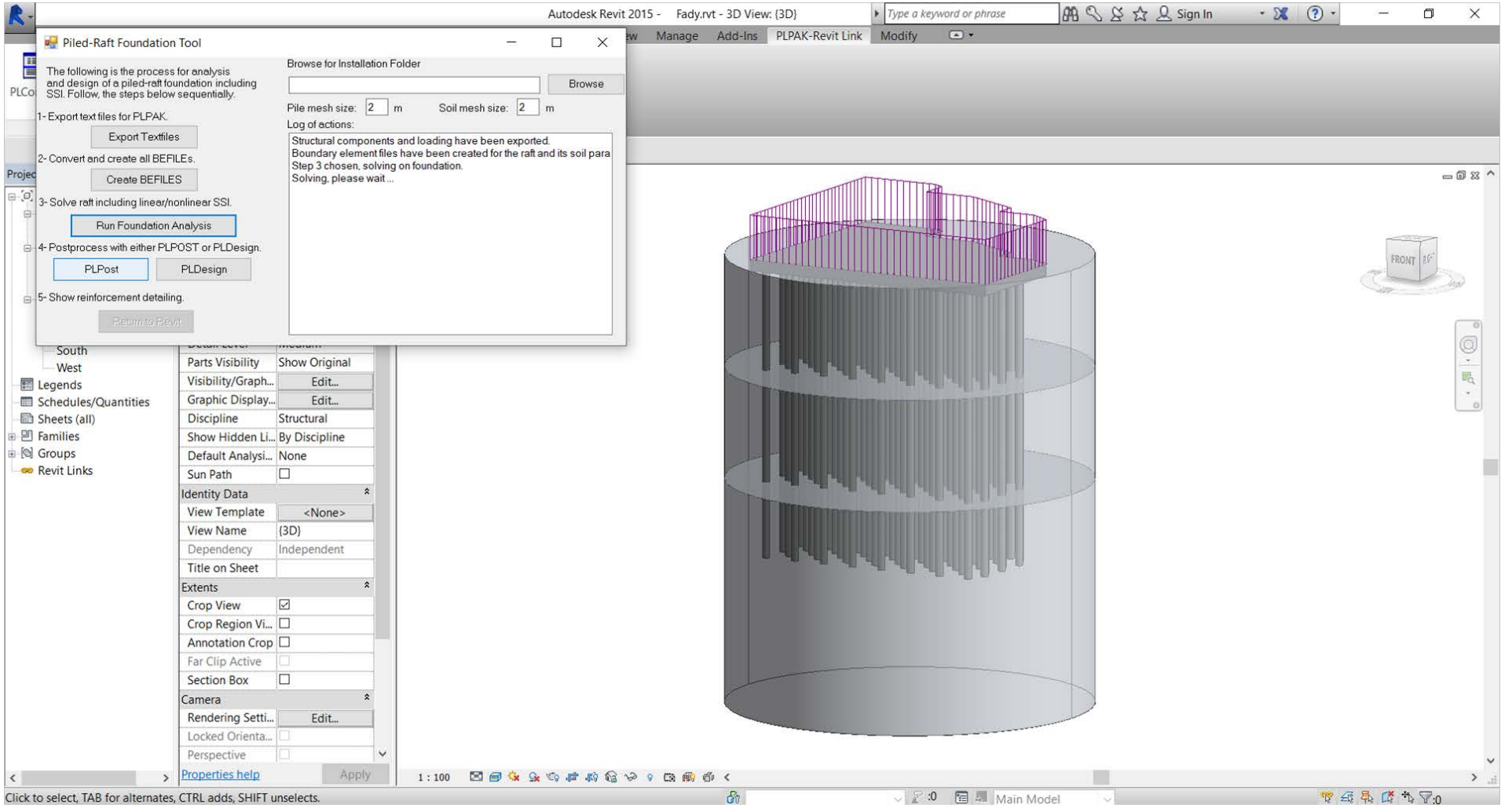


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

15- Open PLPost to show the results

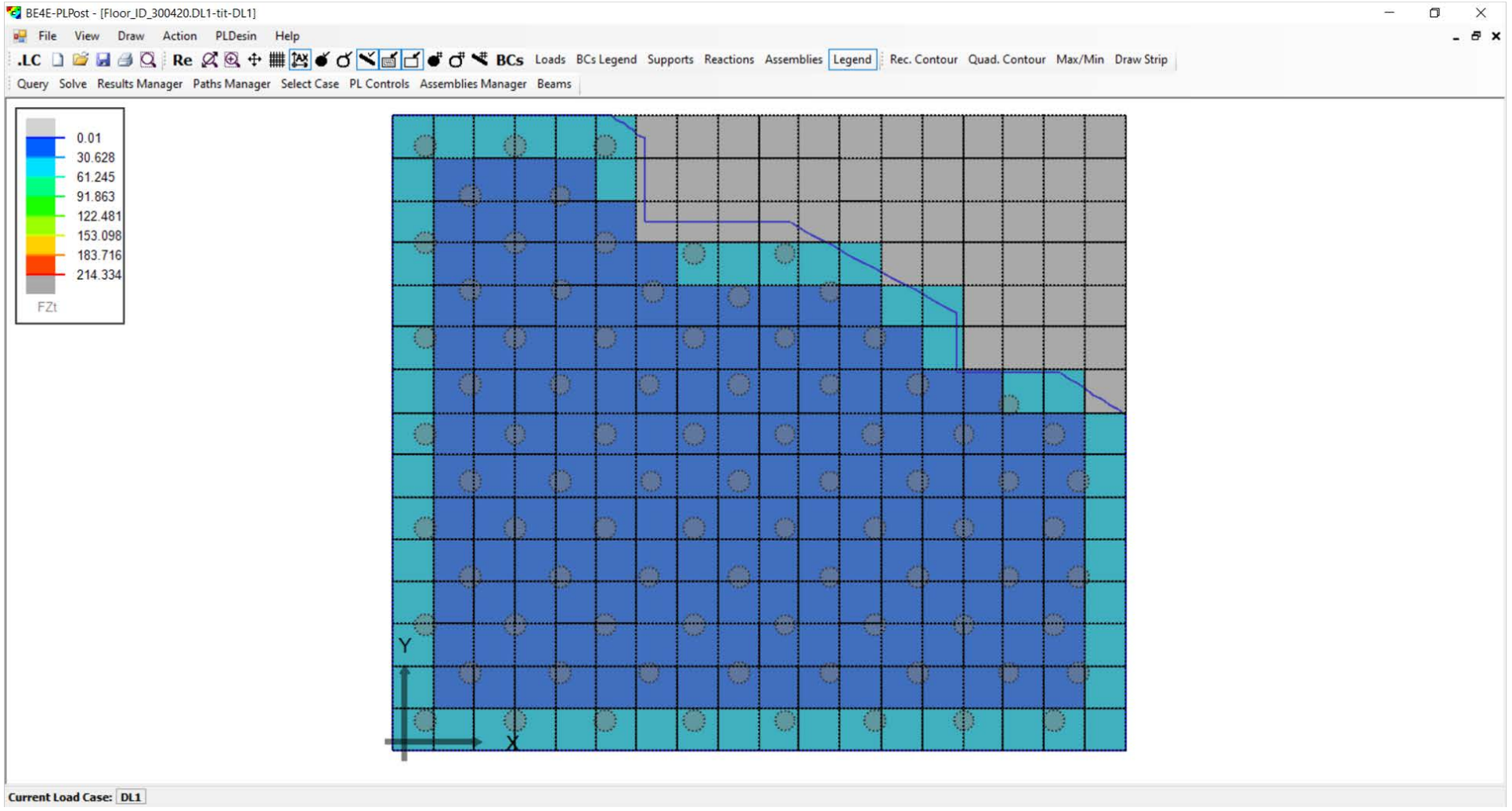


CUFE-BE

Cairo University

4. Foundation Package (Foundation)

Soil and piles nonlinear reactions

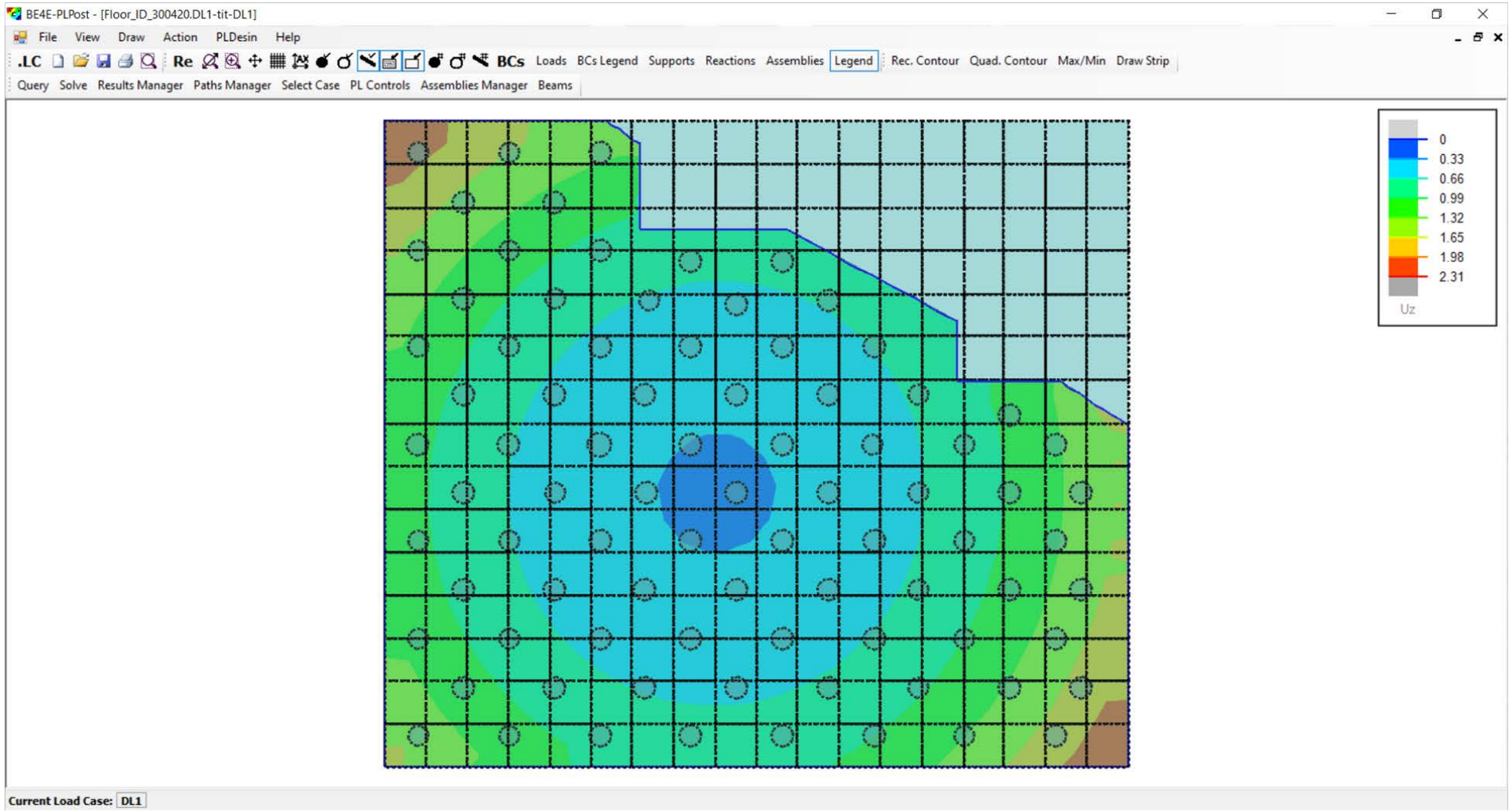


CUFE-BE

Cairo University

4. Foundation Package (Foundation)

Piled raft nonlinear settlement contours



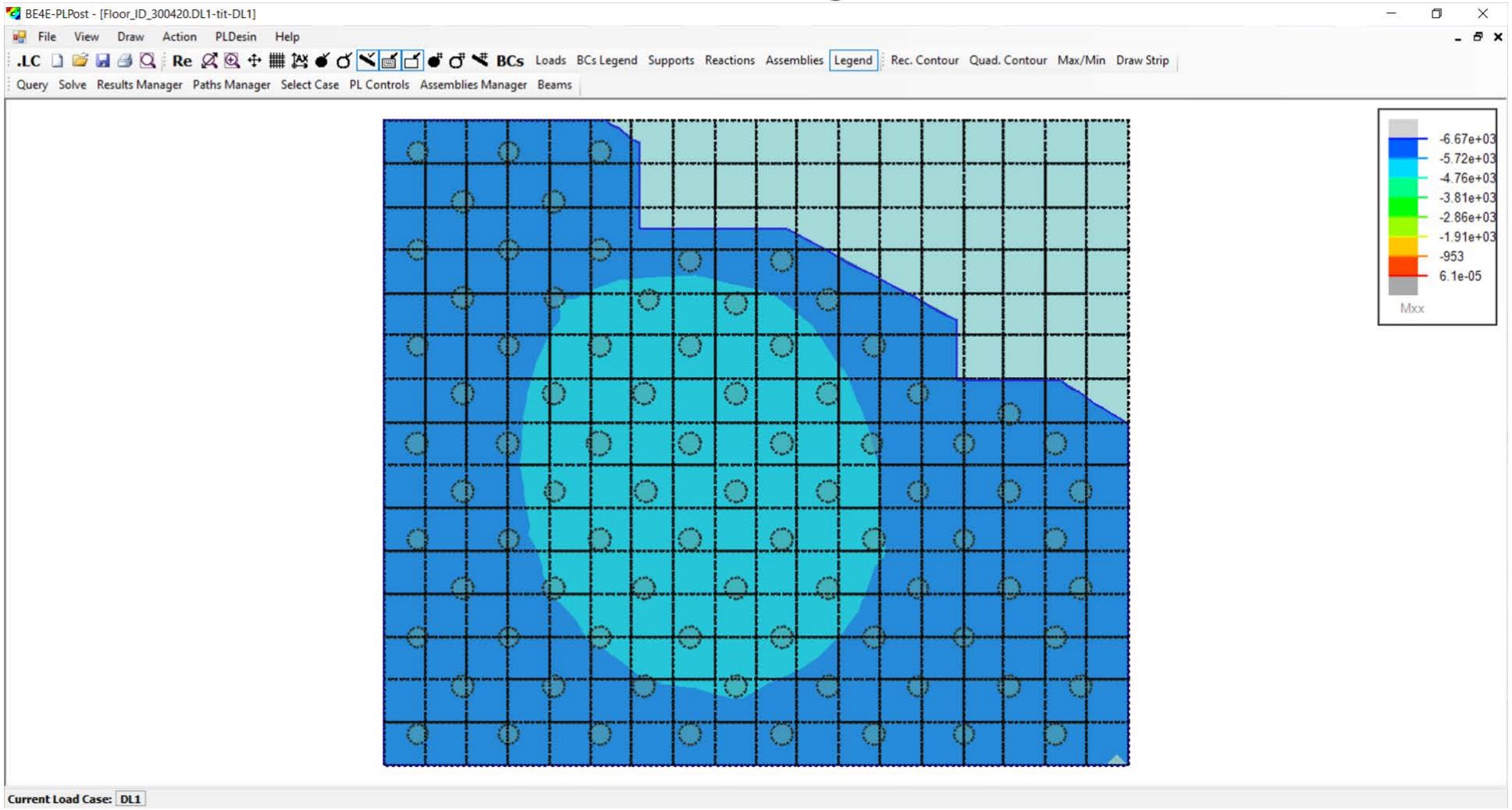
CUFE-BE

Boundary Elements for Engineers
www.be4e.com

Cairo University

4. Foundation Package (Foundation)

Piled raft nonlinear bending moment contours

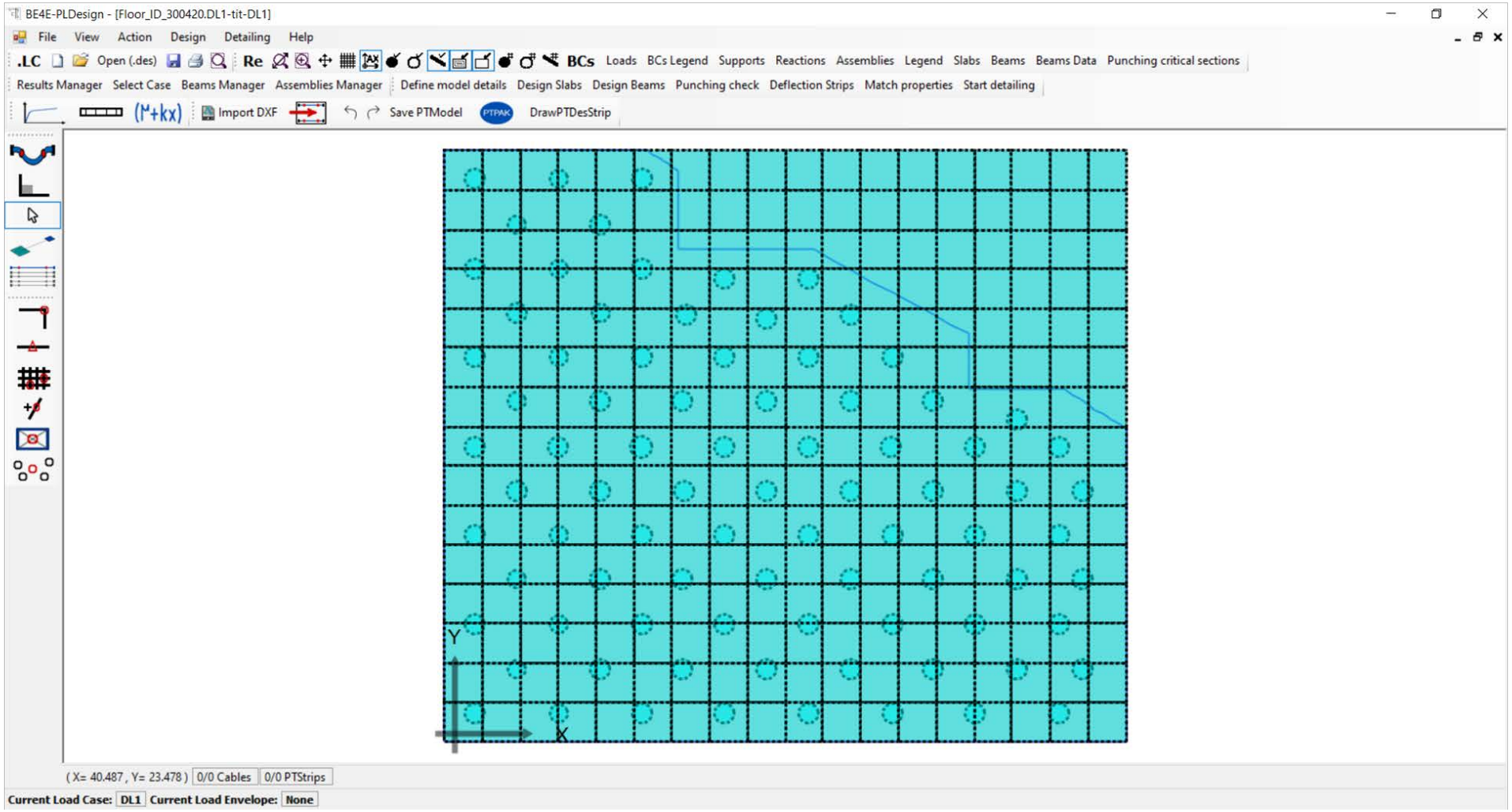


CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

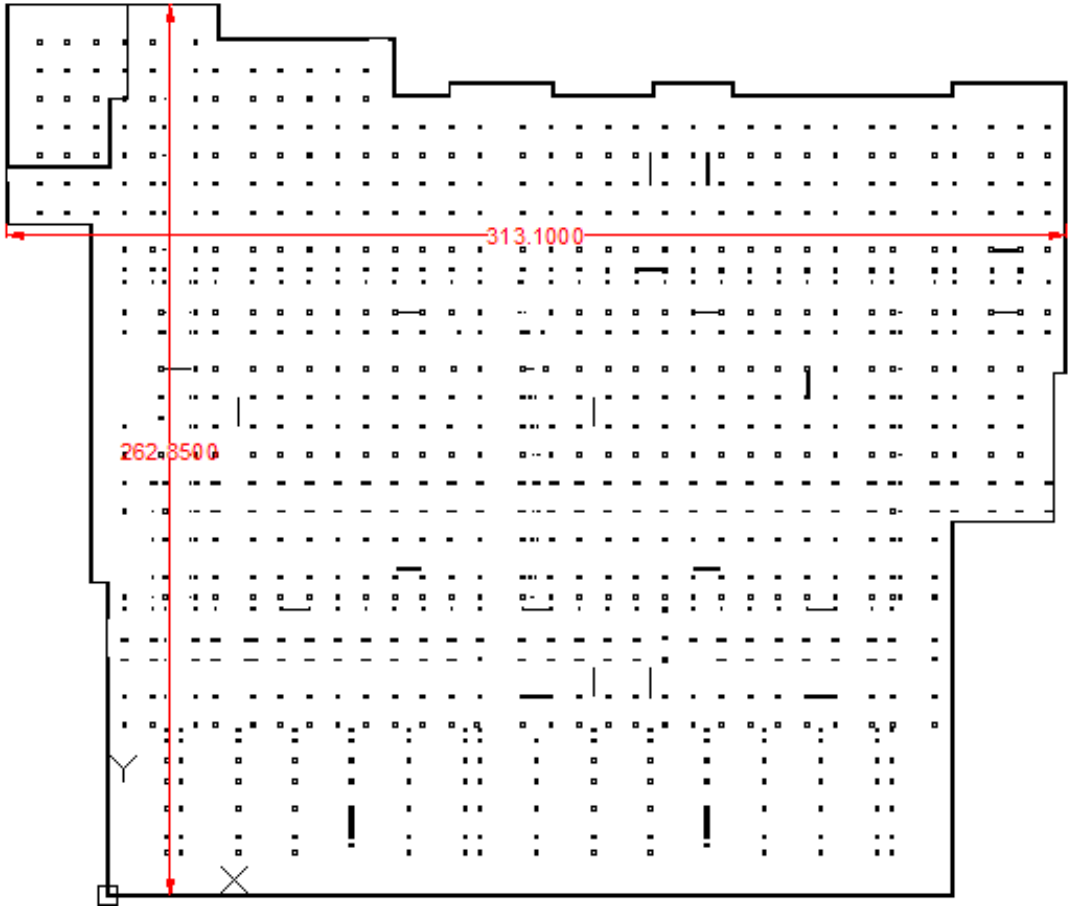
16- Open PLDesign to design the raft as RC or PT raft



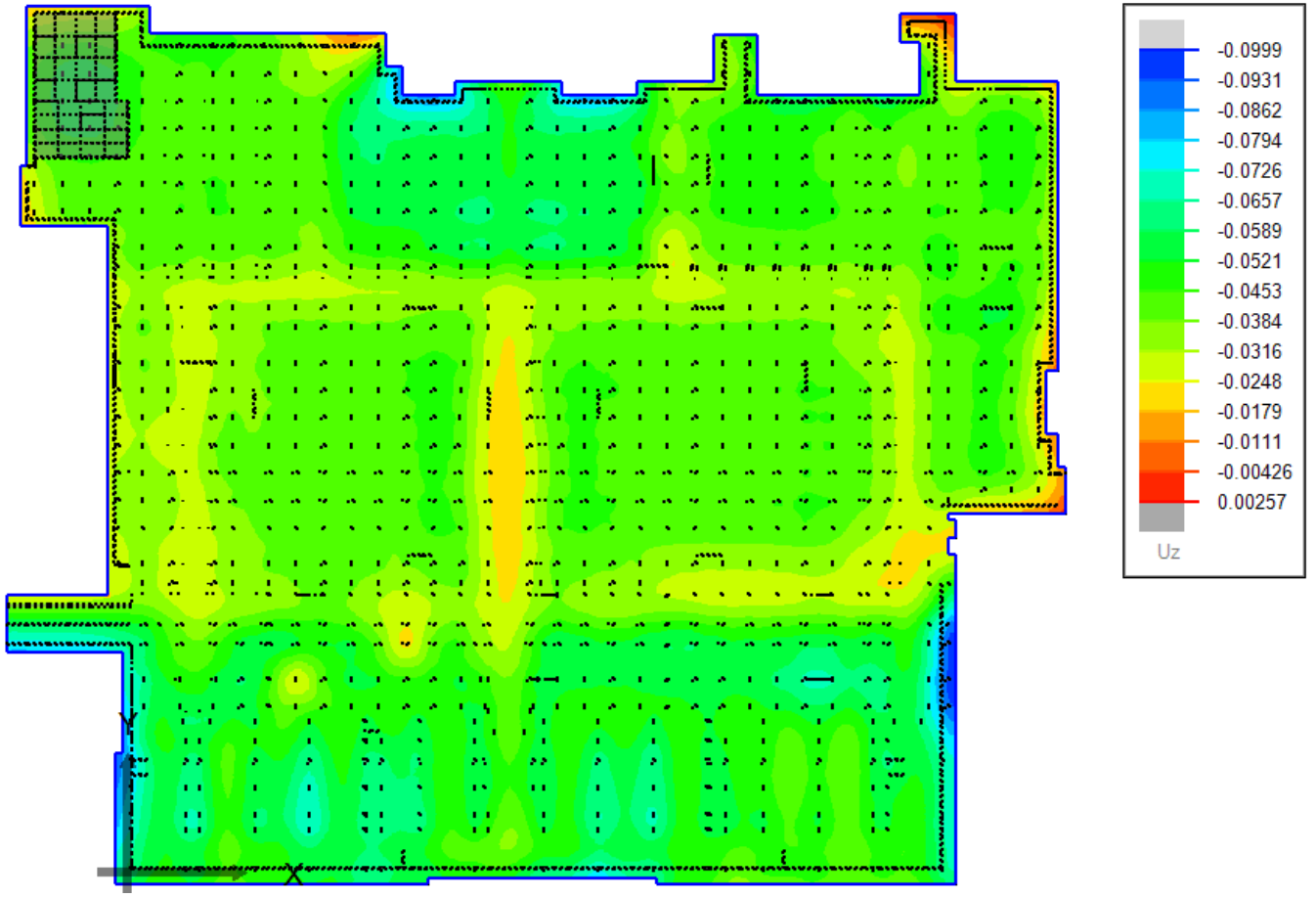
CUFE-BE

Cairo University

4. Foundation Package (Found1.AK)



AutoCAD Drawing

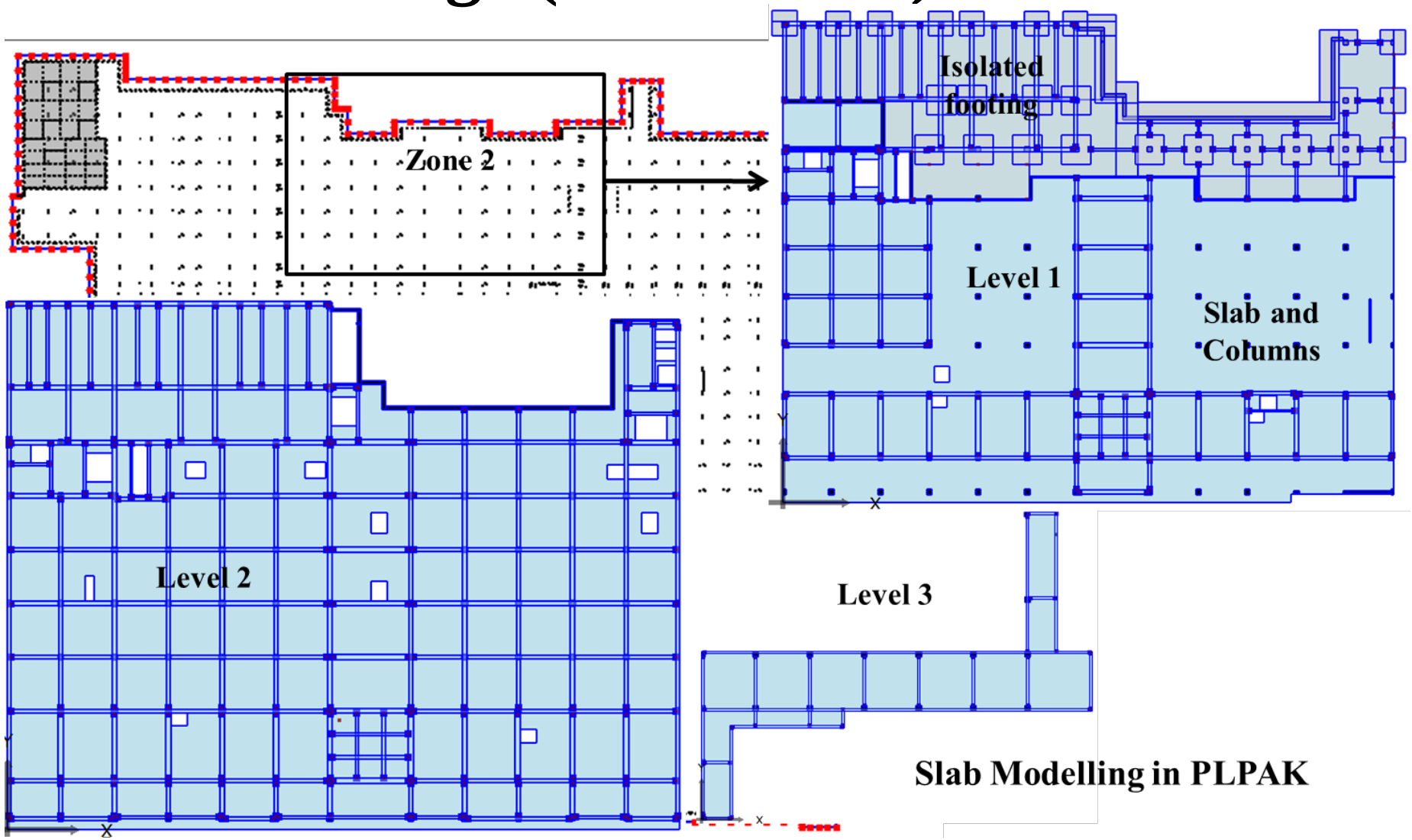


Deformation contour

CUFE-BE

Cairo University

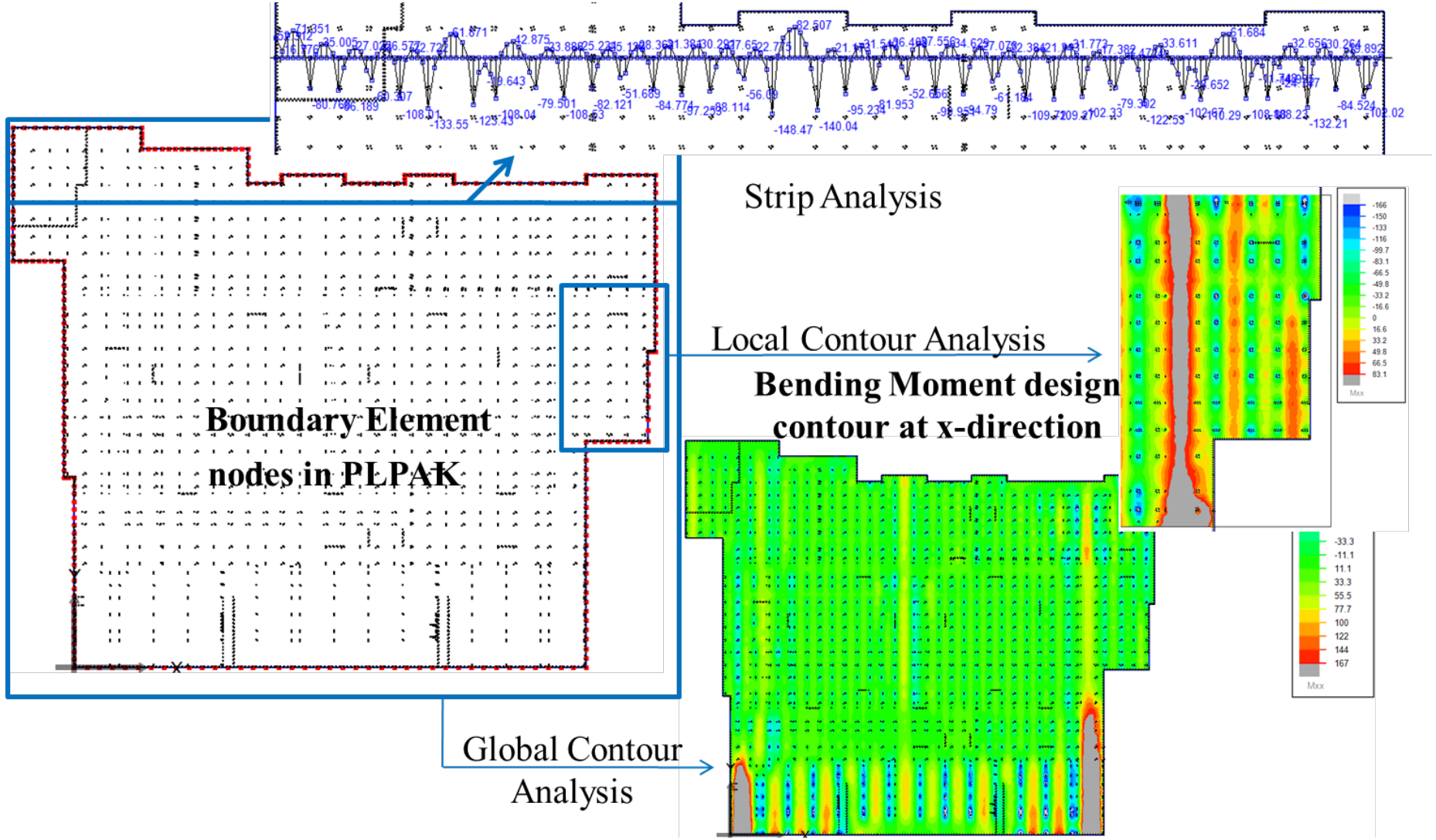
4. Foundation Package (Foundation)



CUFE-BE

Cairo University

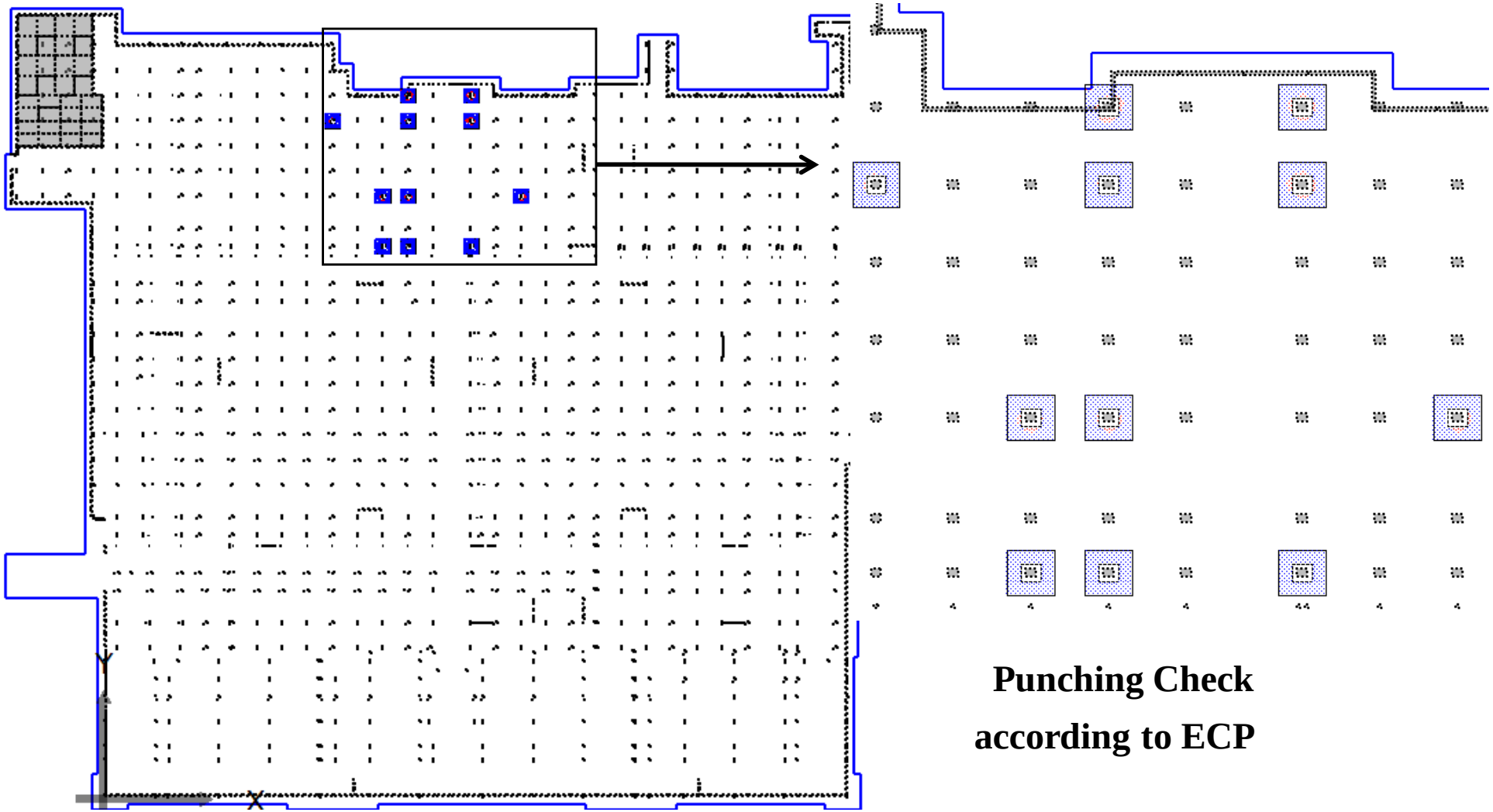
4. Foundation Package (Foundation)



CUFE-BE

Cairo University

4. Foundation Package (Foundation)



Punching Check

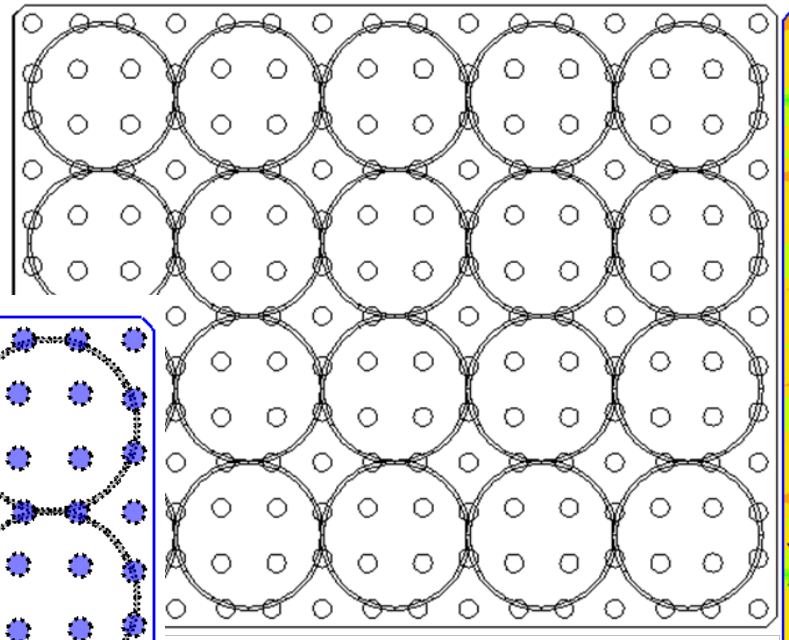
according to ECP

CUFE-BE

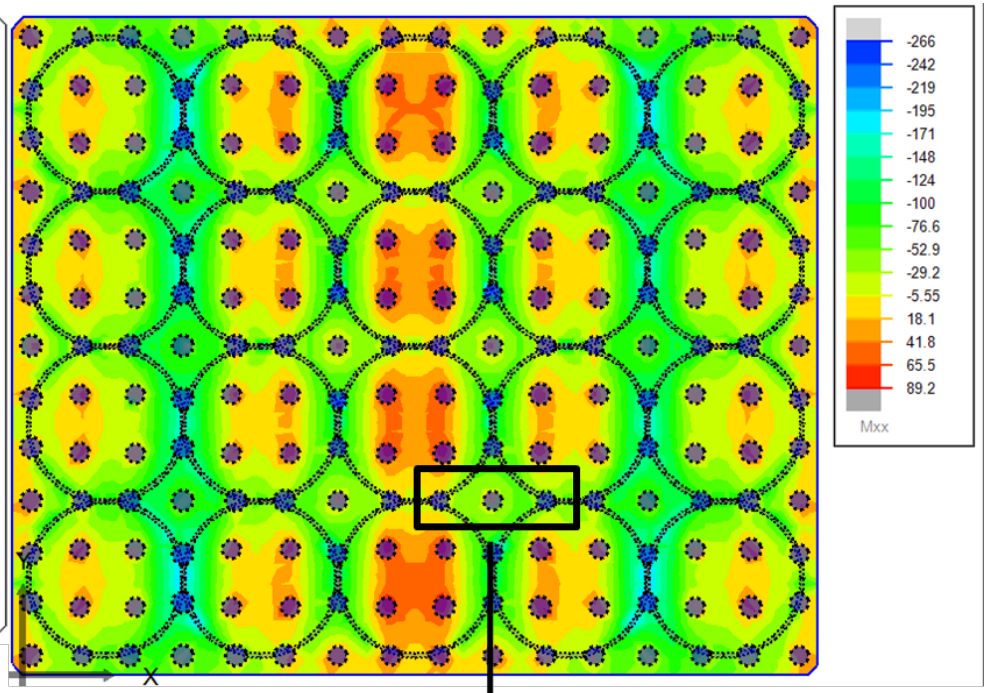
www.be4e.com

Cairo University

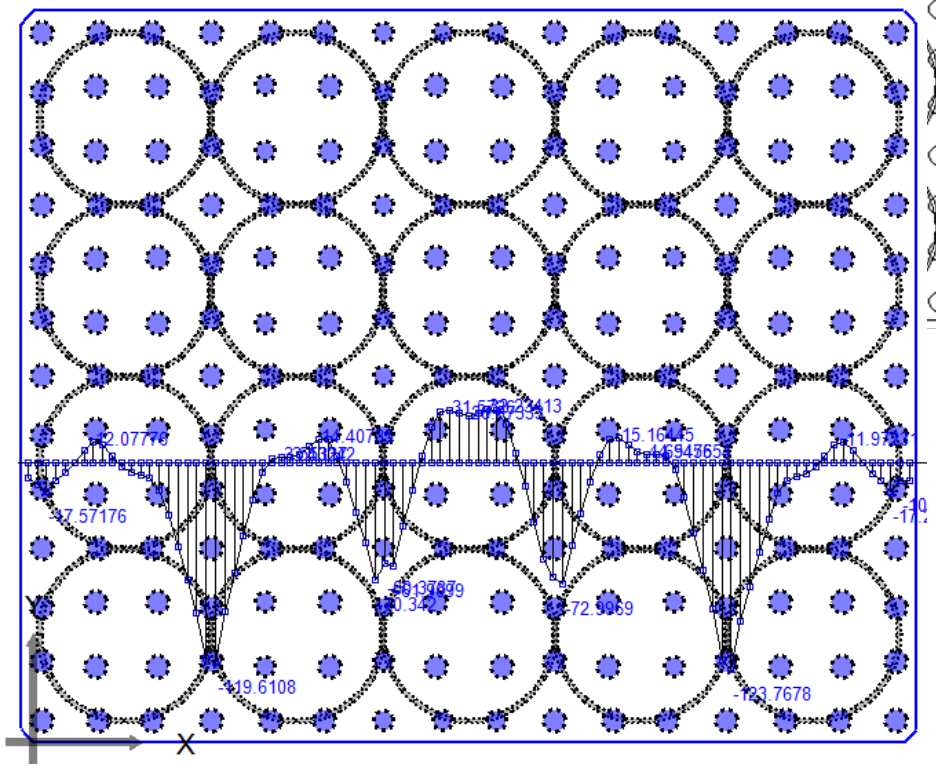
4. Foundation Package (Foundation)

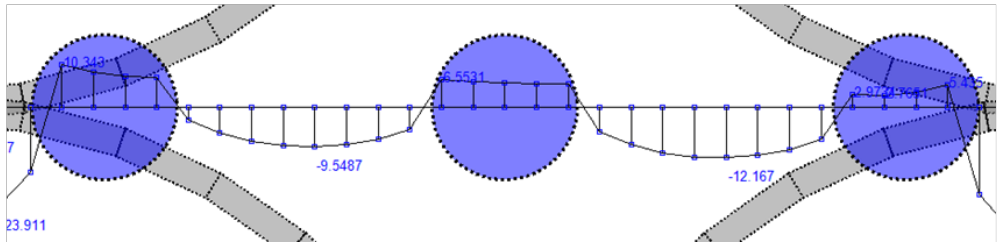


AutoCAD Drawing



Bending Moment contour at x-direction



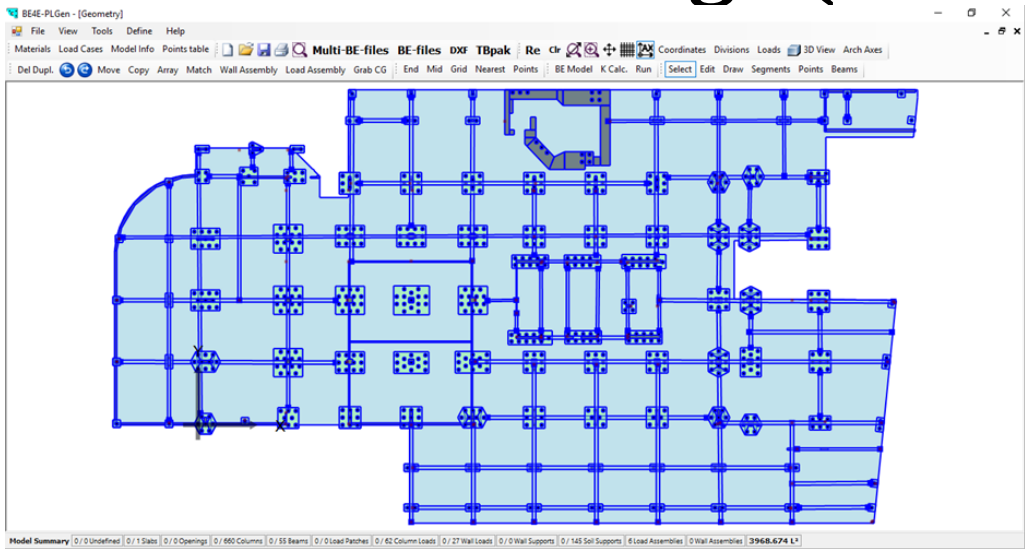


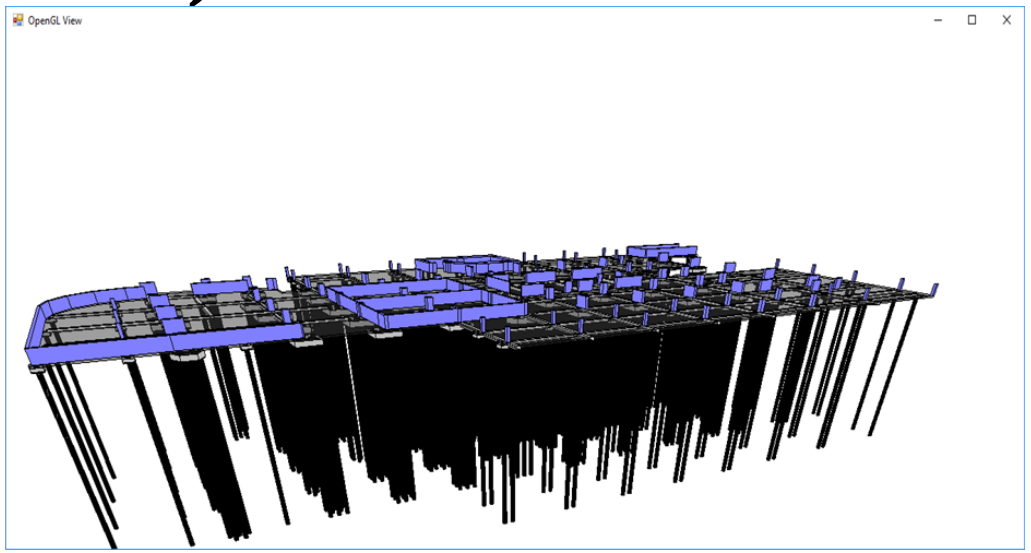
CUFE-BE

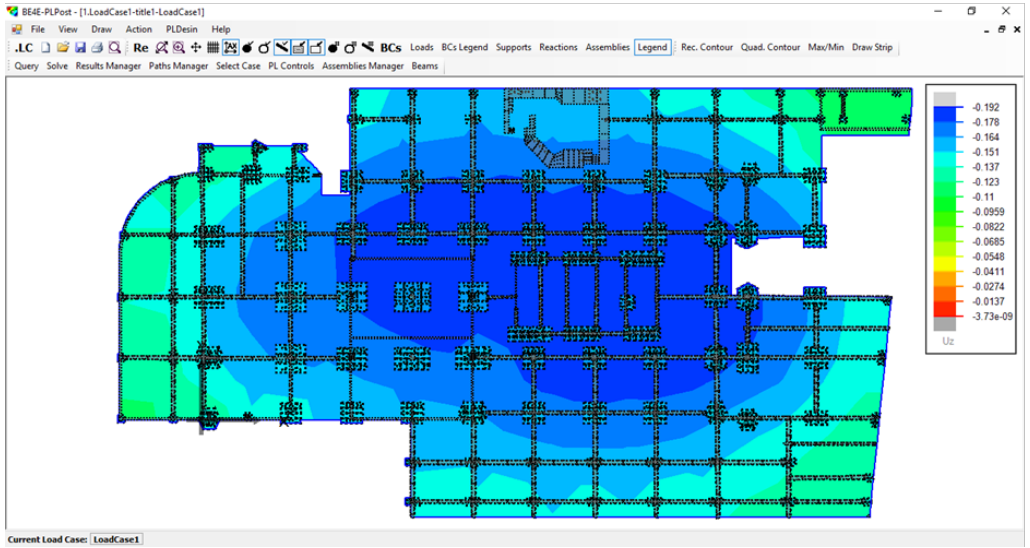
BOUNDARY ELEMENTS FOR ENGINEERS
www.be4e.com

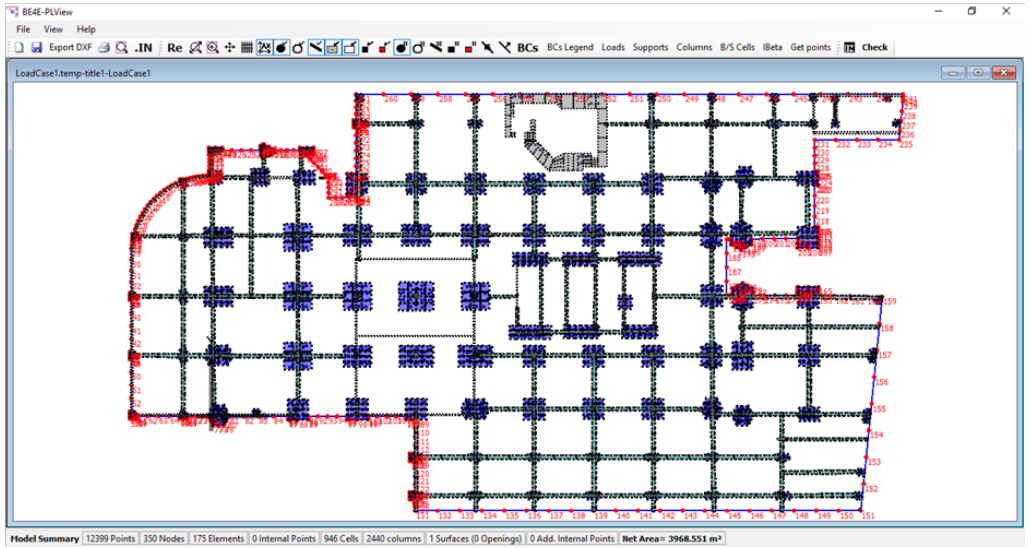
Cairo University

4. Foundation Package (Foundation)





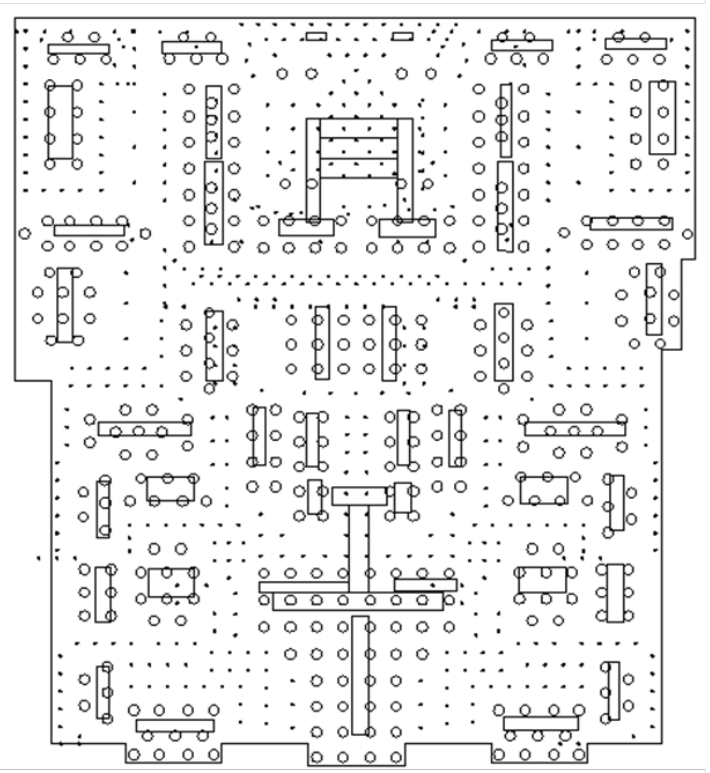




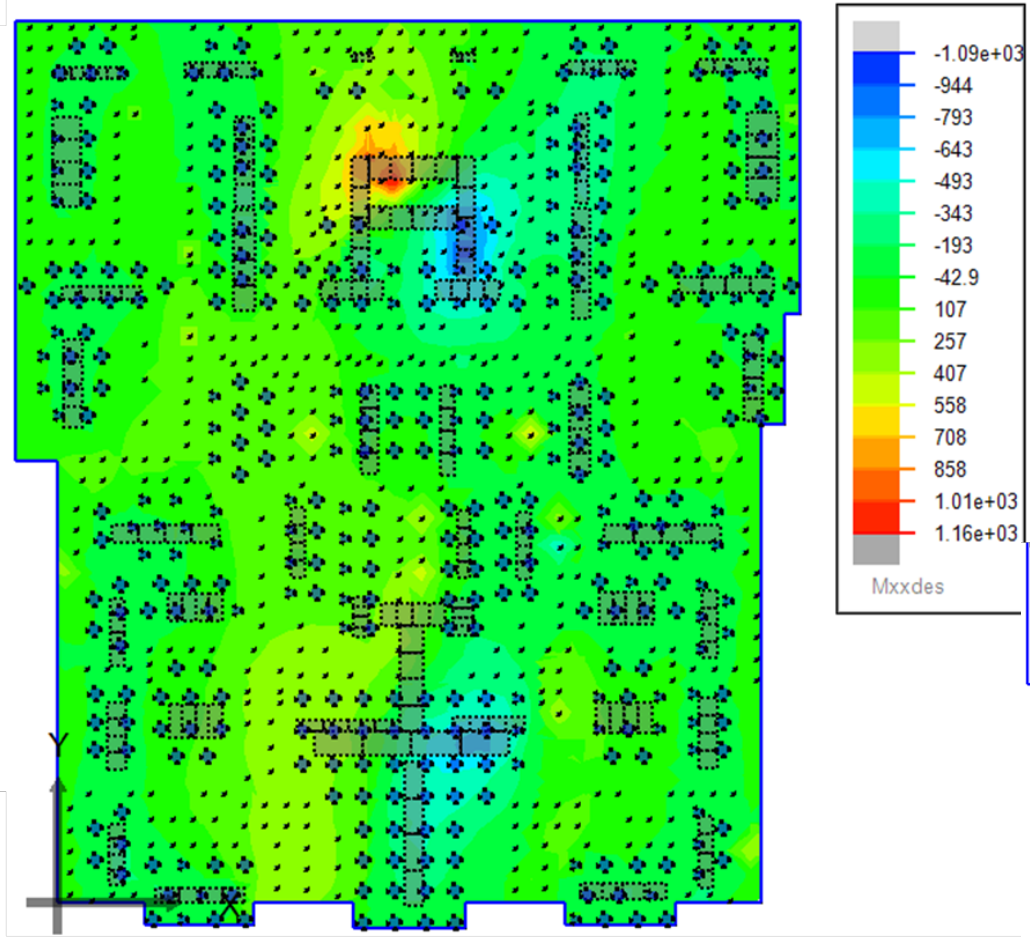
CUFE-BE

Cairo University

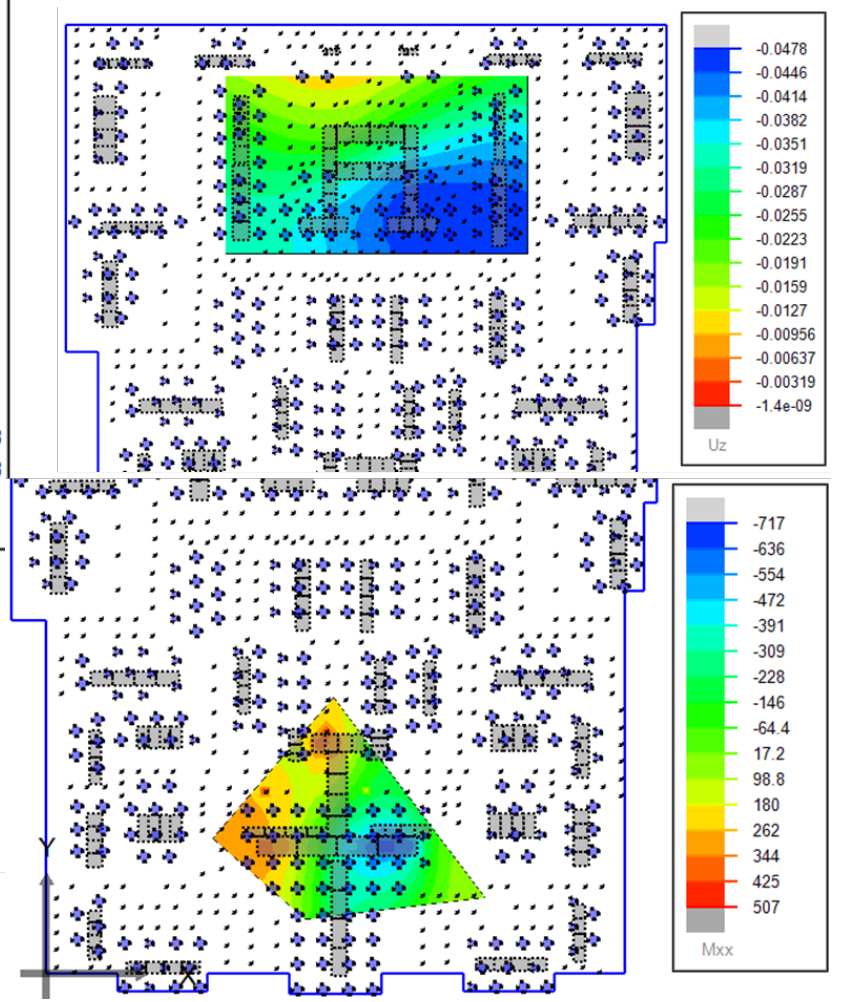
4. Foundation Package (Foundation)



AutoCAD Drawing



Bending Moment design contour at x-direction



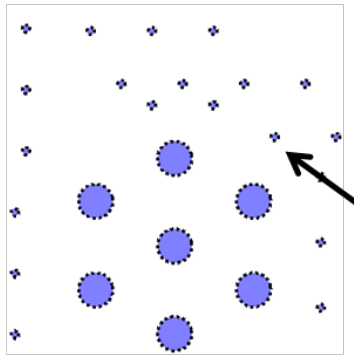
CUFE-BE

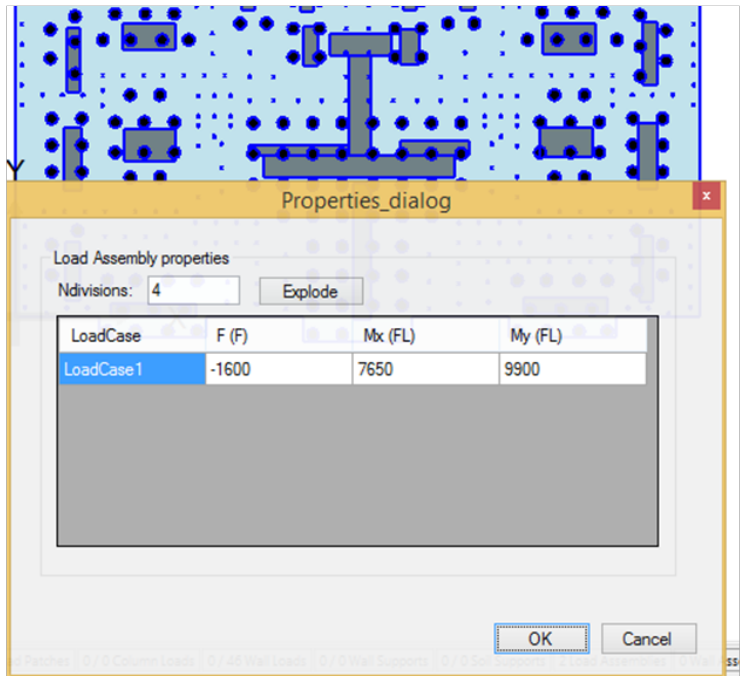
Boundary Elements for Engineers
www.be4e.com

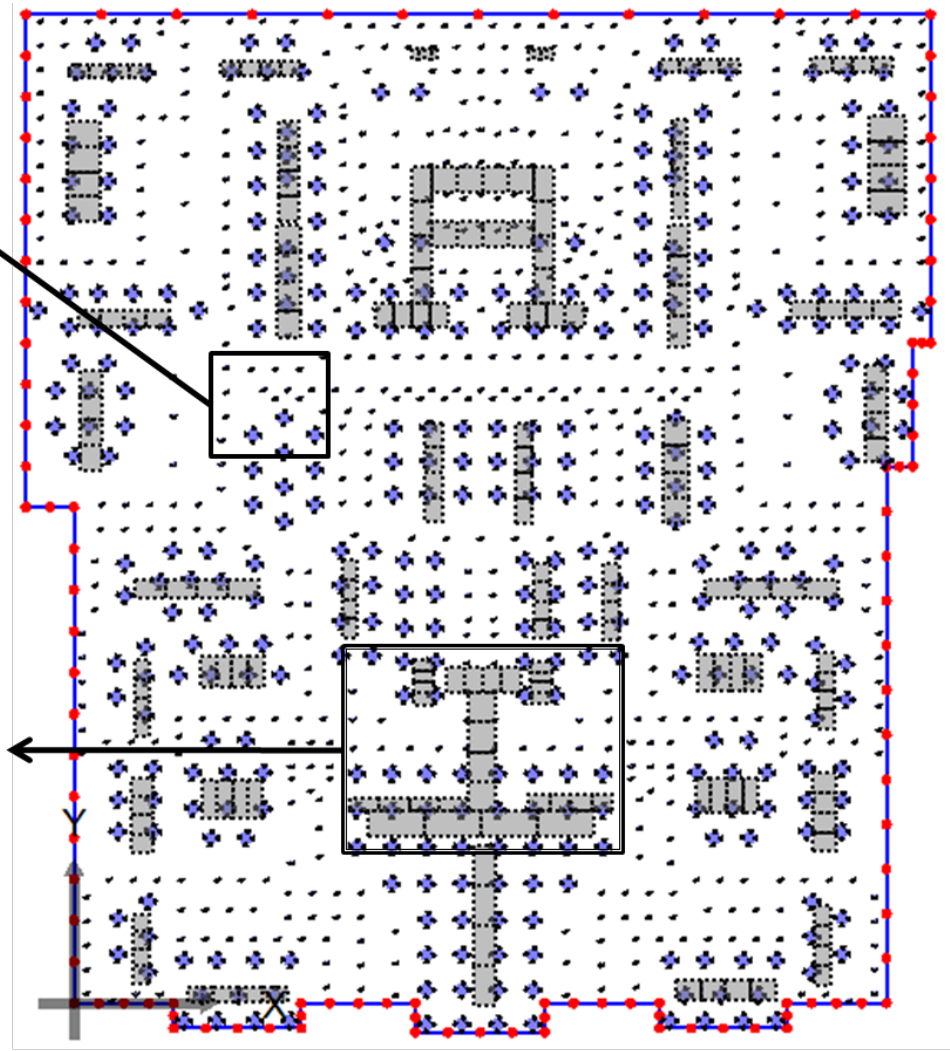
Cairo University

4. Foundation Package (Foundation)

Pile are modeled beside micro piles





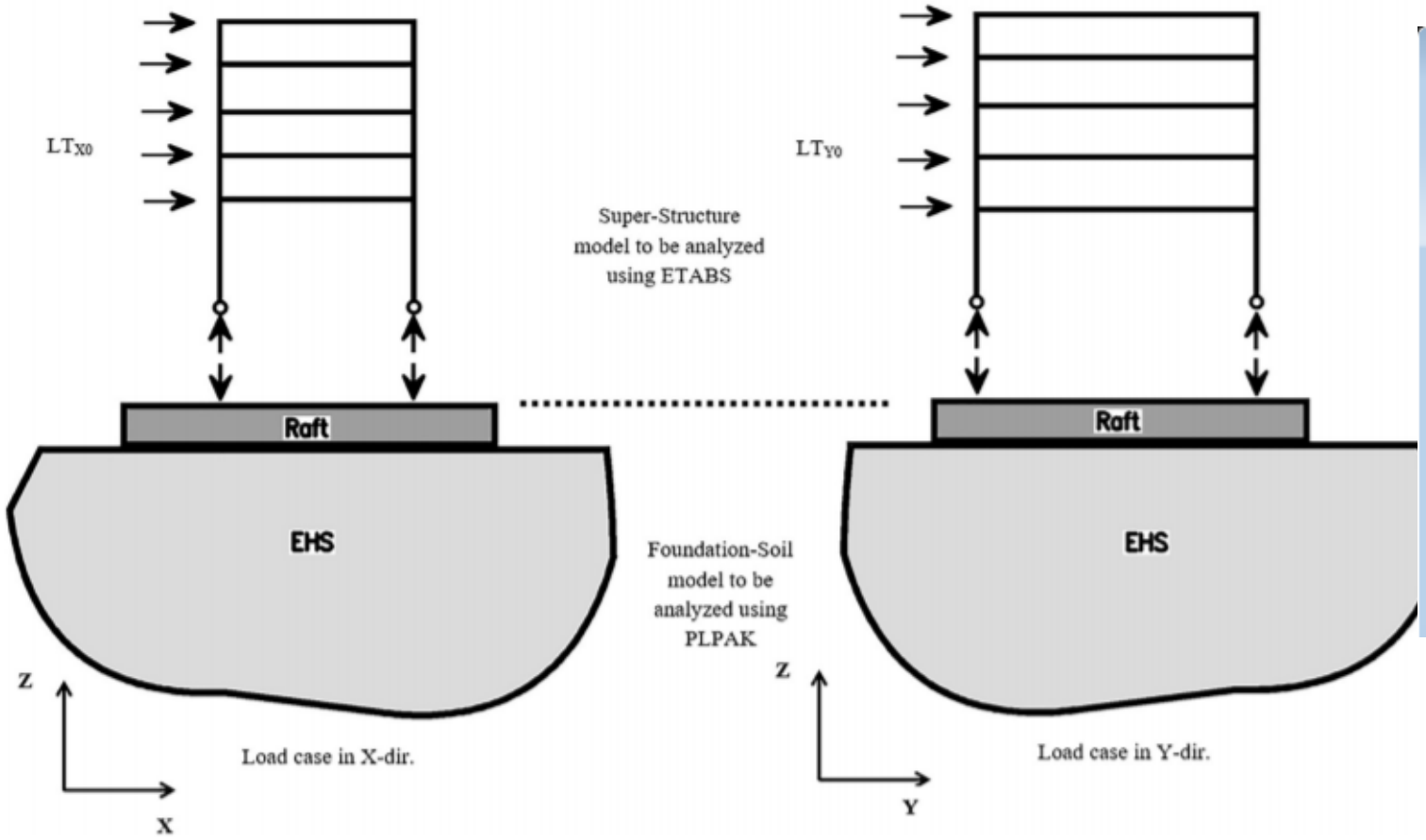


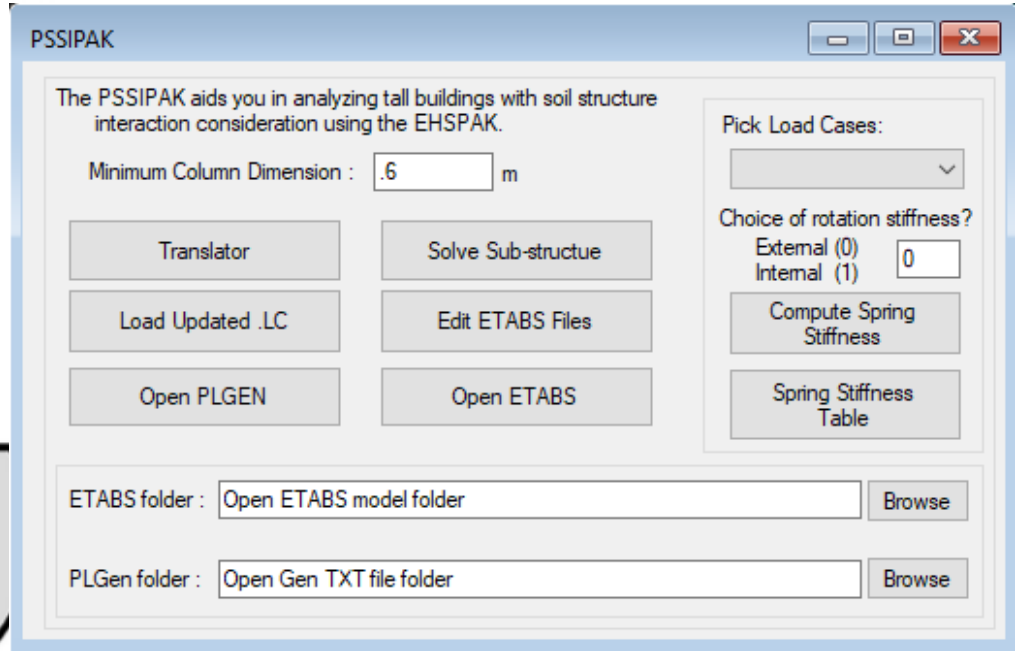
CUFE-BE

Cairo University

4. Foundation Package (FoundPAK)

User can solve building taking into accounts soil-structure interaction by using ETABS-PLPAK iterative solution. Super structure modeled using ETABS software, on the other hand raft/piled raft modeled using FoundPAK.





CUFE-BE

www.be4e.com

Cairo University

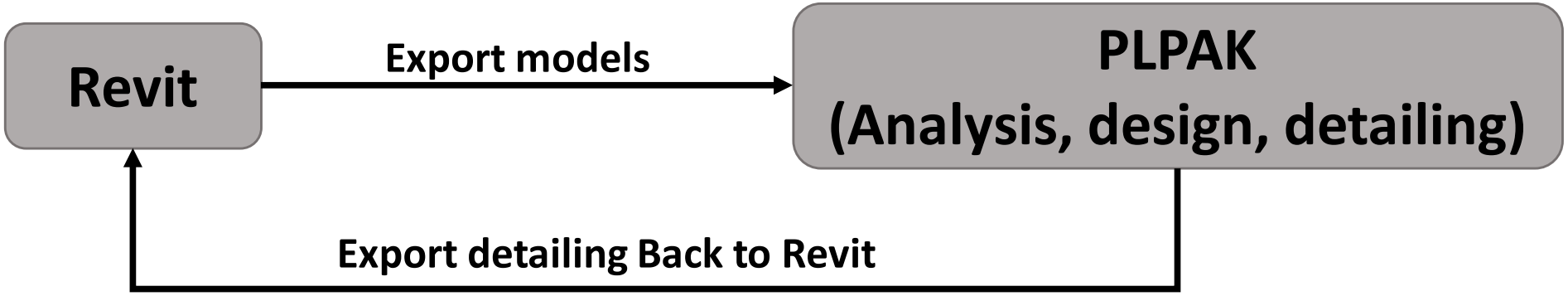
Table of contents

CUFE-BE

www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)



- BIM centered
- Lean process
- Quantity takeoff

CUFE-BE

Boundary Elements for Engineers
www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)

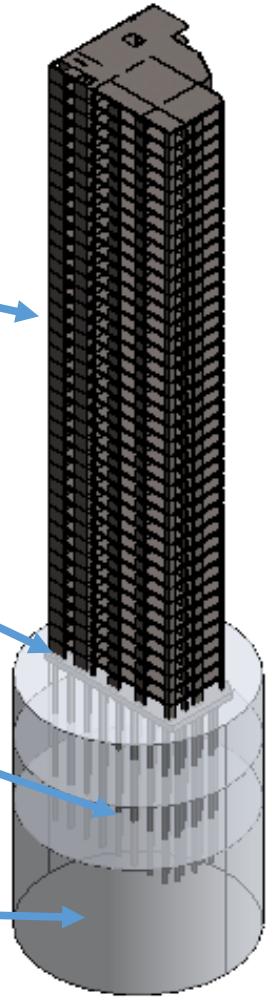
Overall analysis

Structure

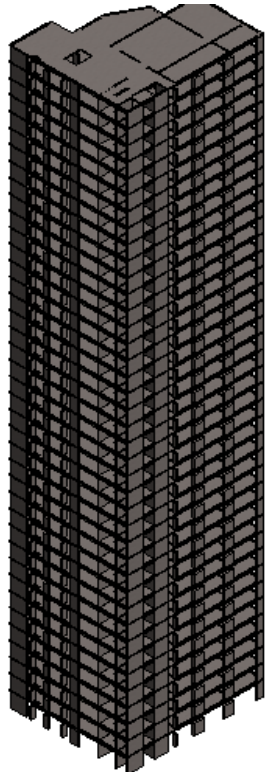
Raft

Piles

Soil



Fixed base analysis

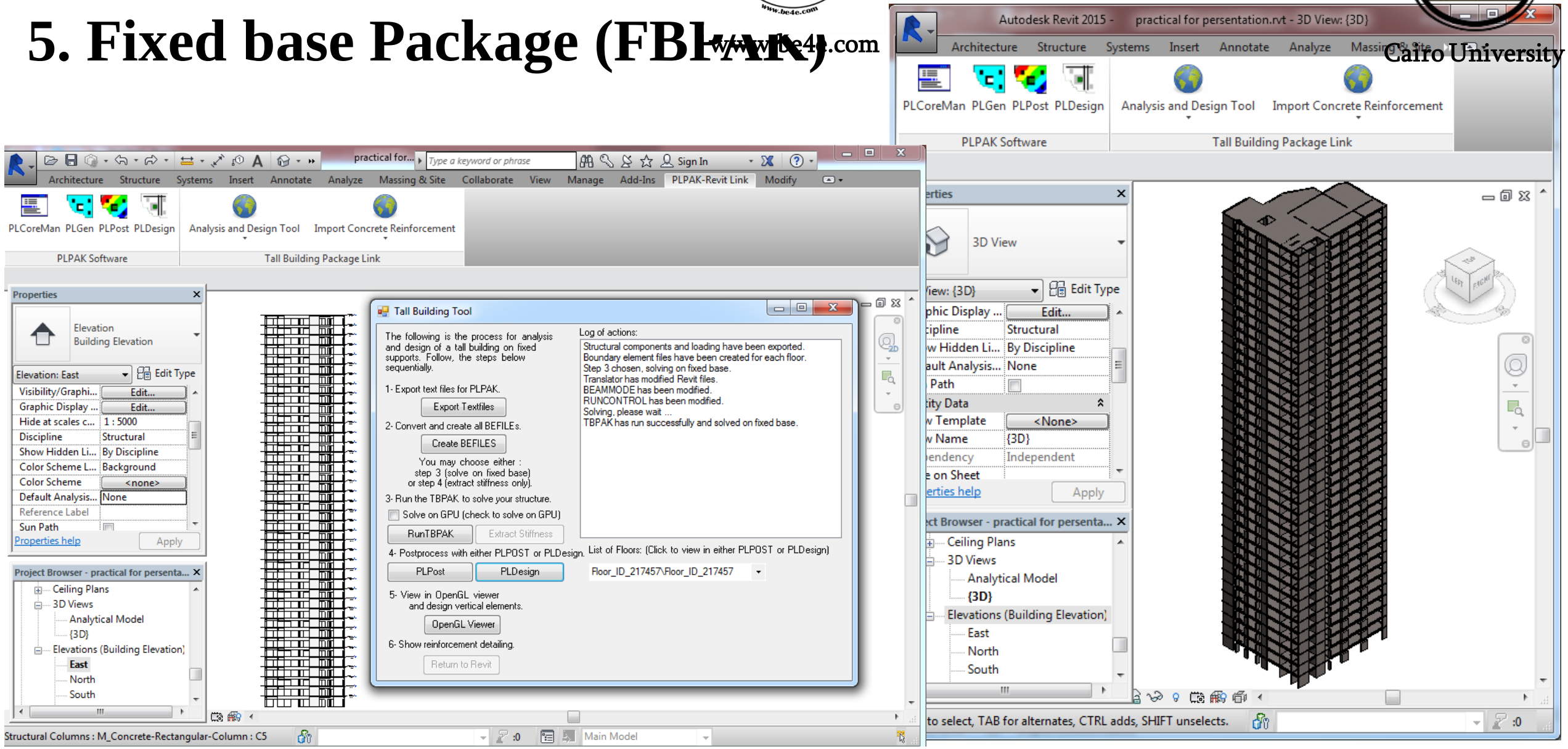


CUFE-BE

www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)

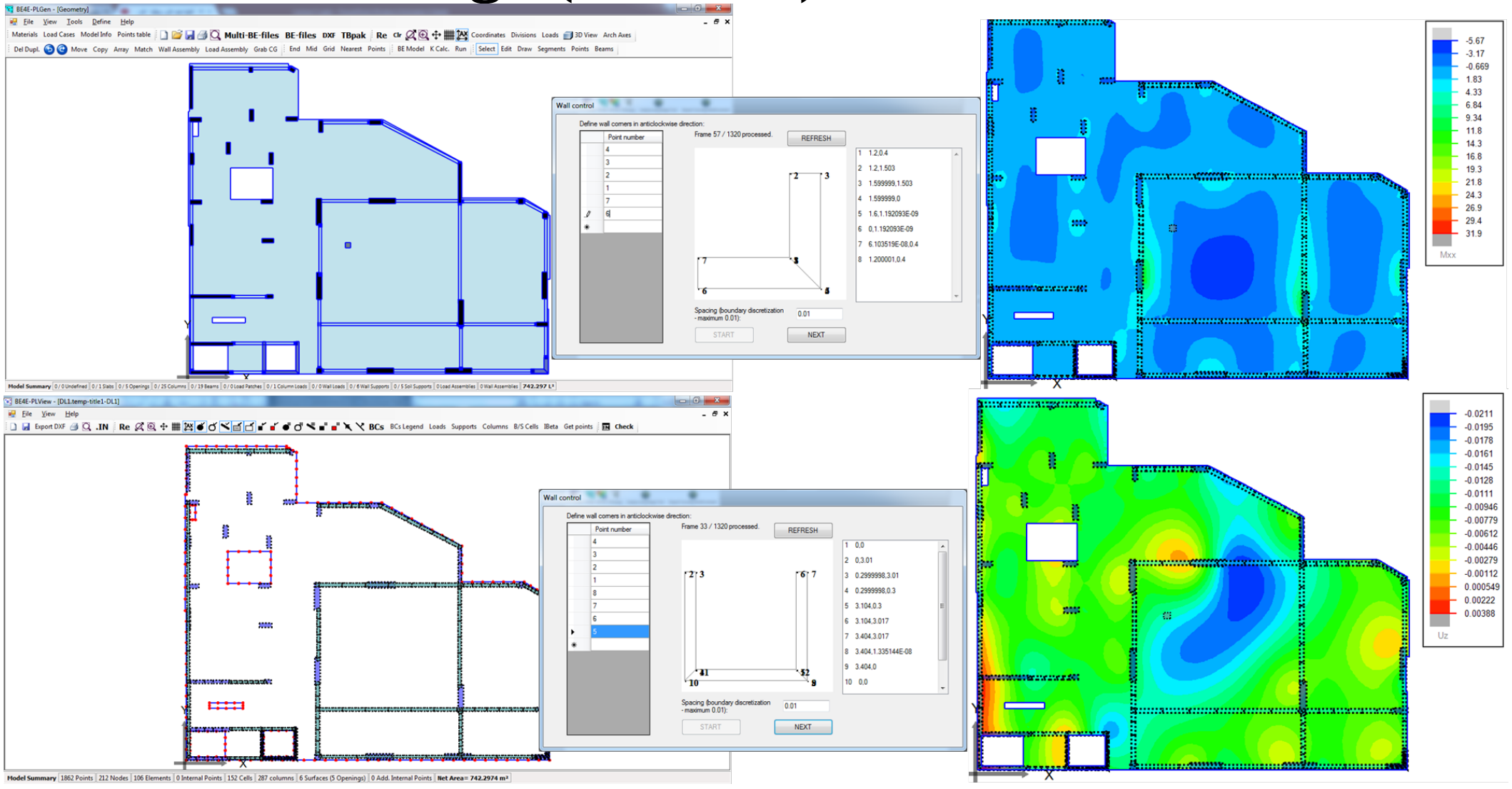


CUFE-BE

www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)



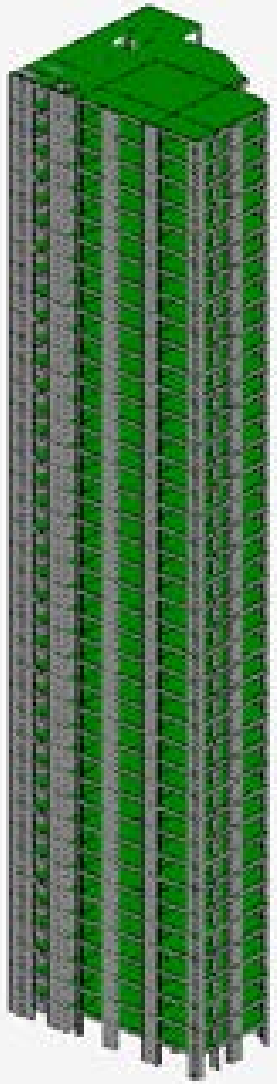
CUFE-BE

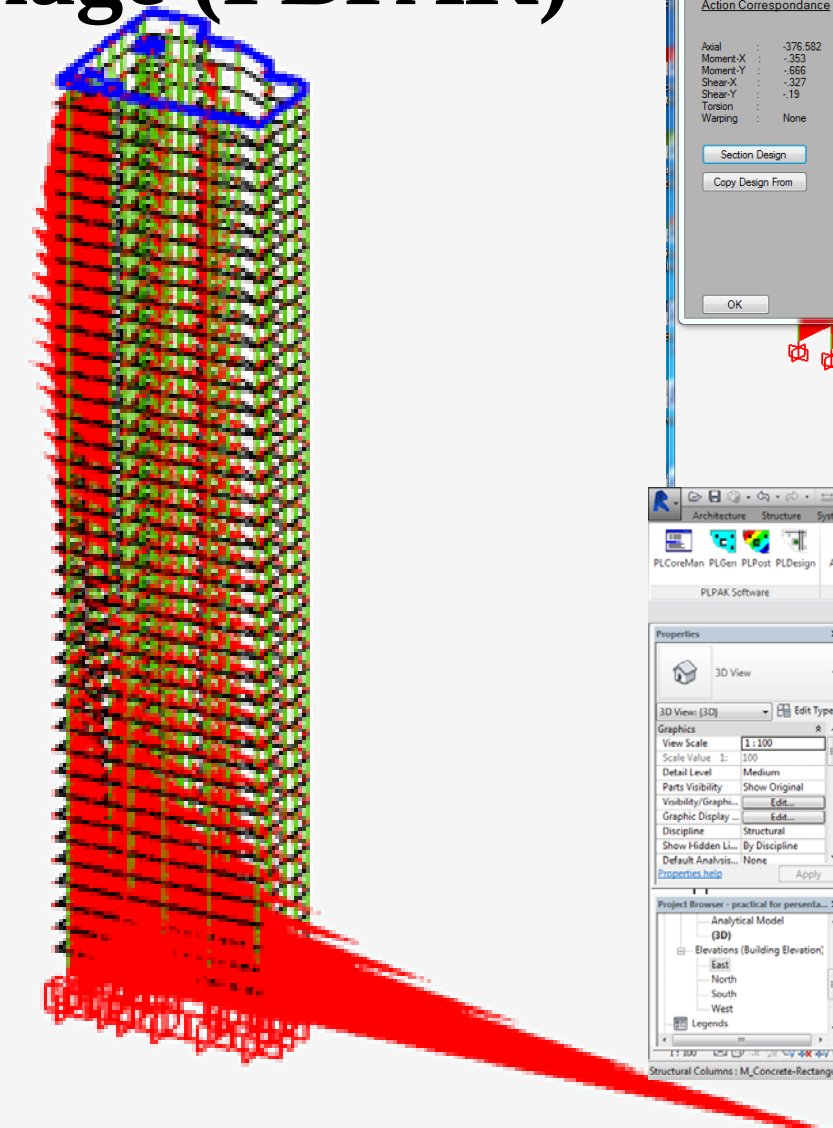
BOUNDARY ELEMENTS FOR ENGINEERS
www.be4e.com

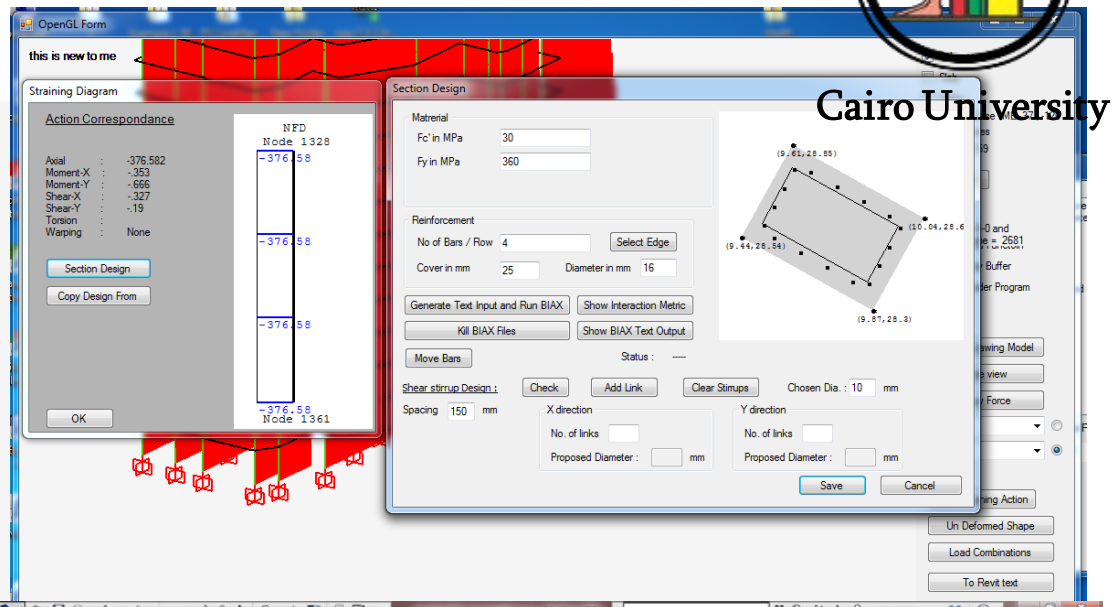
5. Fixed base Package (FBPAK)

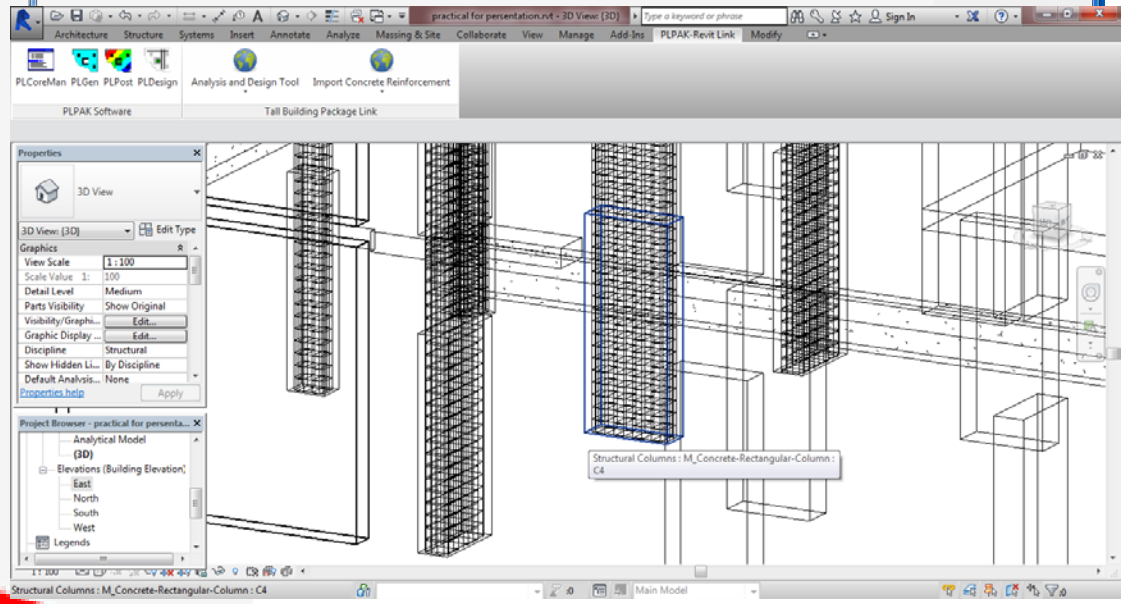
www.be4e.com

Cairo University







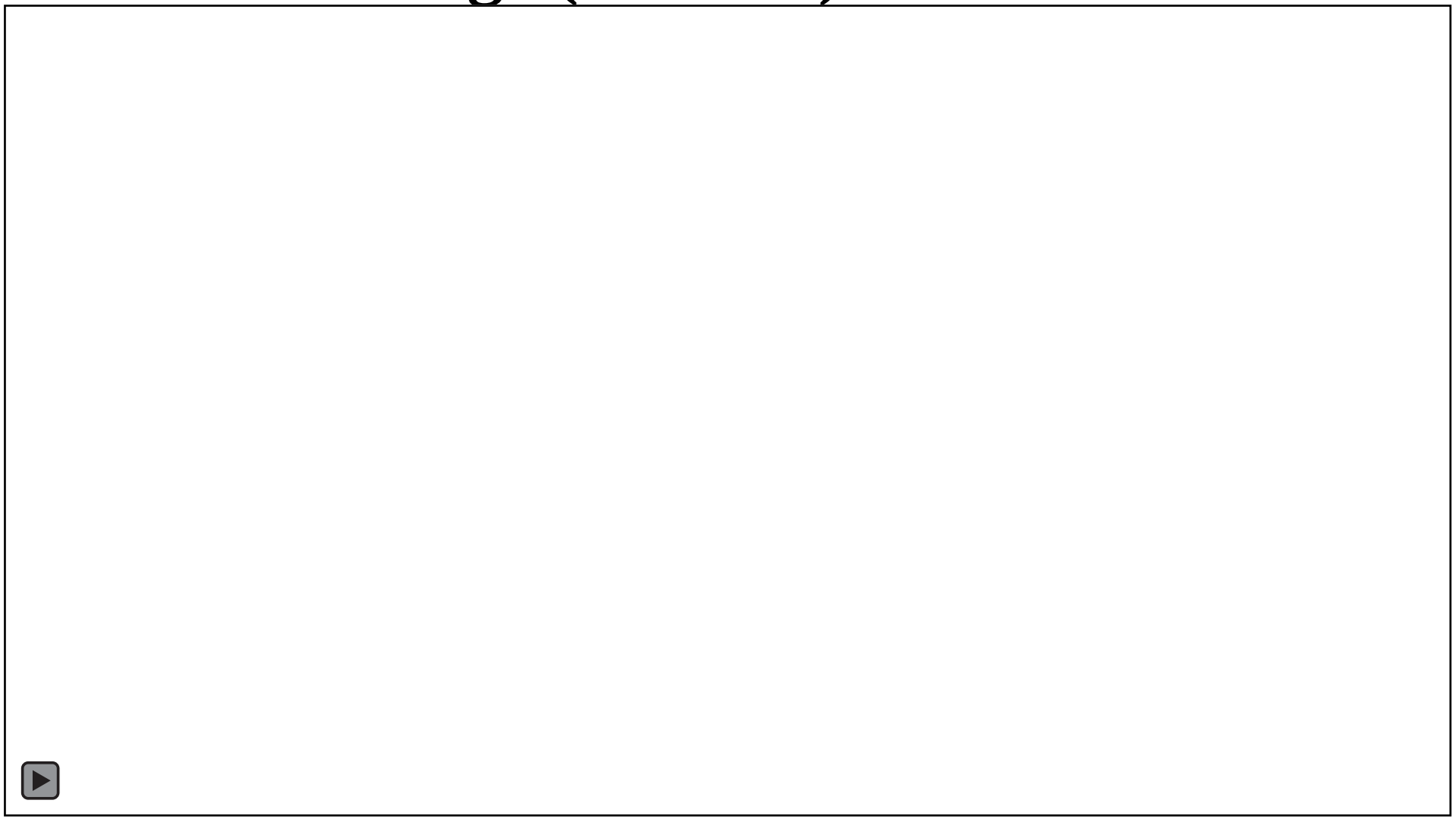


CUFE-BE

www.be4e.com

Cairo University

5. Fixed base Package (FBI-ANK)



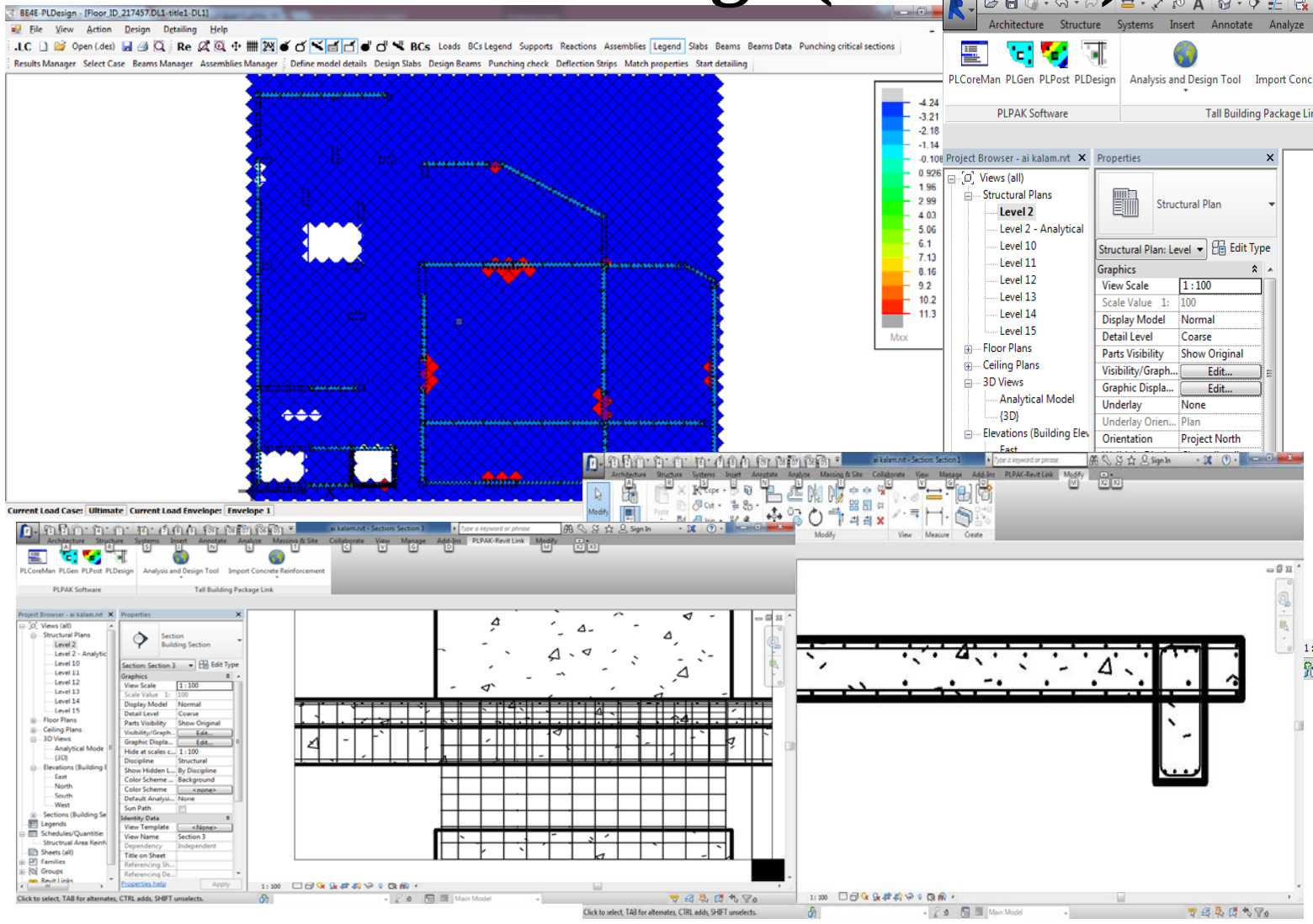
CUFE-BE

BOUNDARY ELEMENTS FOR ENGINEERS
www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)

www.be4e.com

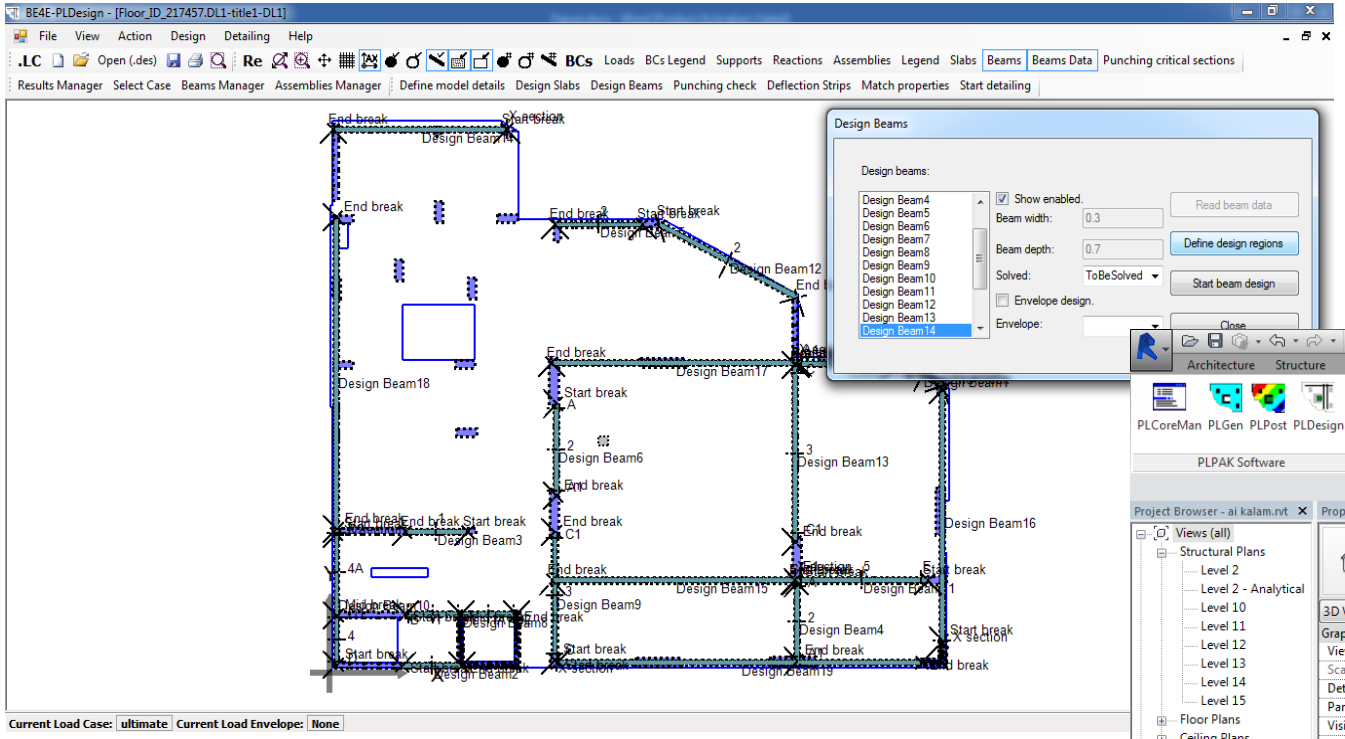


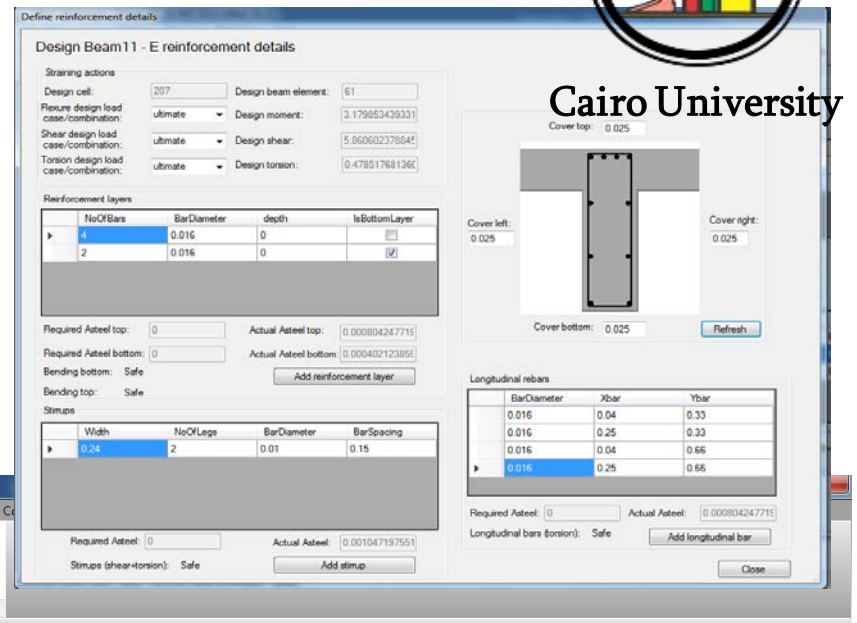
CUFE-BE

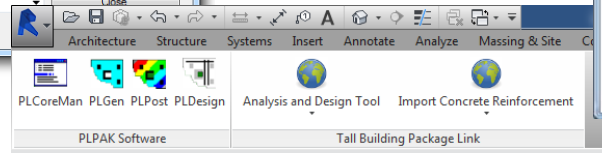
5. Fixed base Package (FBP-MK)

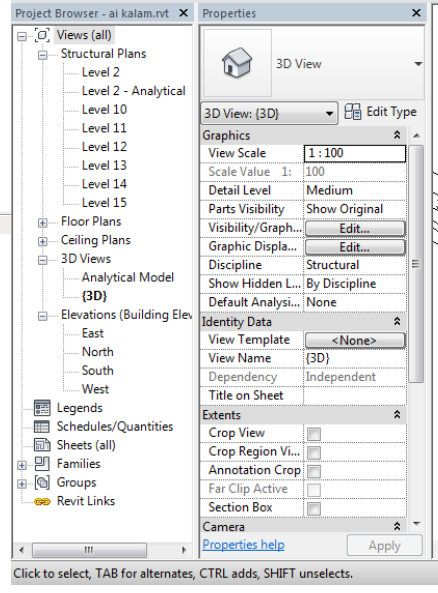
www.be4e.com

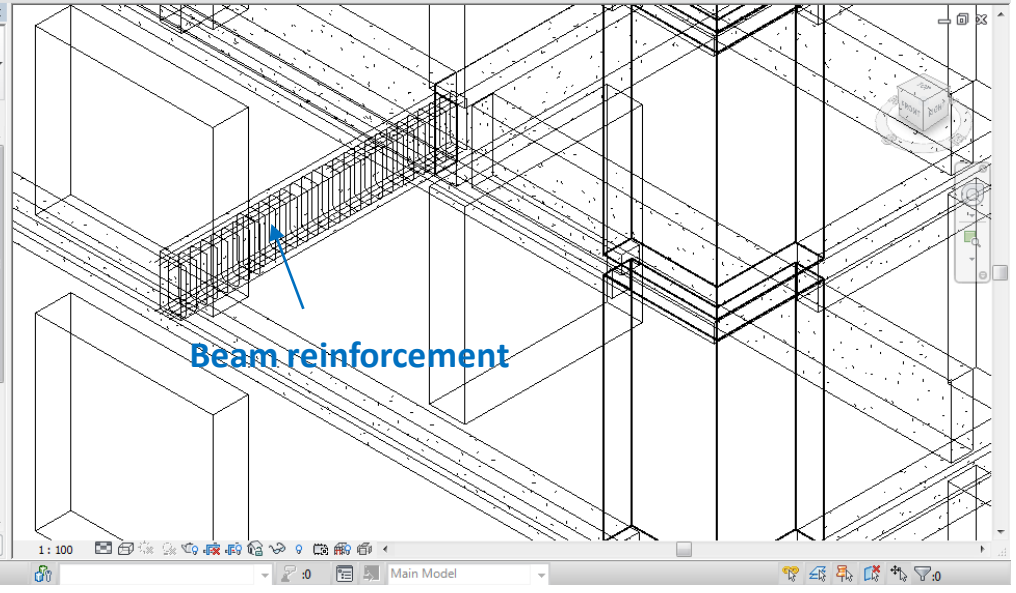
Cairo University









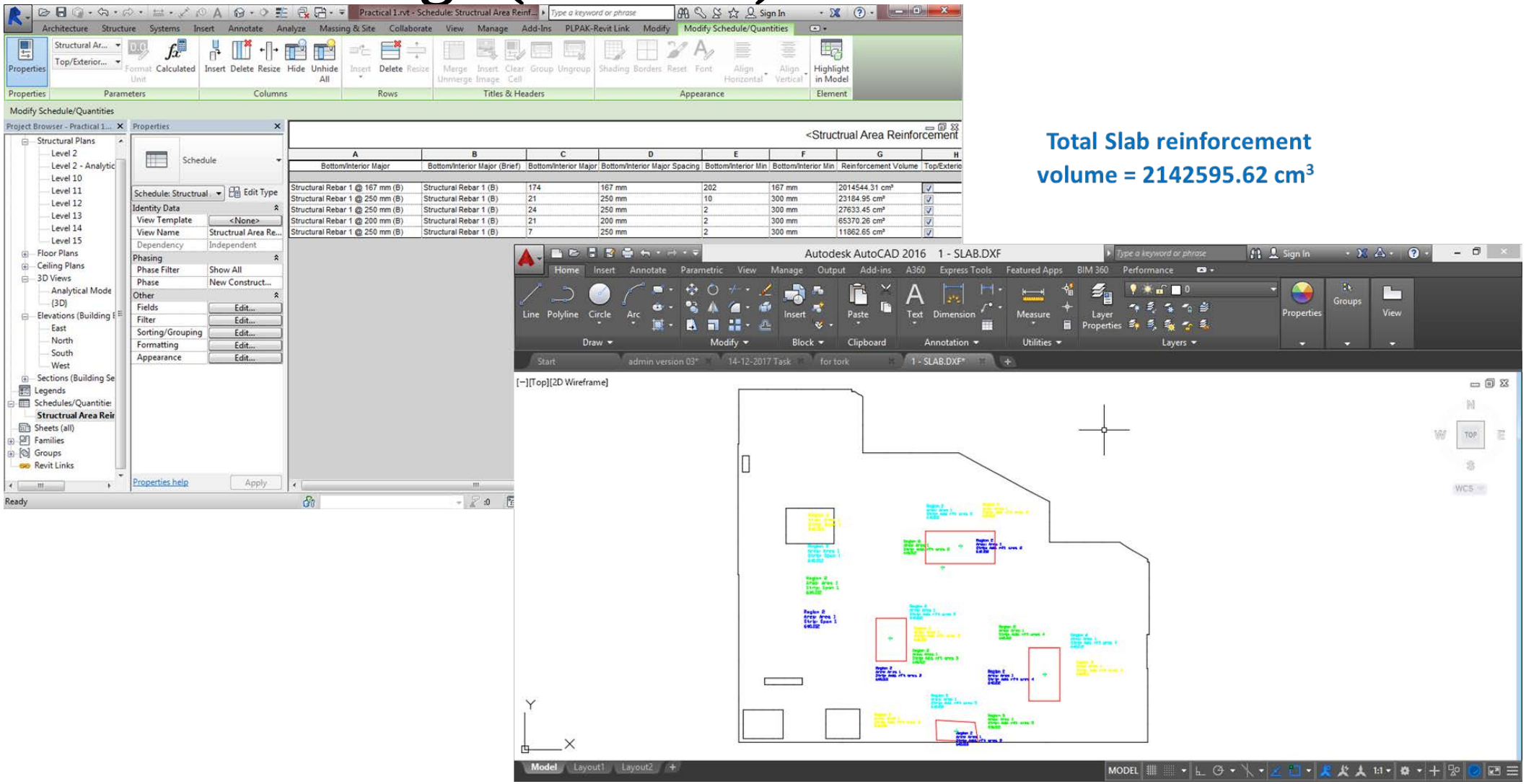


CUFE-BE

www.be4e.com

Cairo University

5. Fixed base Package (FBP)



Total Slab reinforcement volume = 2142595.62 cm³

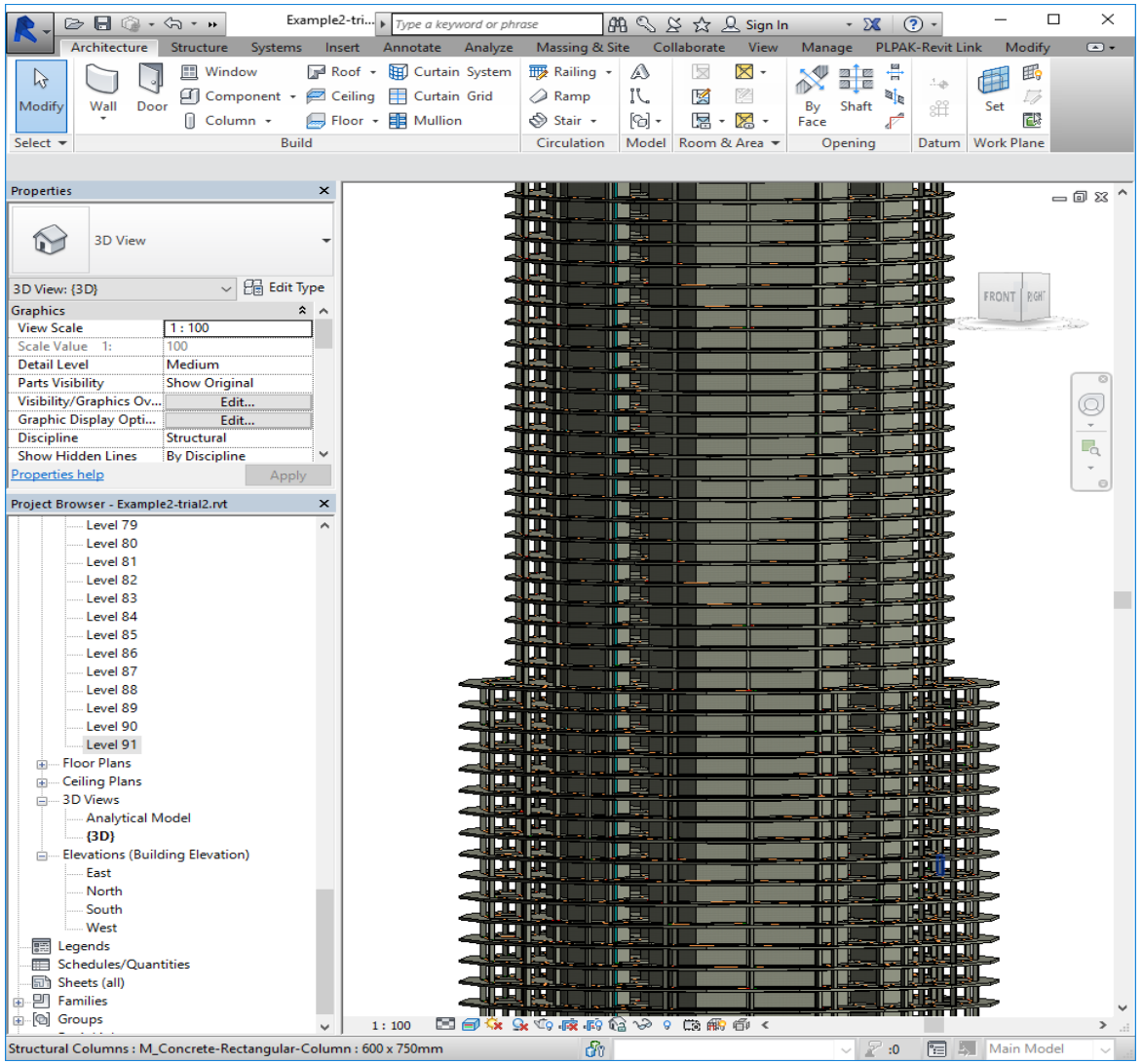
CUFE-BE

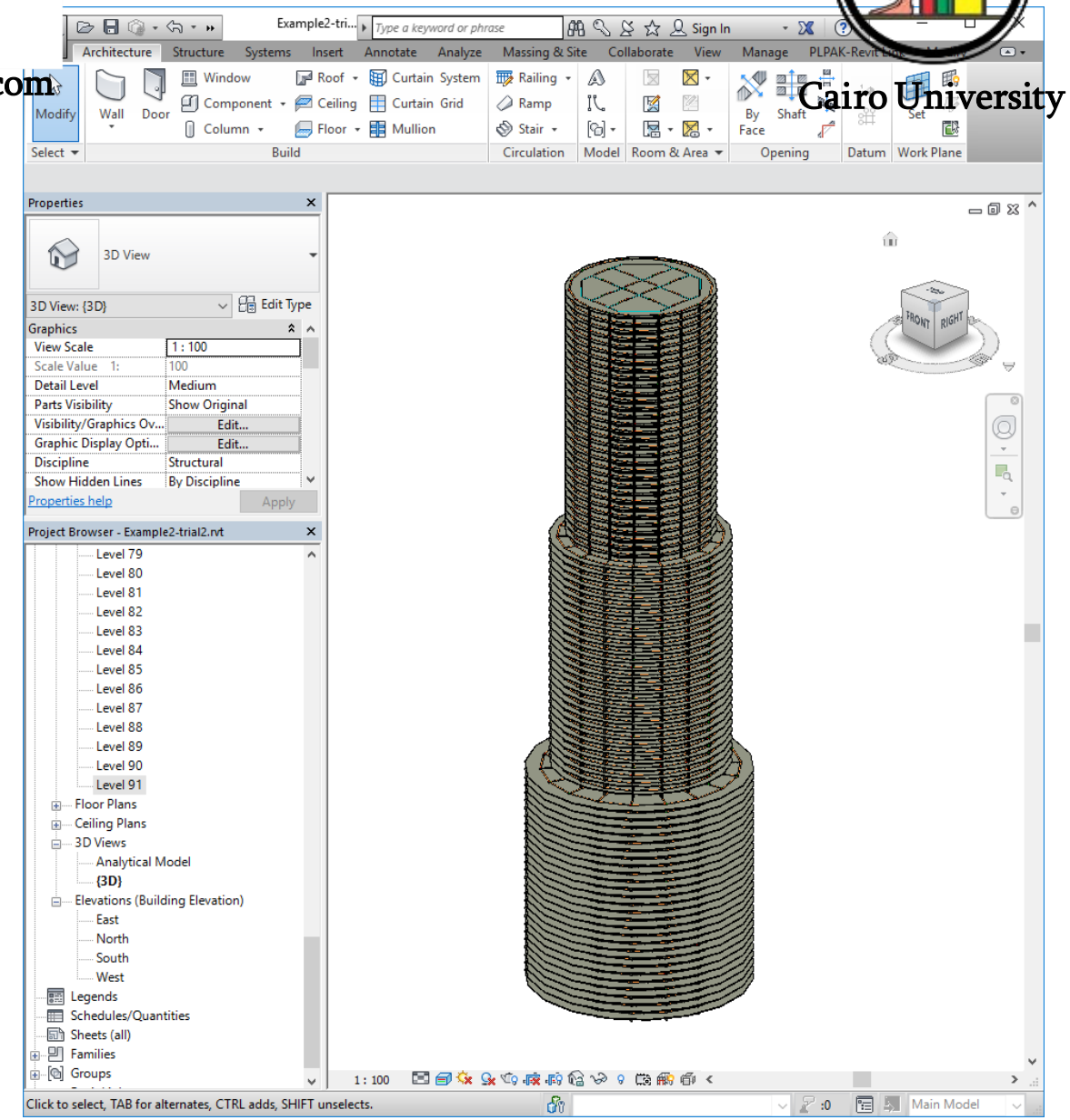
BOUNDARY ELEMENTS FOR ENGINEERS
BE4E
www.be4e.com

5. Fixed base Package (FBP)

www.be4e.com

Cairo University



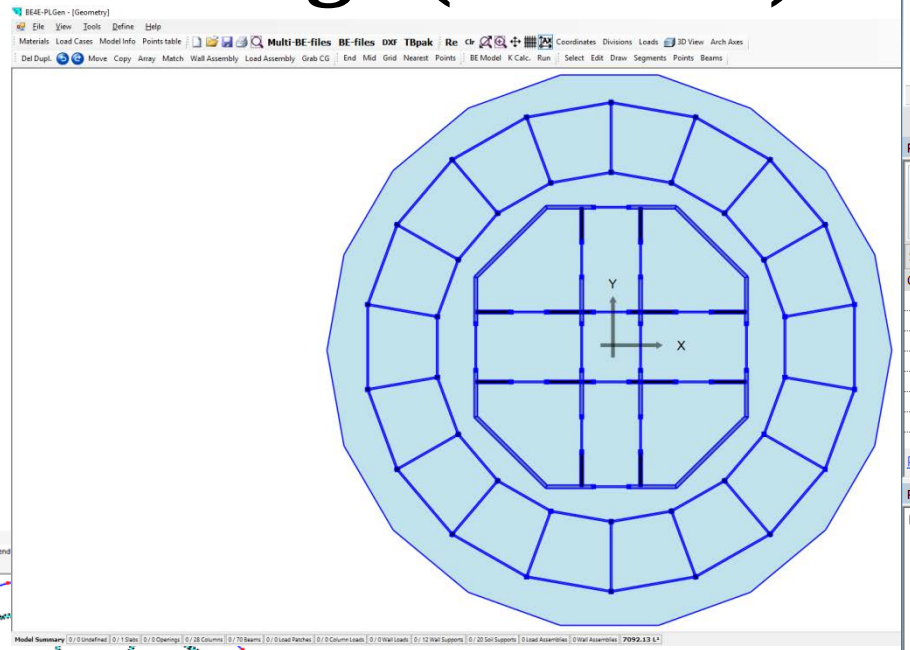


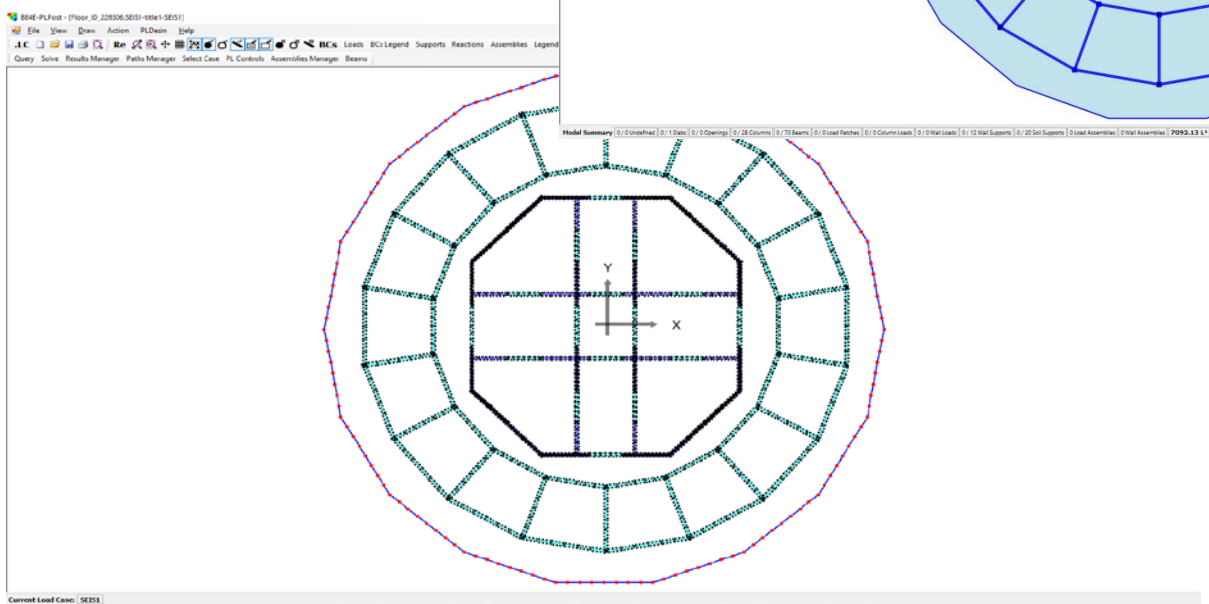
CUFE-BE

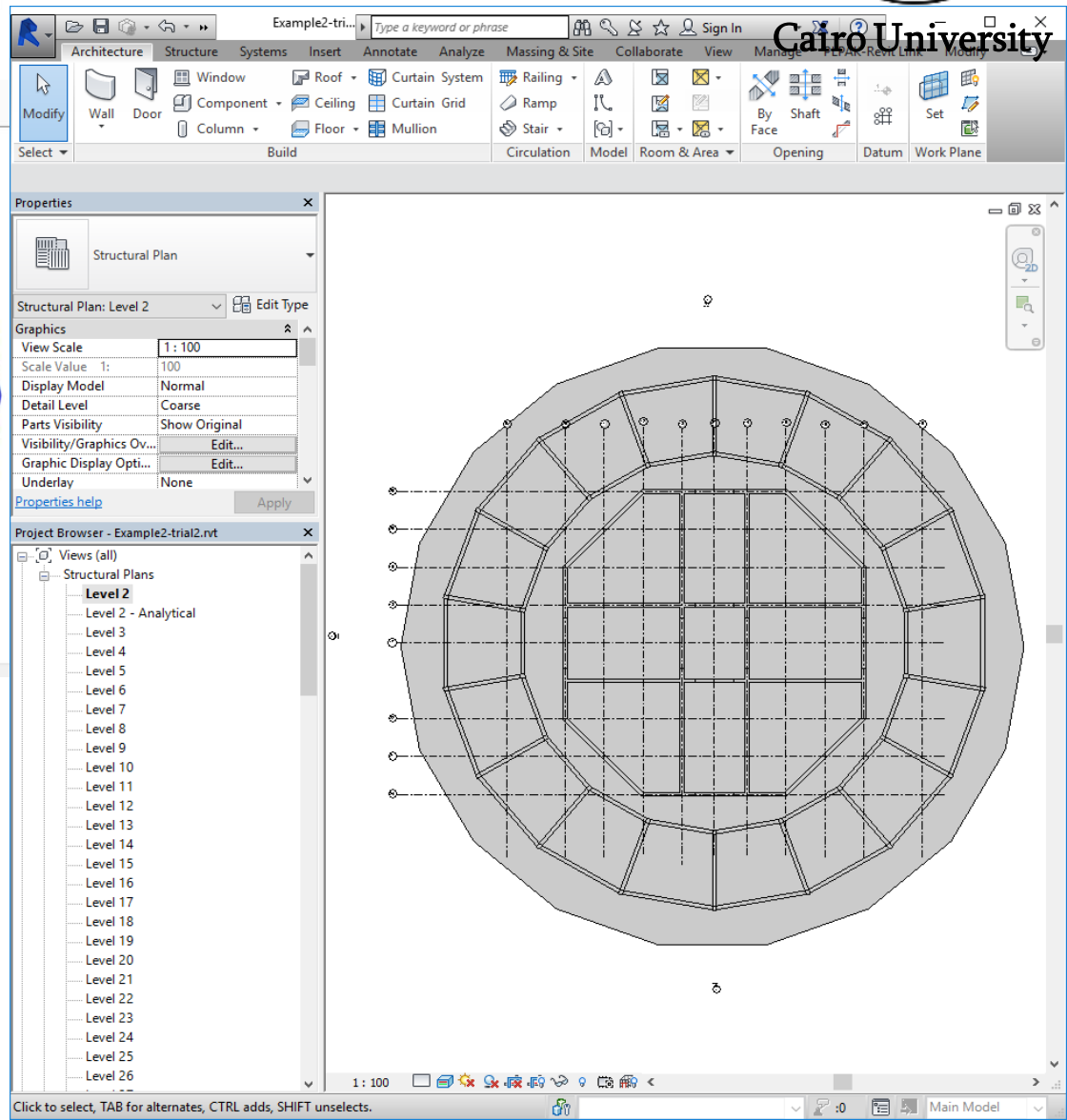
www.be4e.com

Cairo University

5. Fixed base Package (FBP)







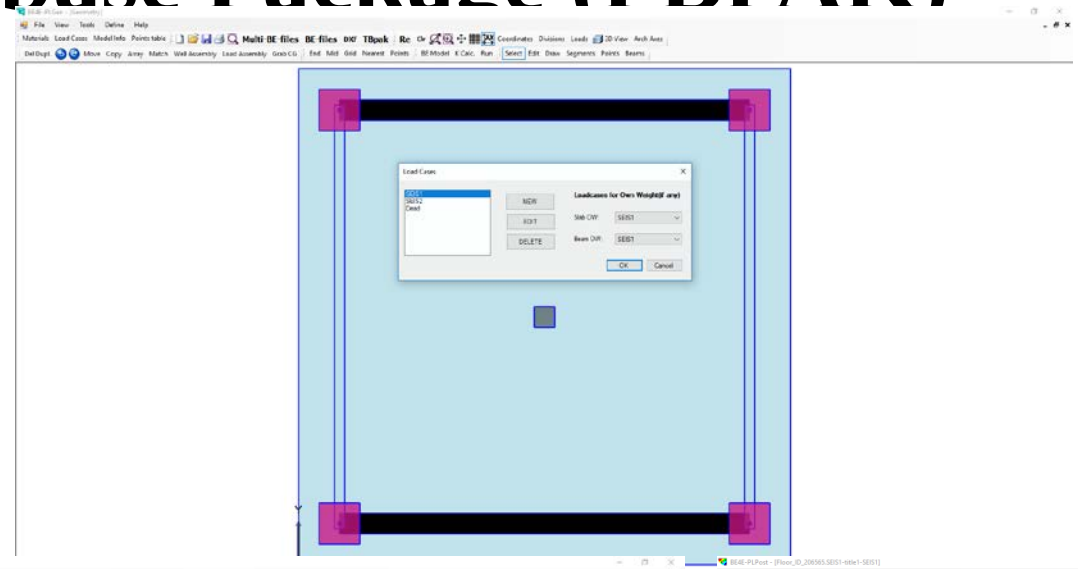
CUFE-BE

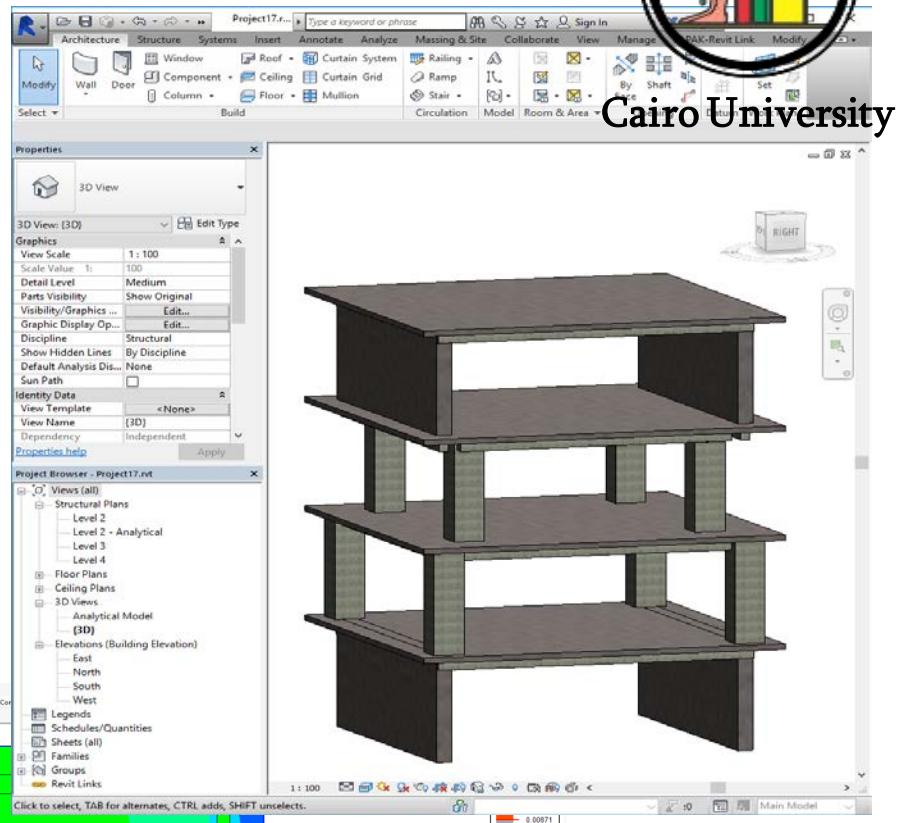
BOUNDARY ELEMENTS FOR ENGINEERS
BE4E
www.be4e.com

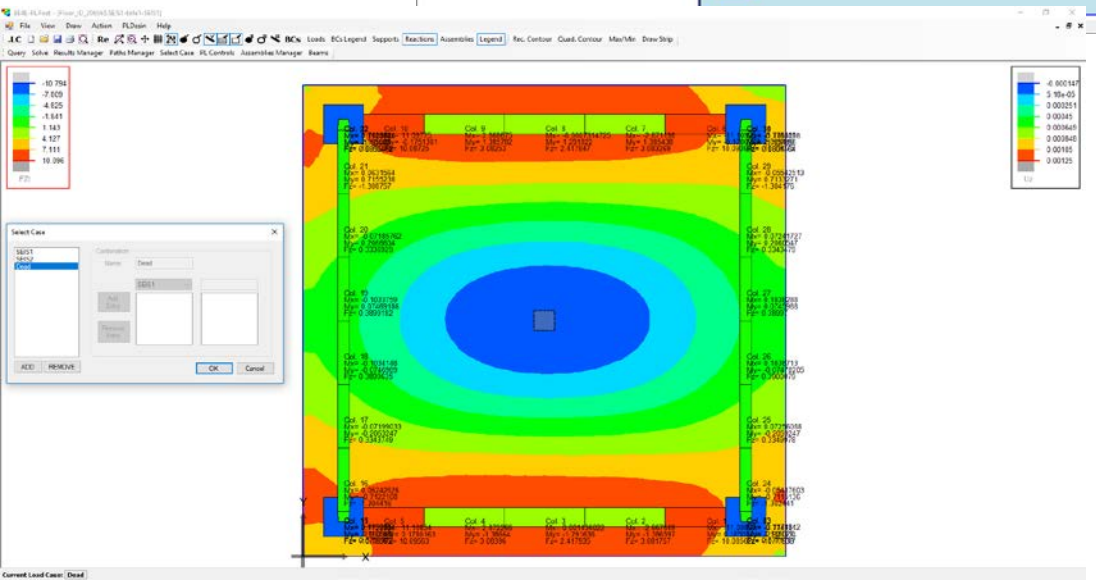
5. Fixed base Package (FBP)

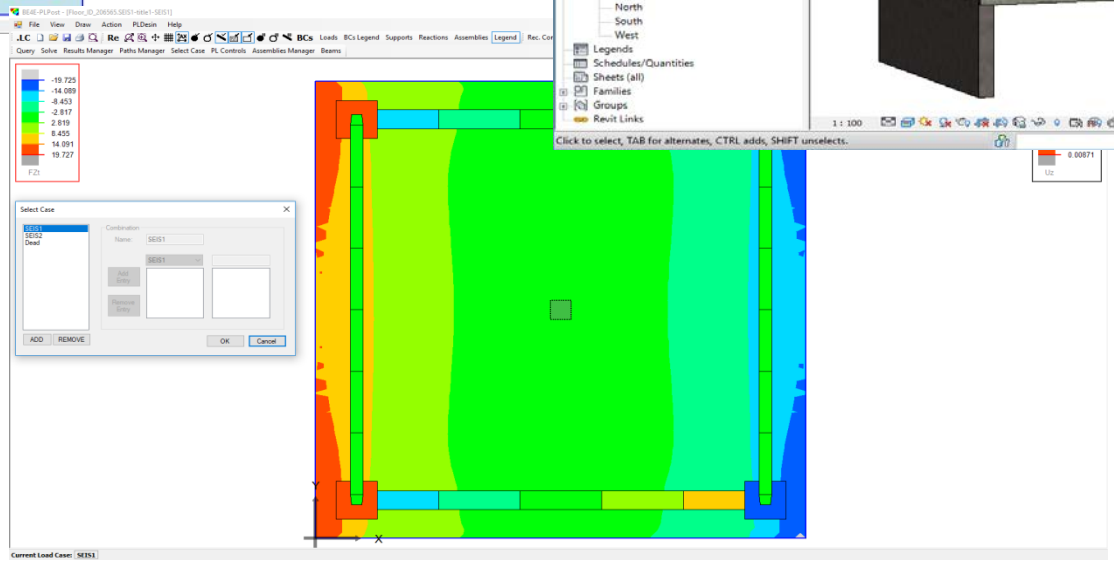
www.be4e.com

Cairo University







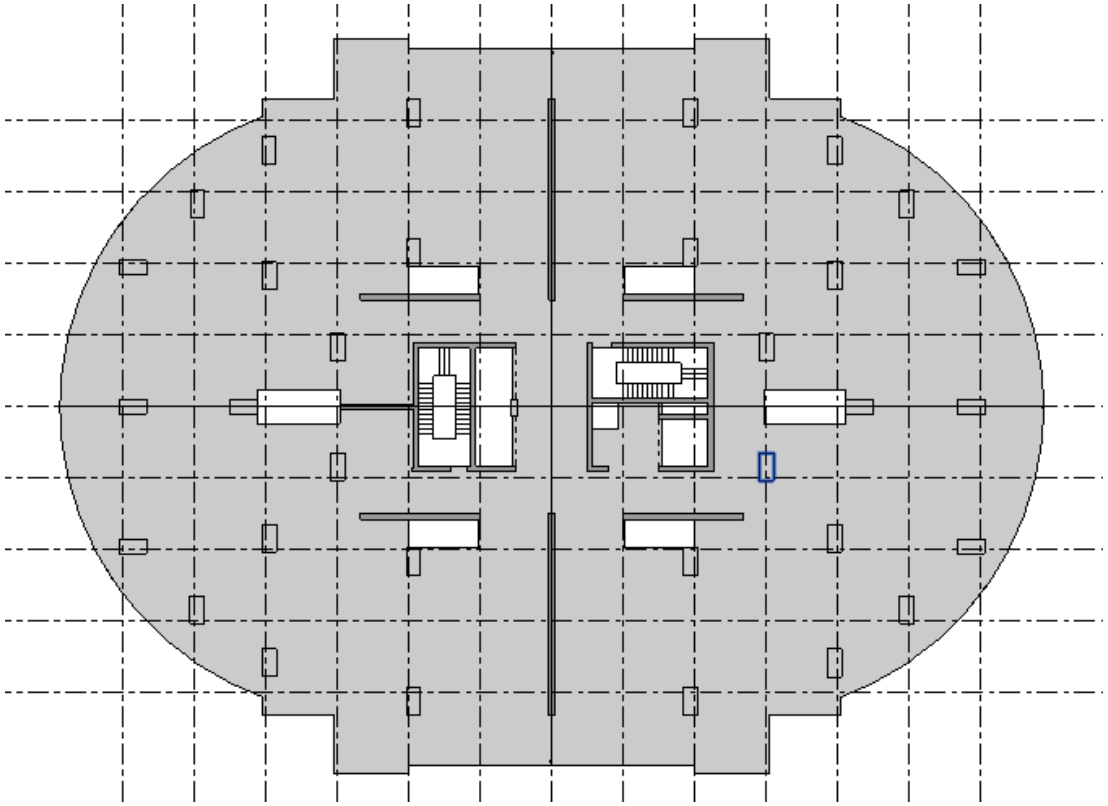


CUFE-BE

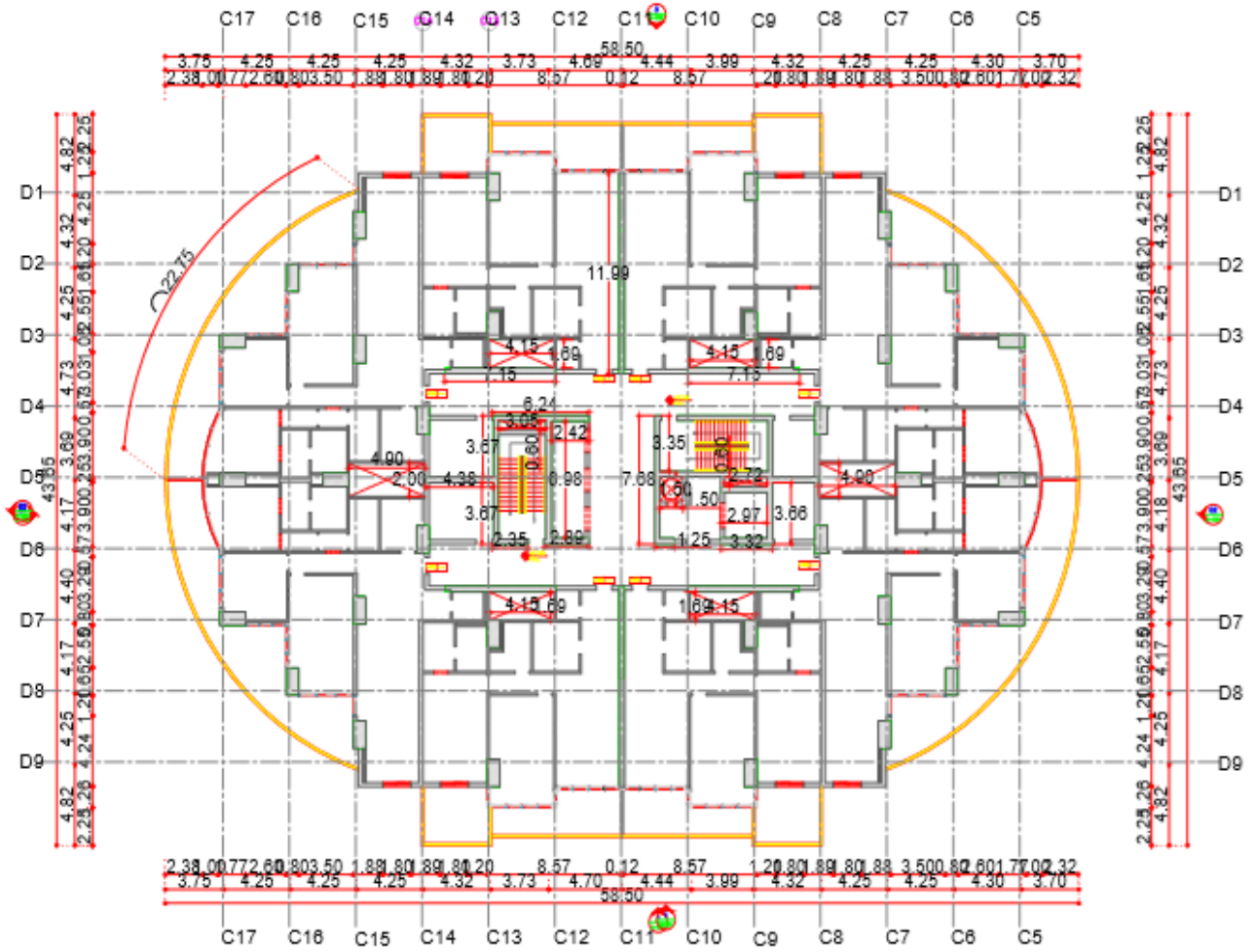
www.be4e.com

Cairo University

5. Fixed base Package (FBP)



Plan view in Revit model

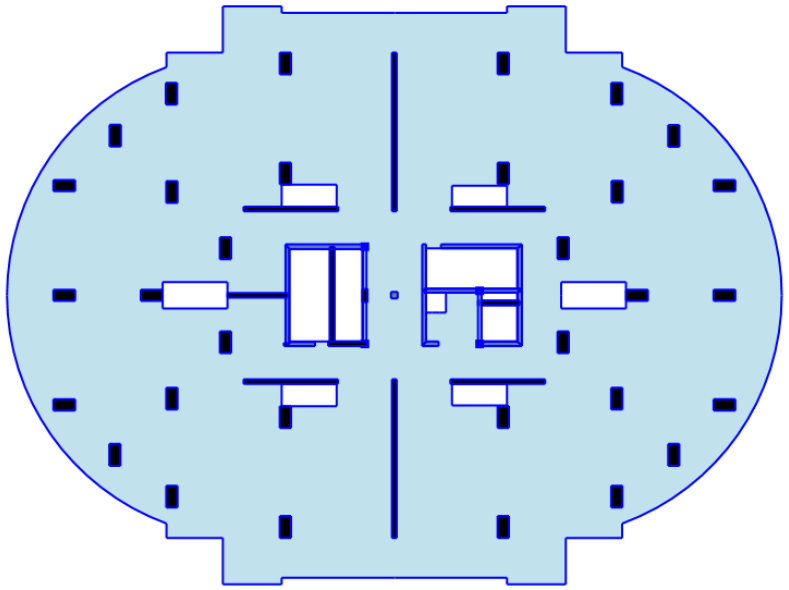


CUFE-BE

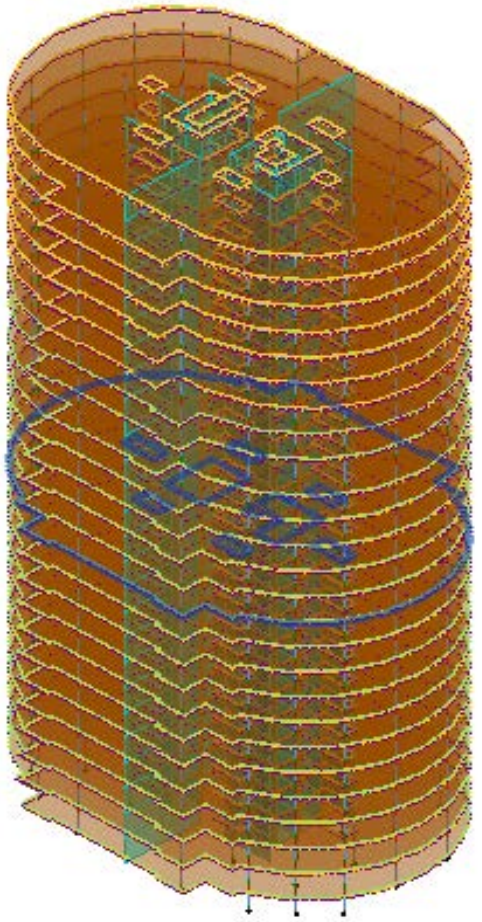
www.be4e.com

Cairo University

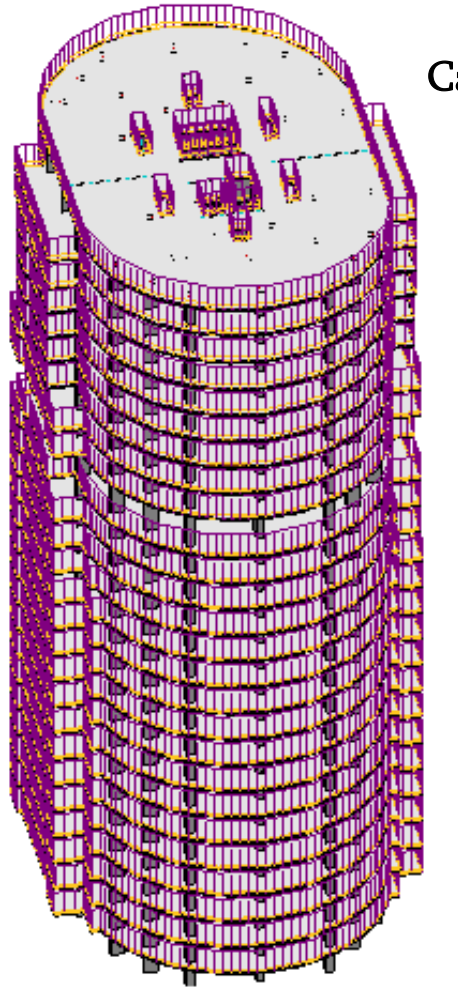
5. Fixed base Package (FBPAK)



PLGen model exported from Revit



Revit analytical model



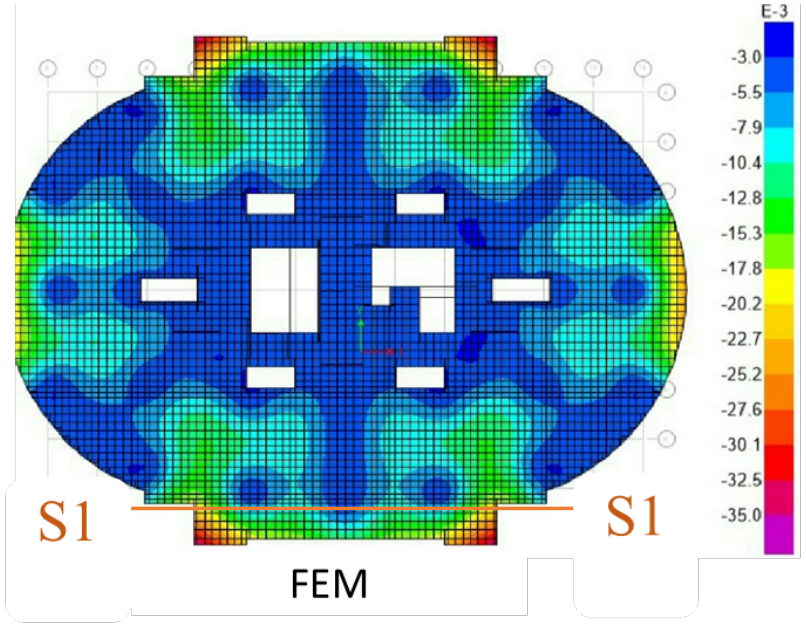
Revit geometrical model with vertical loads

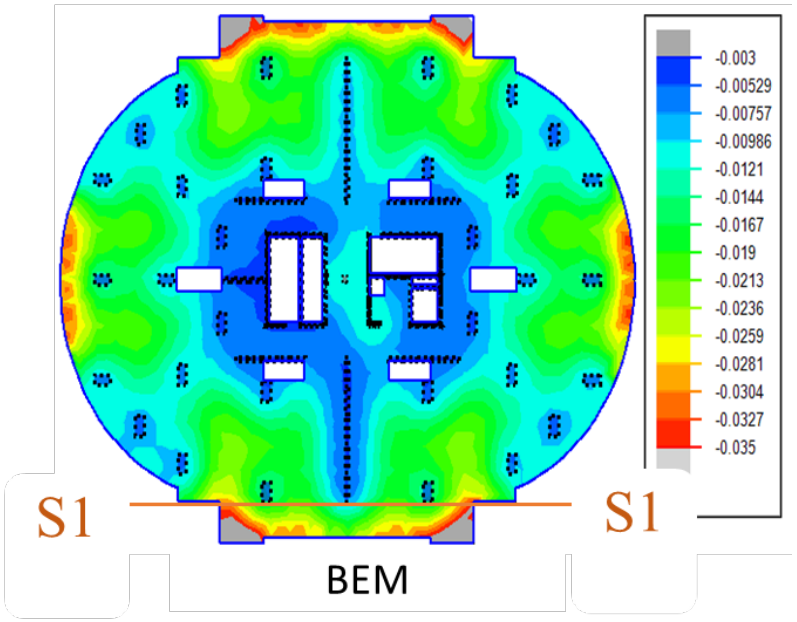
CUFE-BE

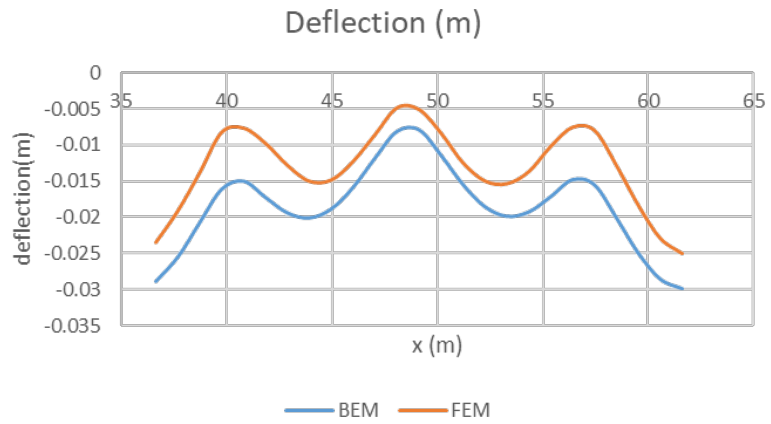
www.be4e.com

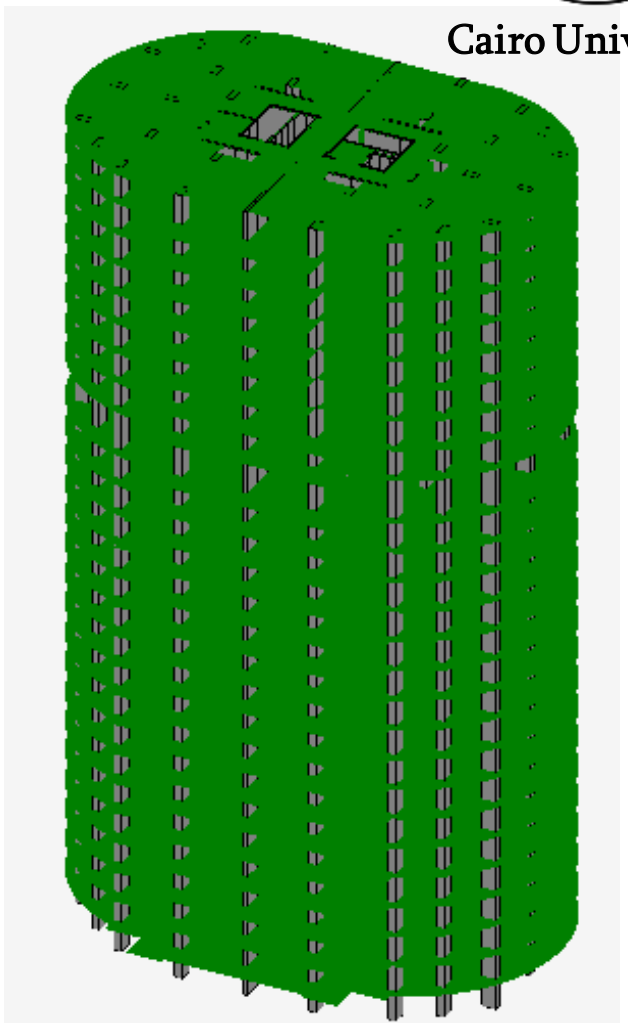
Cairo University

5. Fixed base Package (FBPAK)









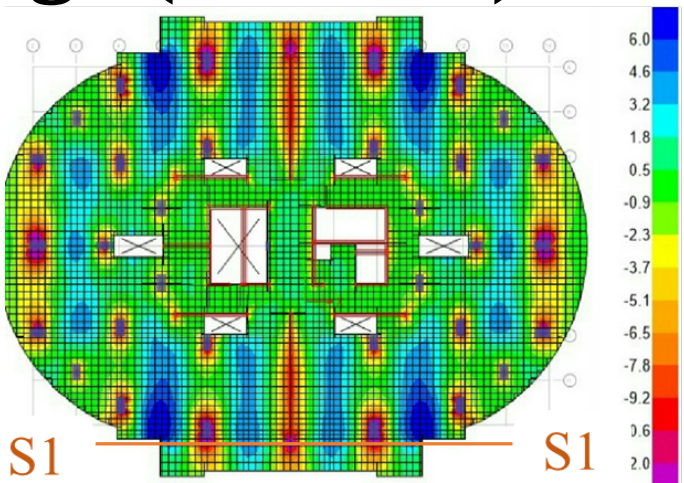
PLPAK 3D model

CUFE-BE

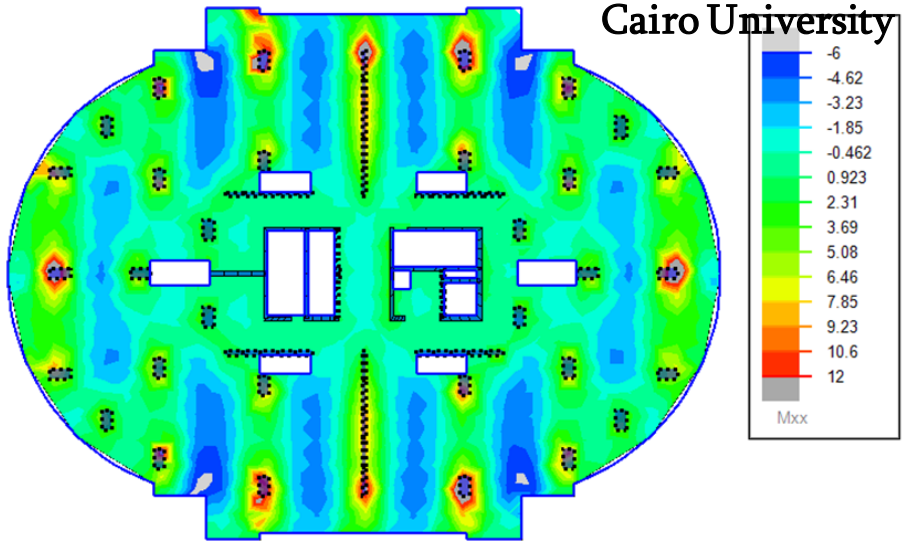
www.be4e.com

Cairo University

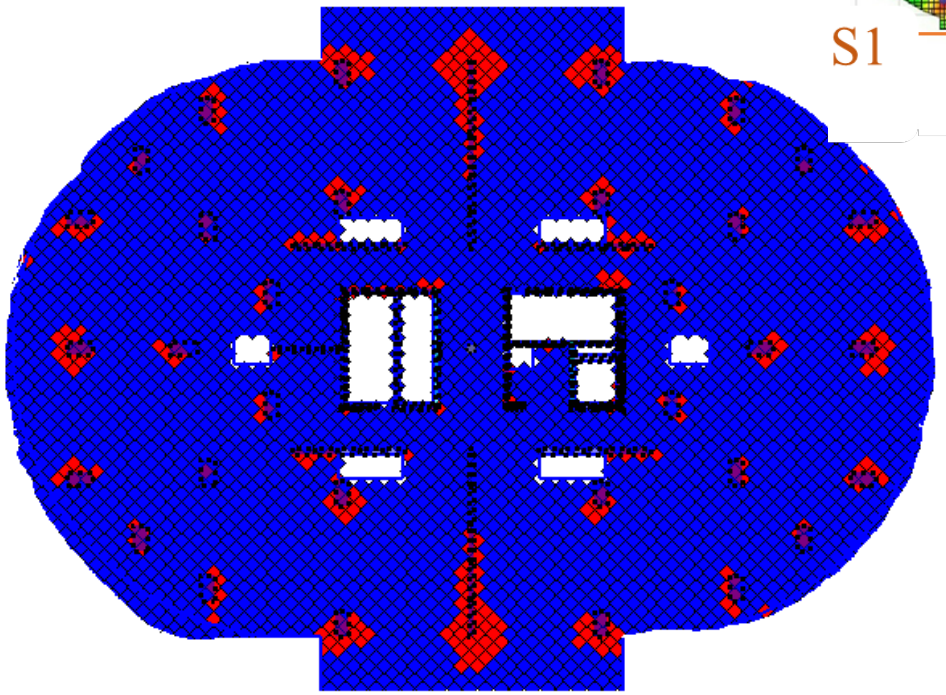
5. Fixed base Package (FBI-AK)



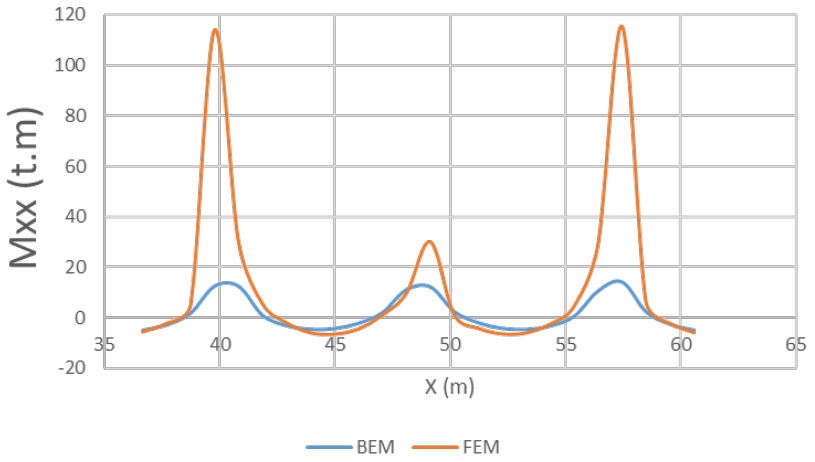
FEM



BEM



Moment about X-X (t.m)



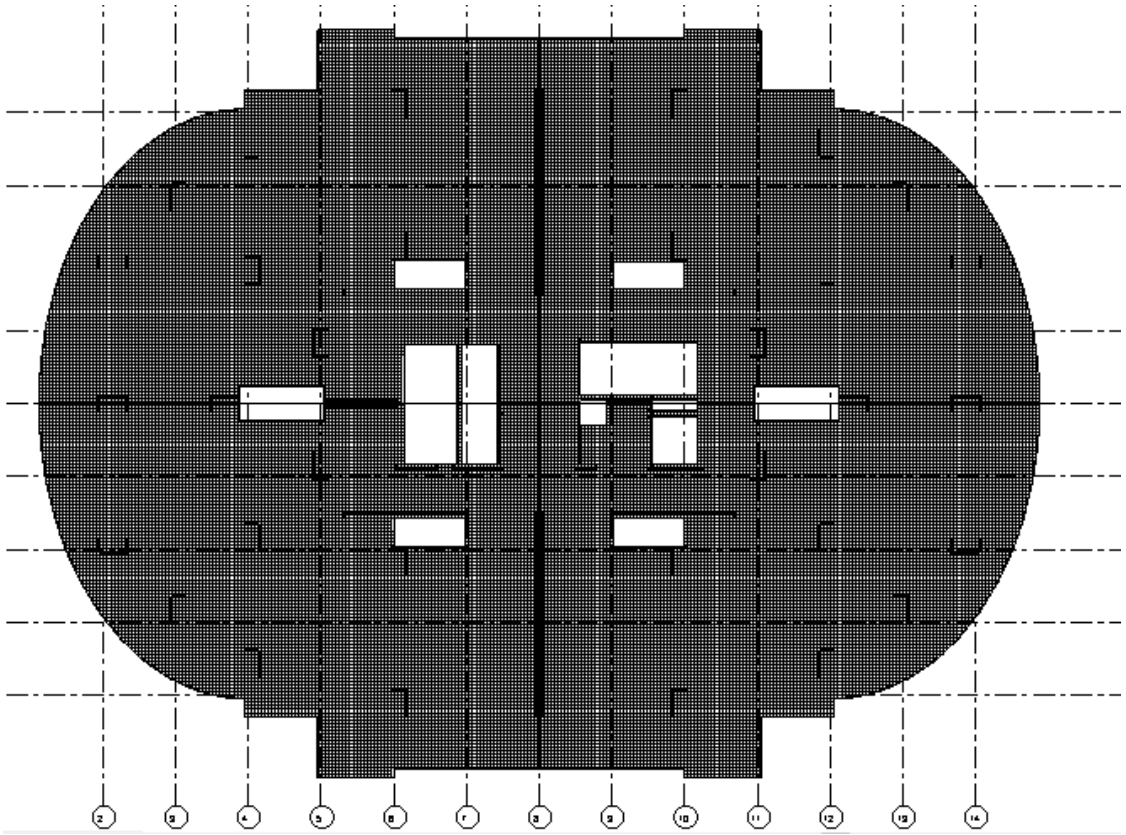
CUFE-BE

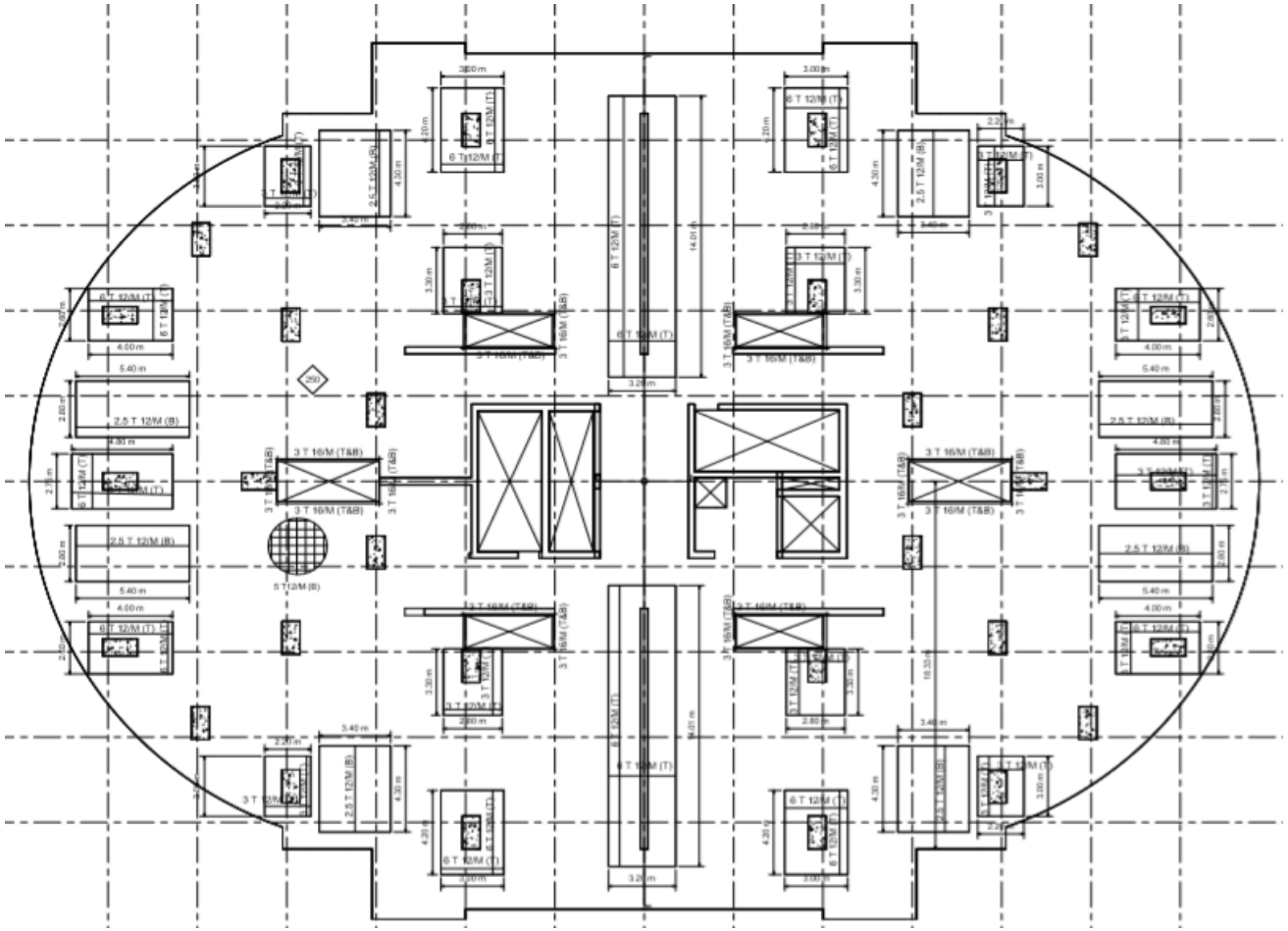
Boundary Elements for Engineers
www.be4e.com

5. Fixed base Package (FBP-MK)

www.be4e.com

Cairo University





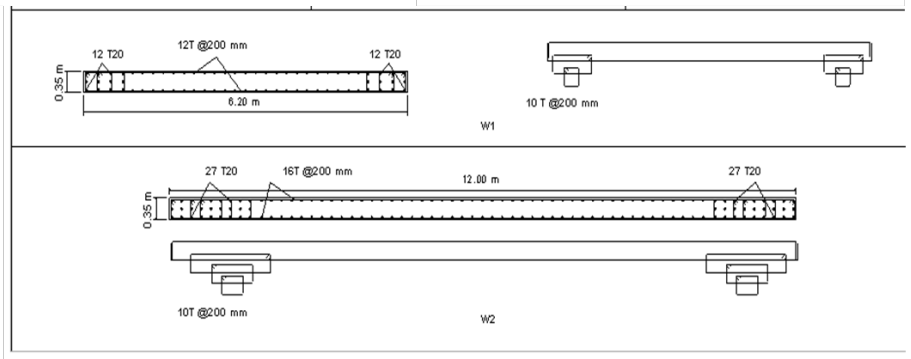
CUFE-BE

www.be4e.com

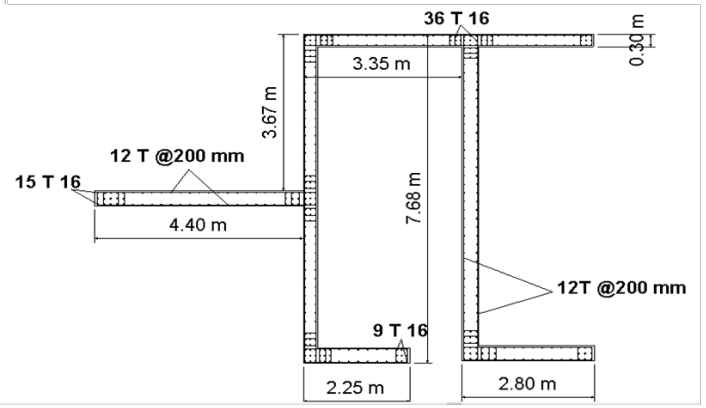
Cairo University

5. Fixed base Package (FBP-AK)

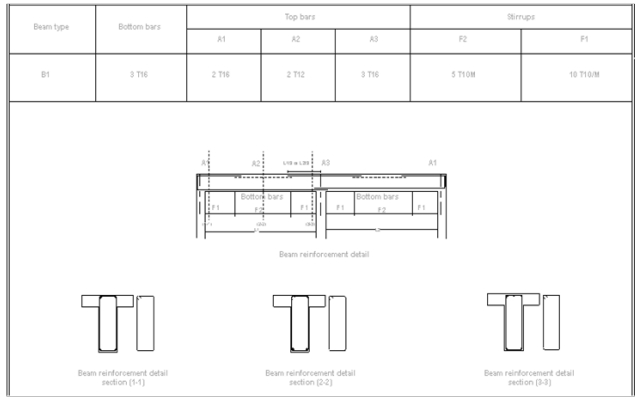
Design of Shear walls:

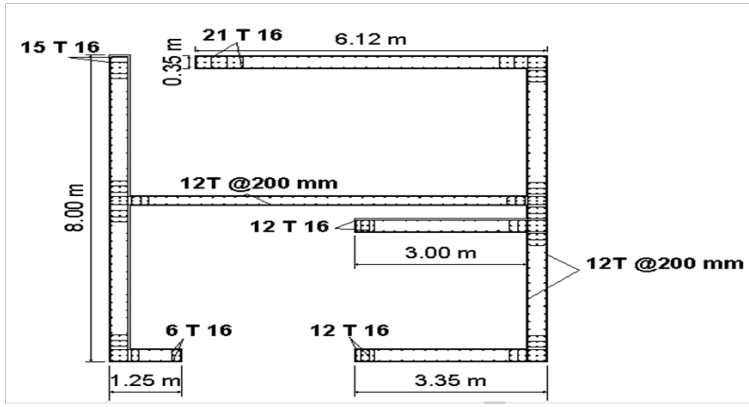


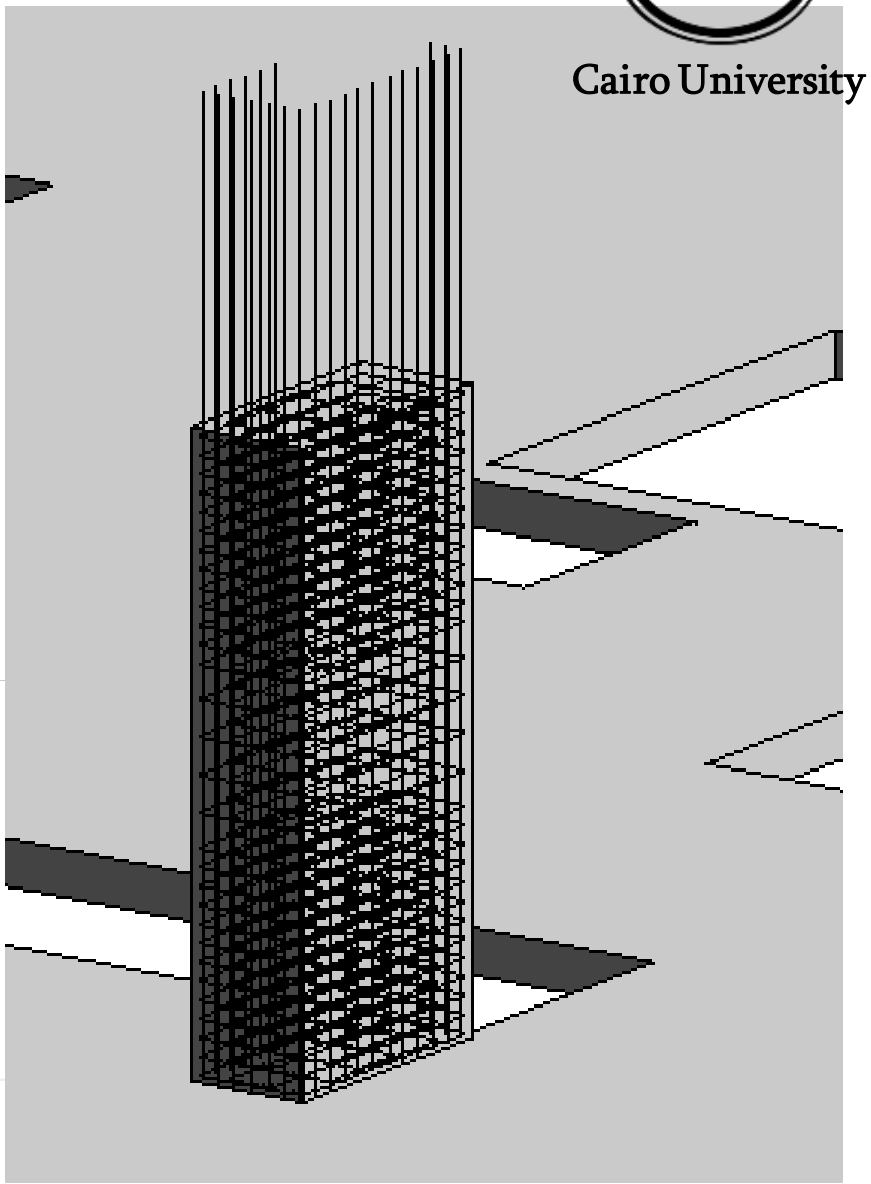
Design of Cores:



Design of beams:







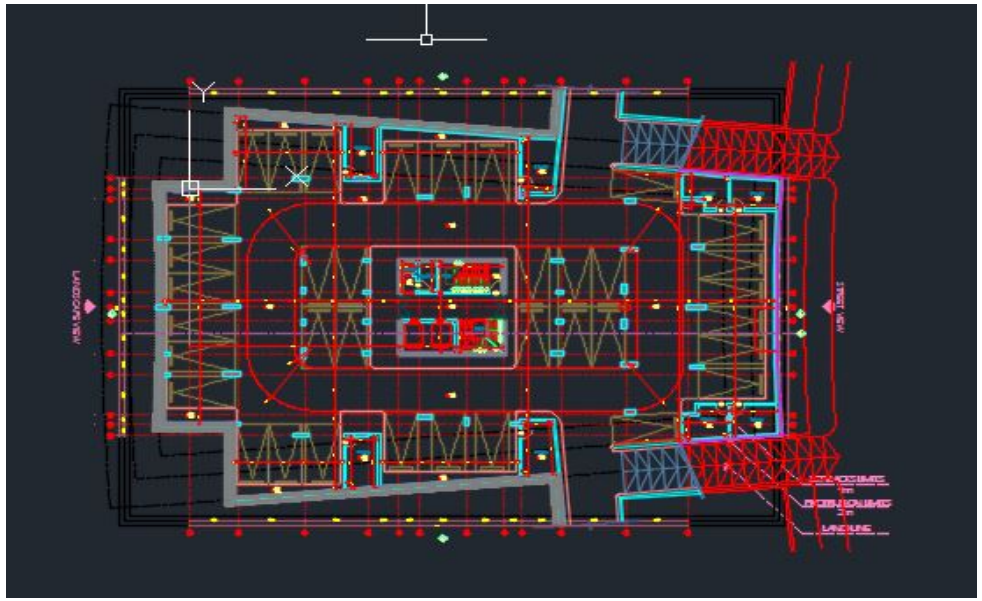
CUFE-BE

Boundary Elements for Engineers
www.be4e.com

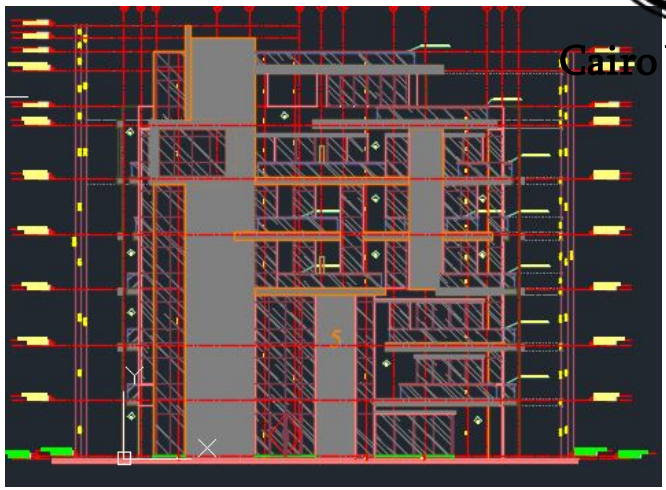
Cairo University

5. Fixed base Package (FBP-AK)

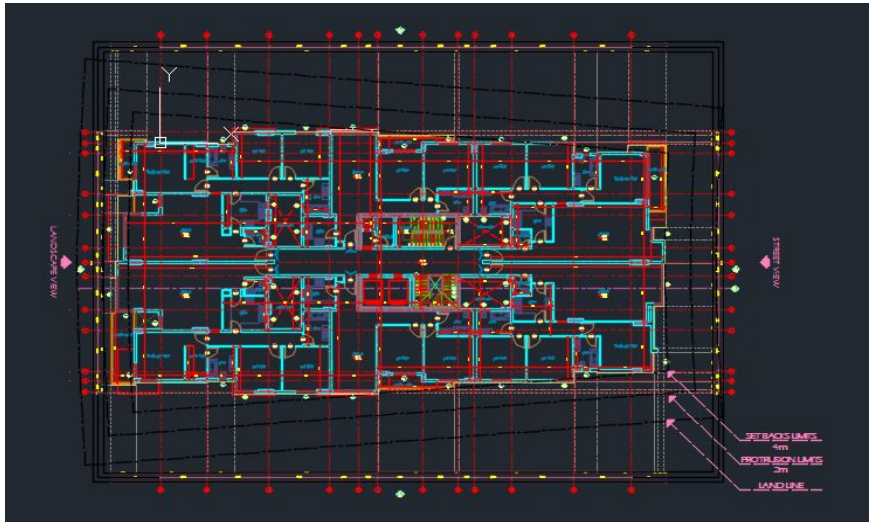
The project is a residential building, consisting of 8 different floors.
The average area of slabs = 770m^2 and the height =2.97m, for basement slab =1150m^2 and the height equals 3.06m



Architectural plan for the basement



Elevation of the building



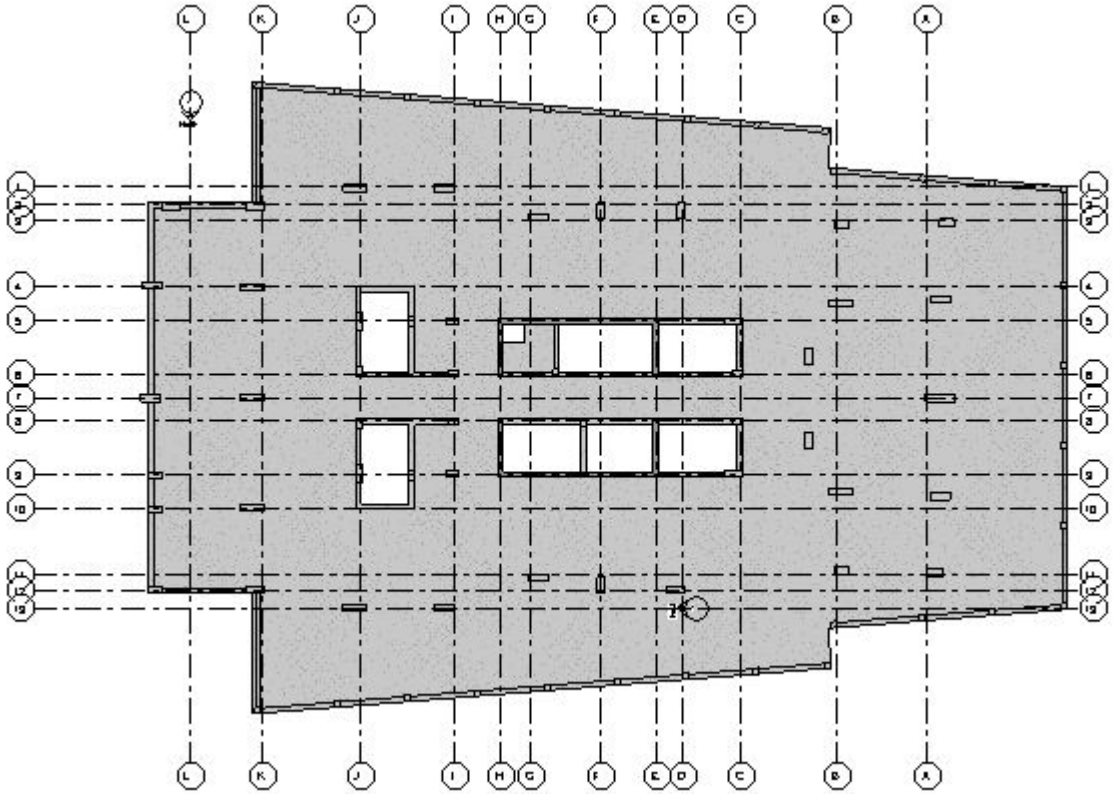
Architectural plan for the first floor.

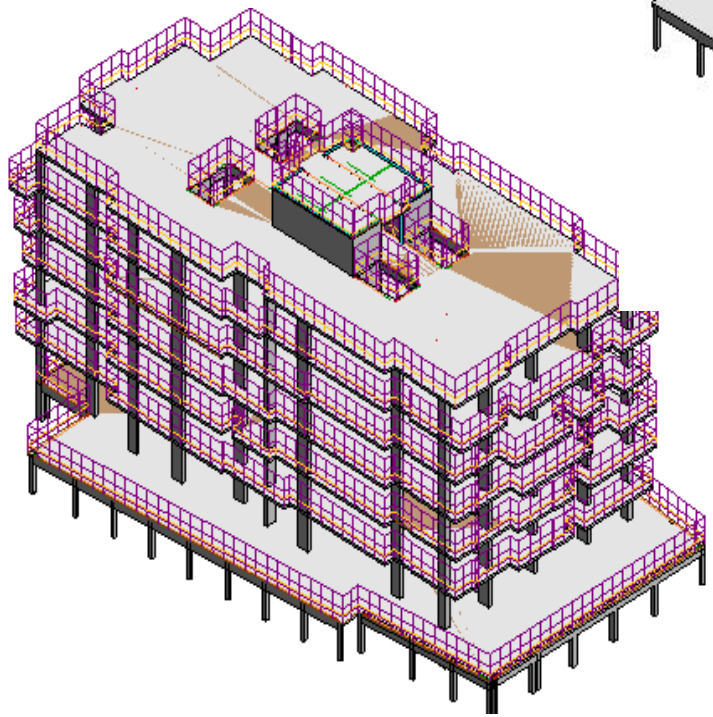
CUFE-BE

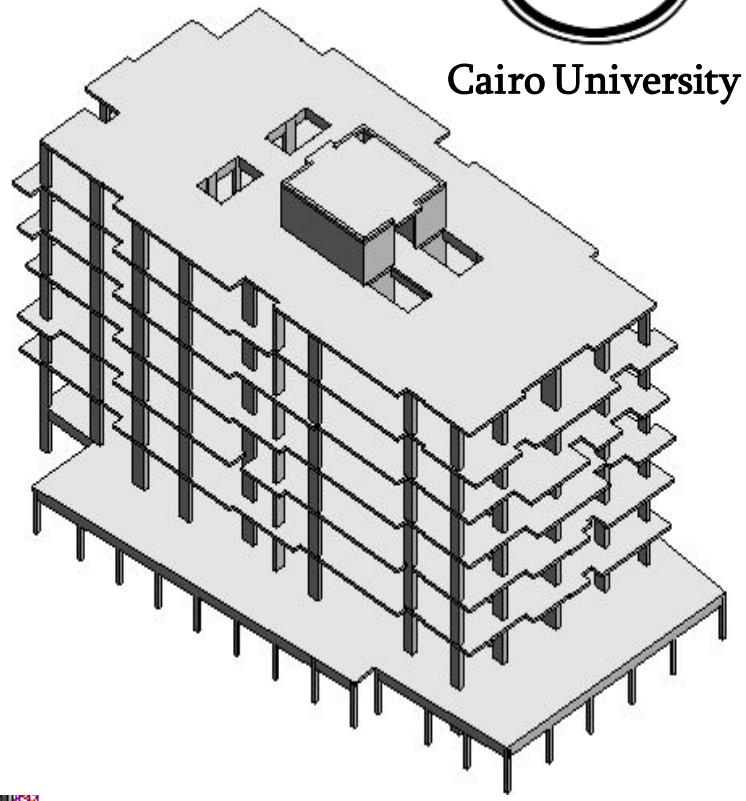
www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)





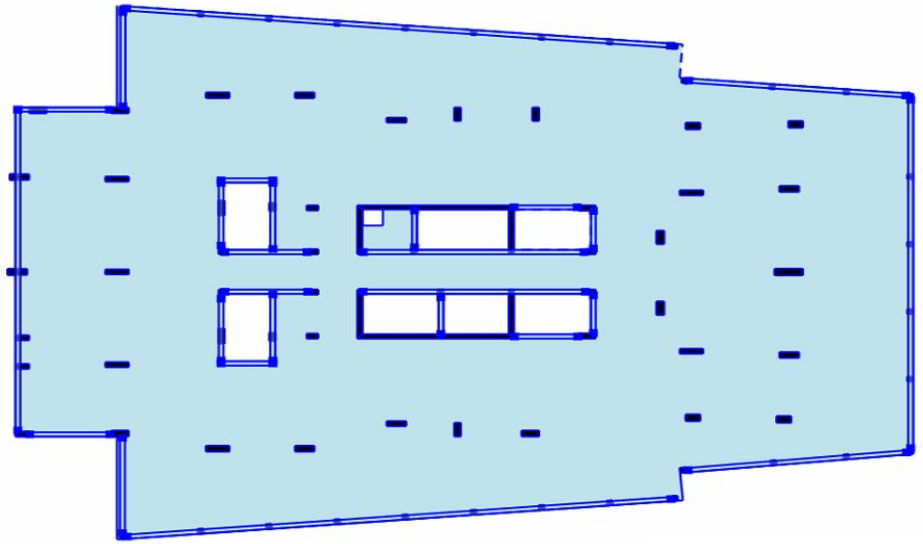


CUFE-BE

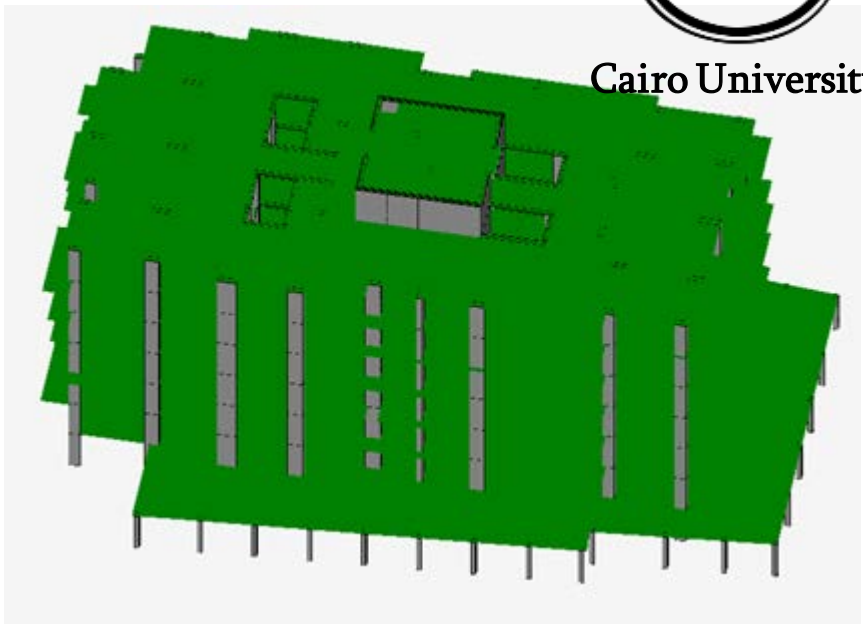
www.be4e.com

Cairo University

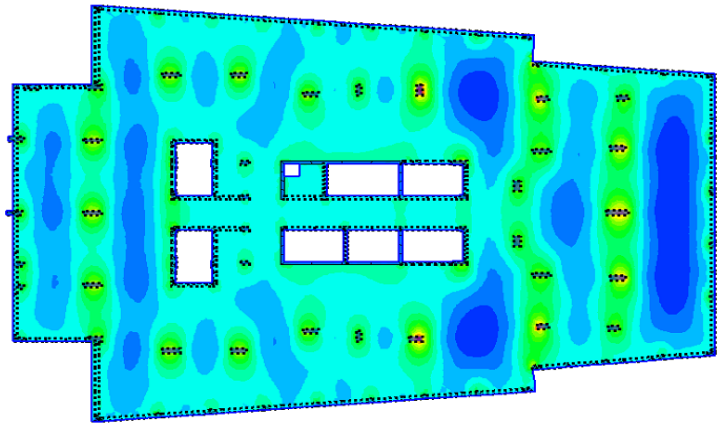
5. Fixed base Package (FBPAK)



Basement Floor in PLGen



3D PLPAK model



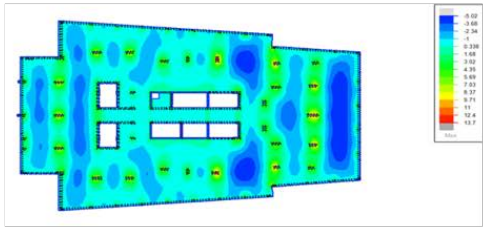
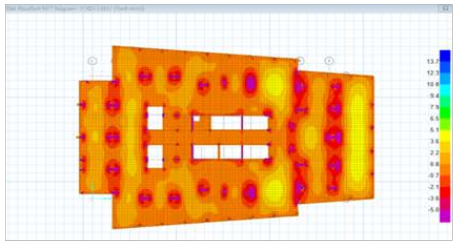
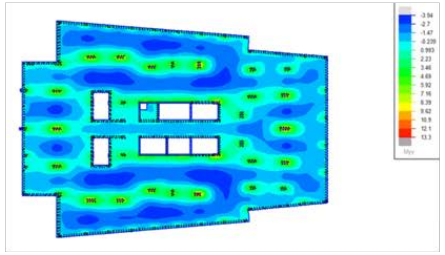
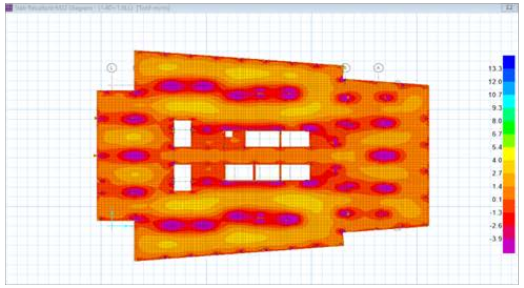
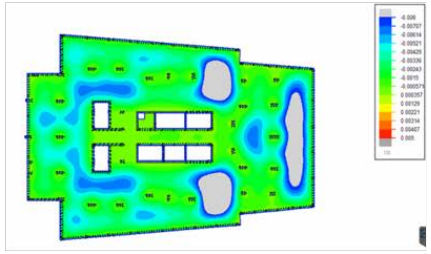
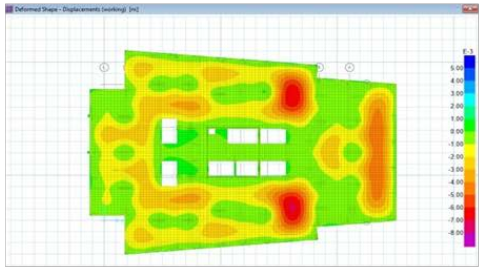
Bending moment Mxx of Basement Floor in PLPOST

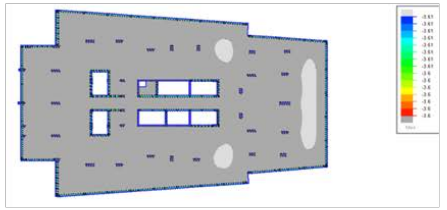
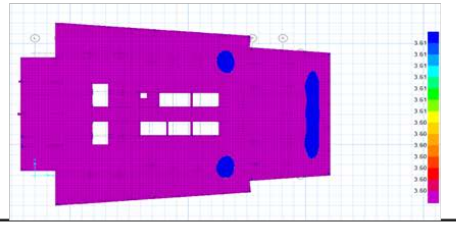
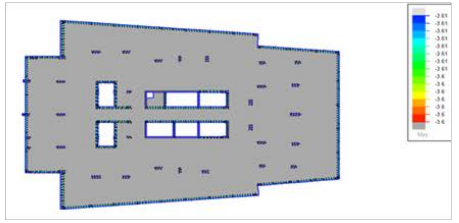
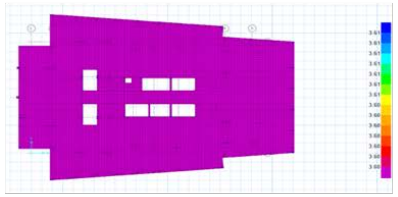
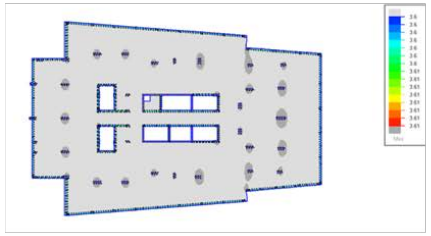
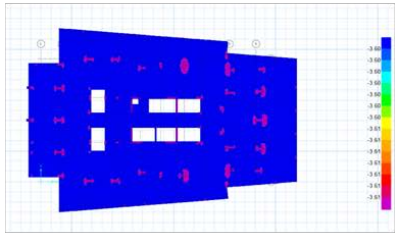
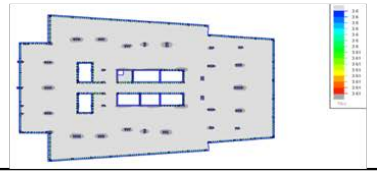
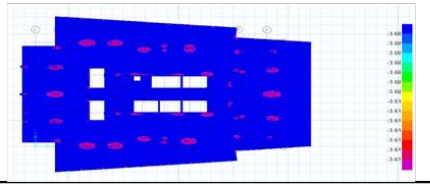
CUFE-BE

Boundary Elements for Engineers
www.be4e.com

Cairo University

5. Fixed base Package (FBI-AK)

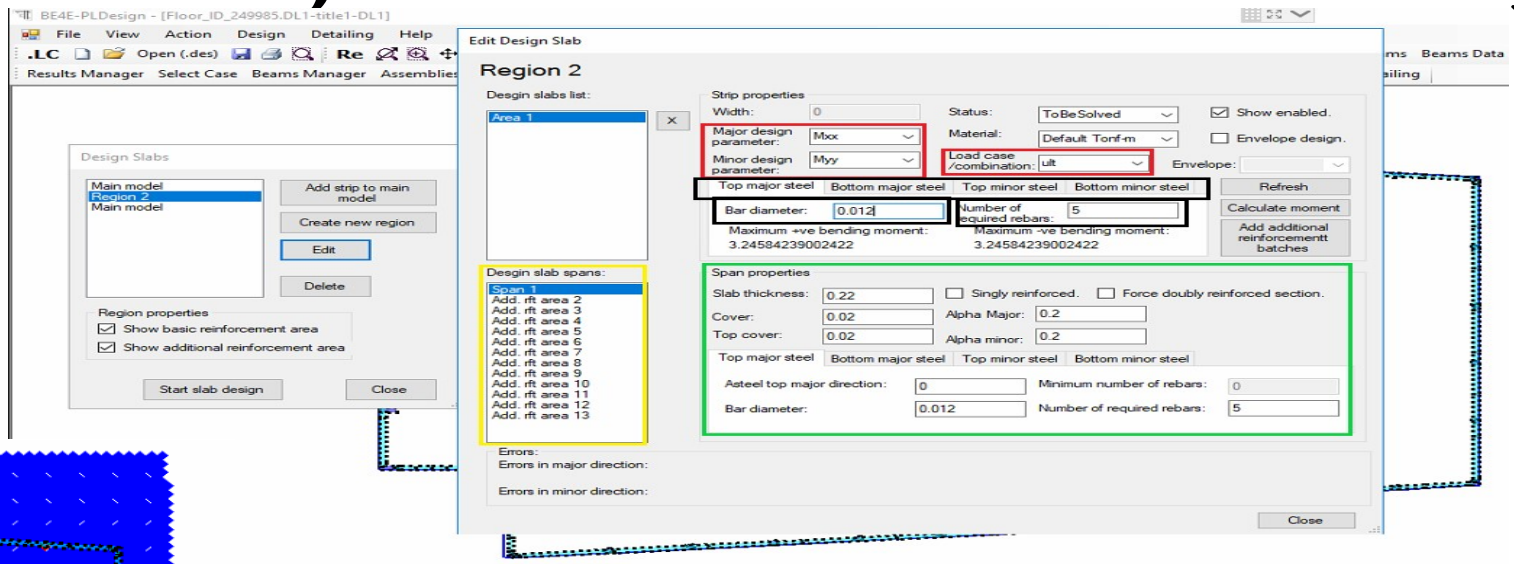
	PLPOST (BE)	SAFE (FE)
Mxx		
Myy		
Def.		

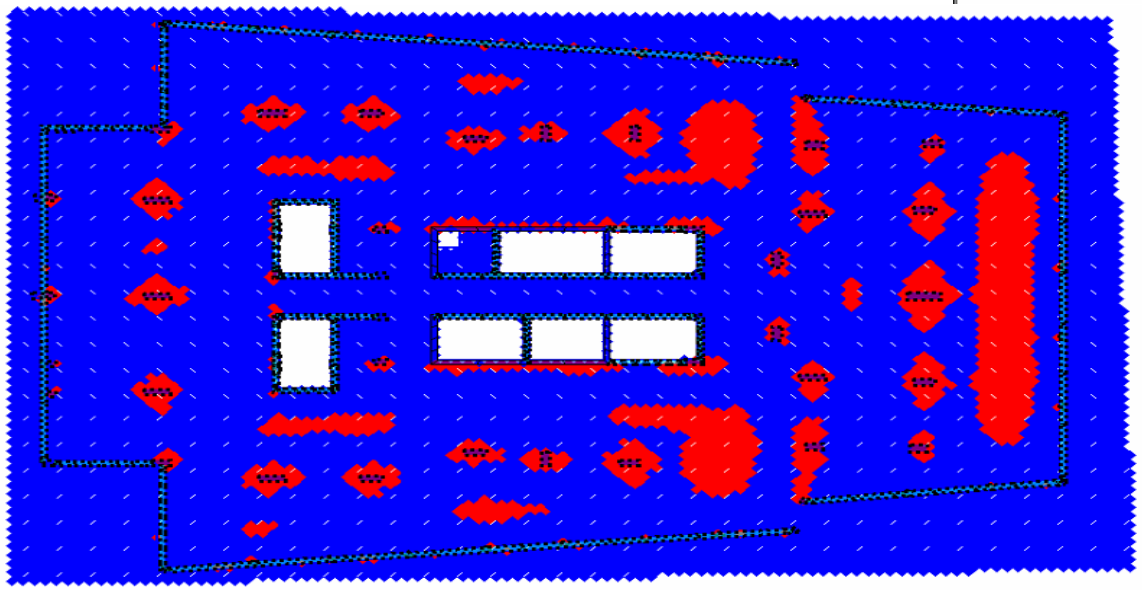
	PLPOST (BE)	SAFE (FE)
Mxx (B)		
Myy (B)		
Mxx (T)		
Myy (T)		

CUFE-BE

5. Fixed base Package (FBLMK)

Cairo University





Basement slab design in PLDesign

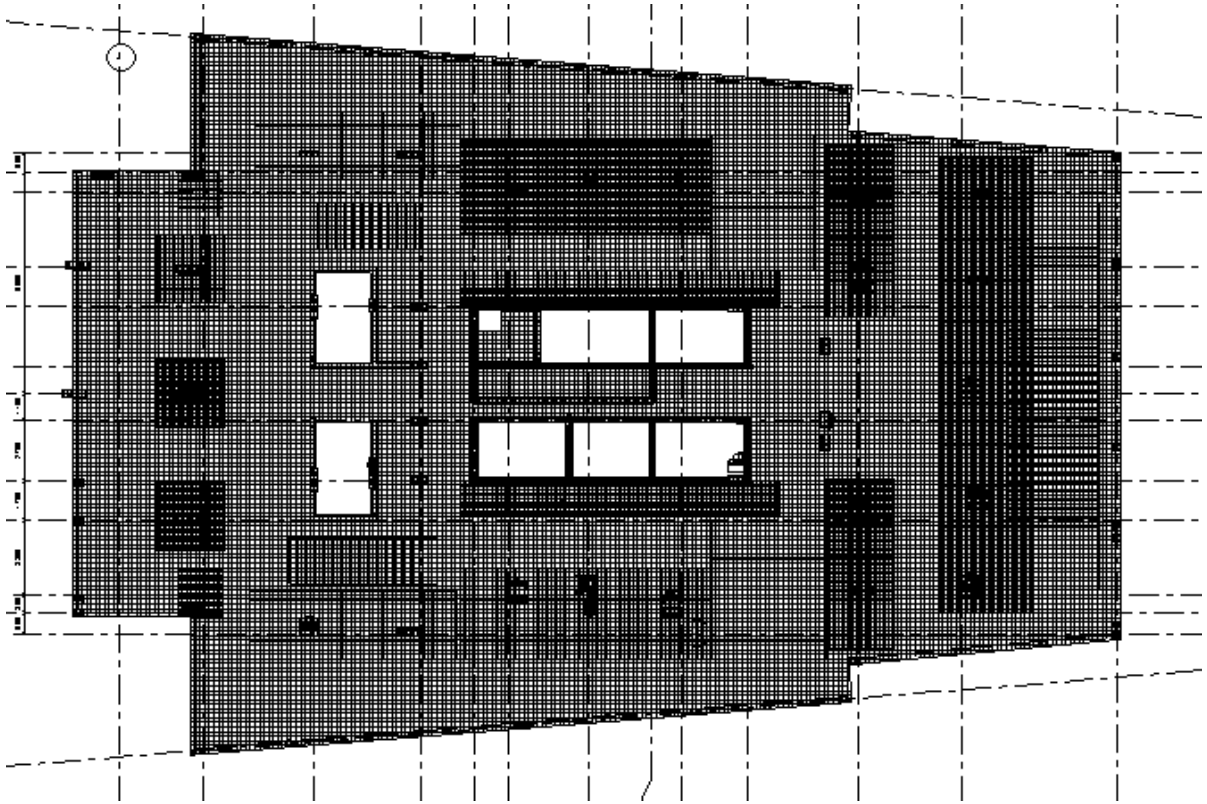
CUFE-BE

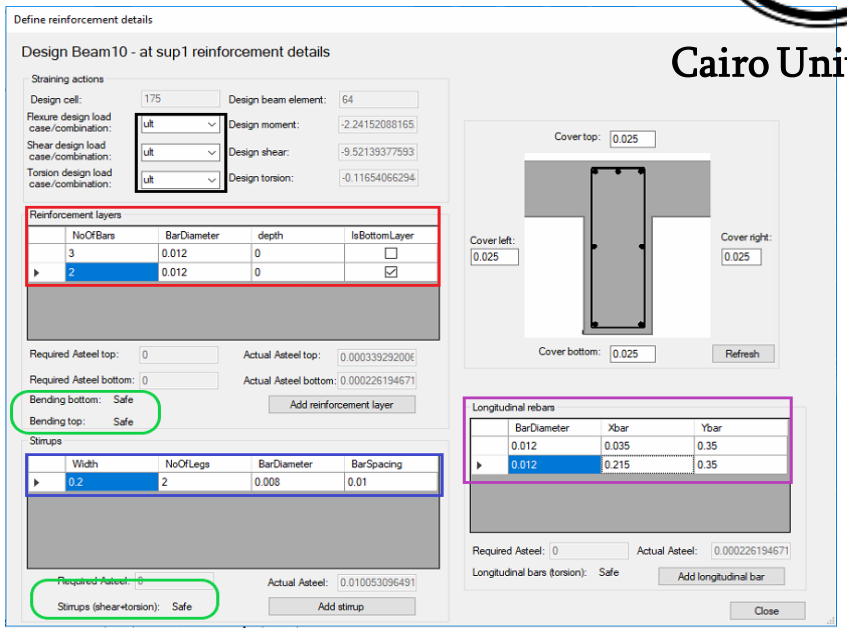
BOUNDARY ELEMENTS FOR ENGINEERS
www.be4e.com

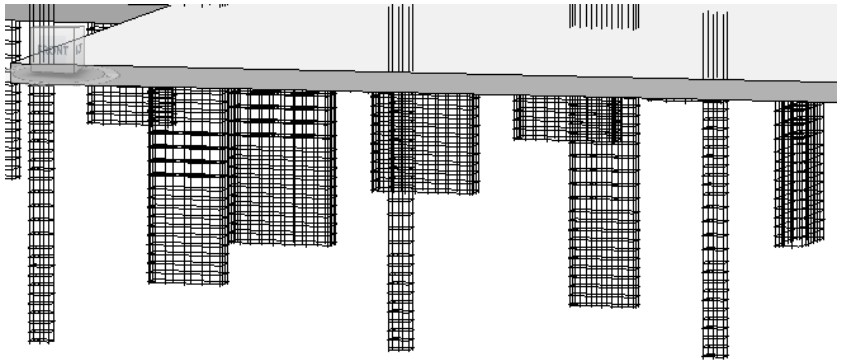
5. Fixed base Package (FBP-AK)

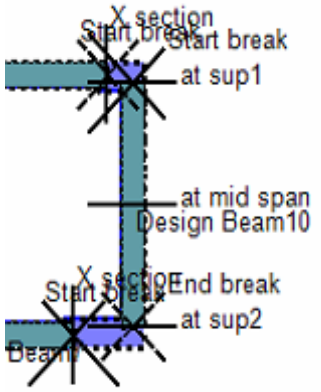
www.be4e.com

Cairo University







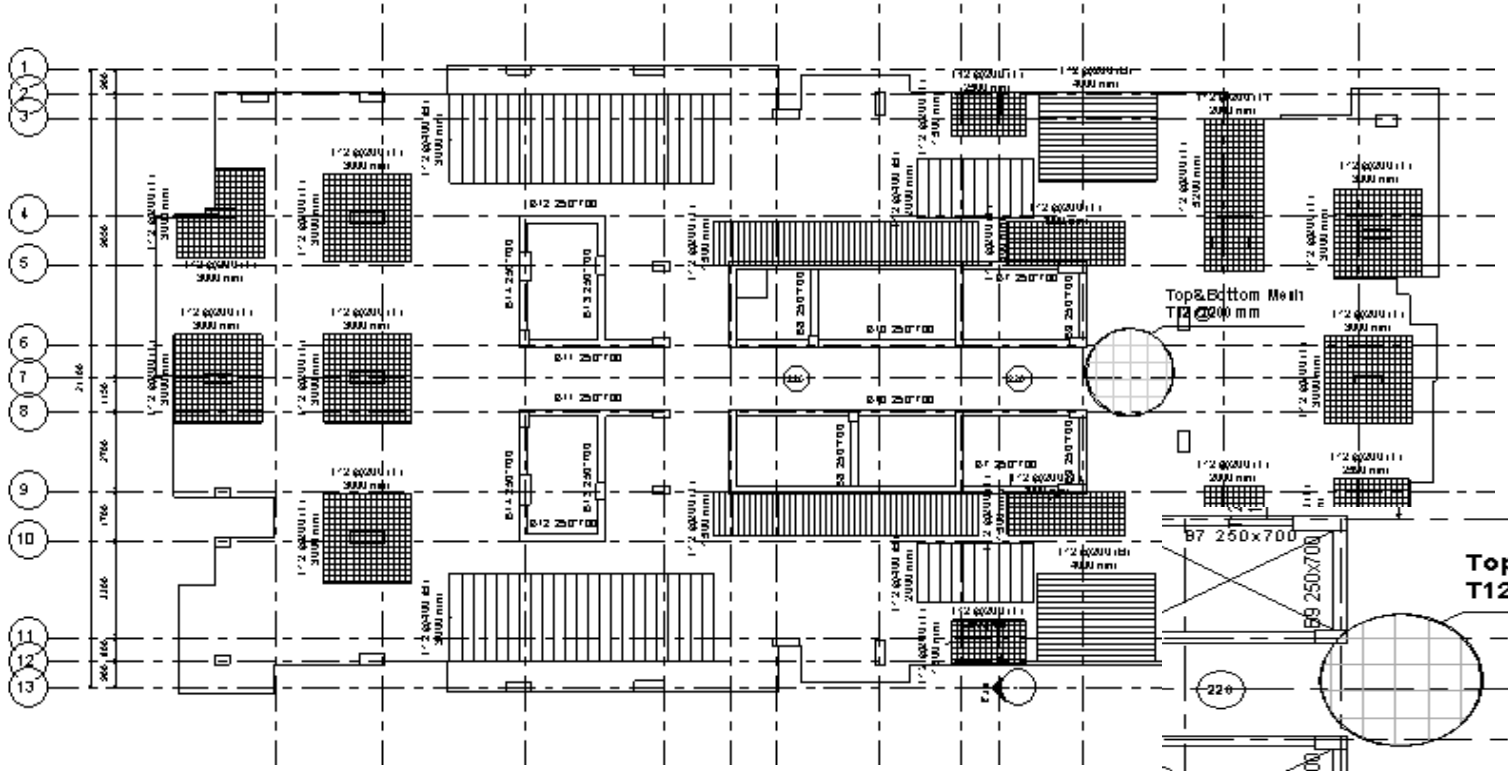


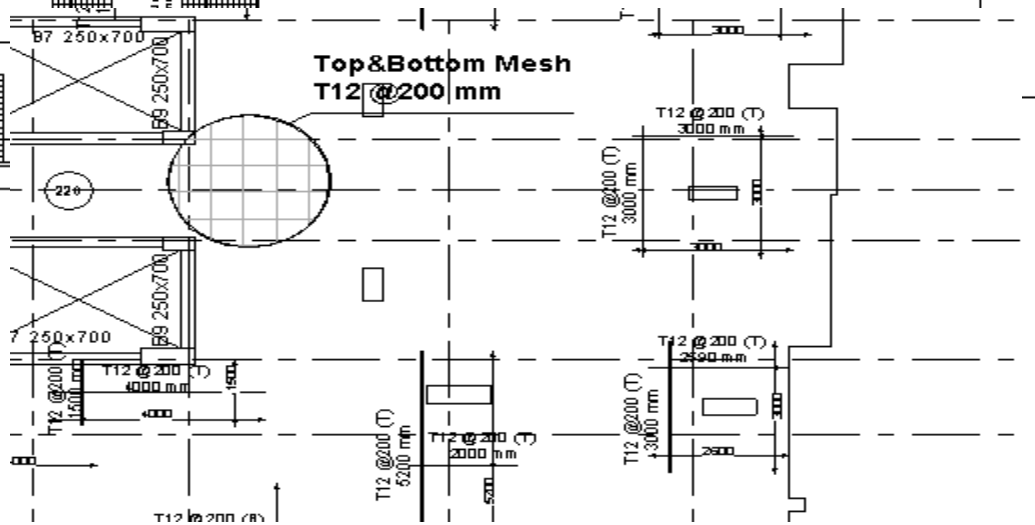
CUFE-BE

5. Fixed base Package (FBP-MK)

www.be4e.com

Cairo University





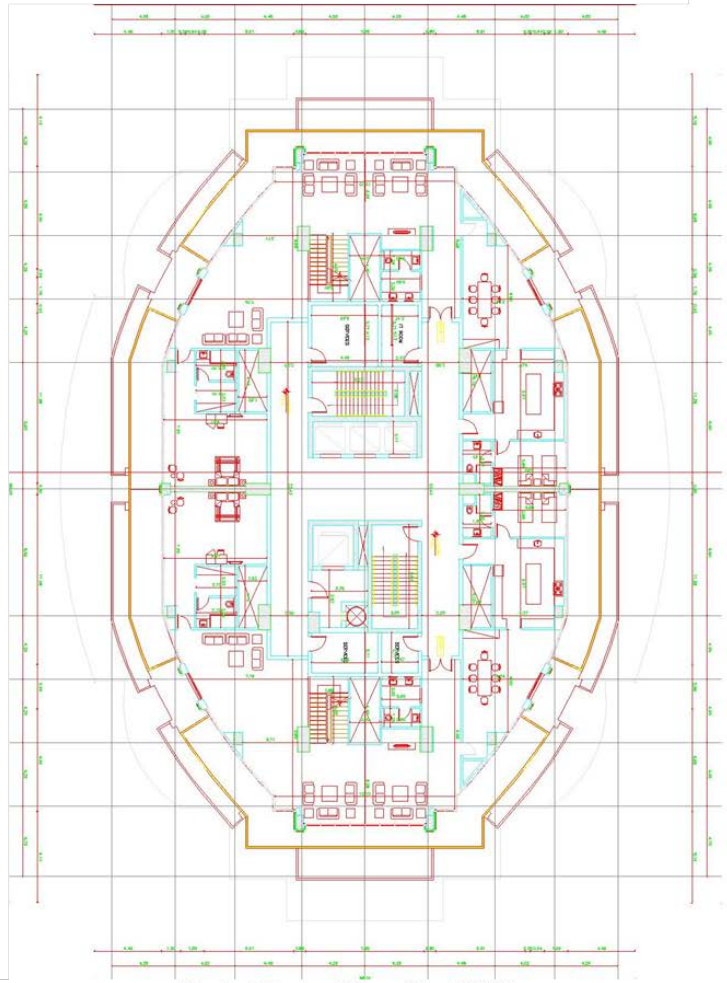
column	section (scale 1:25)
c1	
c2	
c3	

CUFE-BE

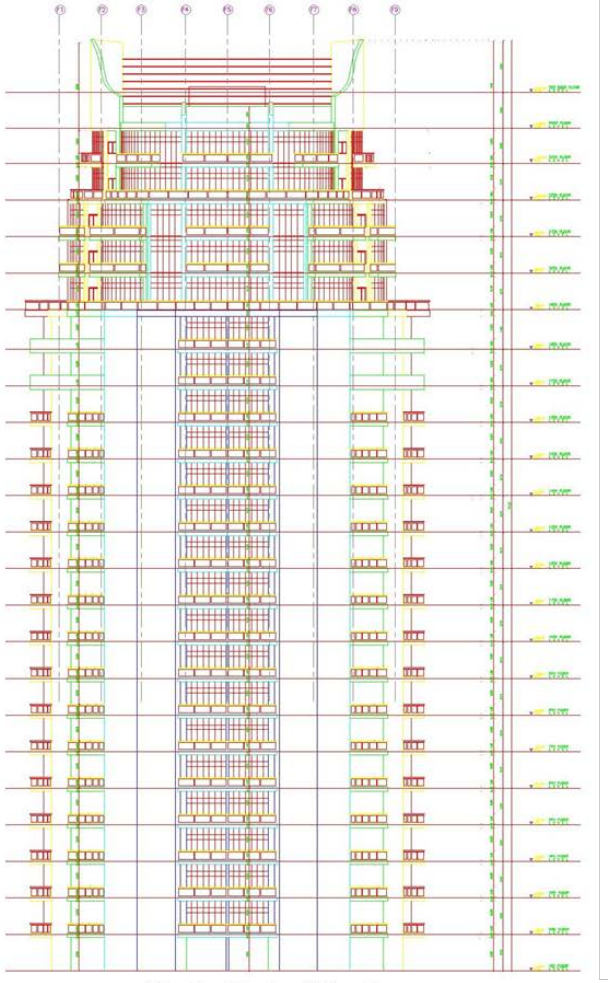
www.be4e.com

Cairo University

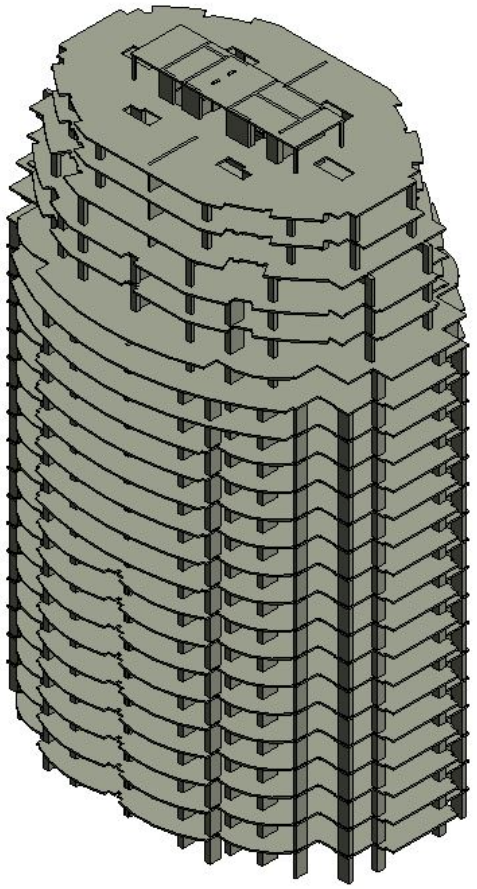
5. Fixed base Package (FBP-ATK)



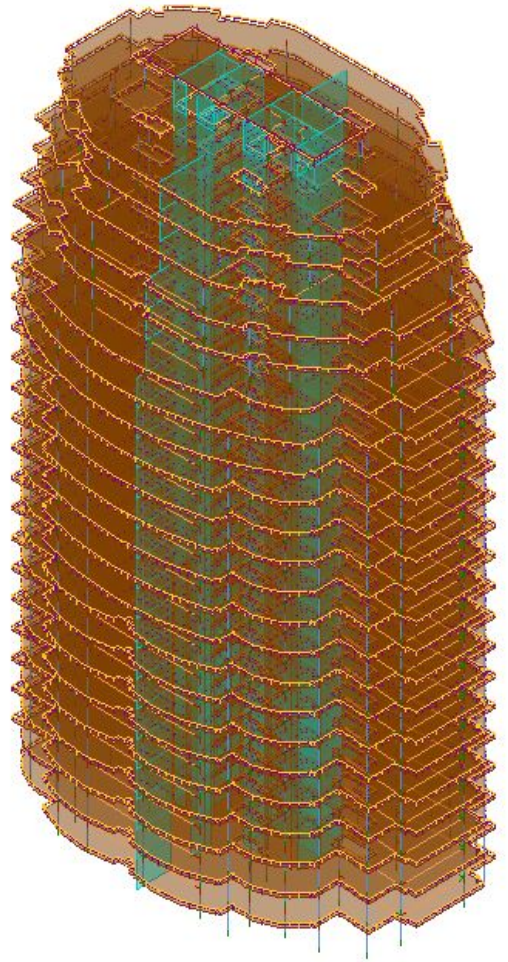
The Architectural Plan of the 22nd Floor.



The Architectural Elevation.



Revit 3D geometric Model



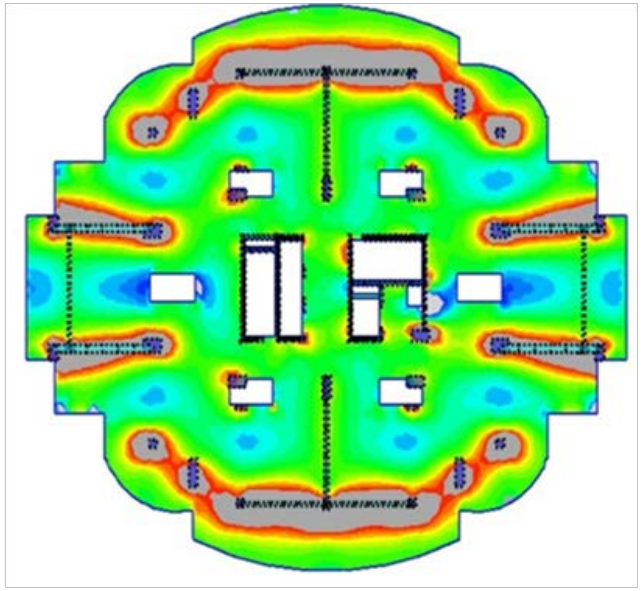
Revit 3D analytical Model

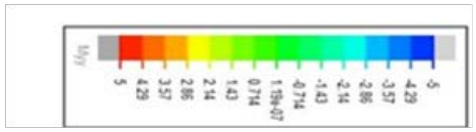
CUFE-BE

www.be4e.com

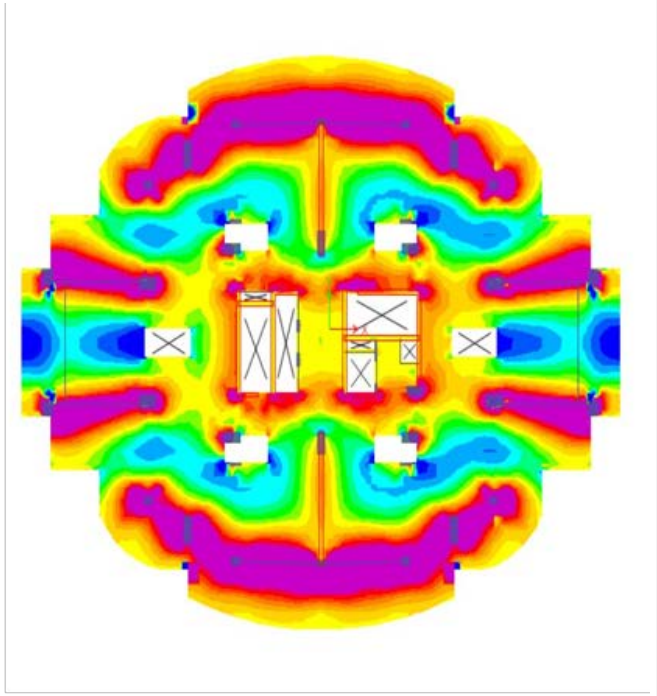
Cairo University

5. Fixed base Package (FBPAK)

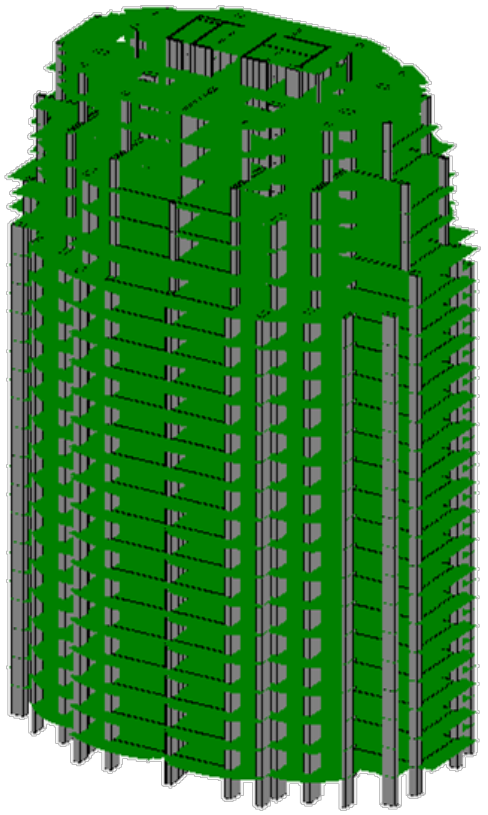




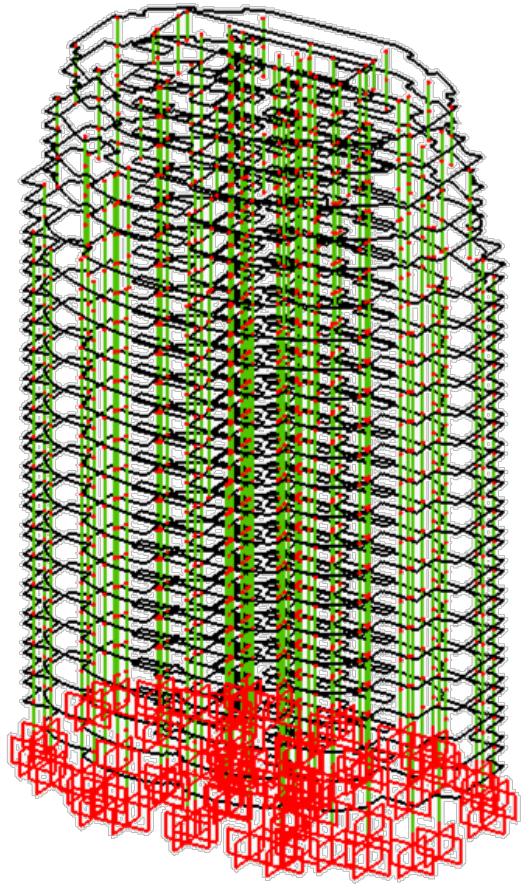
The M_{yy}'s contour for the 19th floor on BE tool "PLPAK" in t.m.



The M_{yy}'s contour for the 19th floor on FE tool "SAFE" in t.m.



PLPAK 3D geometric Model



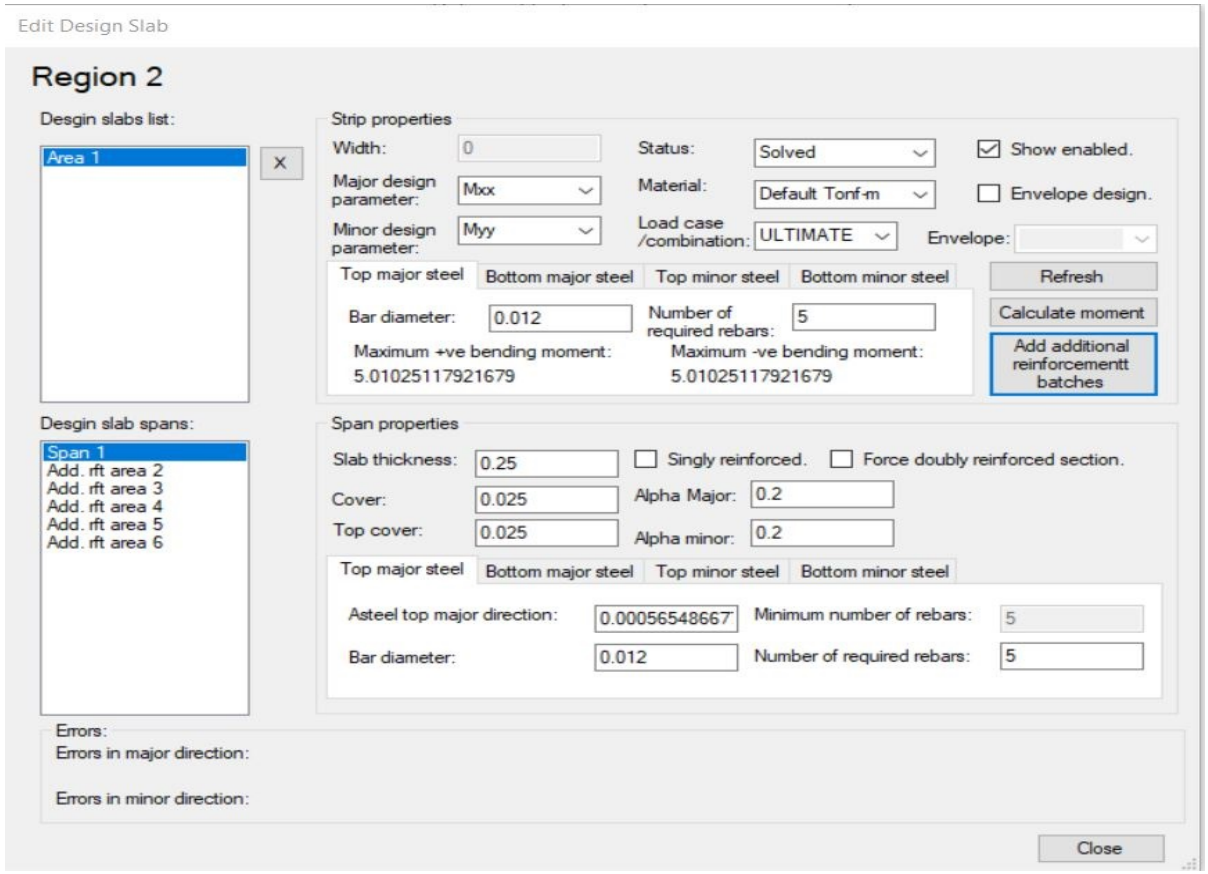
PLPLAK 3D analytical Model

CUFE-BE

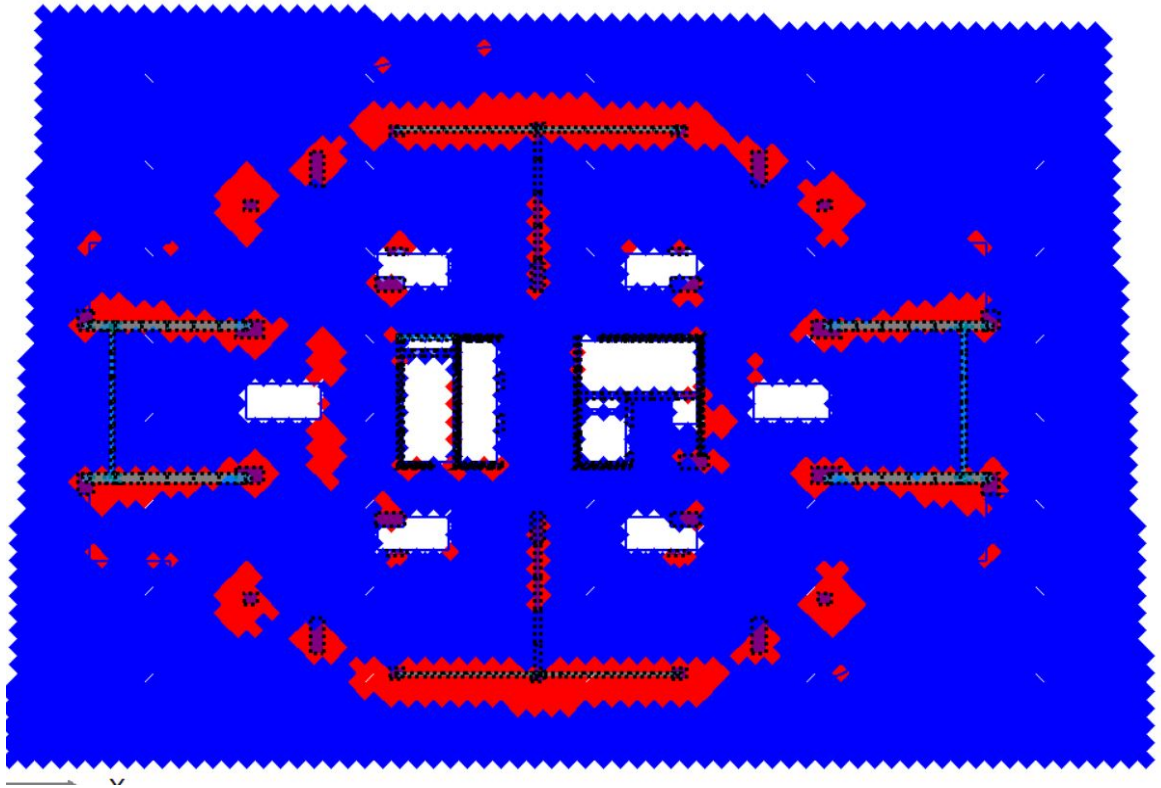
www.be4e.com

Cairo University

5. Fixed base Package (FBPAK)



The slab design tool where RFT is generated.

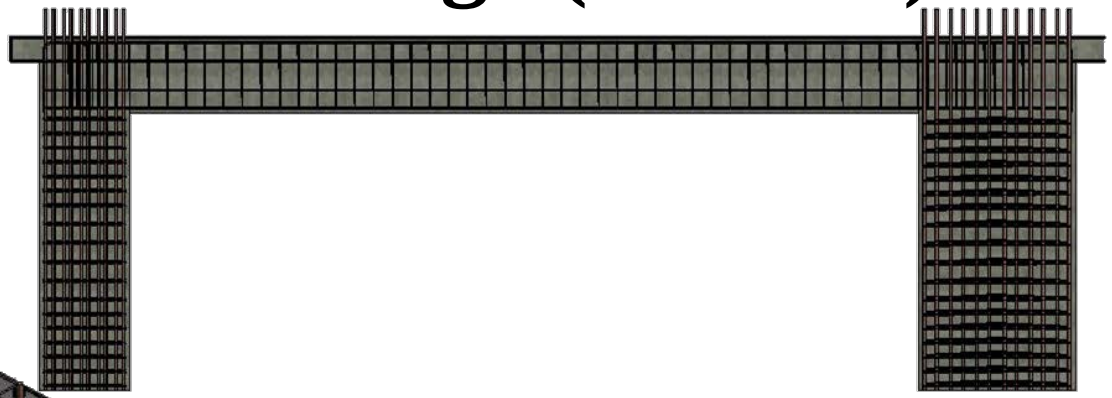


The moment contour on PLGen where additional RFT is needed

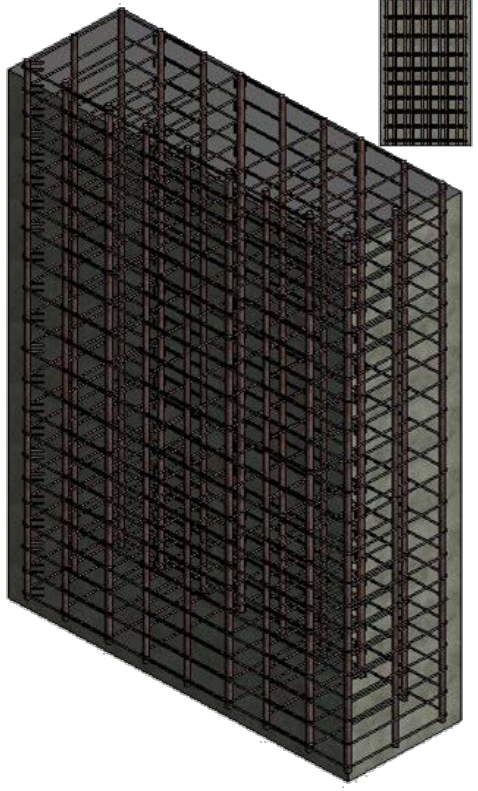
CUFE-BE

Cairo University

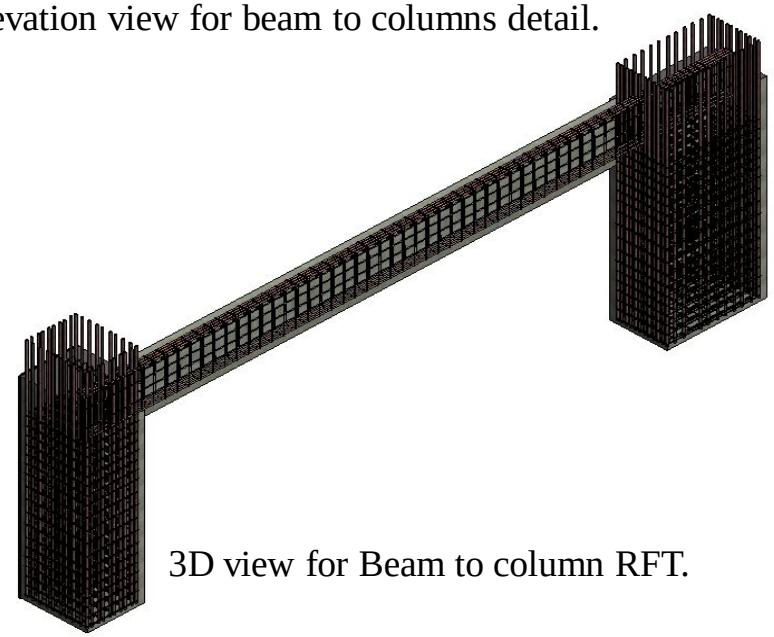
5. Fixed base Package (FBP-AK)



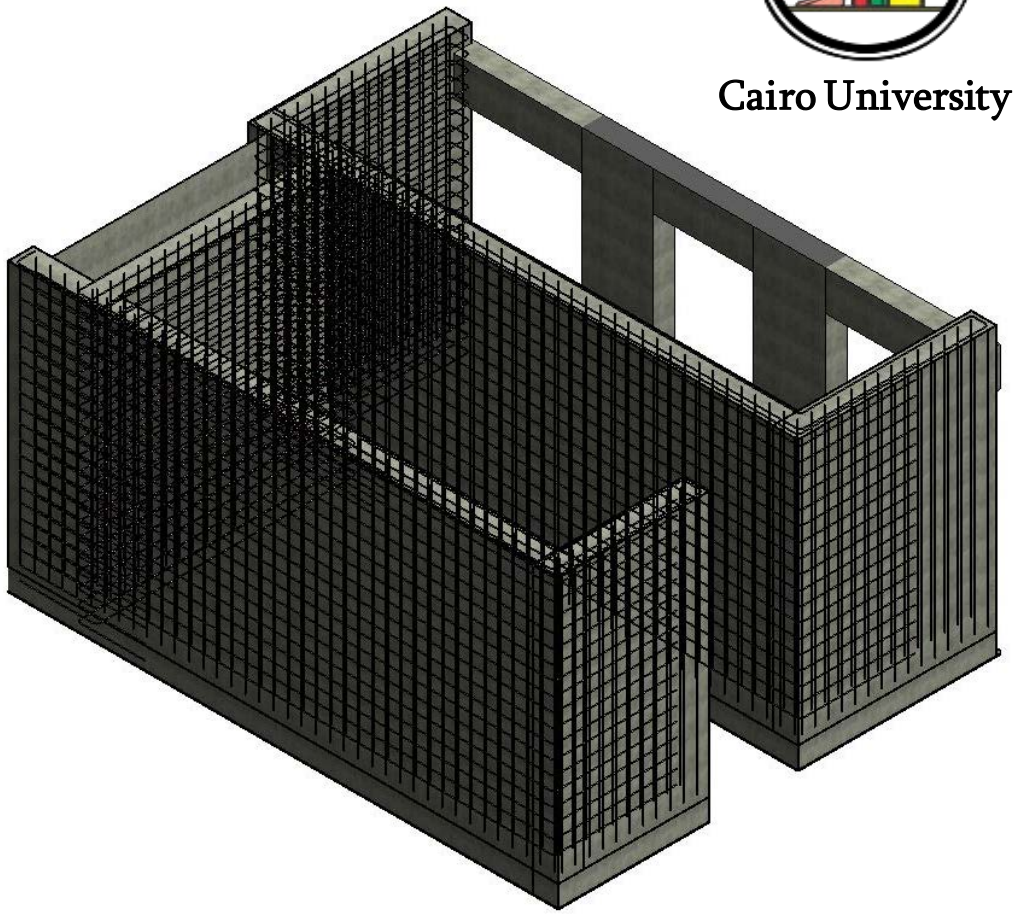
Elevation view for beam to columns detail.



3D view for column RFT detail.



3D view for Beam to column RFT.



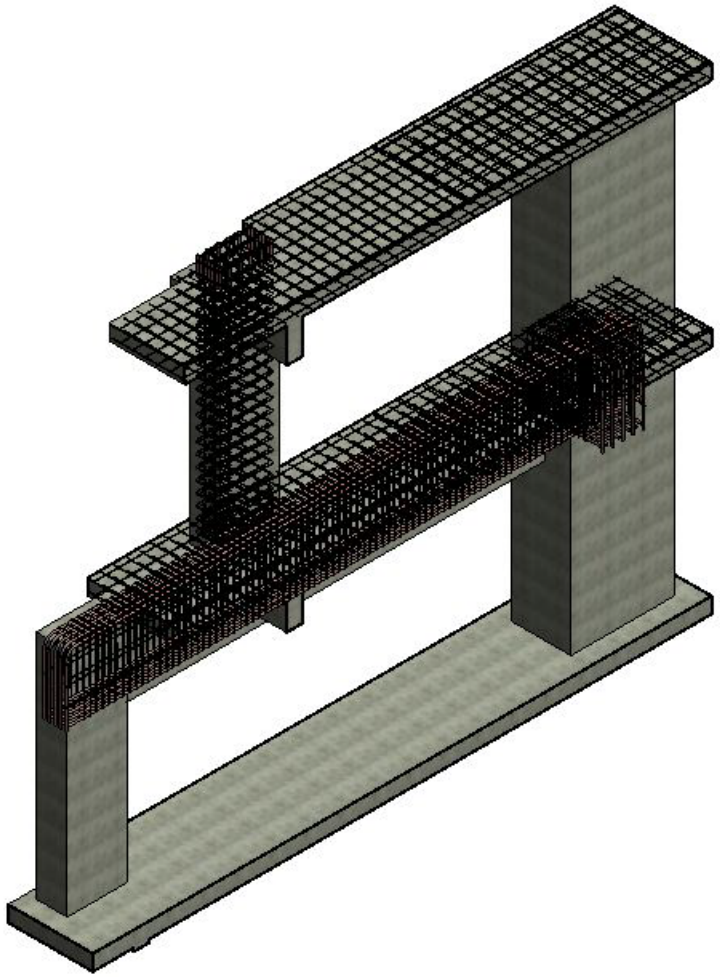
3D view for core RFT detail.

CUFE-BE

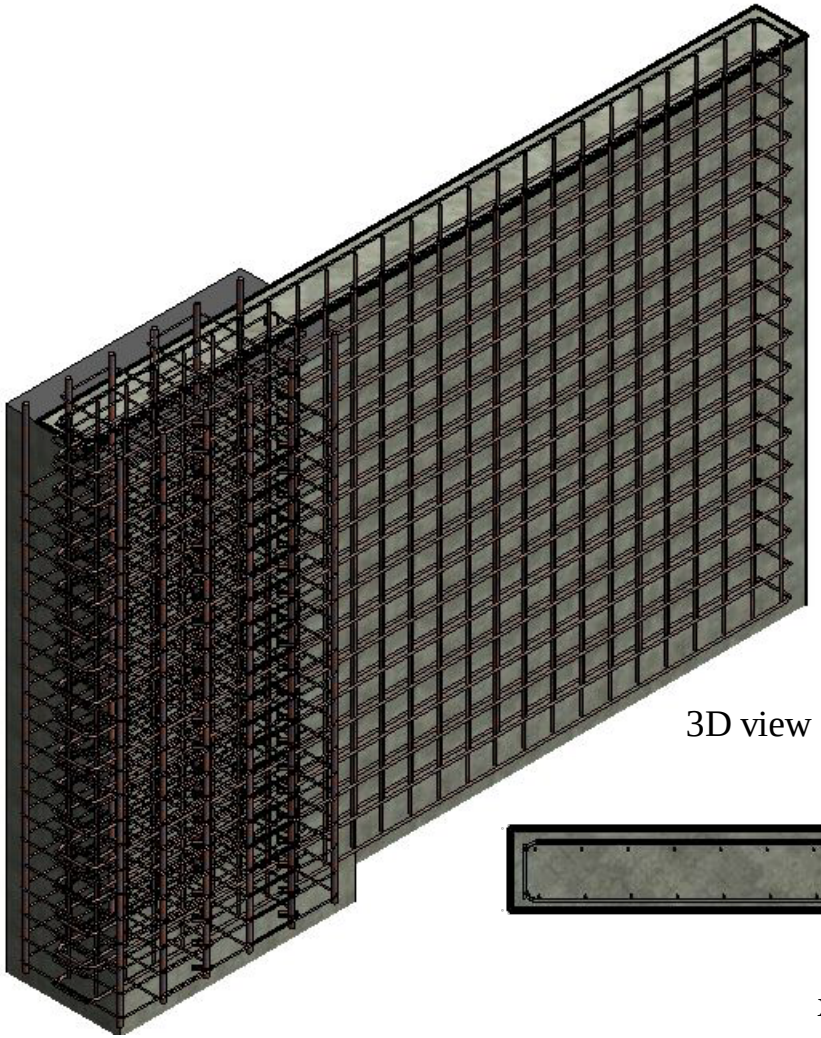
www.be4e.com

Cairo University

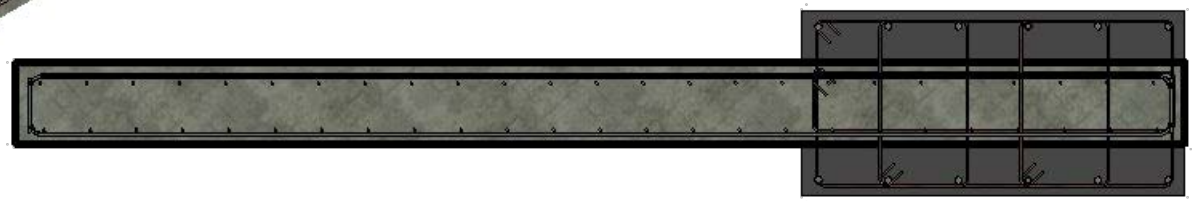
5. Fixed base Package (FBP-MK)



3D Detailing between beams and above column.



3D view for shear wall detail.



x-section for shear wall Detail.

CUFE-BE

www.be4e.com

Cairo University

Table of contents

CUFE-BE

www.be4e.com

Cairo University

What is the PTPAK?

- PTPAK (Post tension package) is a structural design tool package for post-tensioned plate bending structures based on the boundary element method for shear deformable plate bending theory, using different codes like (ACI, EC, and ECP).
- The PTPAK is a added to the PLPAK-Basic package to design reinforced concrete building slabs and foundations.
- The PTPAK is not only consider about design, but also about detailing and calculation sheet forming.
- In PTPAK the user can change the cable profile (13 templates) to serve the different structure conditions.
- In PTPAK the user can draw reinforcement on slab and determine the reinforcement at beams (without post tension).
- In the PTPAK the calculation is not only for load combination, but also for envelopes.

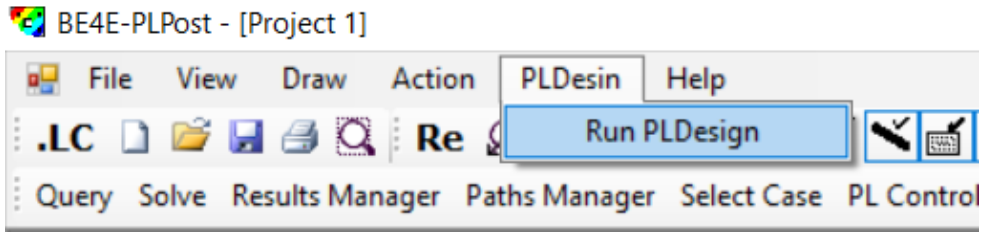
CUFE-BE

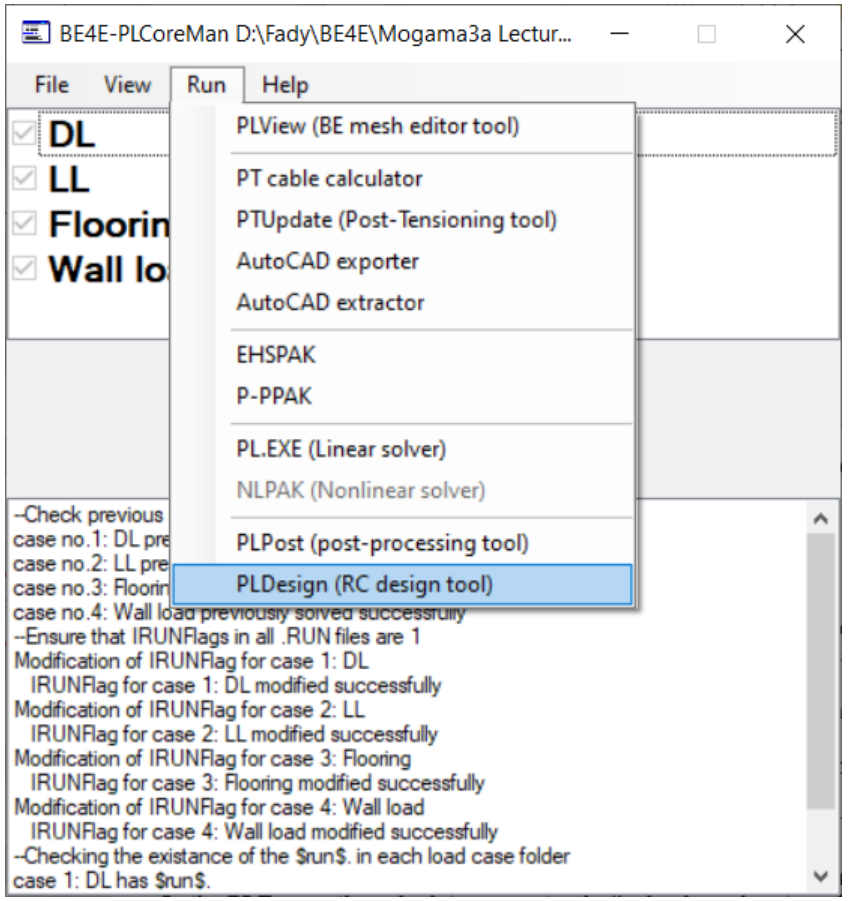
www.be4e.com

Cairo University

What is the PTPAK?

- The user can go to PTPAK by two ways either by using PLPost or PLCoreMan as follows:





CUFE-BE

www.be4e.com

Cairo University

6. PTPAK Package

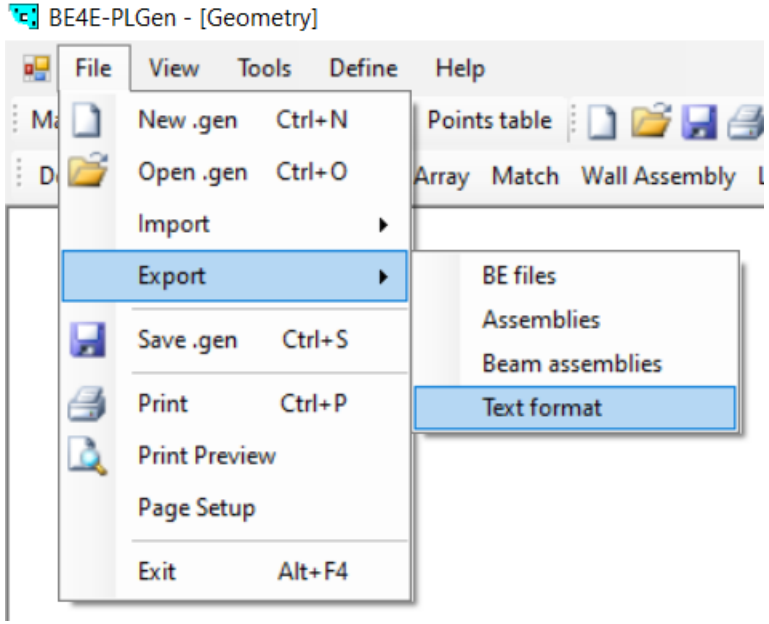
CUFE-BE

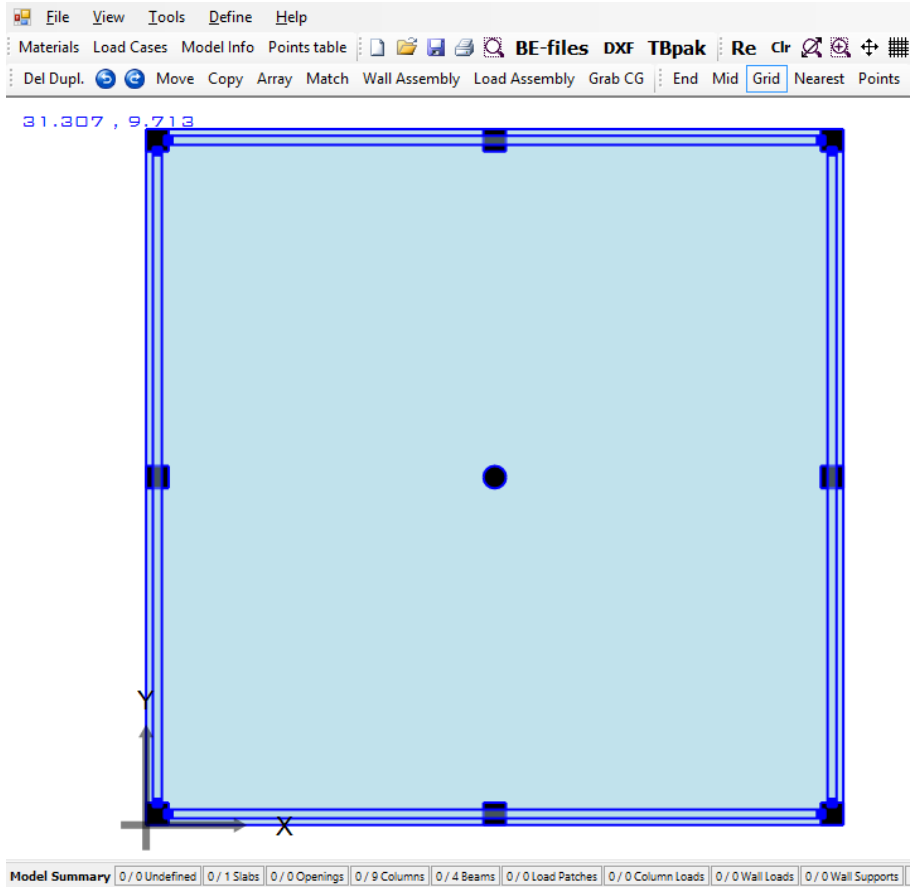
www.be4e.com

Cairo University

6.1. File needed to be exported before using PTPAK

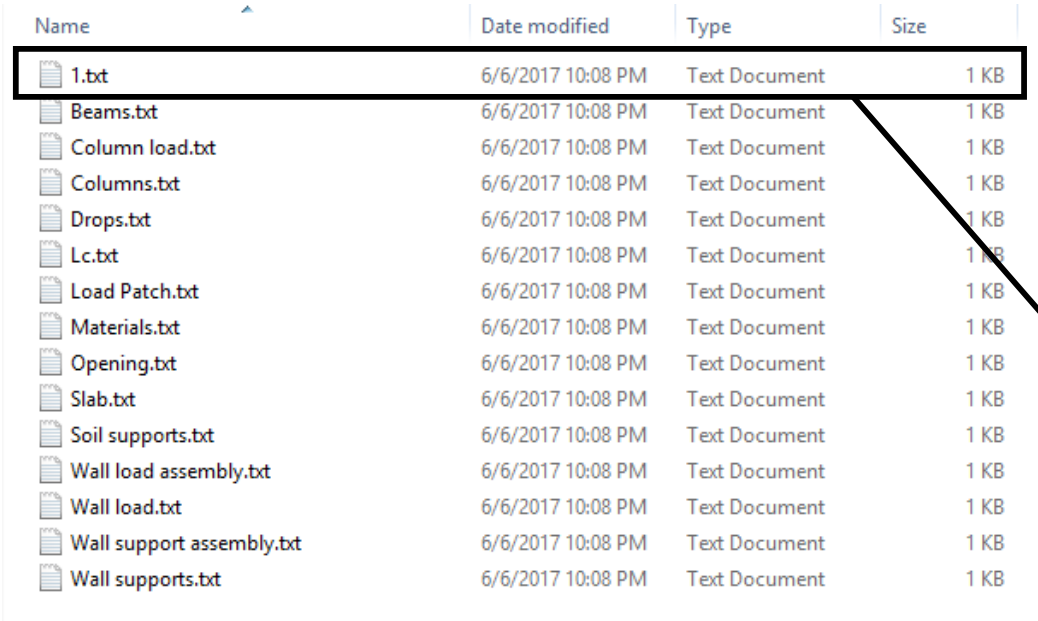
After drawing the problem (without post tension) in PLGen as shown below BE-Files should exported and the text files also for the problem.



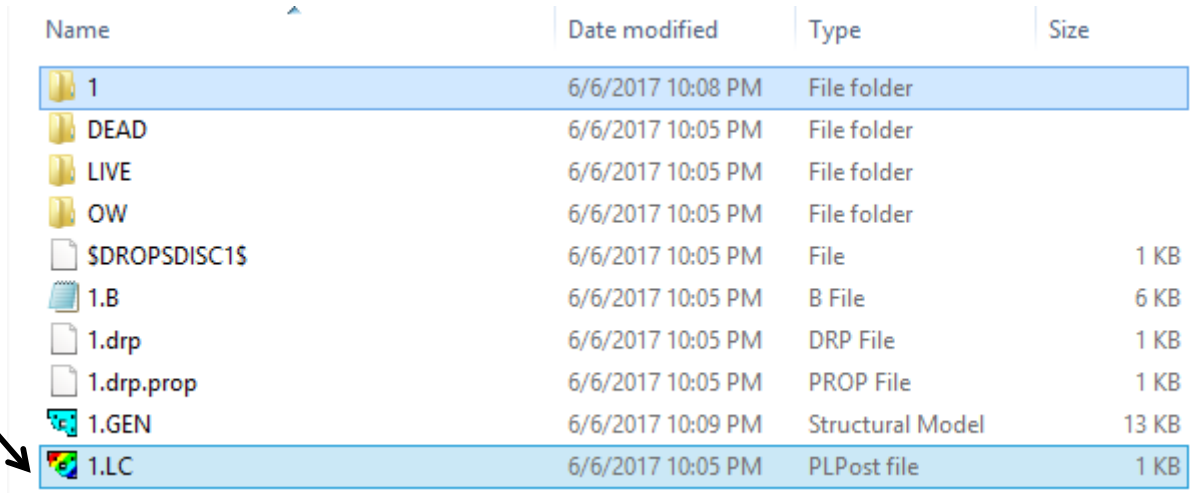


6.1. File needed to be exported before using PTPAK

N.B. the text format should named similarly as .LC file in a created folder with also the same name of .LC file.



Name	Date modified	Type	Size
1.txt	6/6/2017 10:08 PM	Text Document	1 KB
Beams.txt	6/6/2017 10:08 PM	Text Document	1 KB
Column load.txt	6/6/2017 10:08 PM	Text Document	1 KB
Columns.txt	6/6/2017 10:08 PM	Text Document	1 KB
Drops.txt	6/6/2017 10:08 PM	Text Document	1 KB
Lc.txt	6/6/2017 10:08 PM	Text Document	1 KB
Load Patch.txt	6/6/2017 10:08 PM	Text Document	1 KB
Materials.txt	6/6/2017 10:08 PM	Text Document	1 KB
Opening.txt	6/6/2017 10:08 PM	Text Document	1 KB
Slab.txt	6/6/2017 10:08 PM	Text Document	1 KB
Soil supports.txt	6/6/2017 10:08 PM	Text Document	1 KB
Wall load assembly.txt	6/6/2017 10:08 PM	Text Document	1 KB
Wall load.txt	6/6/2017 10:08 PM	Text Document	1 KB
Wall support assembly.txt	6/6/2017 10:08 PM	Text Document	1 KB
Wall supports.txt	6/6/2017 10:08 PM	Text Document	1 KB



Name	Date modified	Type	Size
1	6/6/2017 10:08 PM	File folder	
DEAD	6/6/2017 10:05 PM	File folder	
LIVE	6/6/2017 10:05 PM	File folder	
OW	6/6/2017 10:05 PM	File folder	
$DROPSDISC1$	6/6/2017 10:05 PM	File	1 KB
1.B	6/6/2017 10:05 PM	B File	6 KB
1.drp	6/6/2017 10:05 PM	DRP File	1 KB
1.drp.prop	6/6/2017 10:05 PM	PROP File	1 KB
1.GEN	6/6/2017 10:09 PM	Structural Model	13 KB
1.LC	6/6/2017 10:05 PM	PLPost file	1 KB

6.1. File needed to be exported before using PTPAK

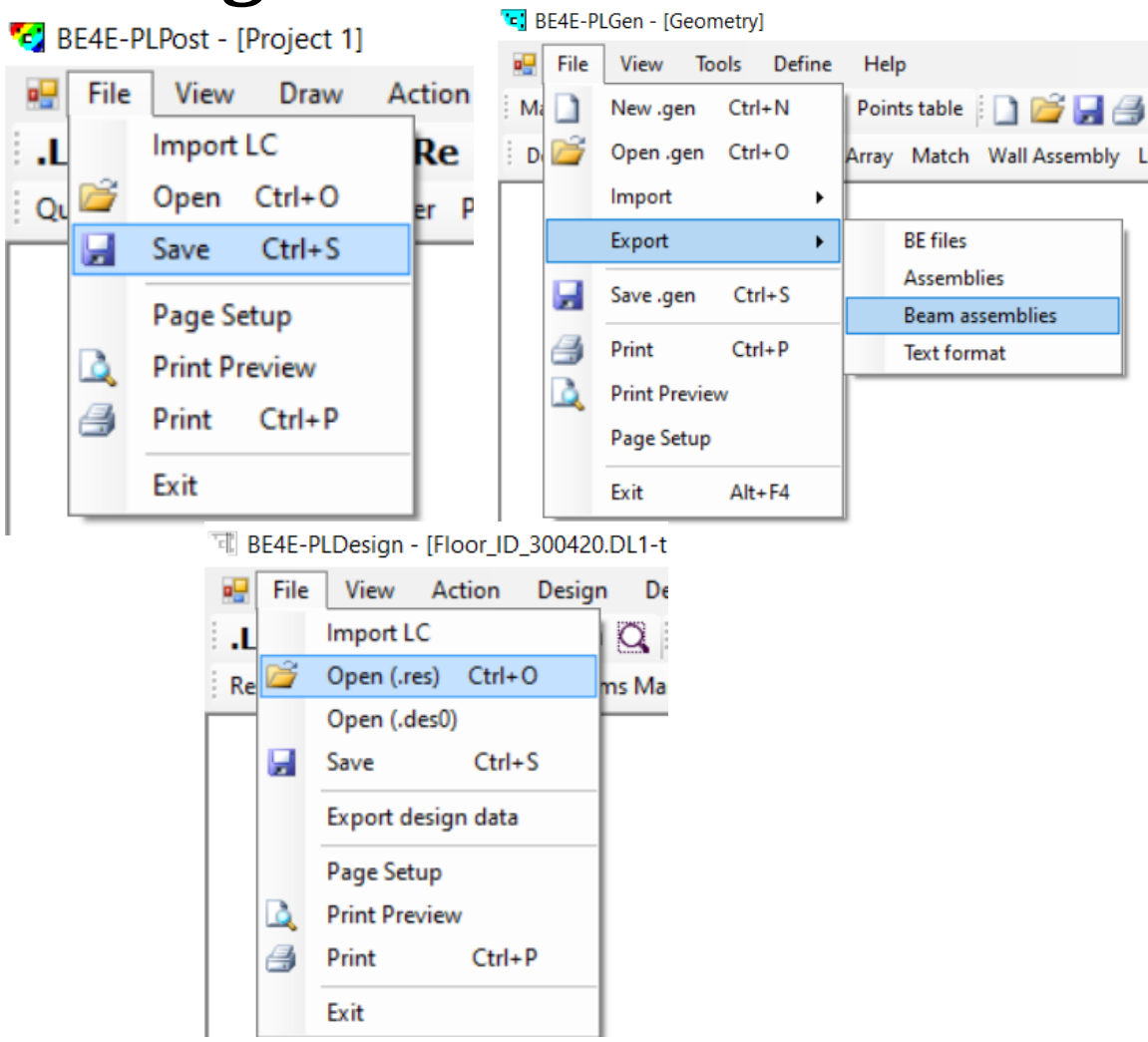
Same as PLDesign, there are cases that user have to export file from PLGen before using PTPAK:

There are cases that user have to export file from PLGen and PLPost before using PLDesign:

- Export beam assemblies: this case is used to design the beams.
- Save the PLPost results: this case is used to design the slab.
- Export assemblies file: this case is used to check punching of the columns.

The previous cases can be restored in the PLDesign as follows:

- Import beam assemblies: this case is used to design the beams (will be demonstrated in beam design section).
- Open the PLPost results: this case is used to design the slab.
- Import assemblies file: this case is used to check punching of the columns.



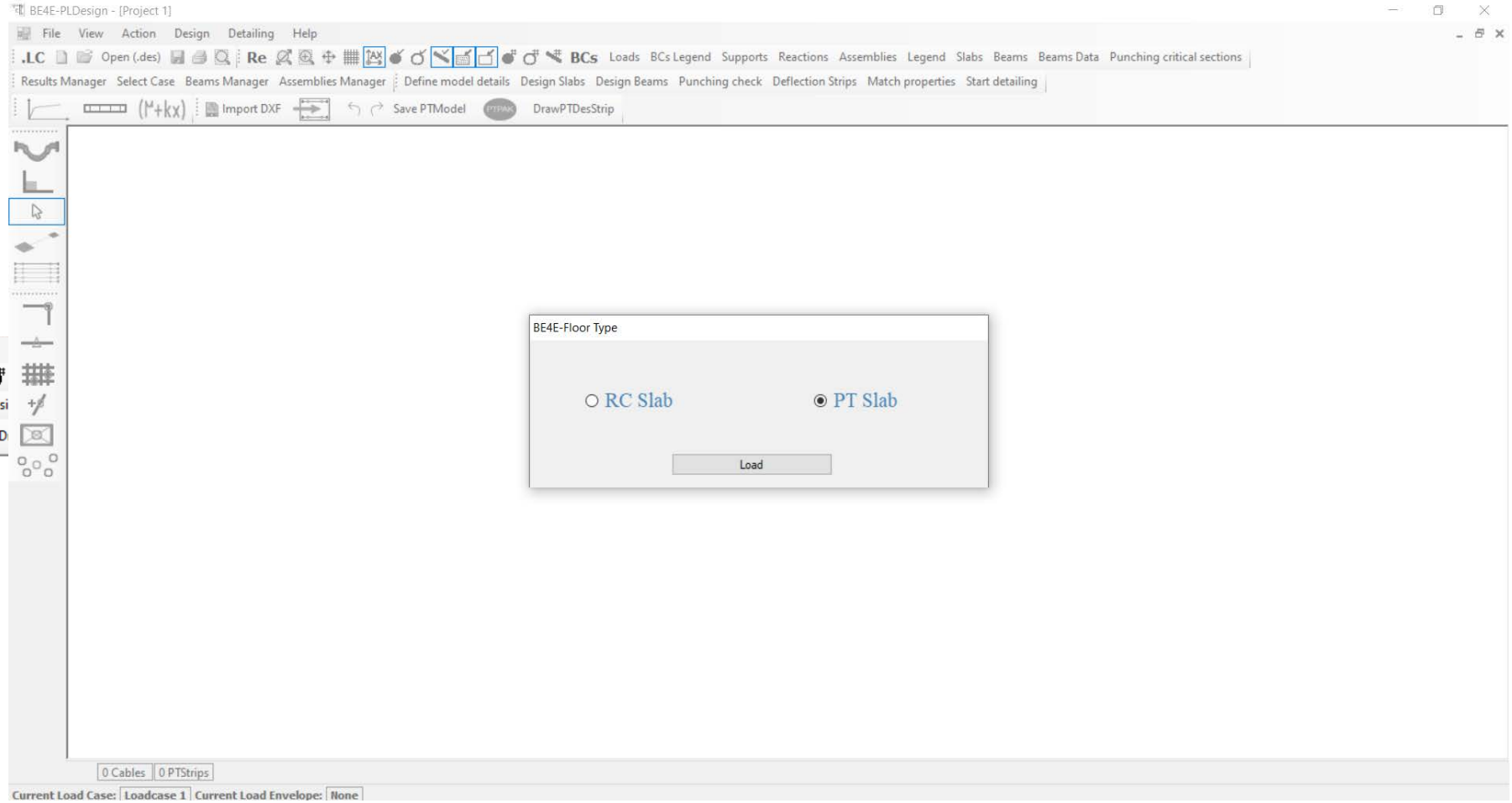
CUFE-BE

www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model

- Choose PT Slab, hence choose Load
- Import Input File (.LC File).



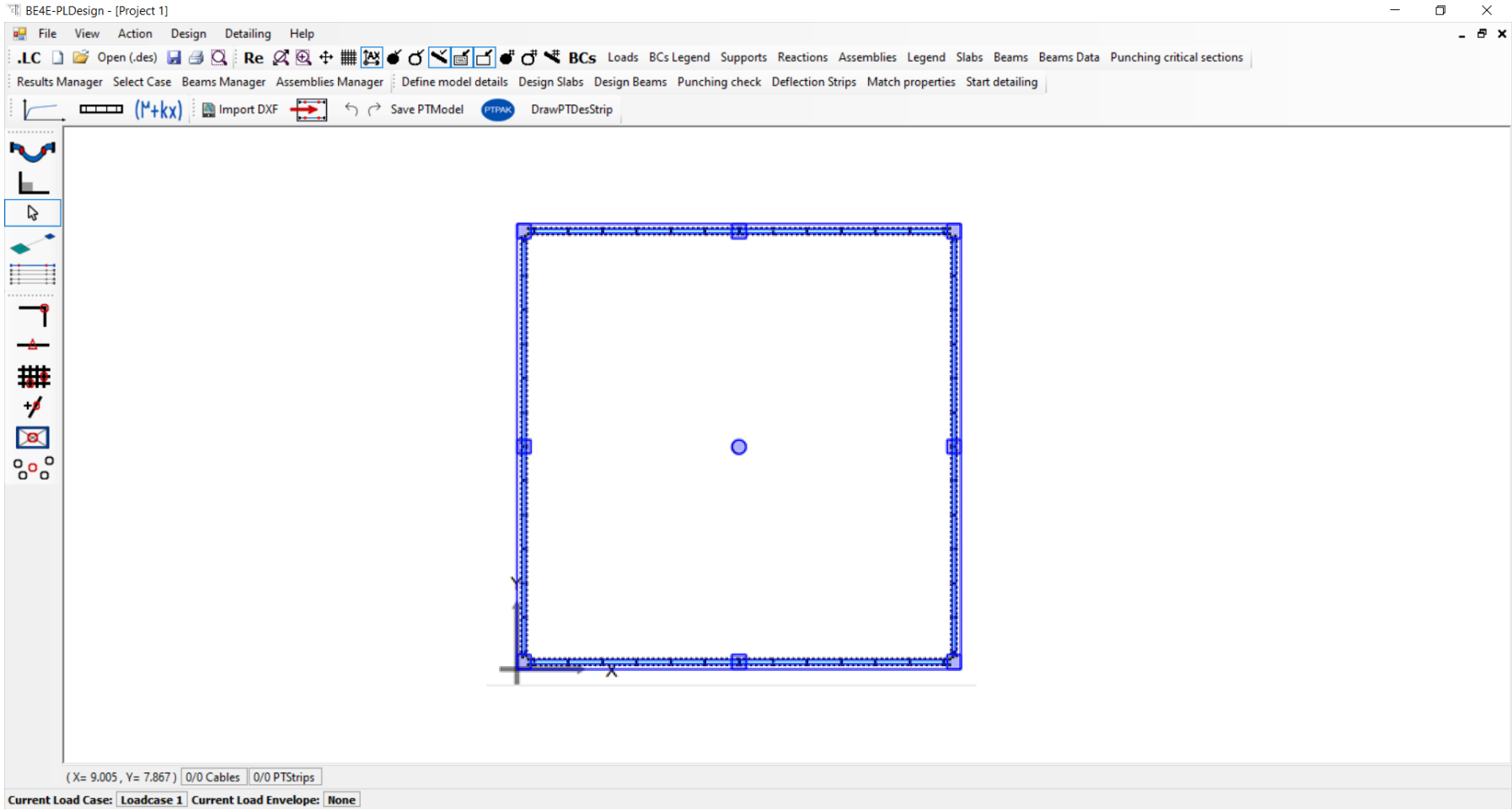
CUFE-BE

www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model

- There are two ways to draw cables:
  1- Export .Dxf for cables.
  2- Draw directly with snapping tools.



CUFE-BE

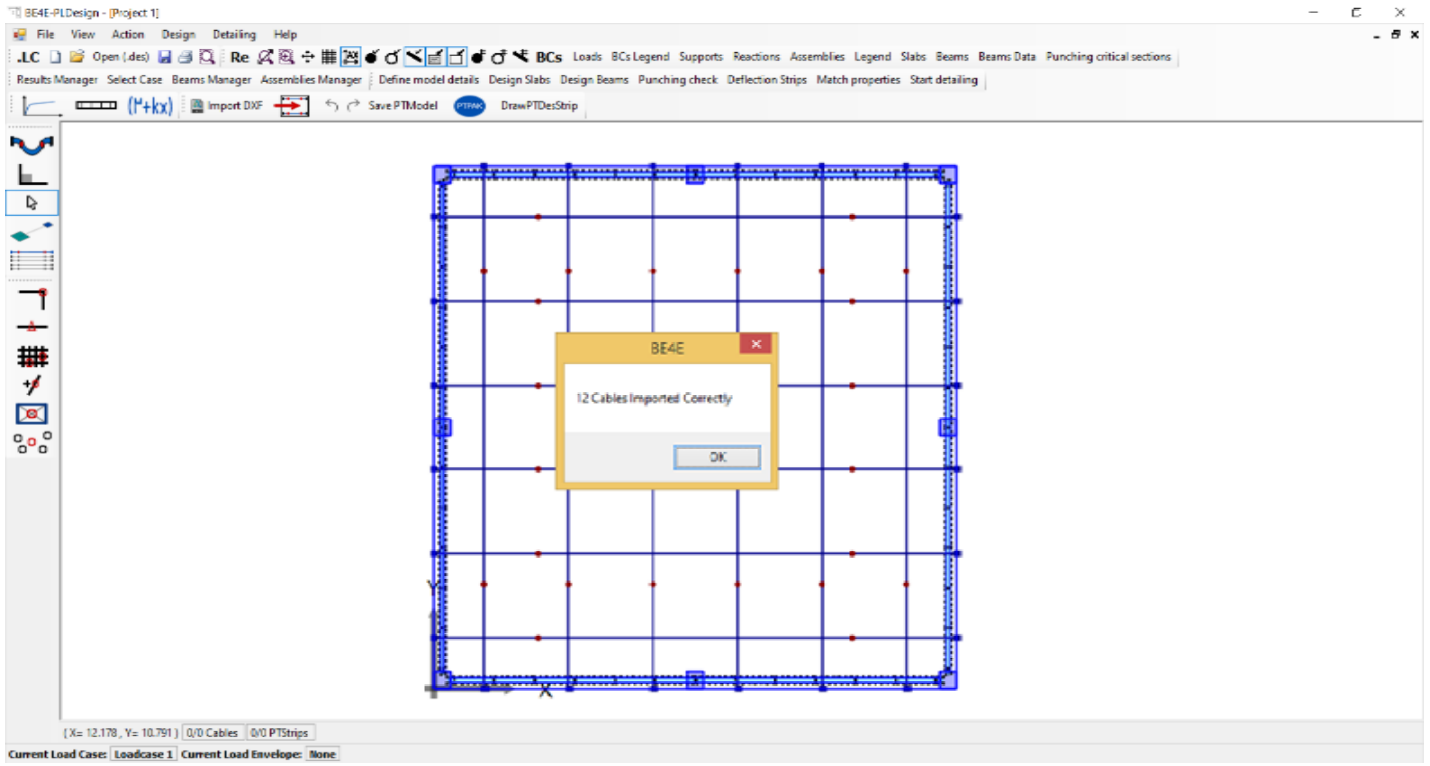
www.be4e.com

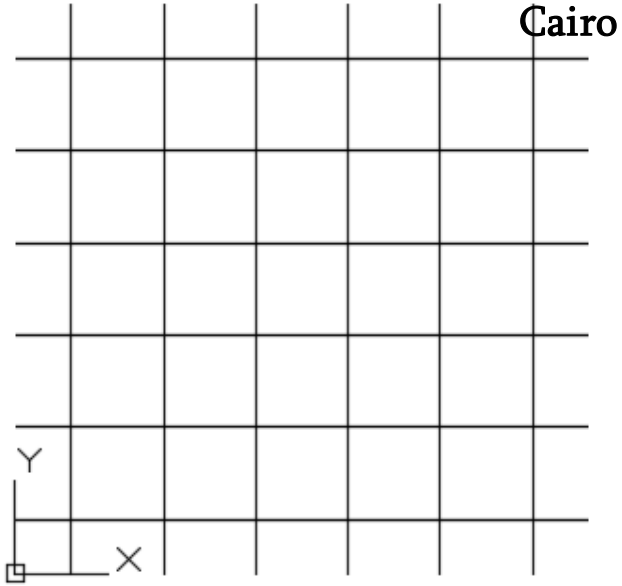
Cairo University

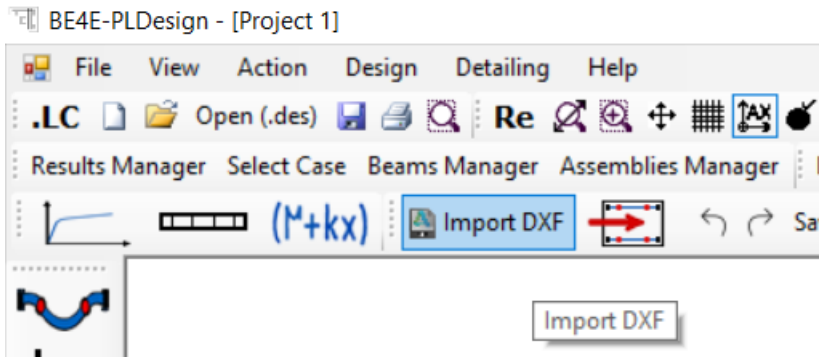
6.2 How can users generate PTPAK Model

A - Export cables from .DXF file:

- Draw cables in AutoCAD file (Polyline) .
- Save as .DXF file.
- Import it from PTPAK.







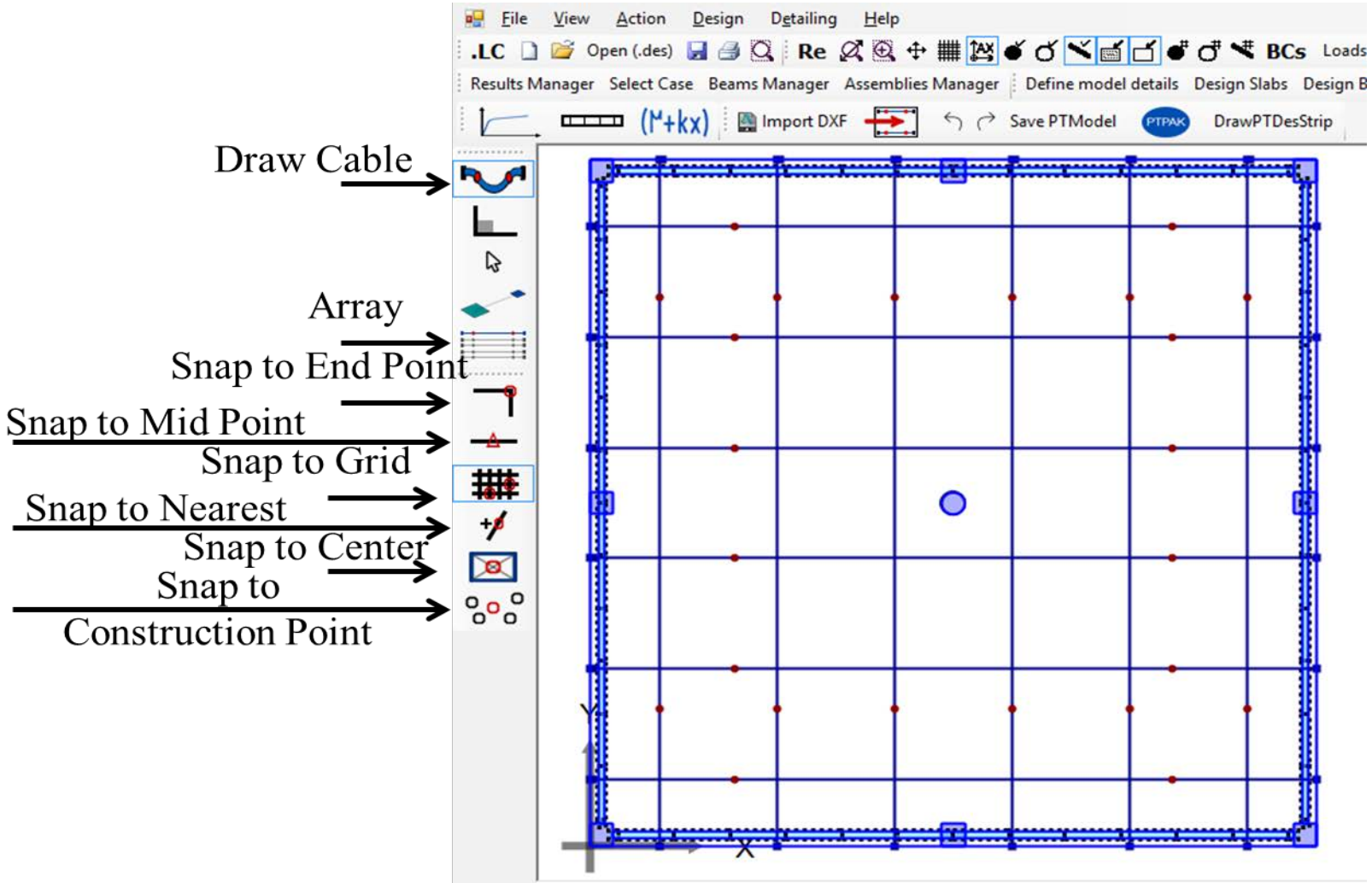
CUFE-BE

www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model

B- Draw Cables from Snap Tools:



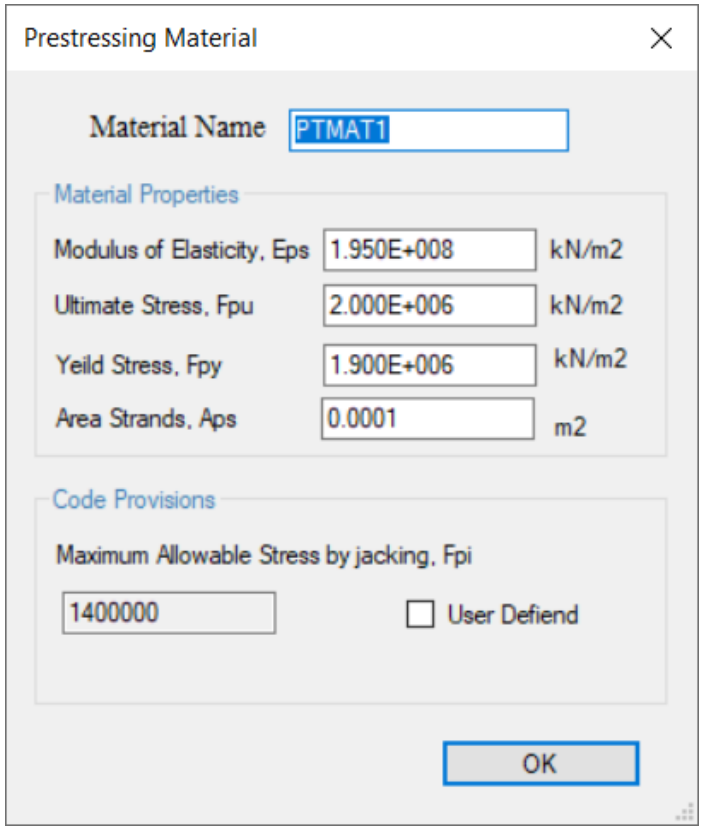
CUFE-BE

www.be4e.com

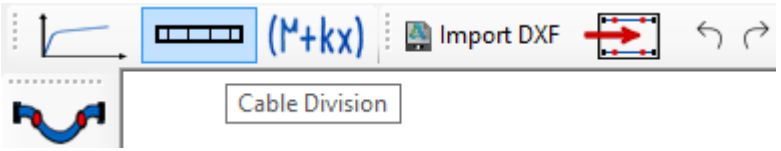
Cairo University

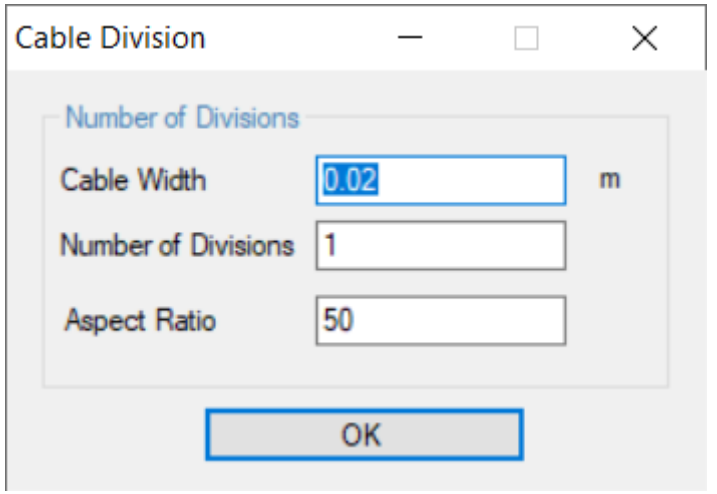
6.2 How can users generate PTPAK Model

- Define Cable Properties:



- Define Cable divisions:





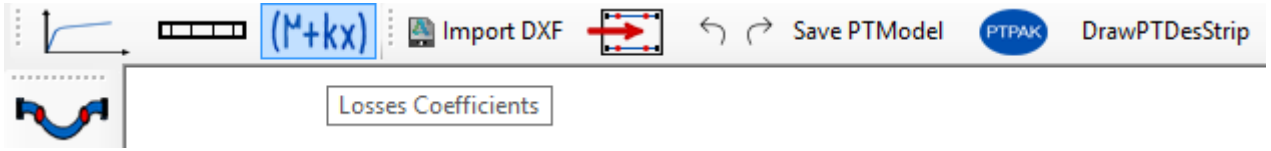
CUFE-BE

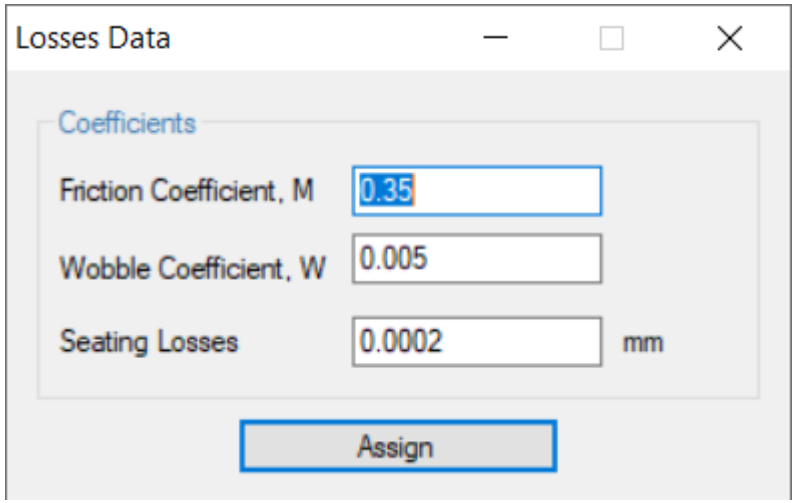
www.be4e.com

Cairo University

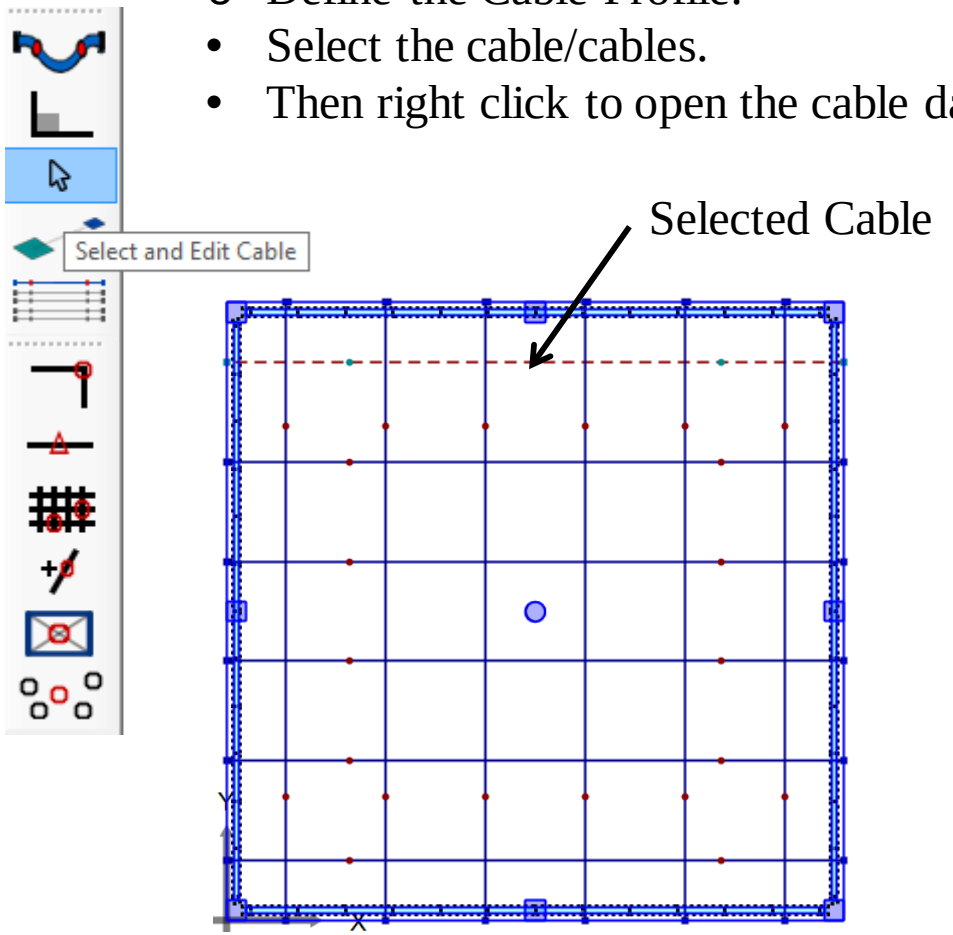
6.2 How can users generate PTPAK Model

- Define Losses Coefficients:





- Define the Cable Profile:
  - Select the cable/cables.
  - Then right click to open the cable data.

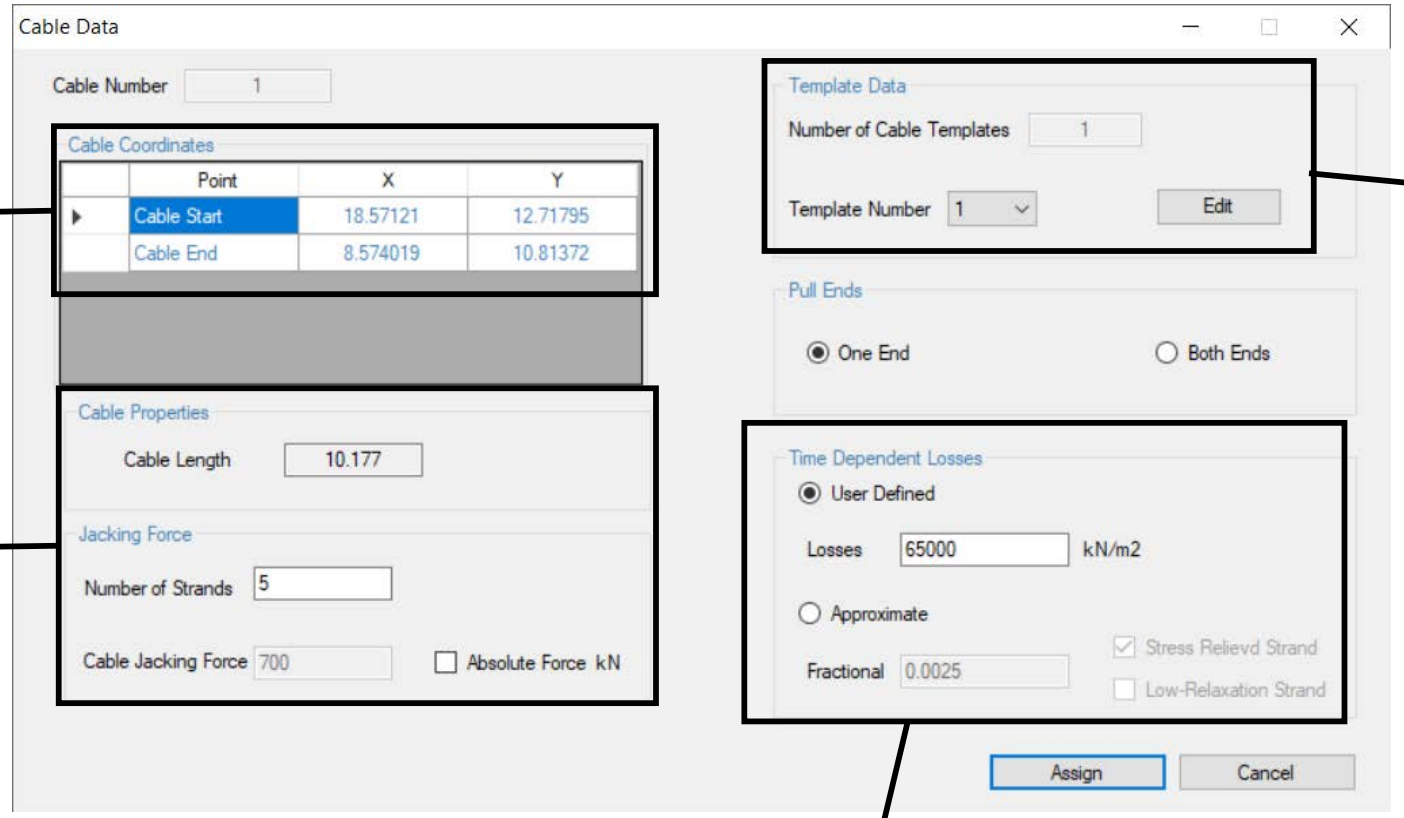


CUFE-BE

www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model



Cable (Start/End) Coordinates

Cable Length/ Jacking Force

Cable Template (13 different template)

Time dependent Losses

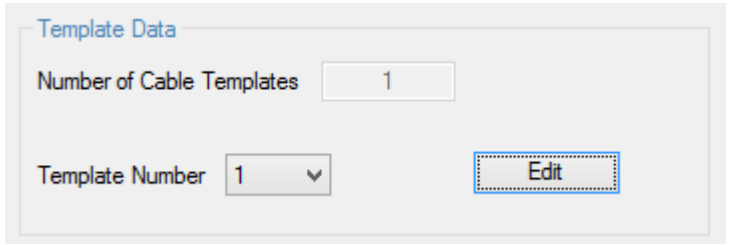
CUFE-BE

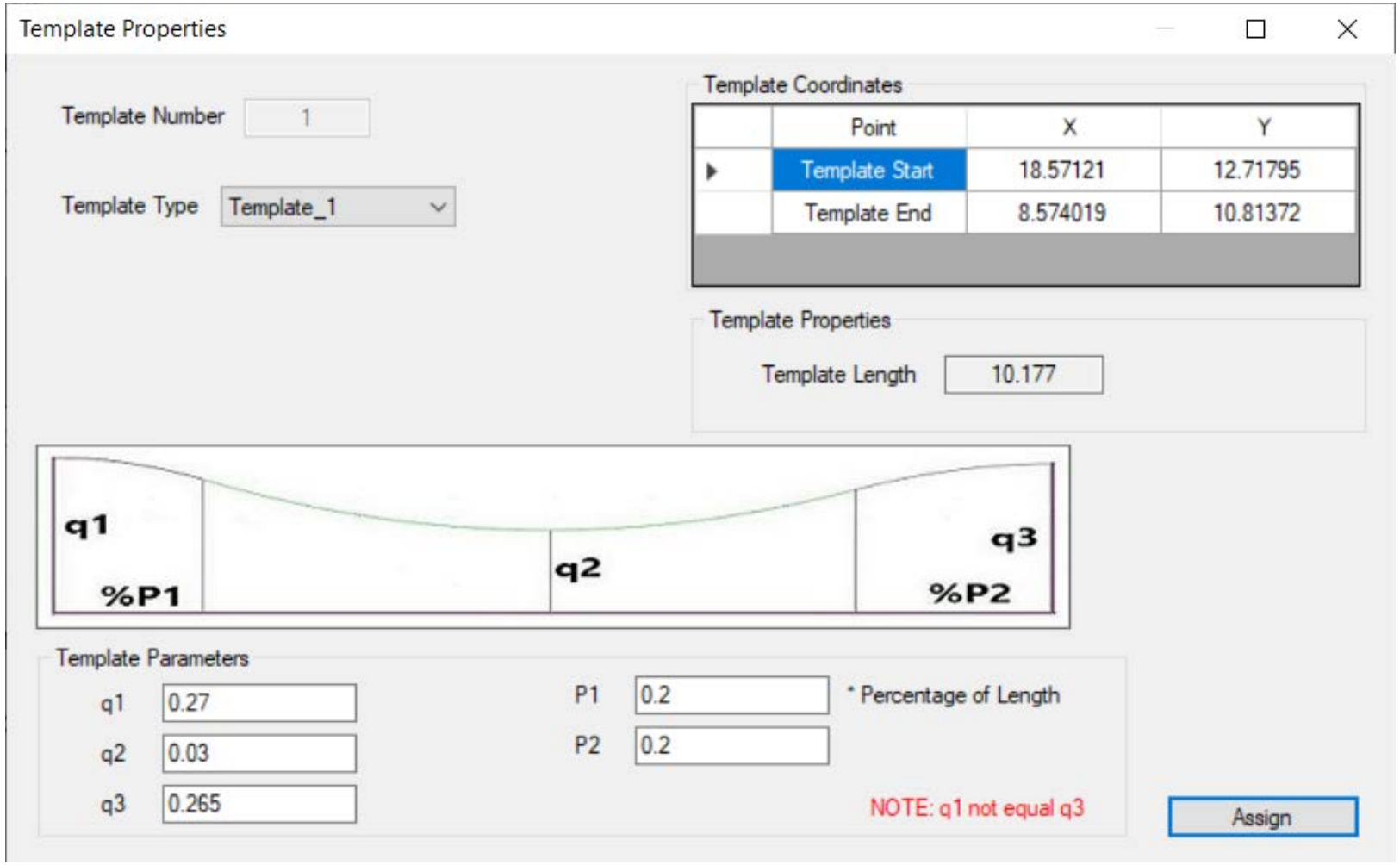
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model

- Click on edit to edit the template data.



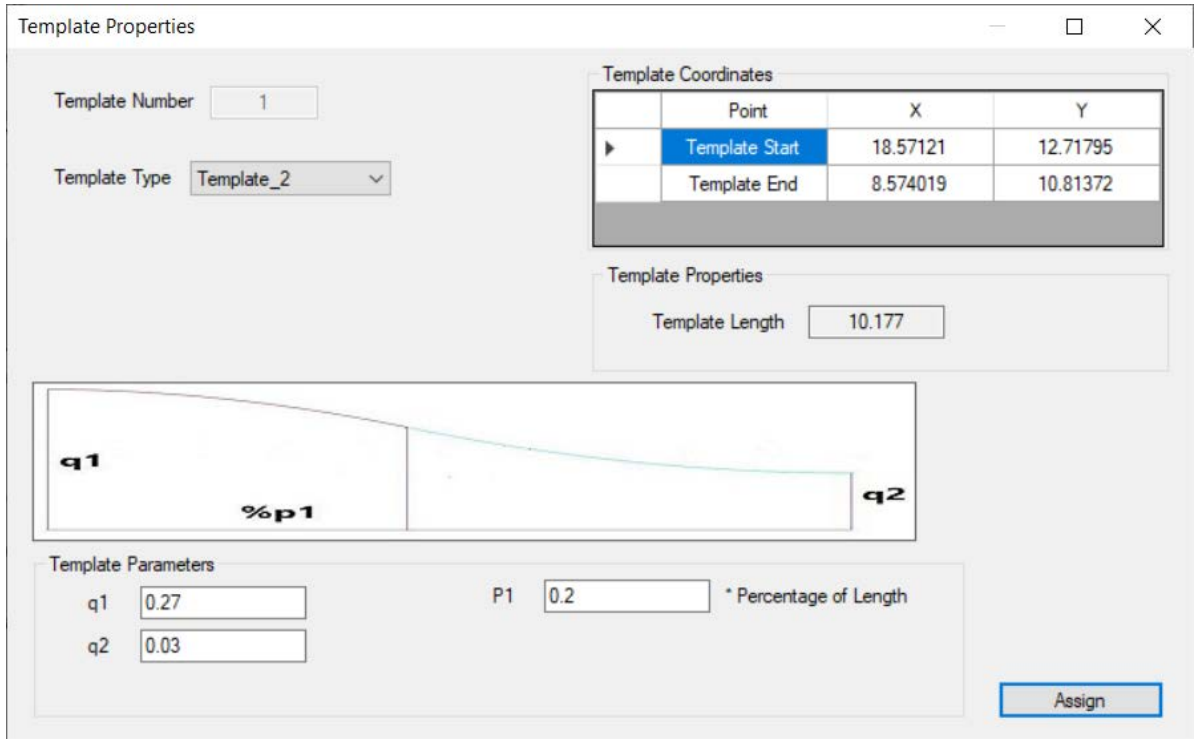


CUFE-BE

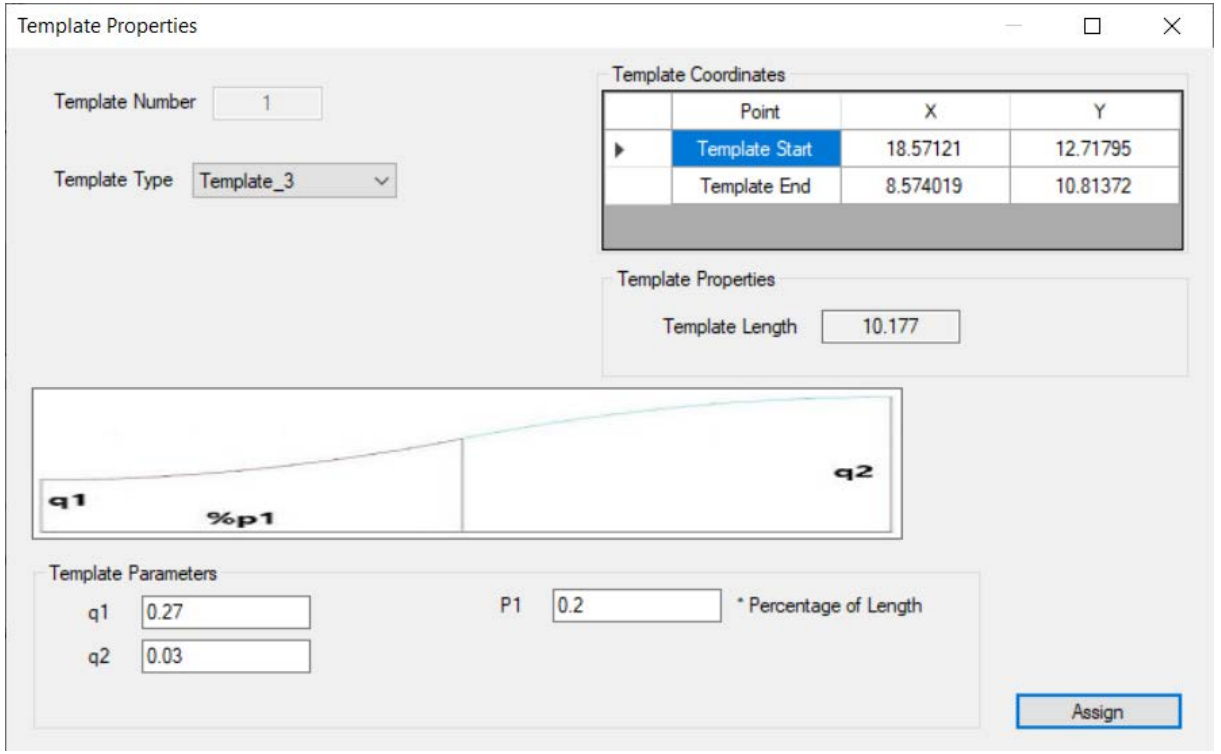
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model



Template 2



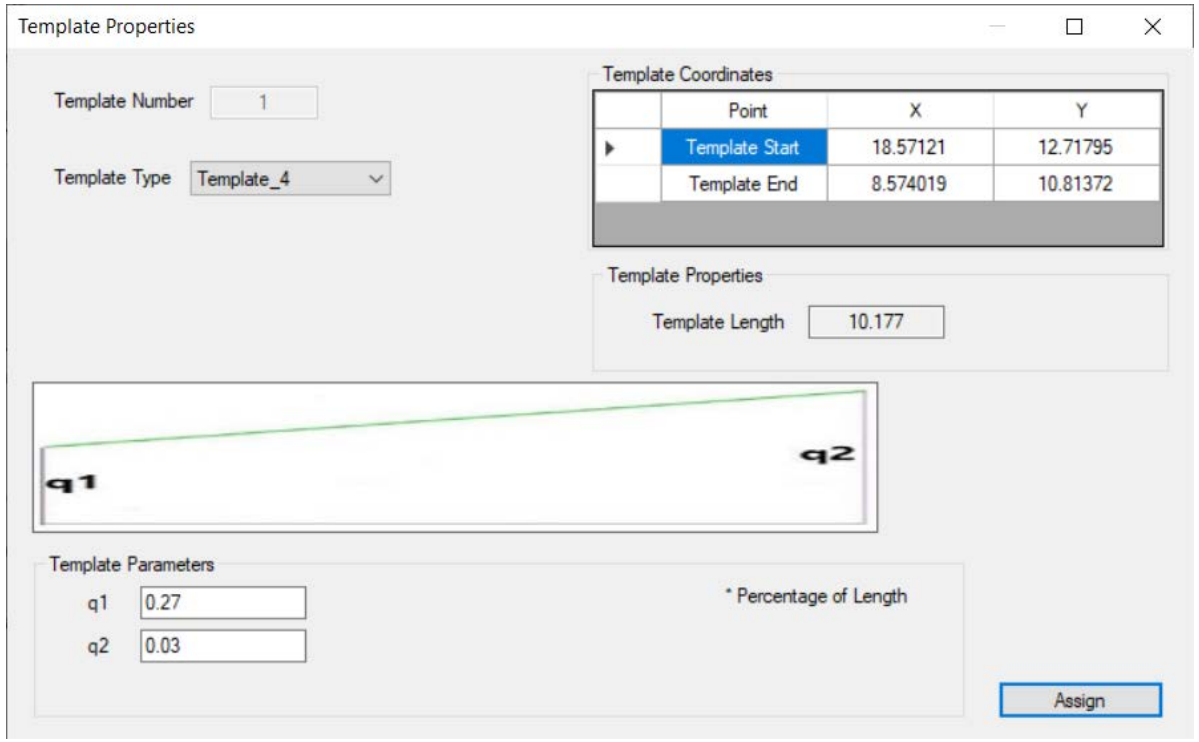
Template 3

CUFE-BE

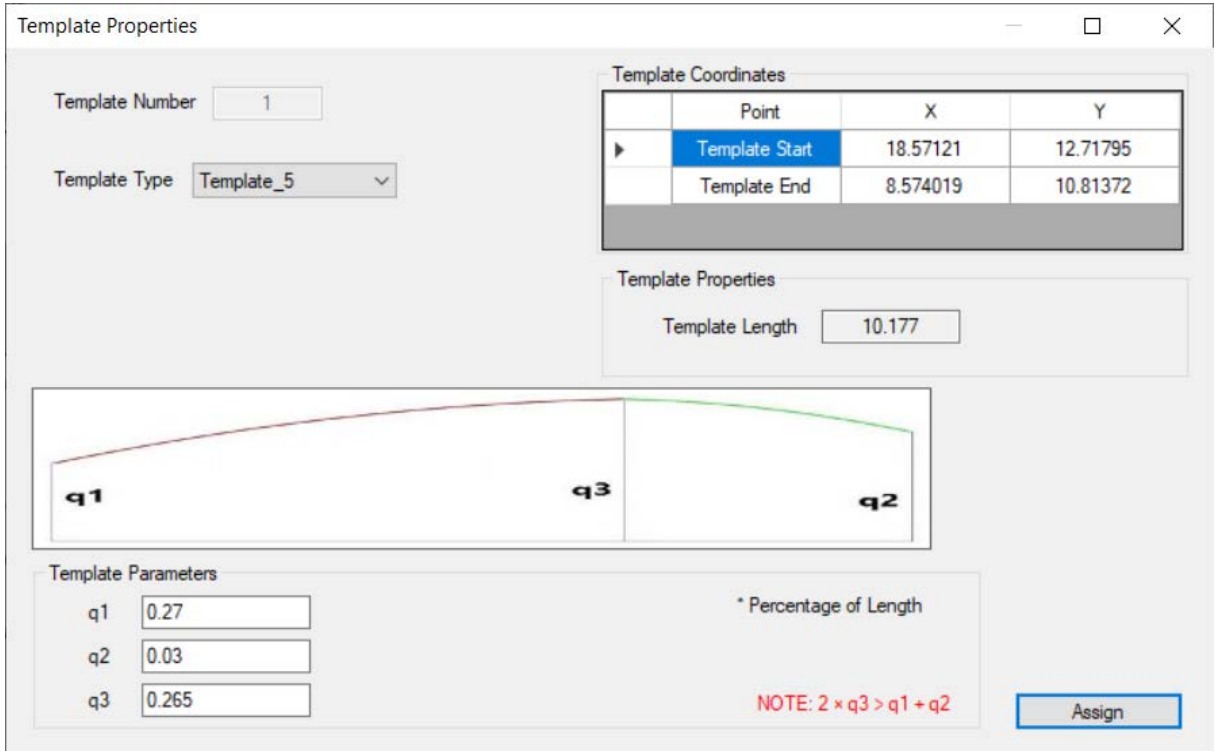
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model



Template 4



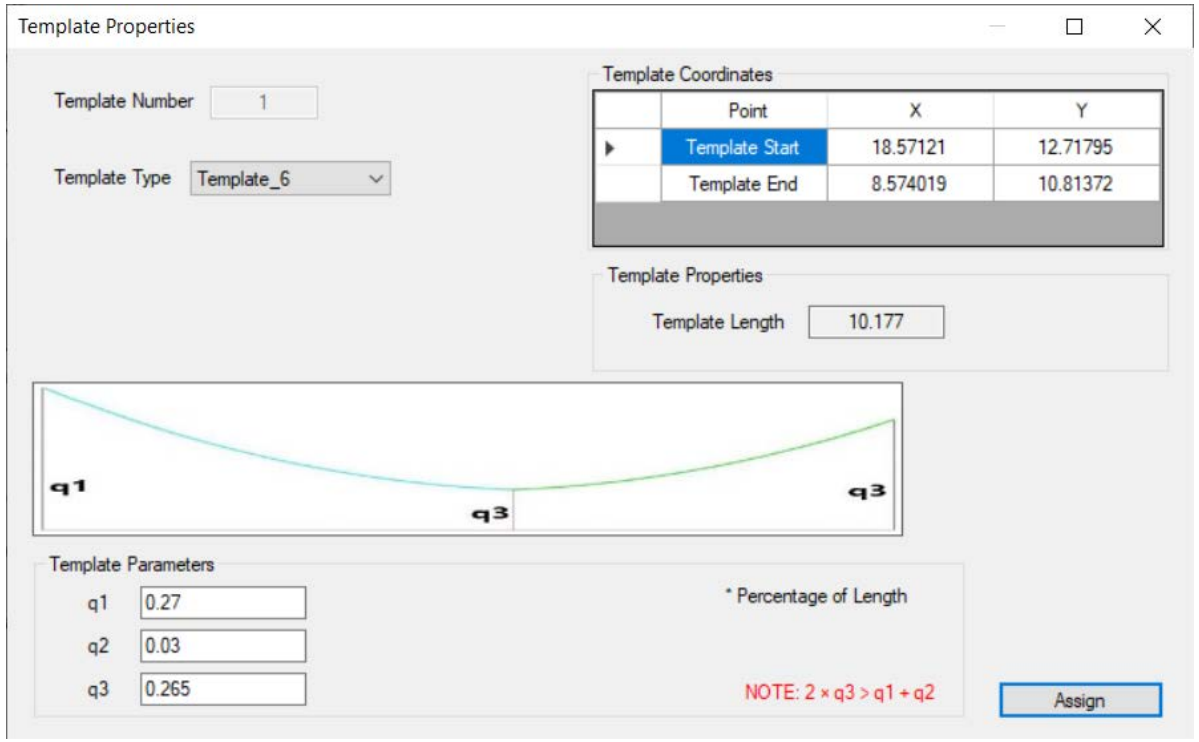
Template 5

CUFE-BE

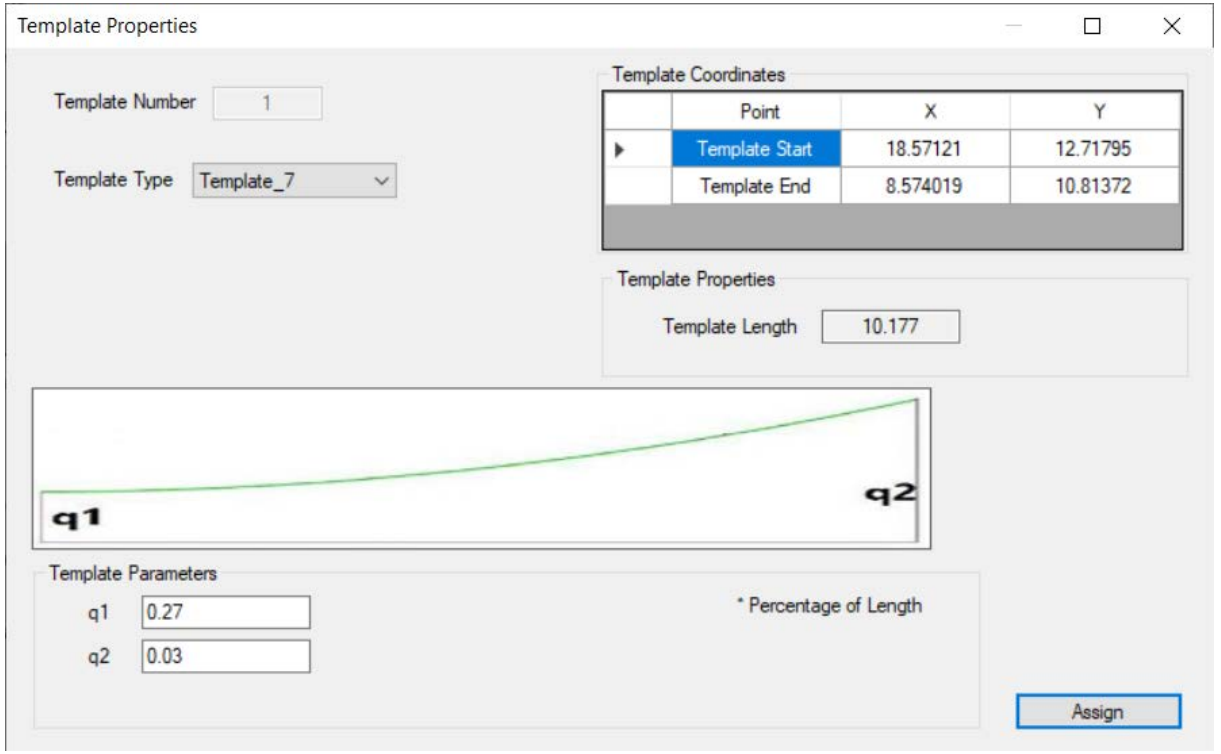
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model



Template 6



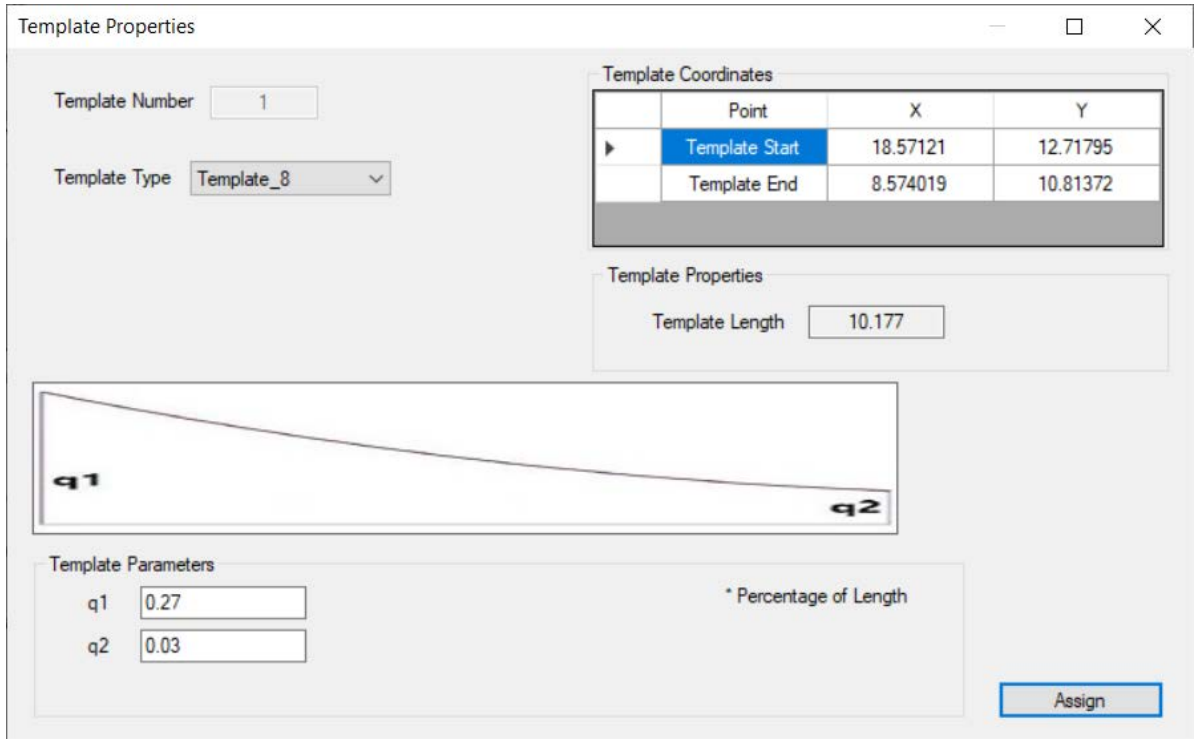
Template 7

CUFE-BE

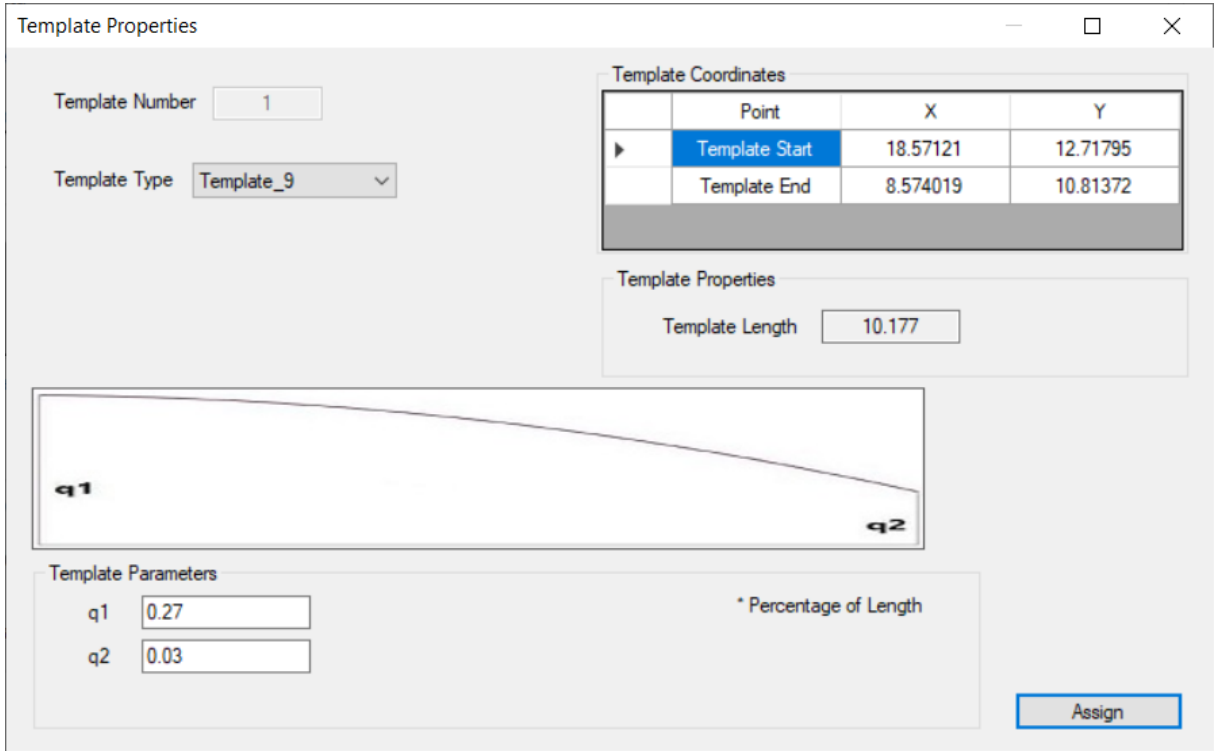
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model



Template 8



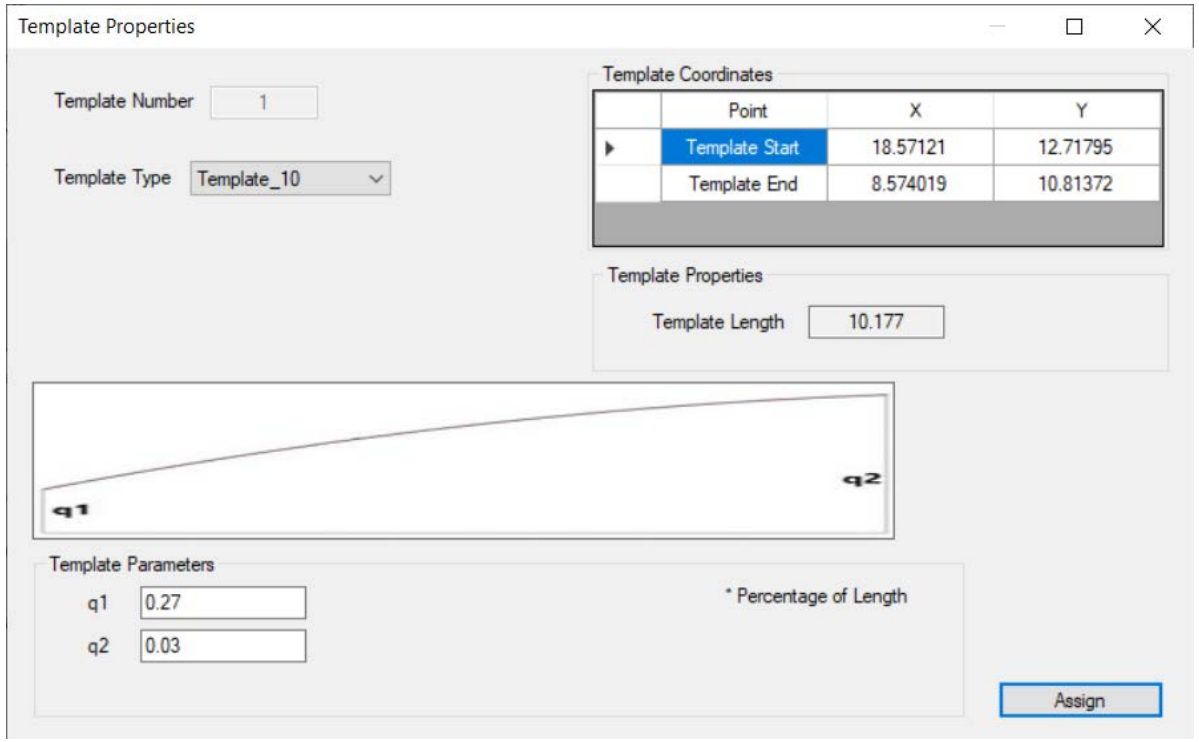
Template 9

CUFE-BE

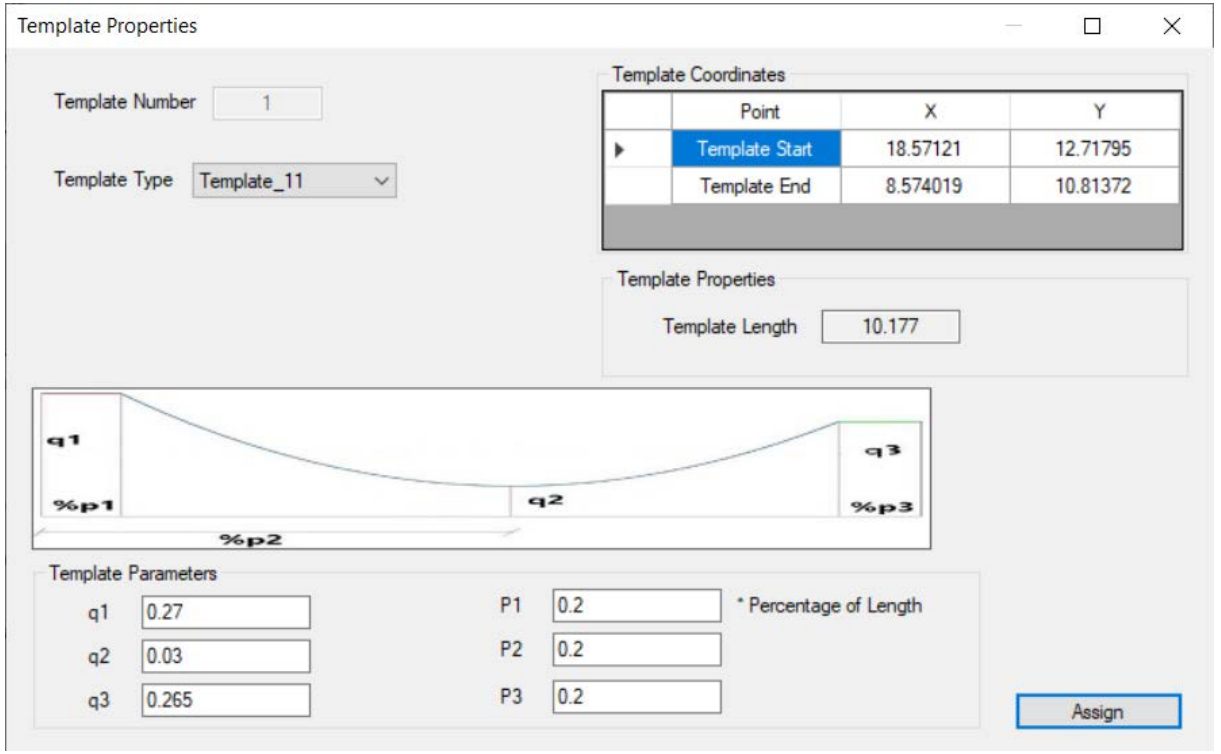
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model

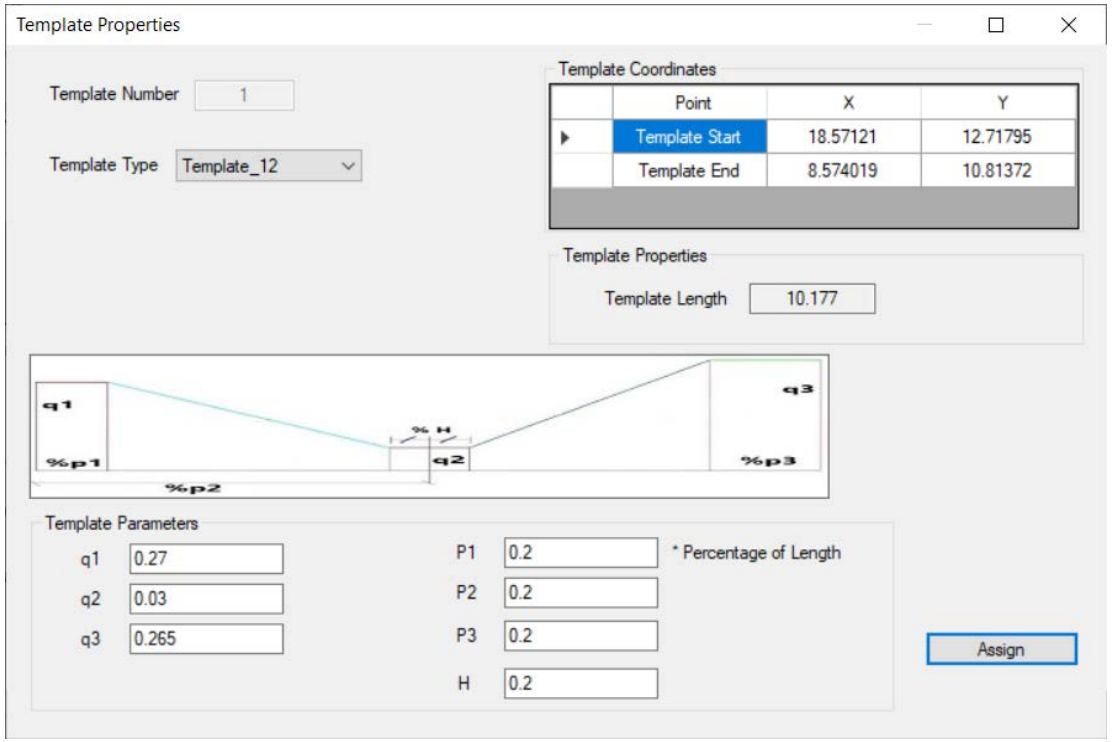


Template 10

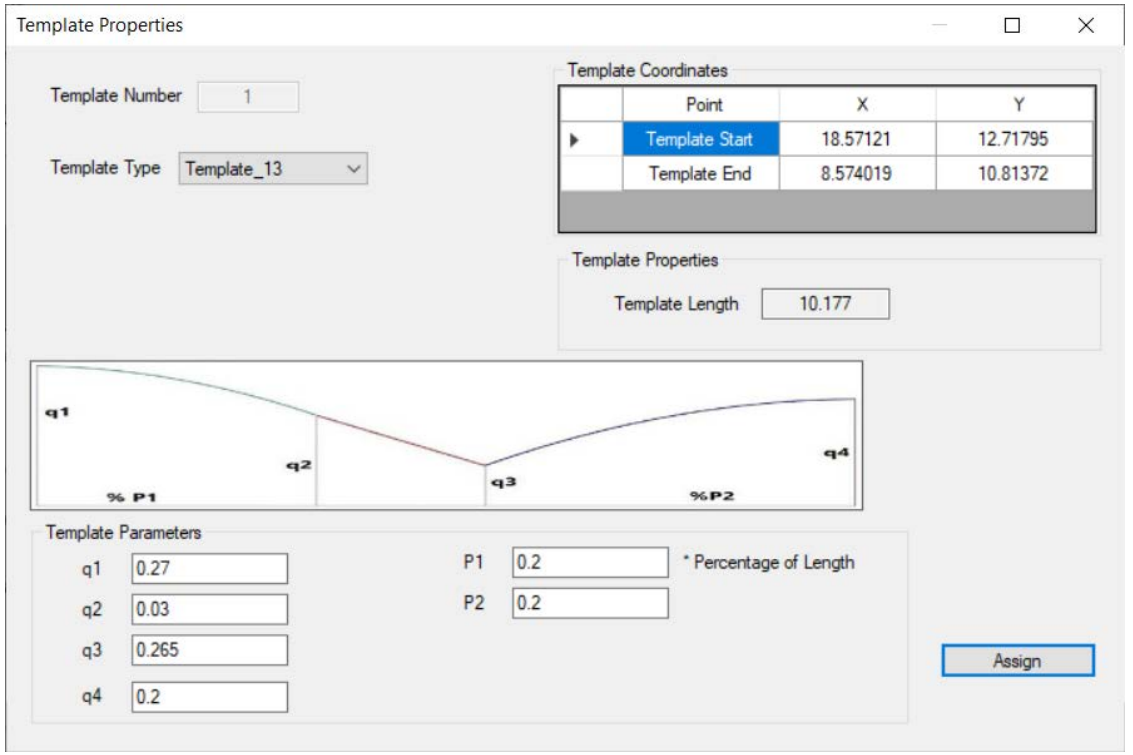


Template 11

6.2 How can users generate PTPAK Model



Template 12



Template 13

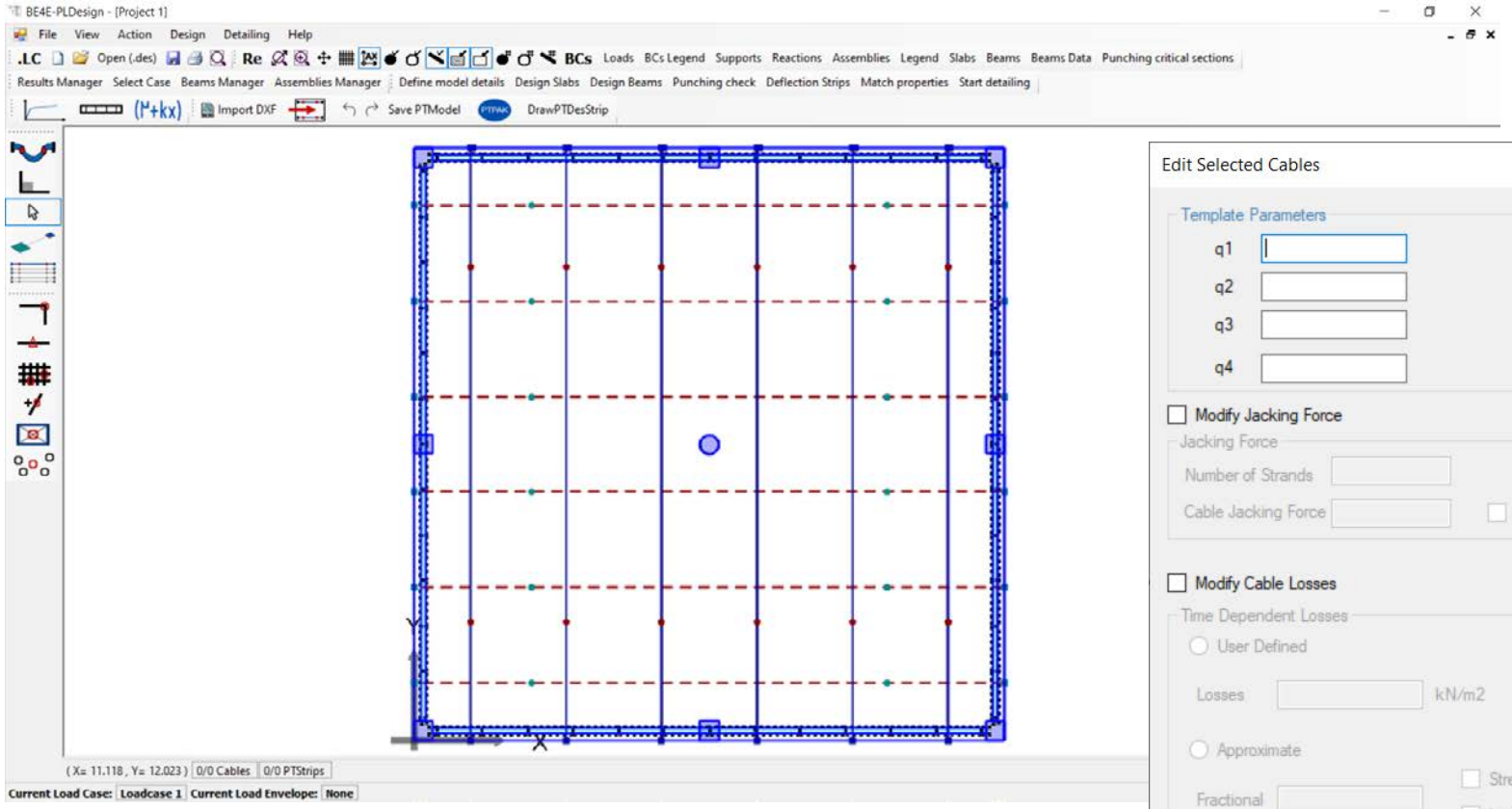
CUFE-BE

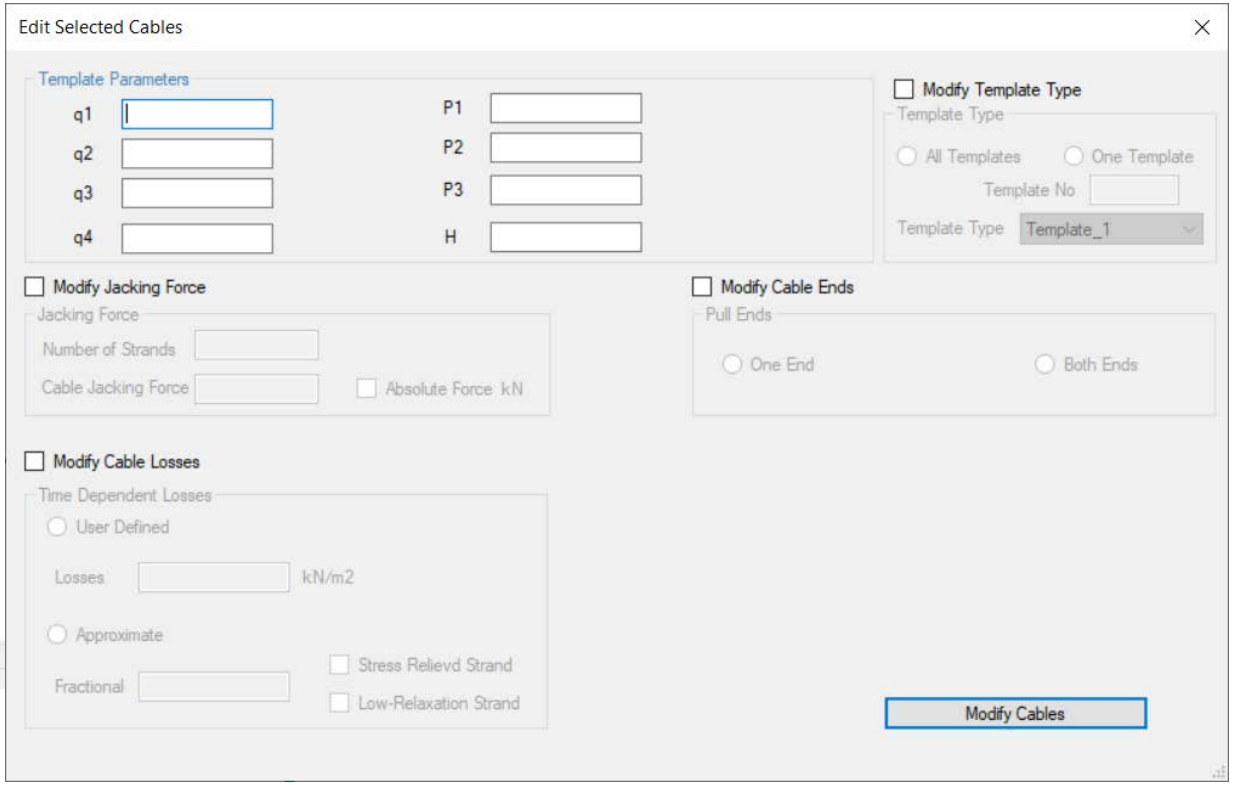
www.be4e.com

Cairo University

6.2 How can users generate PTPAK Model

Instead of choosing cable properties one by one, the user can choose multiple cables with the same properties.





CUFE-BE

www.be4e.com

Cairo University

6. PTPAK Package

6.1 Files need to be exported before using PTPAK ✓

6.2 How can users generate PTPAK Model ✓

- 6.2.1 Draw cables ✓
- 6.2.2 Cables data ✓
- 6.2.3 Cable templates ✓
- 6.2.4 Multiple cable selection ✓

6.3 How to solve the PTPAK model

6.4 Load combinations & load envelopes

6.5 Check the Cable Eccentricity

6.6 Check the Cable stresses

6.7 Optimizer

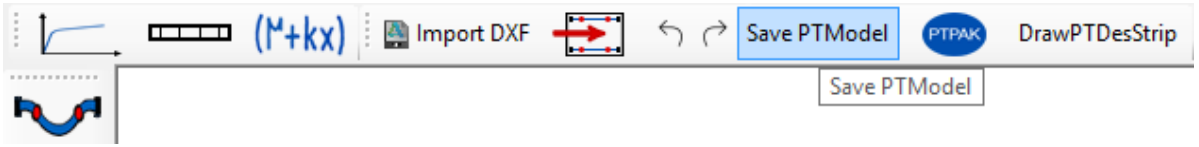
CUFE-BE

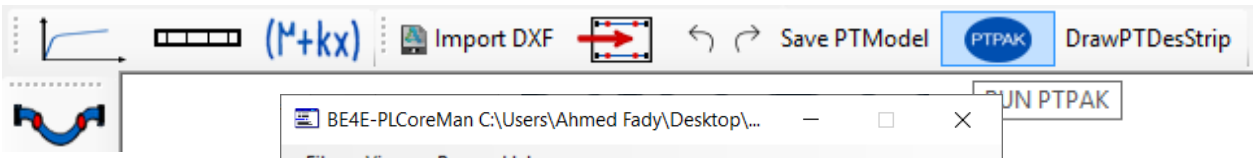
www.be4e.com

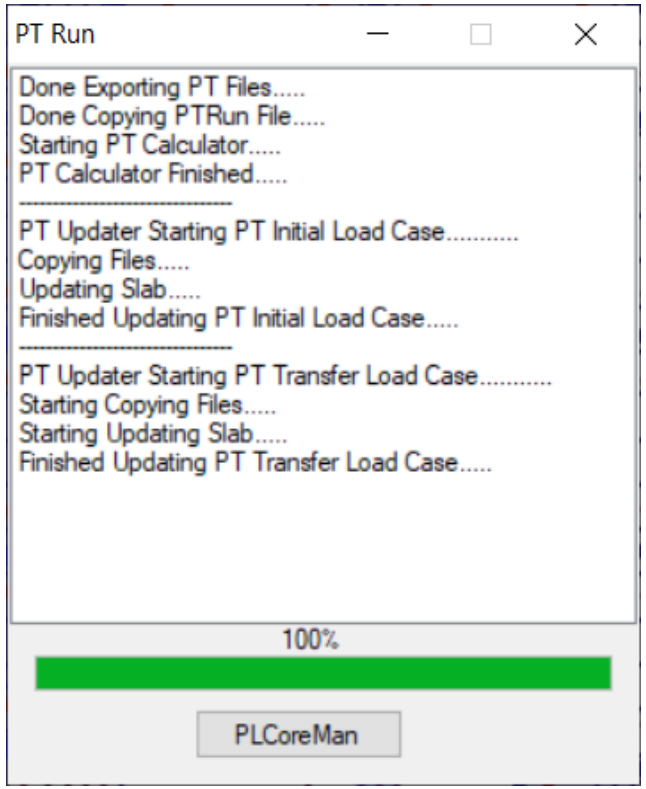
Cairo University

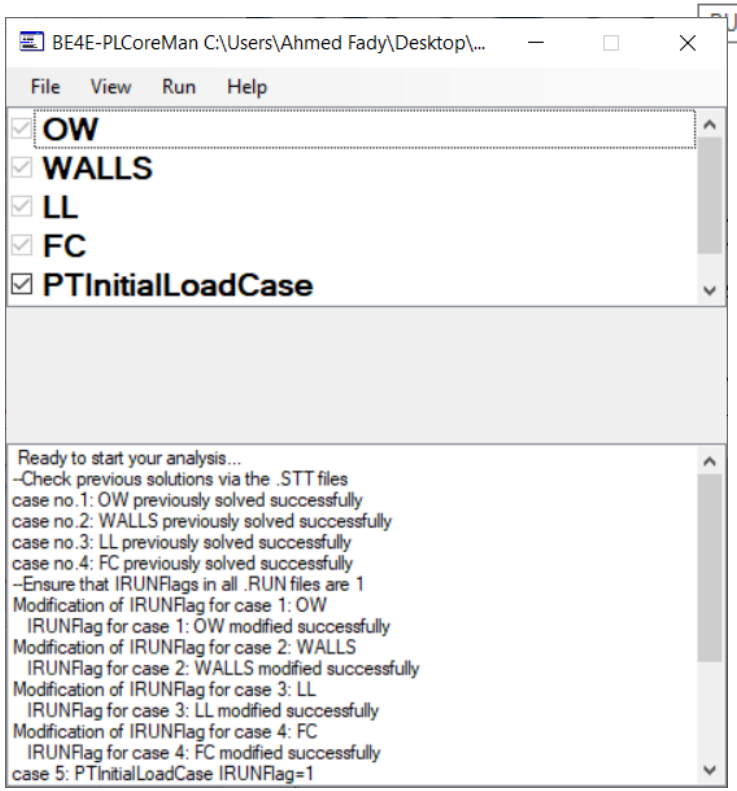
6.3 How to solve the PTPAK model

- Before solving PTPAK, the user should save the PTModel.
- Hence, run PTPAK.
- Open PLCoreMan, and run PL.exe.









CUFE-BE

www.be4e.com

Cairo University

6. PTPAK Package

6.1 Files need to be exported before using PTPAK ✓

6.2 How can users generate PTPAK Model ✓

- 6.2.1 Draw cables ✓
- 6.2.2 Cables data ✓
- 6.2.3 Cable templates ✓
- 6.2.4 Multiple cable selection ✓

6.3 How to solve the PTPAK model ✓

6.4 Load combinations & load envelopes

6.5 Check the Cable Eccentricity

6.6 Check the Cable stresses

6.7 Optimizer

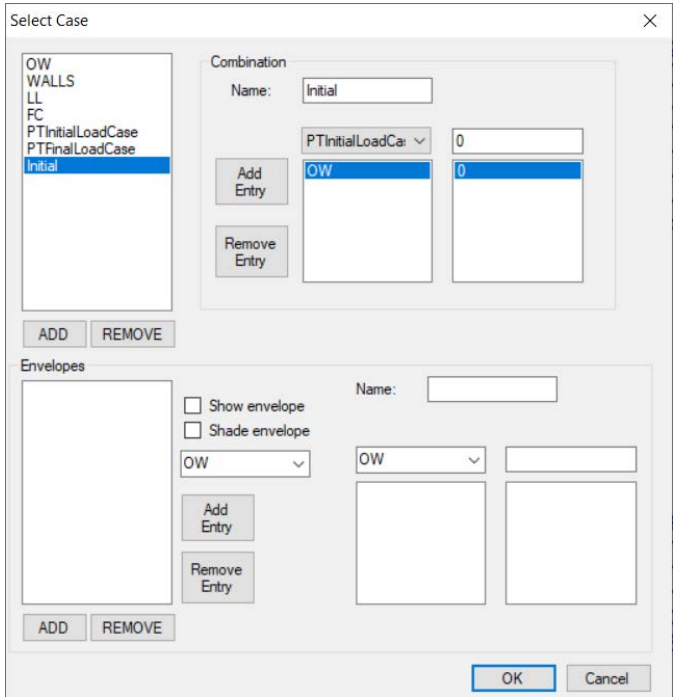
CUFE-BE

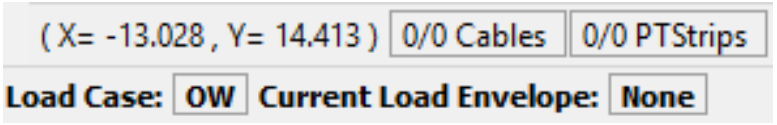
www.be4e.com

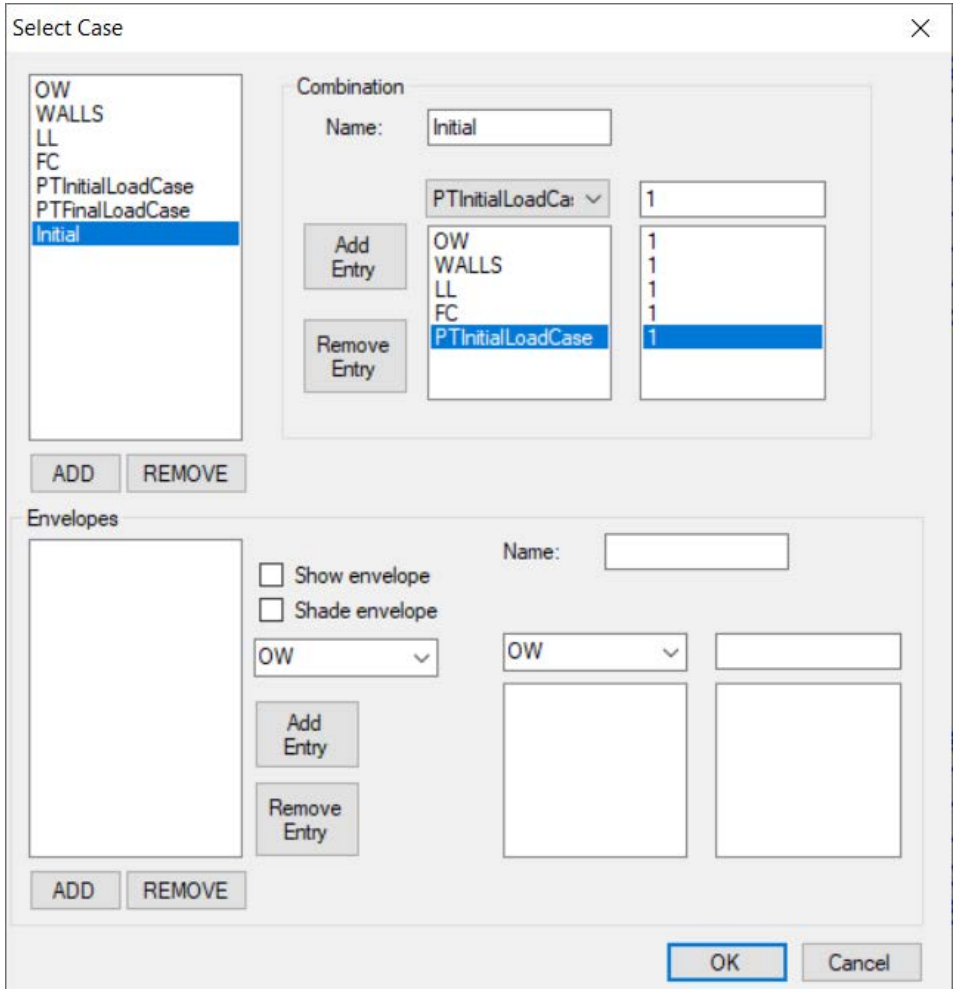
Cairo University

6.4 Load combinations & load envelopes

- Reopen the PTPAK.exe to apply load combinations.
- The lower tabs of the PTPAK, If the user press double click on OW Combinations window will open.







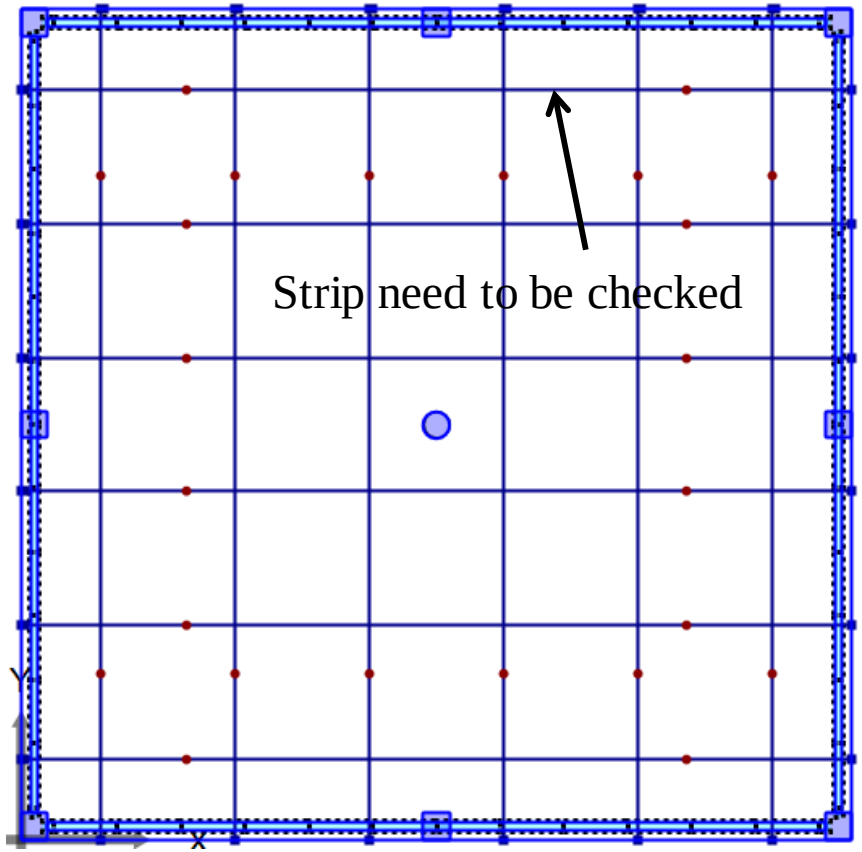
CUFE-BE

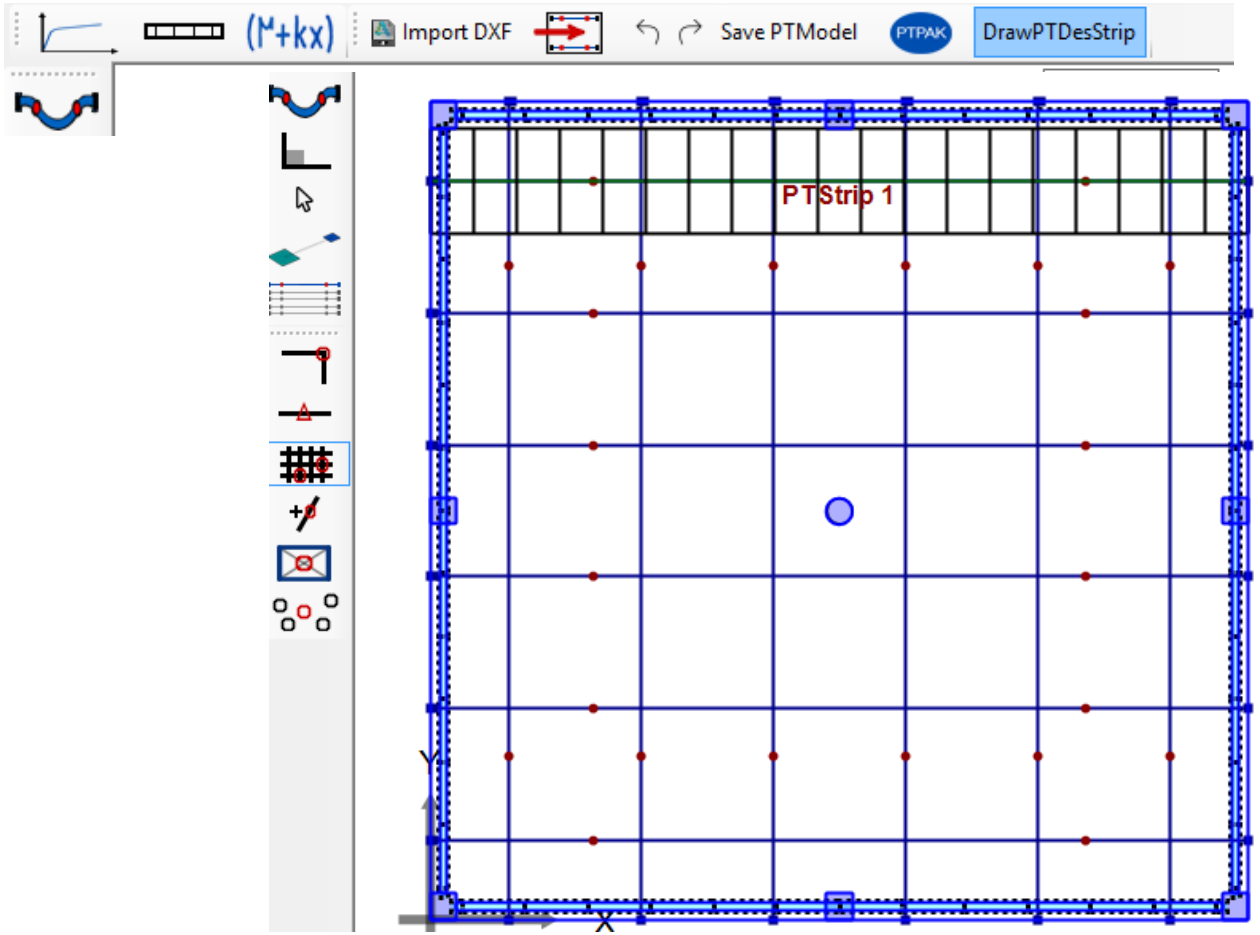
www.be4e.com

Cairo University

6.5 Check the Cable Eccentricity

- The user should check the eccentricity of the cable profile and the stress distribution through the slab cross section.





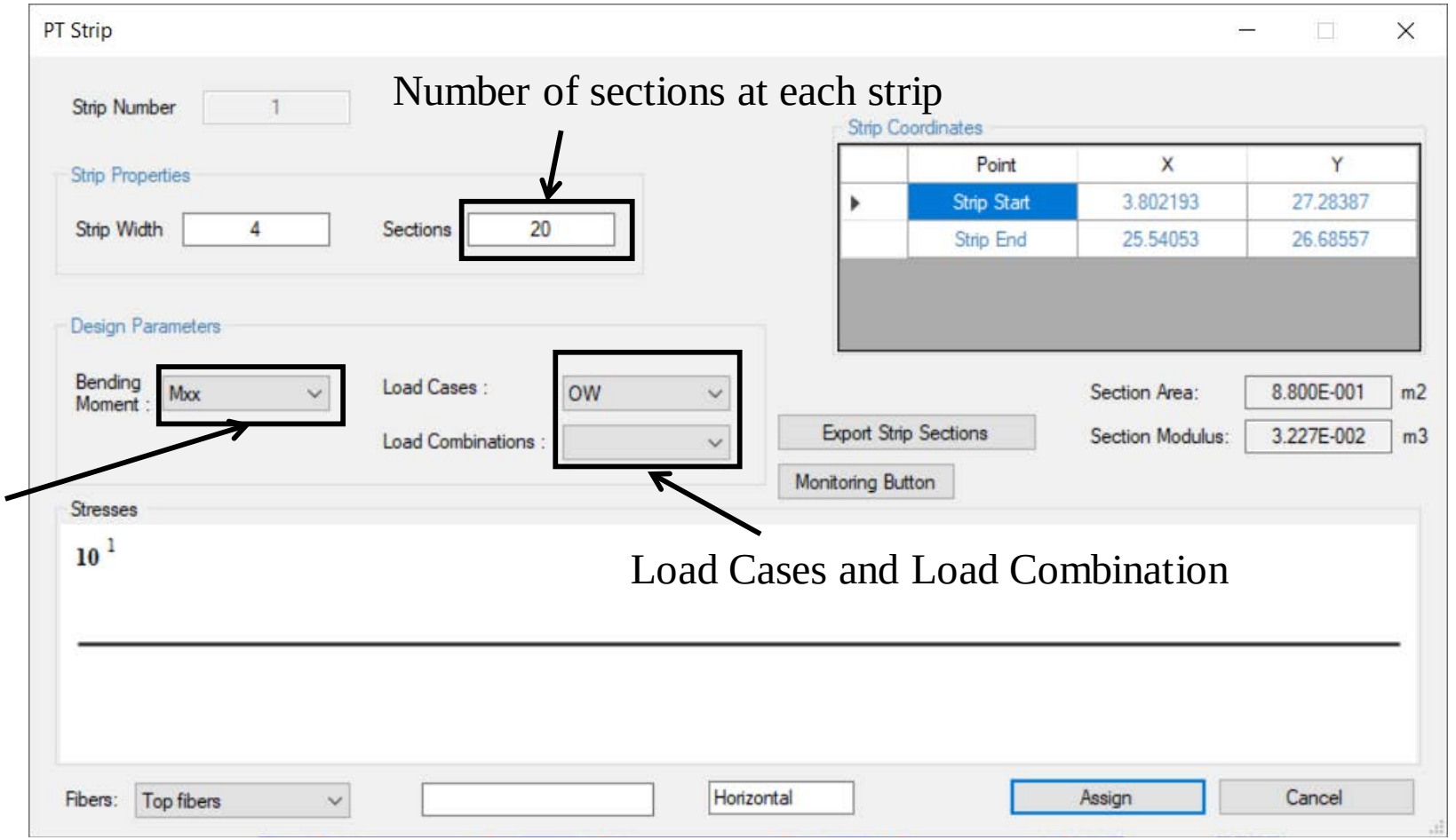
CUFE-BE

www.be4e.com

Cairo University

6.5 Check the Cable Eccentricity

- User should draw the design strip and edit its prosperities.



The direction of bending moment to calculate the section stresses

Load Cases and Load Combination

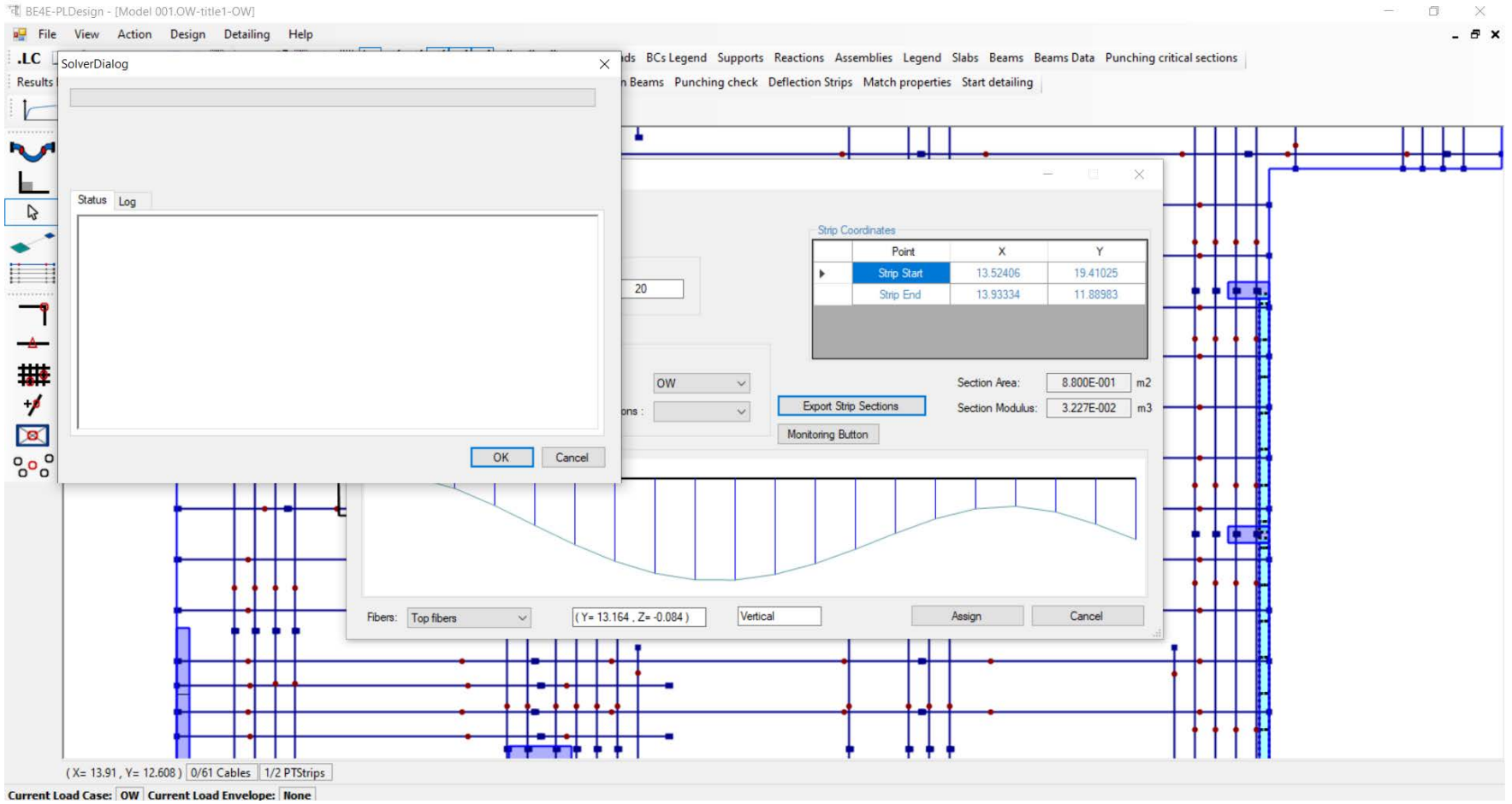
CUFE-BE

www.be4e.com

Cairo University

6.6 Check the Cable stresses

- User export strip sections.



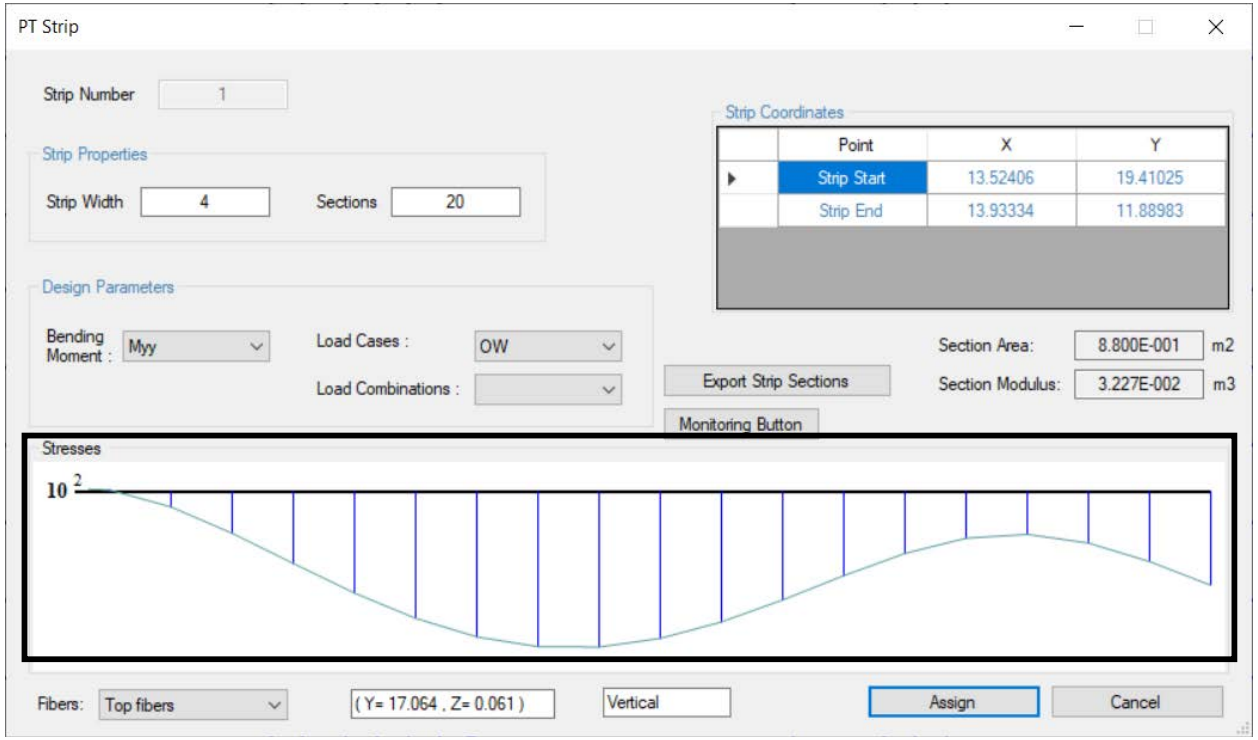
CUFE-BE

www.be4e.com

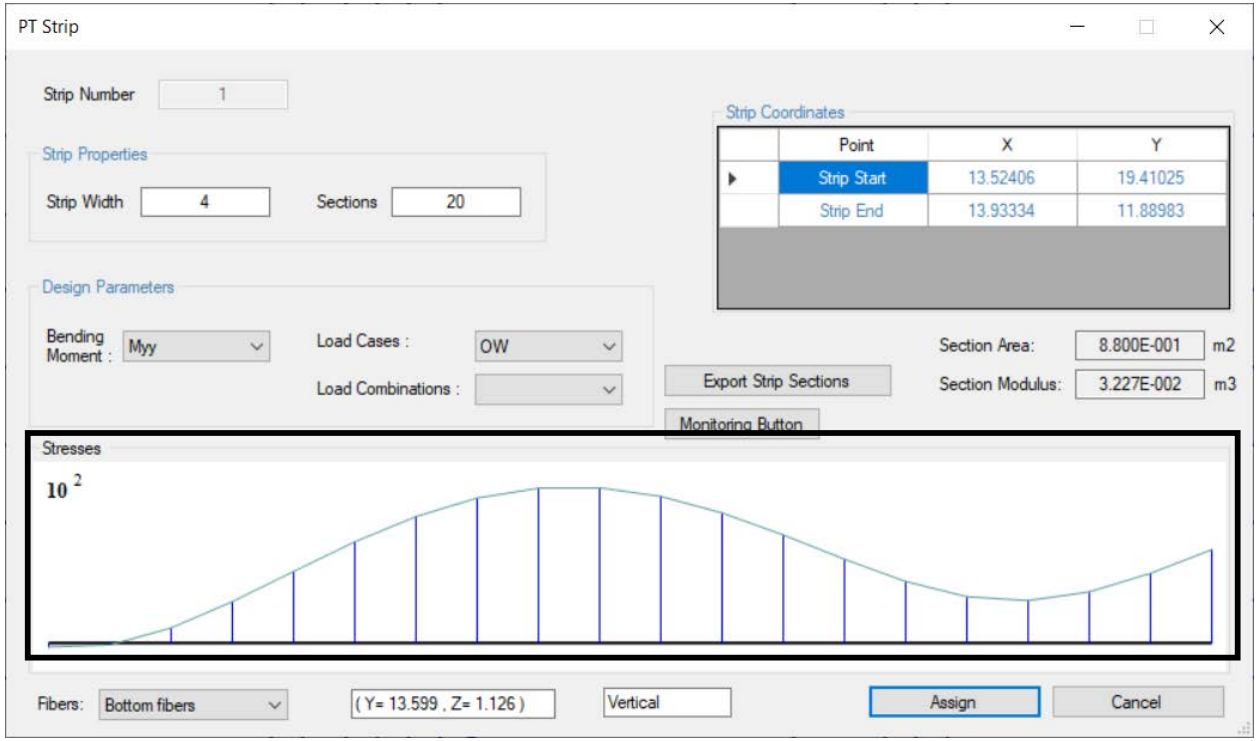
Cairo University

6.6 Check the Cable stresses

- Hence, click on monitoring button to check the stresses.



Top stress distribution over the PTDesign Strip



Bottom stress distribution over the PTDesign Strip

CUFE-BE

www.be4e.com

Cairo University

6. PTPAK Package

6.1 Files need to be exported before using PTPAK

6.2 How can users generate PTPAK Model

6.2.1 Draw cables

6.2.2 Cables data

6.2.3 Cable templates

6.2.4 Multiple cable selection

6.3 How to solve the PTPAK model

6.4 Load combinations & load envelopes

6.5 Check the Cable Eccentricity

6.6 Check the Cable stresses

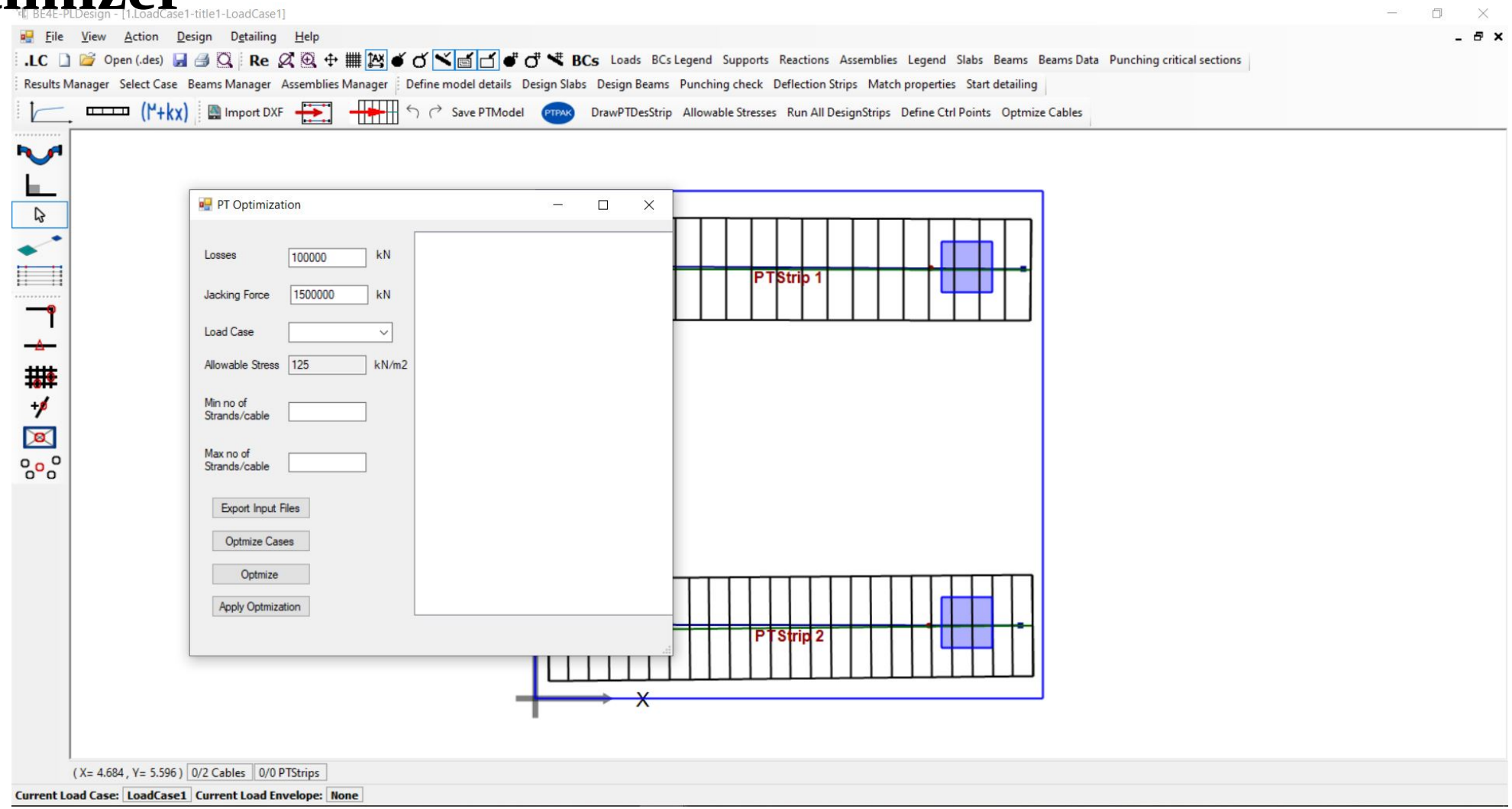
6.7 Optimizer

CUFE-BE

www.be4e.com

Cairo University

6.7 Optimizer

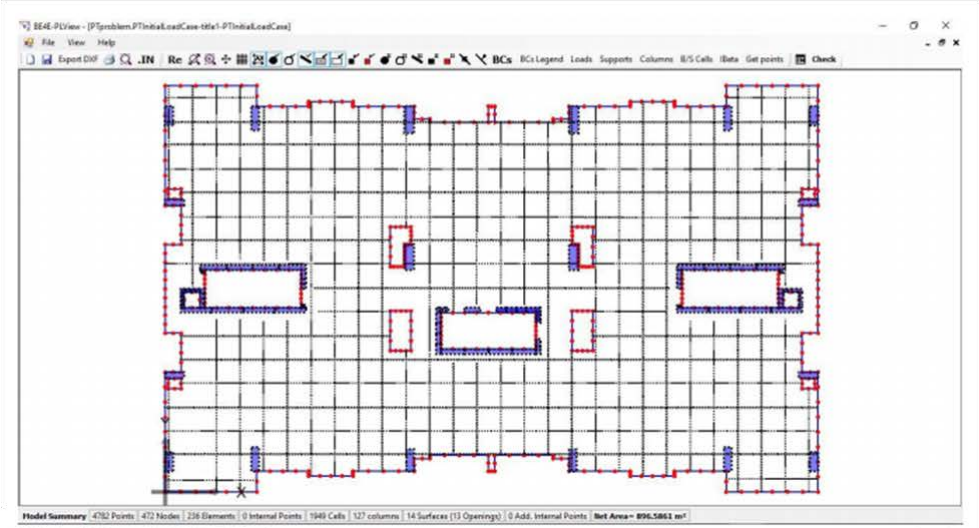


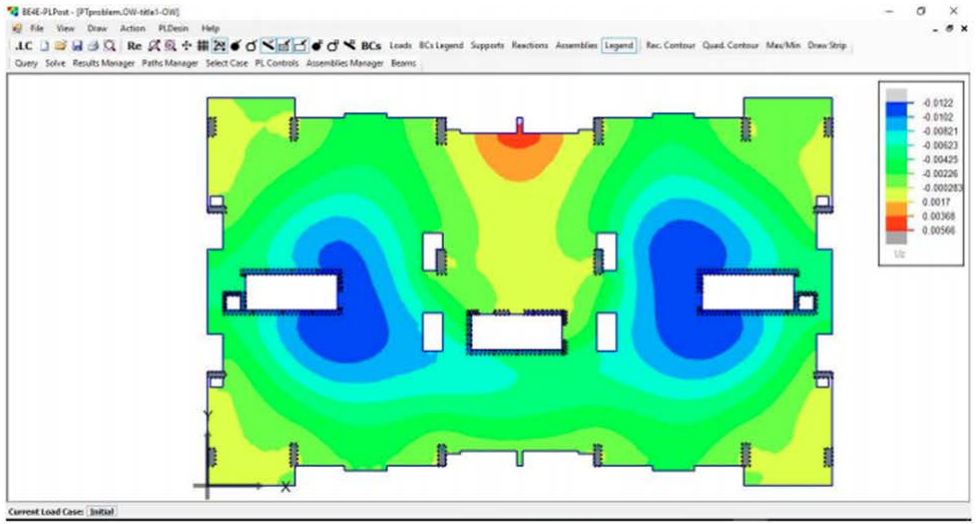
CUFE-BE

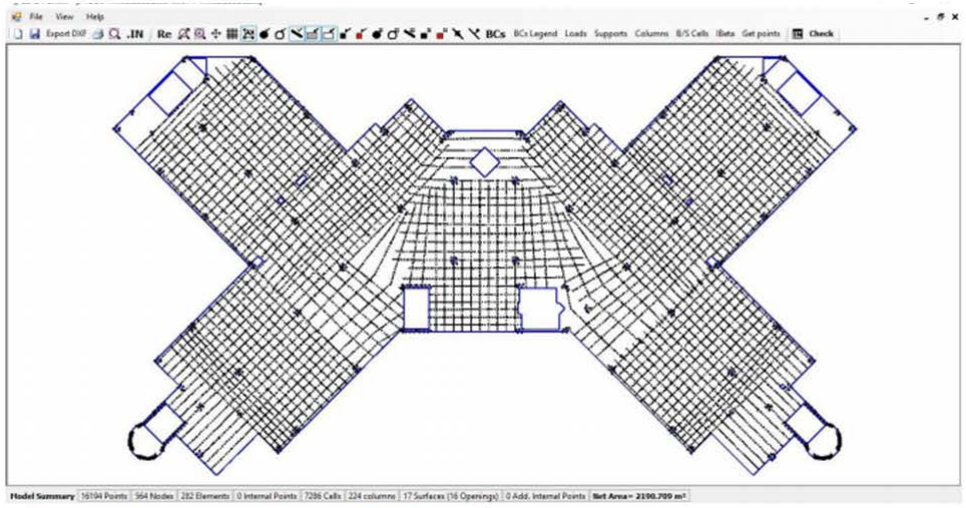
www.be4e.com

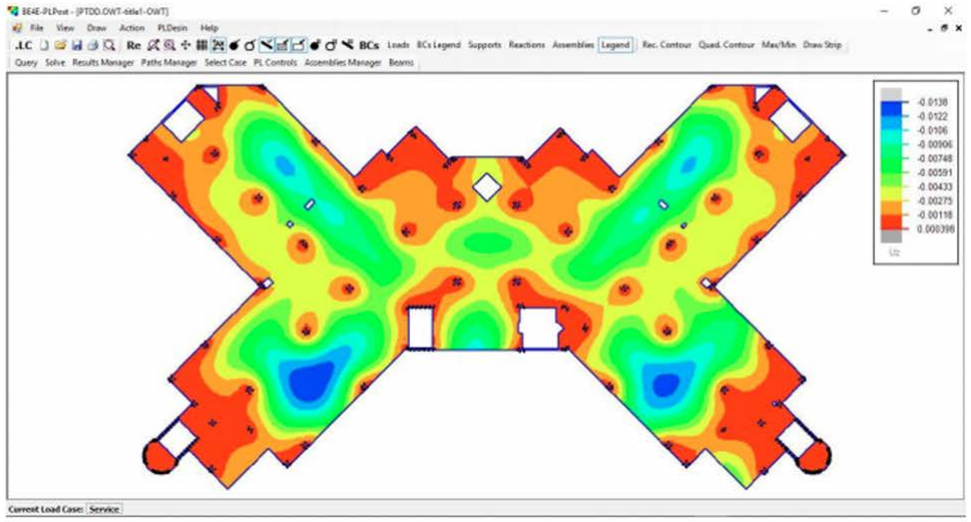
Cairo University

6. Post-tension Package (PTMAK)







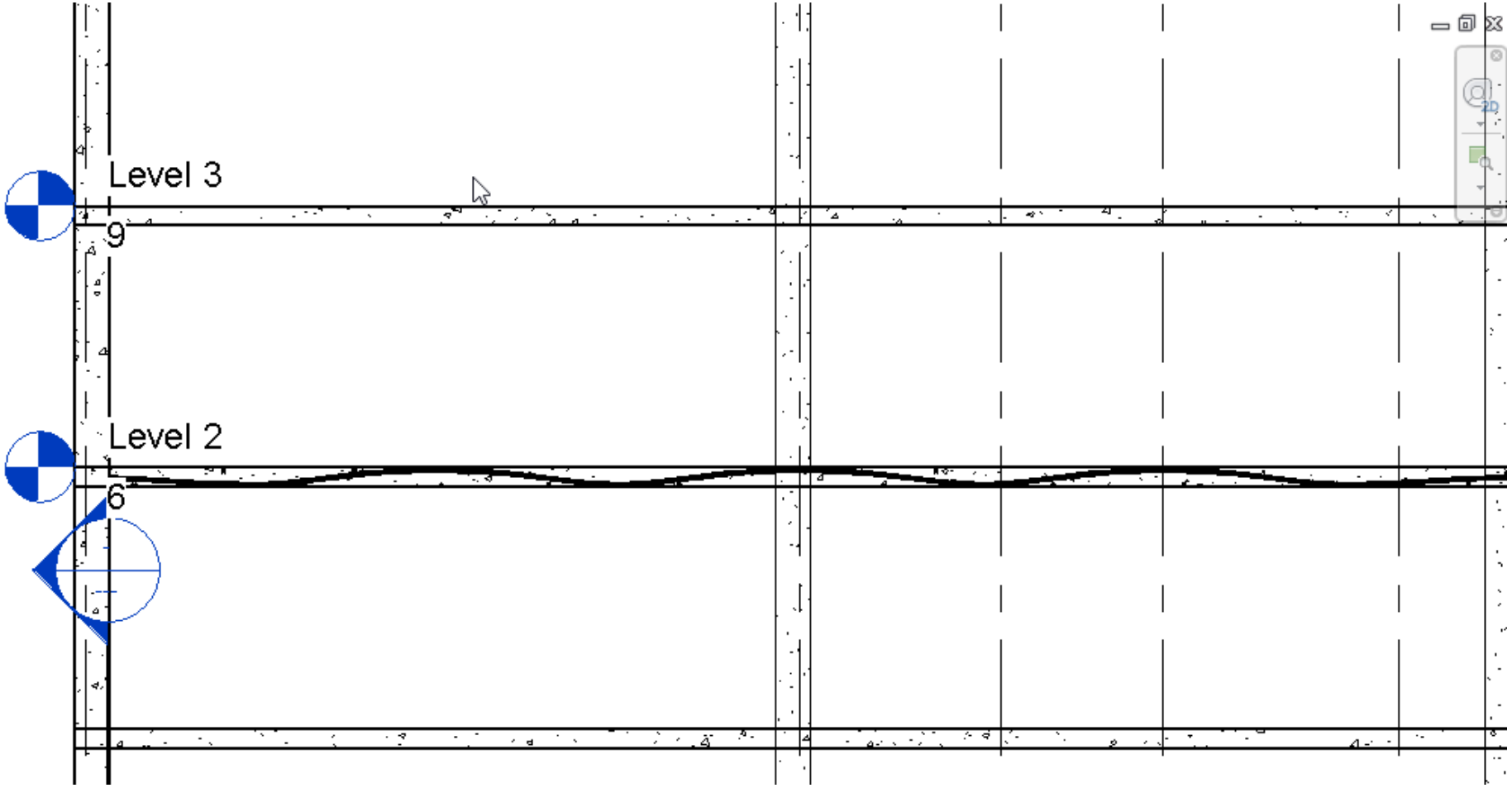


CUFE-BE

www.be4e.com

Cairo University

6. Post-tension Package (Prokon)

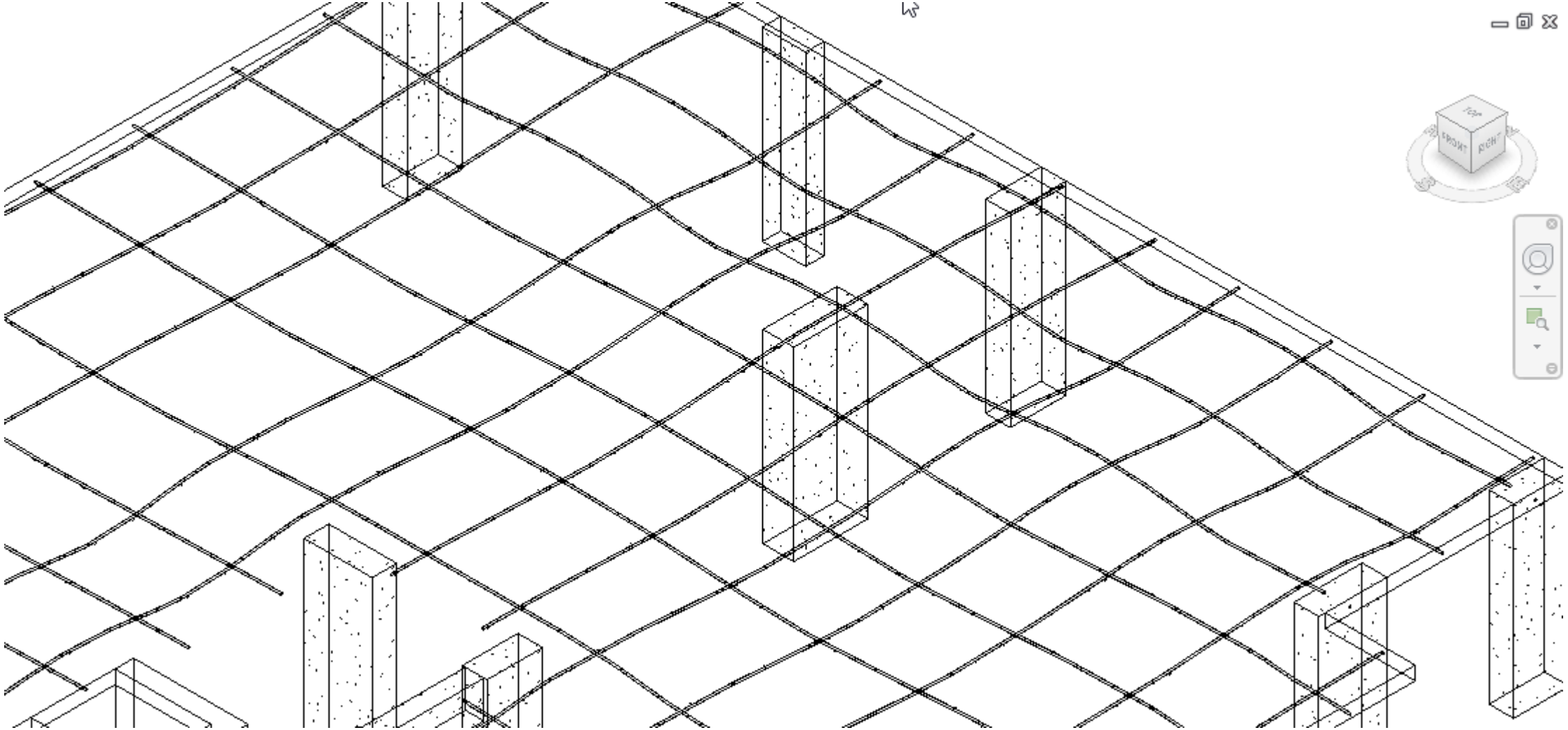


CUFE-BE

www.be4e.com

Cairo University

6. Post-tension Package (Prokon)

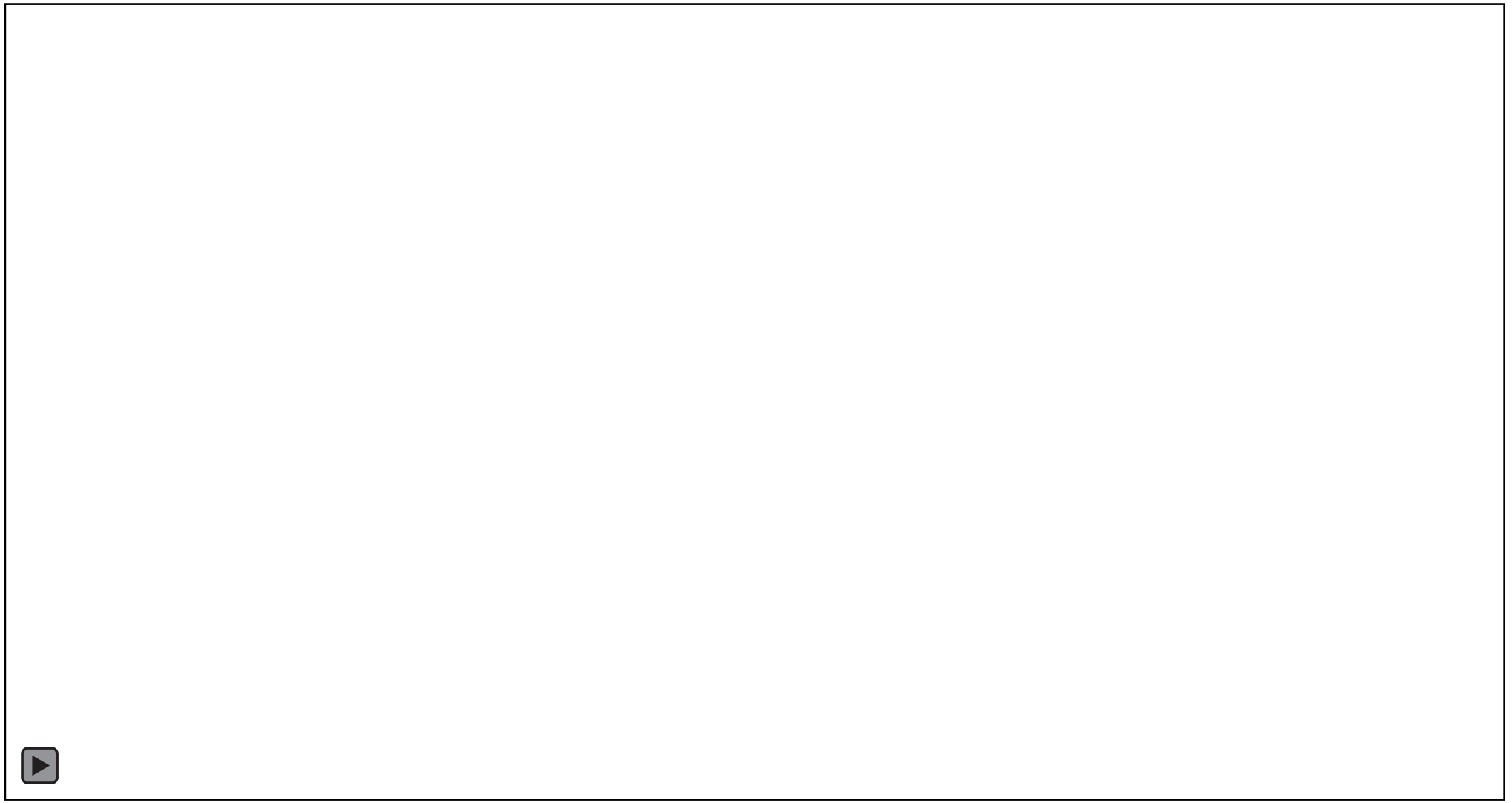


CUFE-BE

www.be4e.com

Cairo University

6. Post-tension Package (Prestress)



CUFE-BE

www.be4e.com

Cairo University

Table of contents

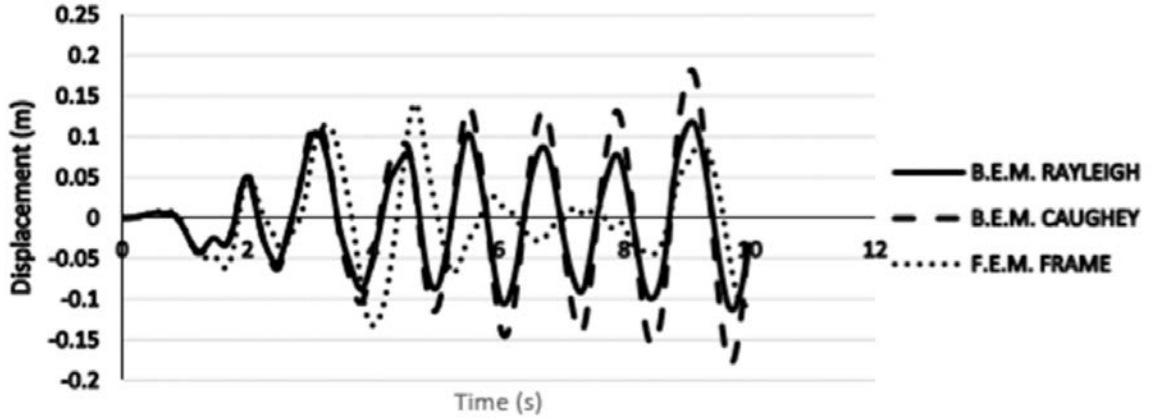
CUFE-BE

www.be4e.com

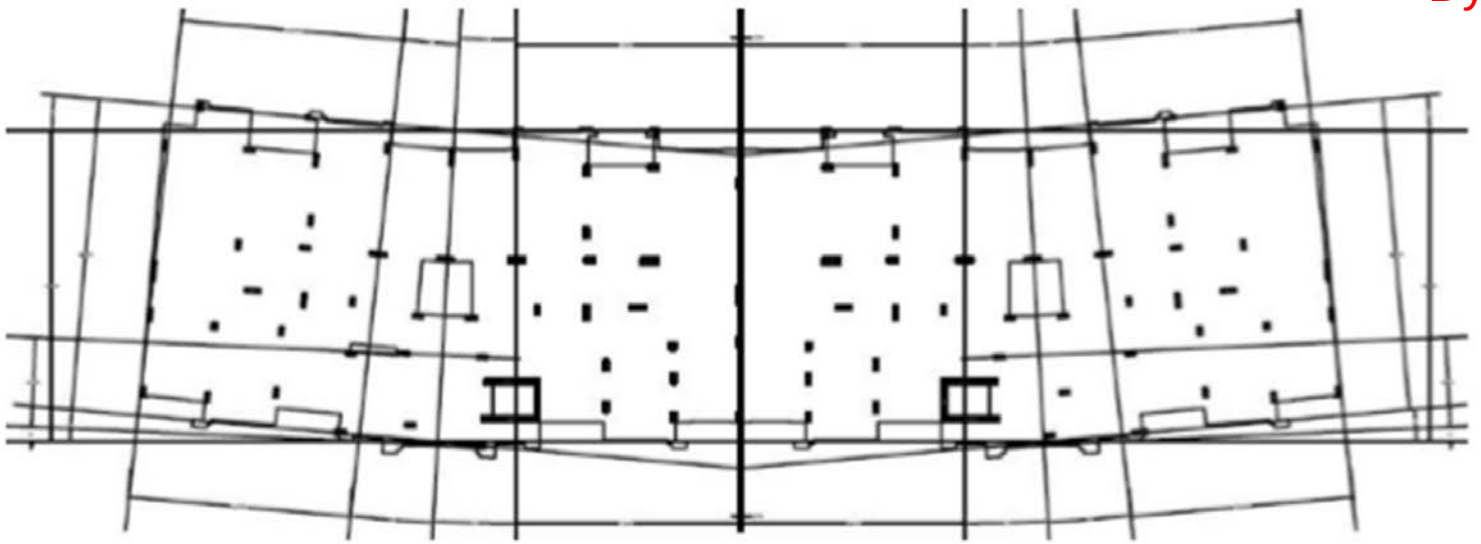
Cairo University

7. Dynamic package (DynPAK)

- Free vibration analysis
- Time history analysis
- Damping effect
- Performance based design



Dynamic analysis of practical building

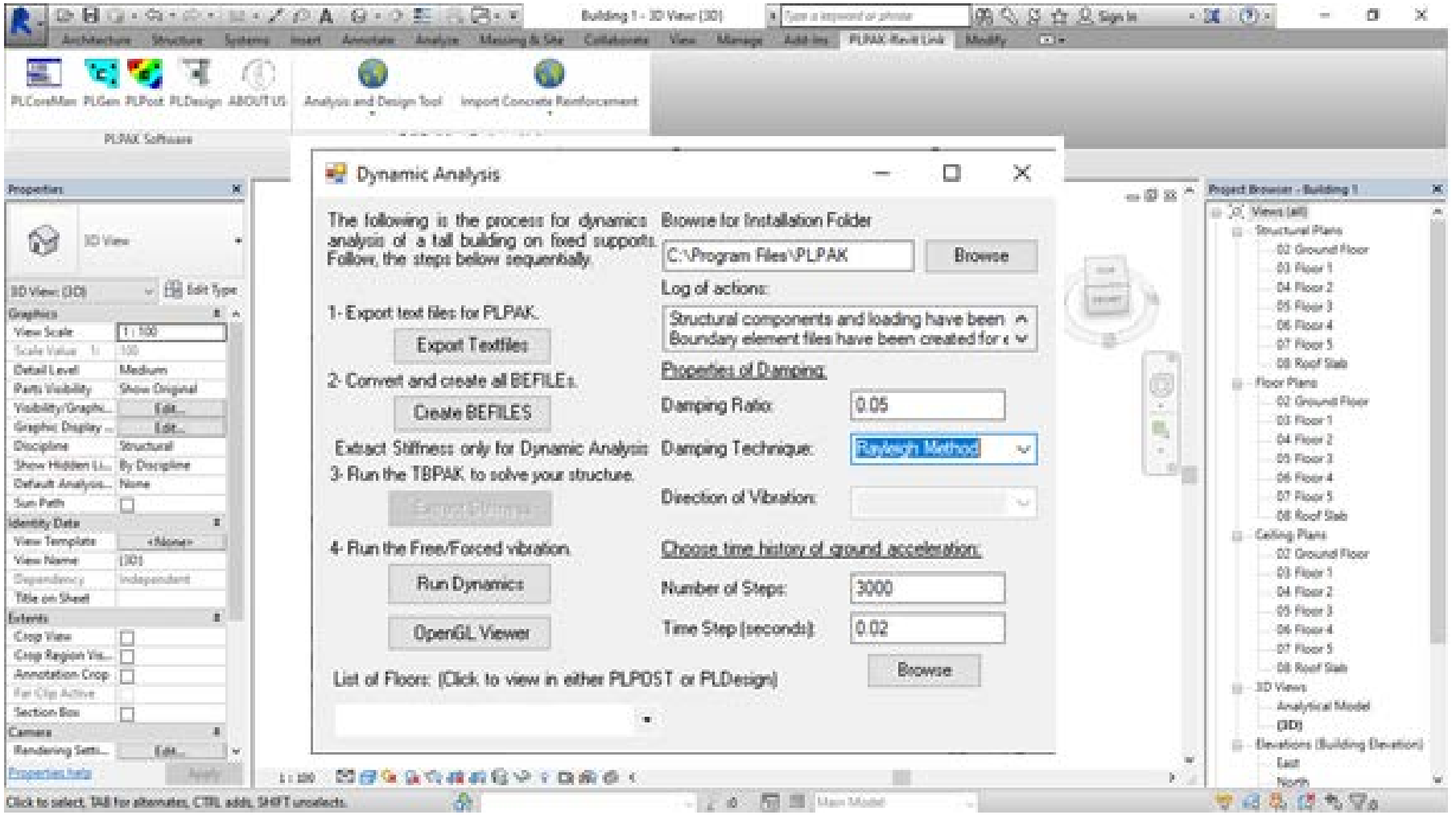


CUFE-BE

www.be4e.com

Cairo University

7. Dynamic package (DynPAK)

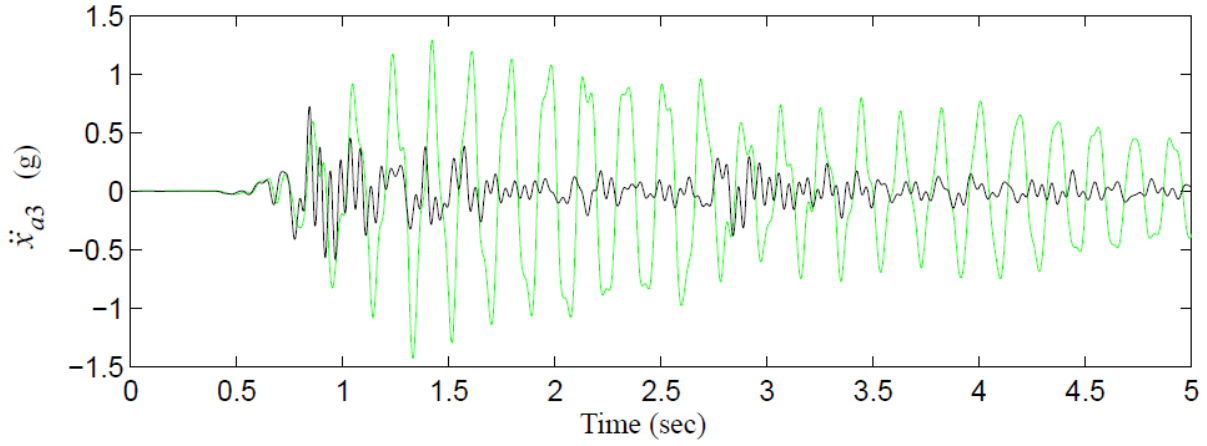


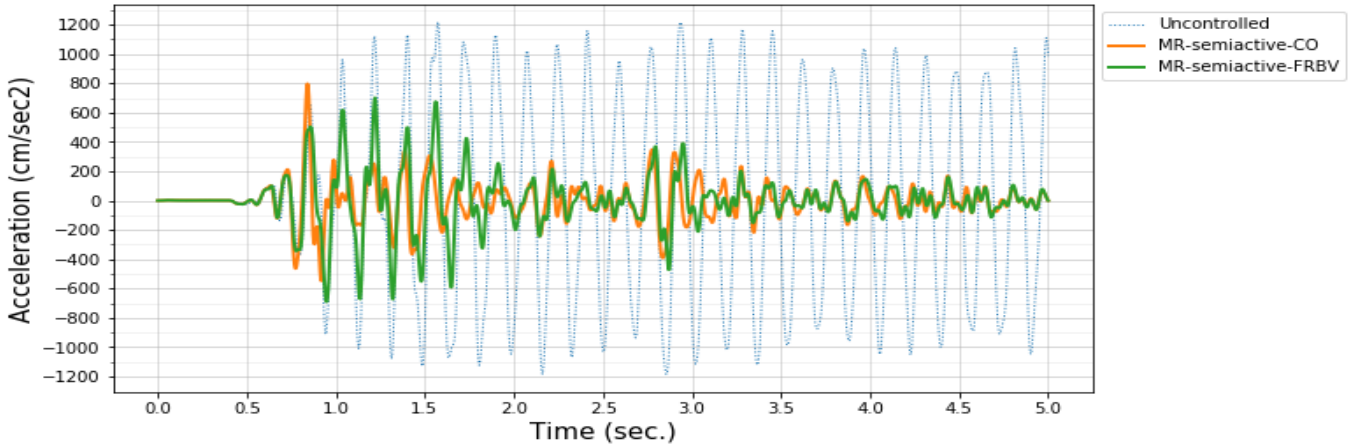
CUFE-BE

7. Dynamic package (DynPAK)

www.be4e.com

Cairo University






```
Evaluation Criteria
=======================
FRBV-Semi Active Evaluation Criteria
=====================================
J1_eq = 1.0010018244176975
J2_eq = 0.9936571875212346
J3_eq = 0.986632446876397
J4_eq = 1.0069900651425197
J5_eq = 0.9946355817928664
J6_eq = 0.9906616492850429
J7_eq = 3.8402258714533455e-05
```

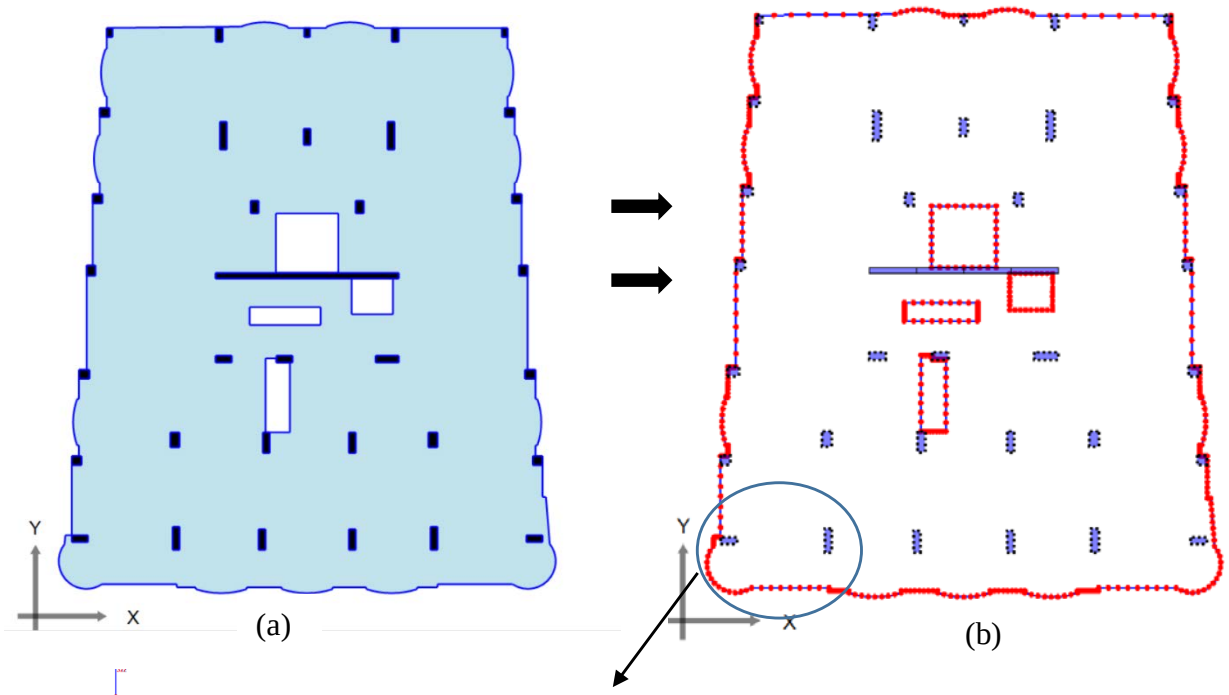
Floor	Number of MR Dampers per Floor	Eccentric (2*Ey)
9	No MR Dampers installed	
8	1	No
7	No MR Dampers installed	
6	No MR Dampers installed	
5	1	No
4	No MR Dampers installed	
3	1	No
2	No MR Dampers installed	
1	1	No

CUFE-BE

www.be4e.com

Cairo University

7. Dynamic package (DynPAK)



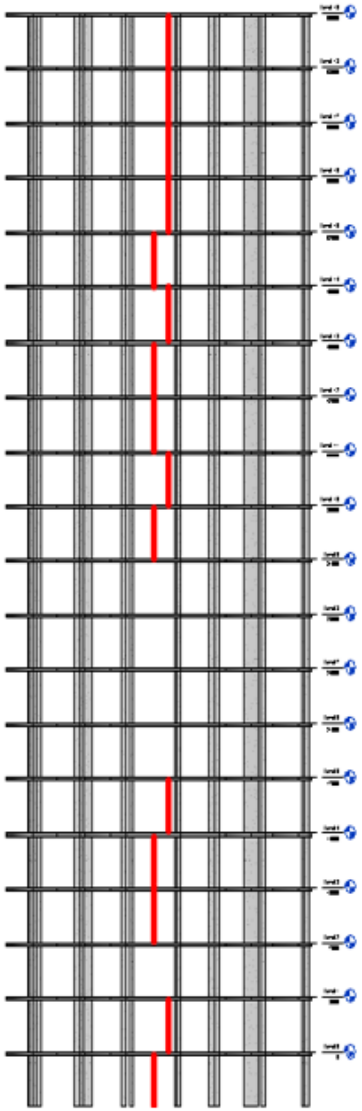


Table 4.8: Genetic Algorithm output for localization of MR dampers for High-Rise Building Model I

Floor	Number of MR Dampers per Floor	Eccentric (2*Ey)
20	7	Yes
19	7	Yes
18	9	Yes
17	9	Yes
16	5	No
15	9	Yes
14	5	No
13	9	No
12	5	Yes
11	7	No
10	*No MR Dampers installed*	
9	*No MR Dampers installed*	
8	*No MR Dampers installed*	
7	*No MR Dampers installed*	
6	7	Yes
5	9	No
4	7	No
3	*No MR Dampers installed*	
2	5	Yes
1	9	No

CUFE-BE

www.be4e.com

Cairo University

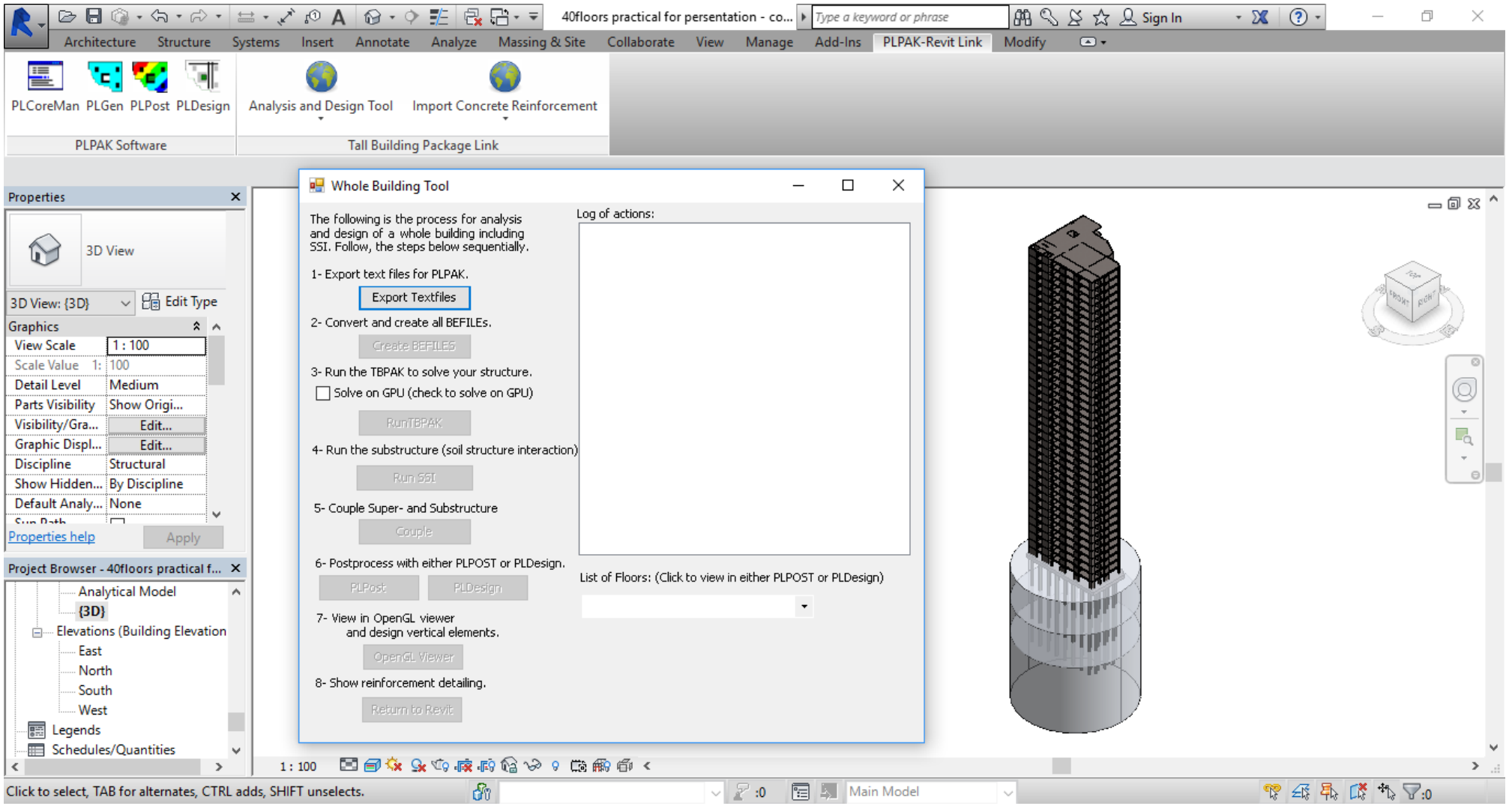
Table of contents

CUFE-BE

www.be4e.com

Cairo University

8. Overall building package (ETABS/PLPAK)

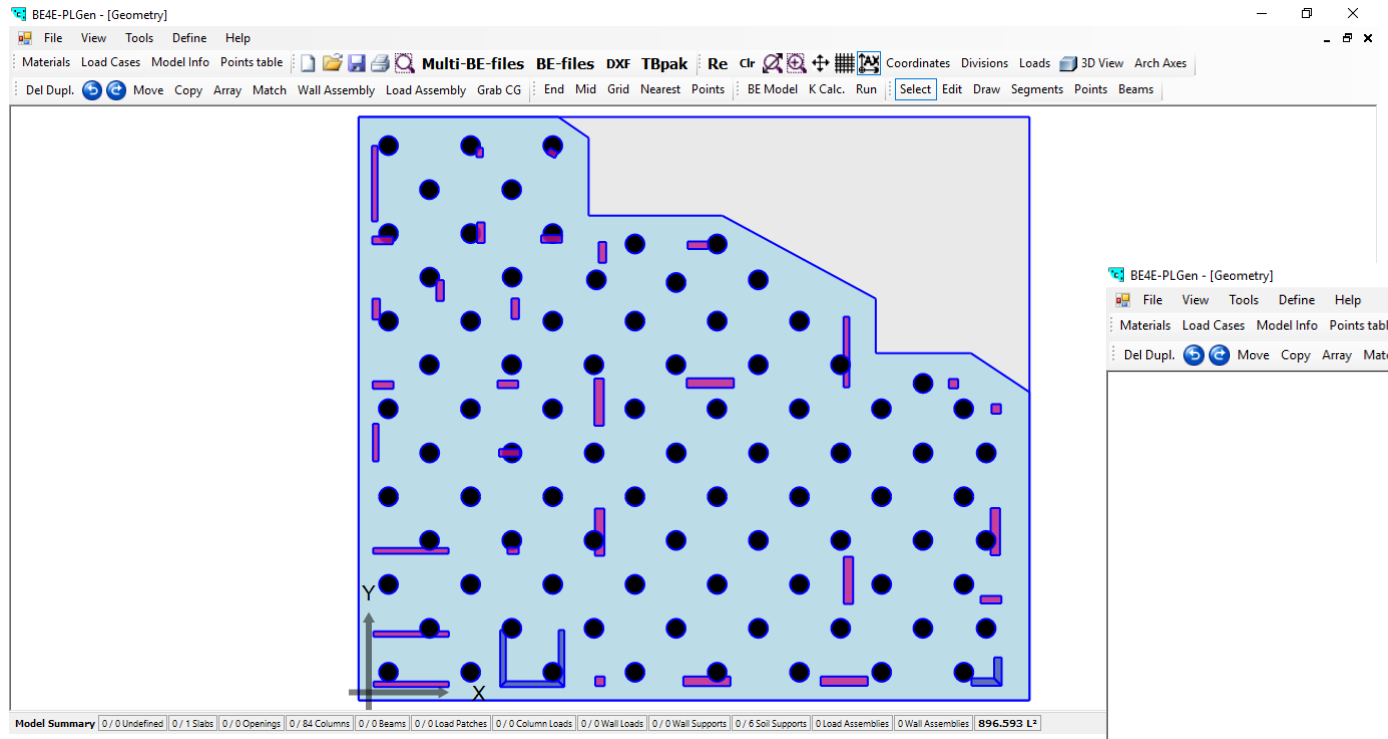


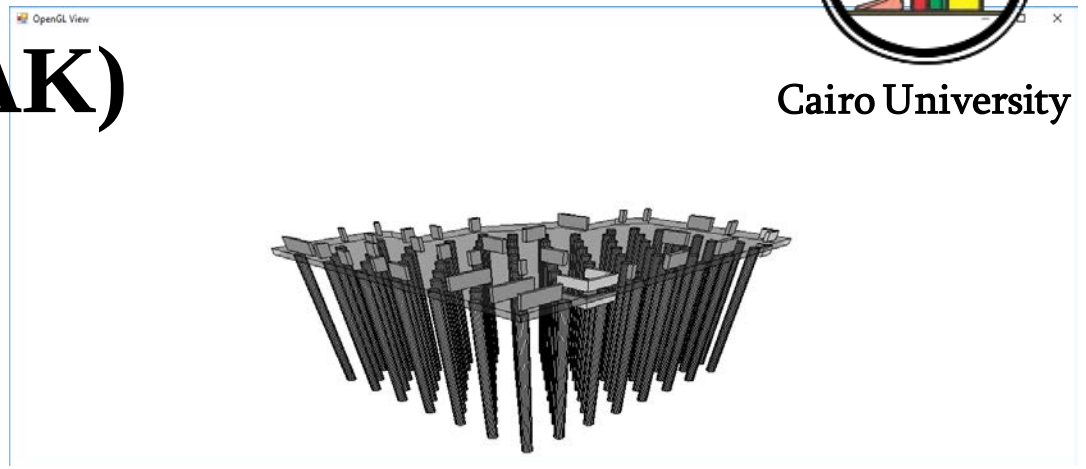
CUFE-BE

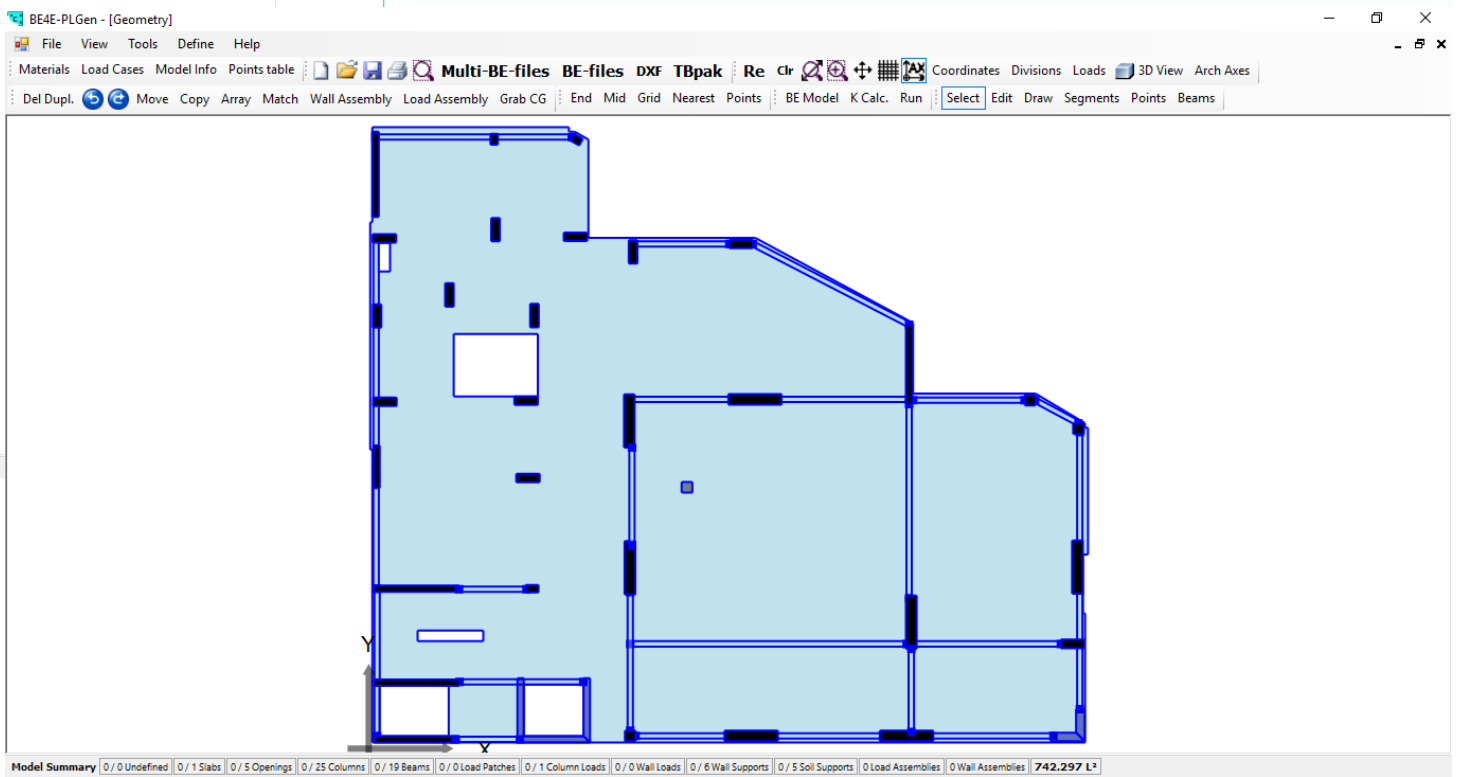
www.be4e.com

Cairo University

8. Overall building package (U-BEAK)





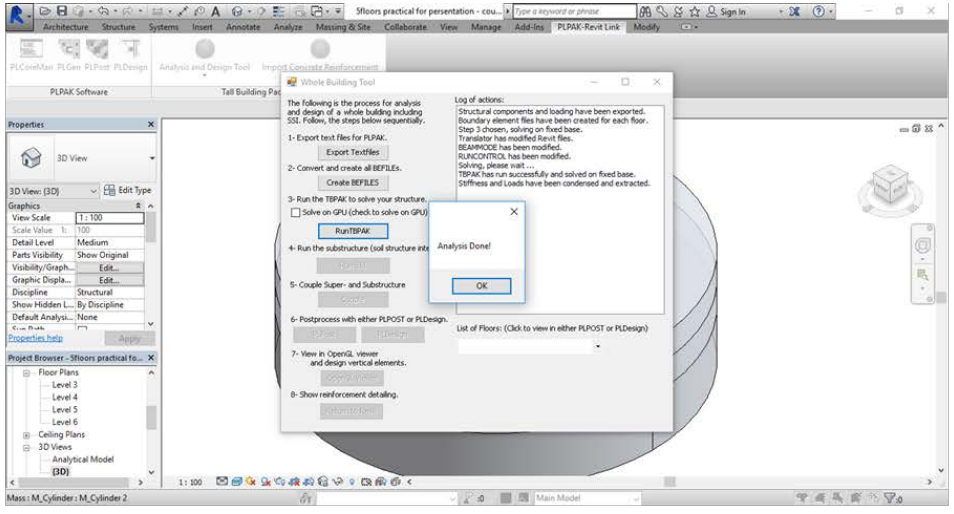


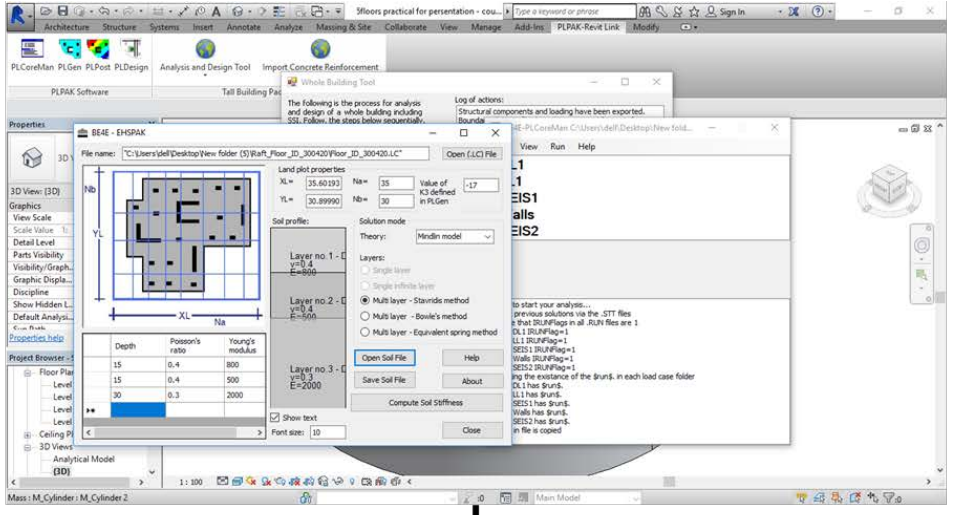
CUFE-BE

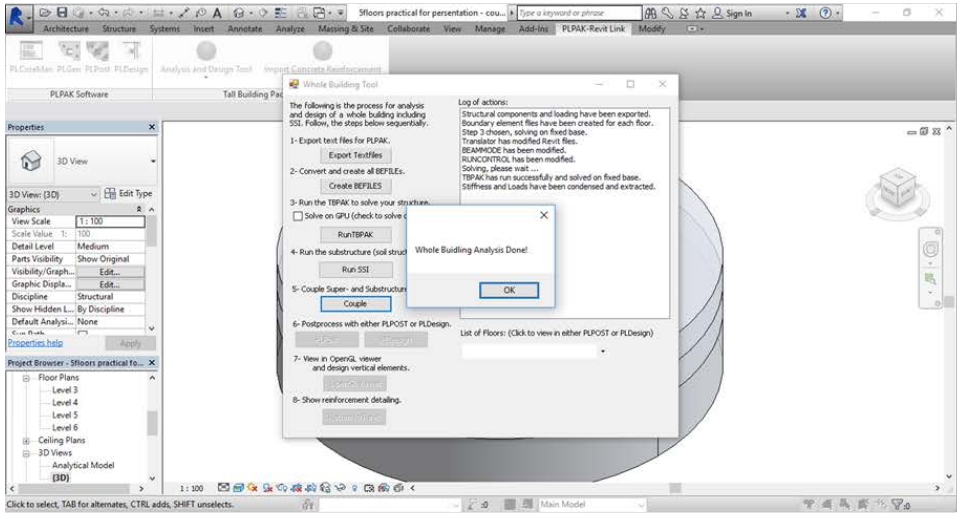
www.be4e.com

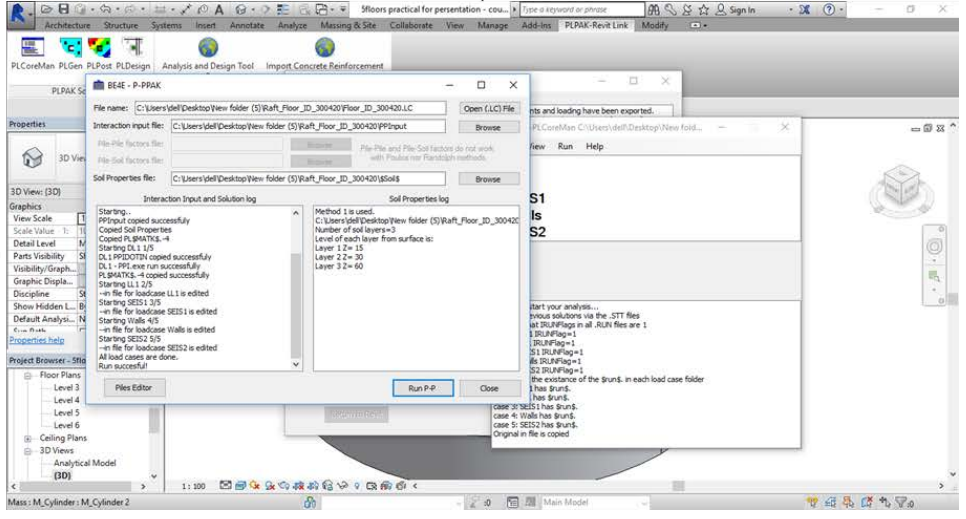
Cairo University

8. Overall building package (ETABS/PLPAK)







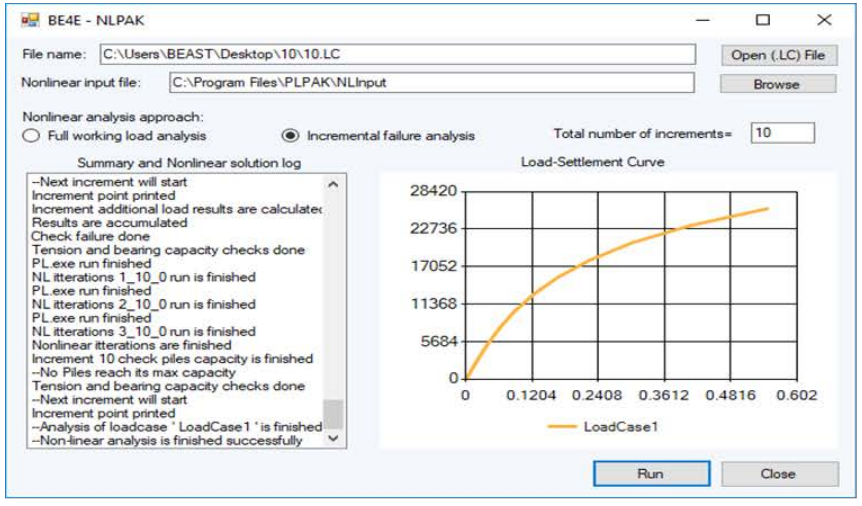


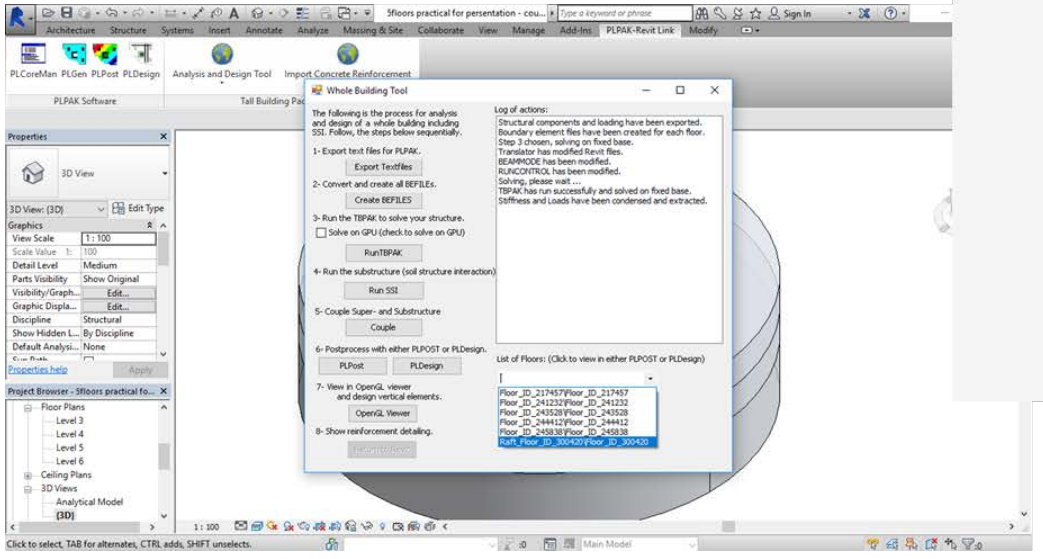
CUFE-BE

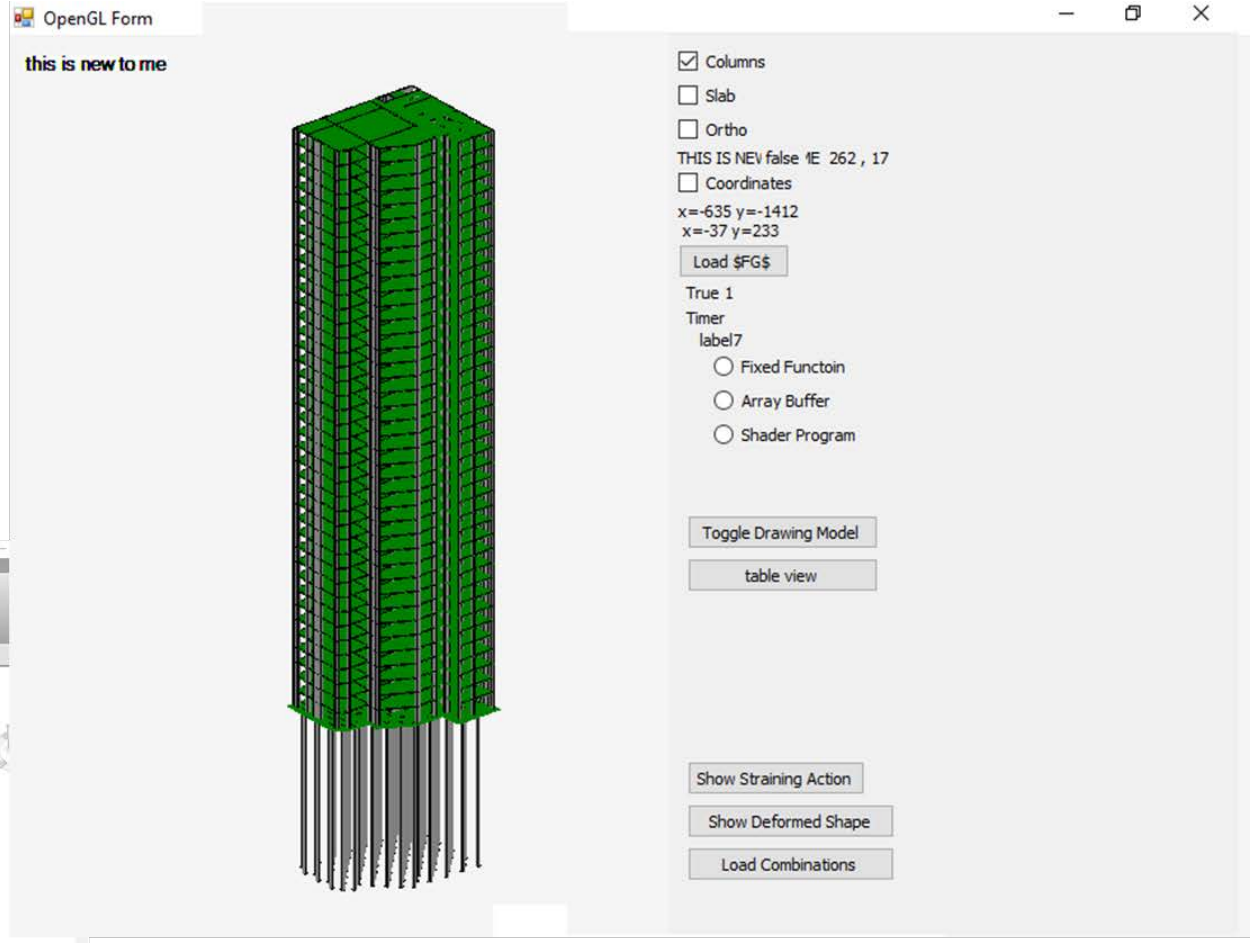
www.be4e.com

Cairo University

8. Overall building package (CUFE-AK)





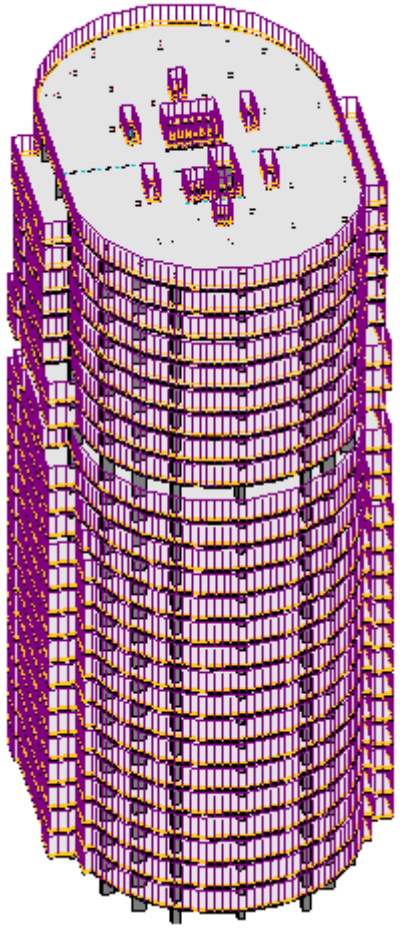


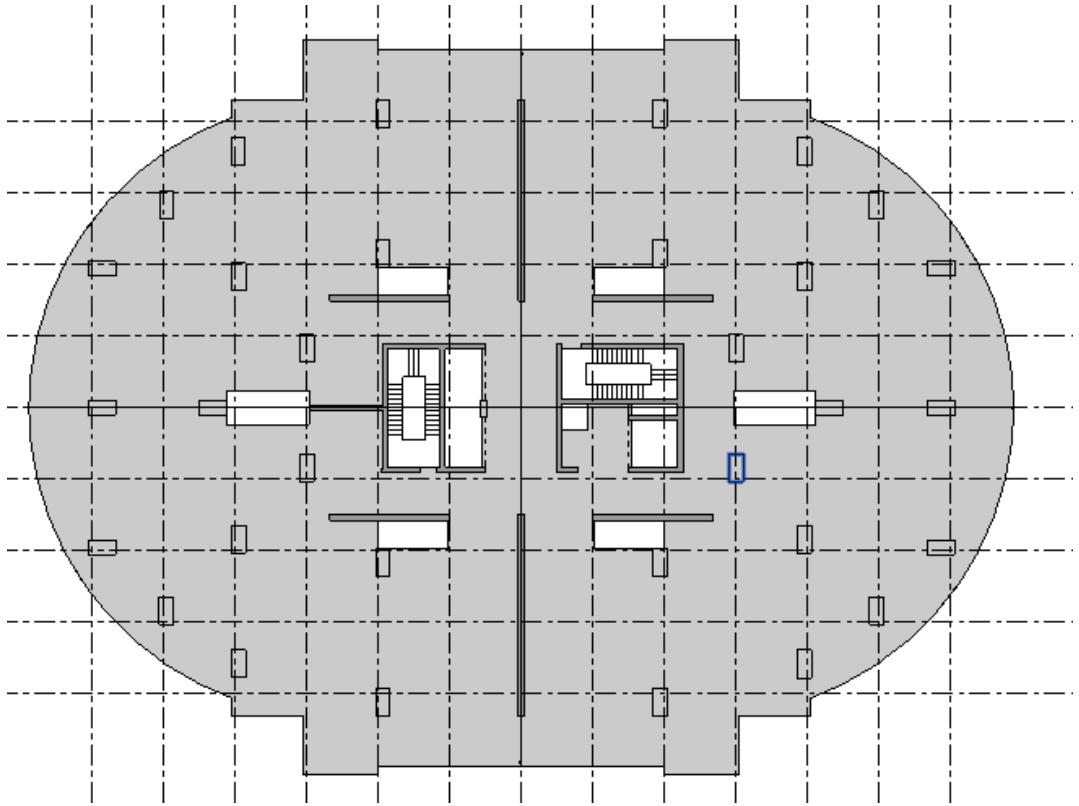
CUFE-BE

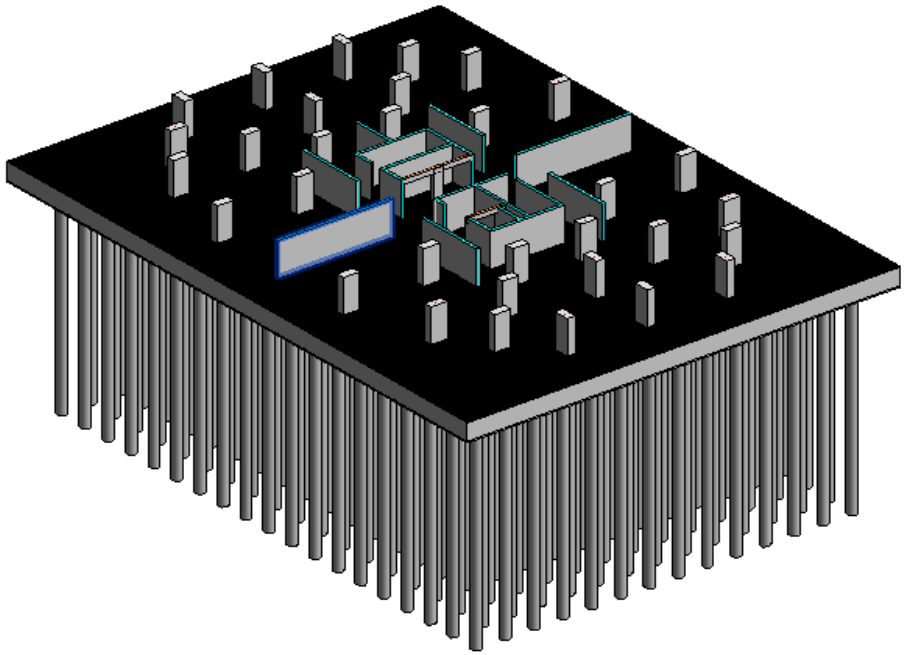
www.be4e.com

Cairo University

8. Overall building package (OBPAK)





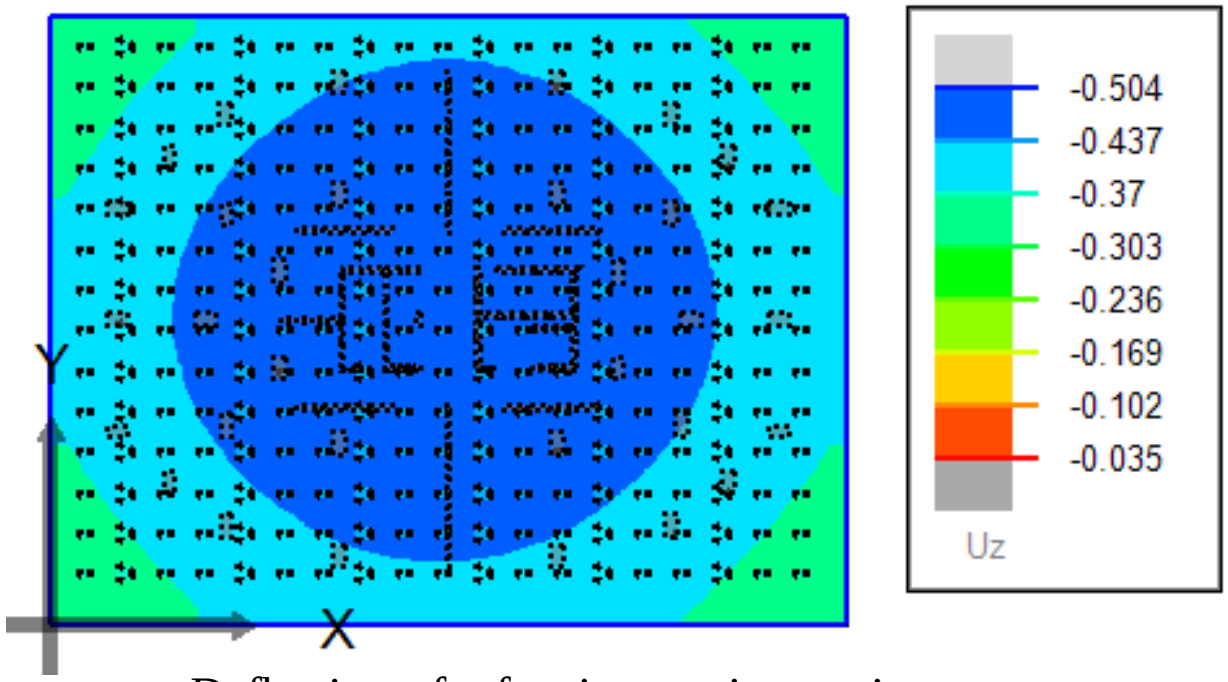


CUFE-BE

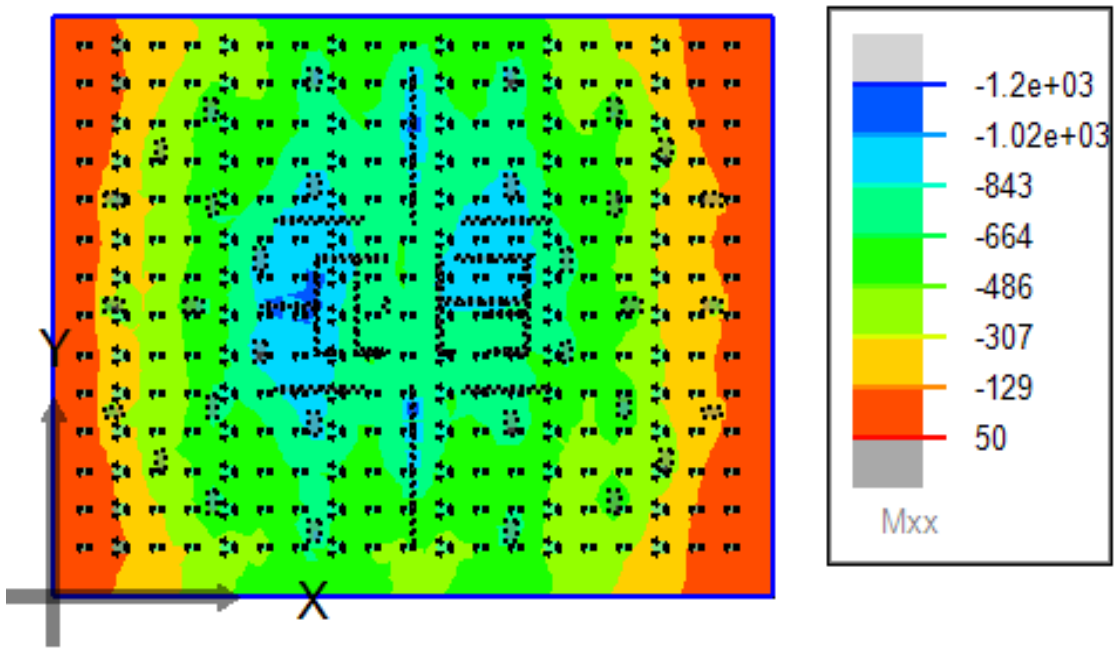
www.be4e.com

Cairo University

8. Overall building package (CUFE-AK)



Deflection of raft using p-p interaction.



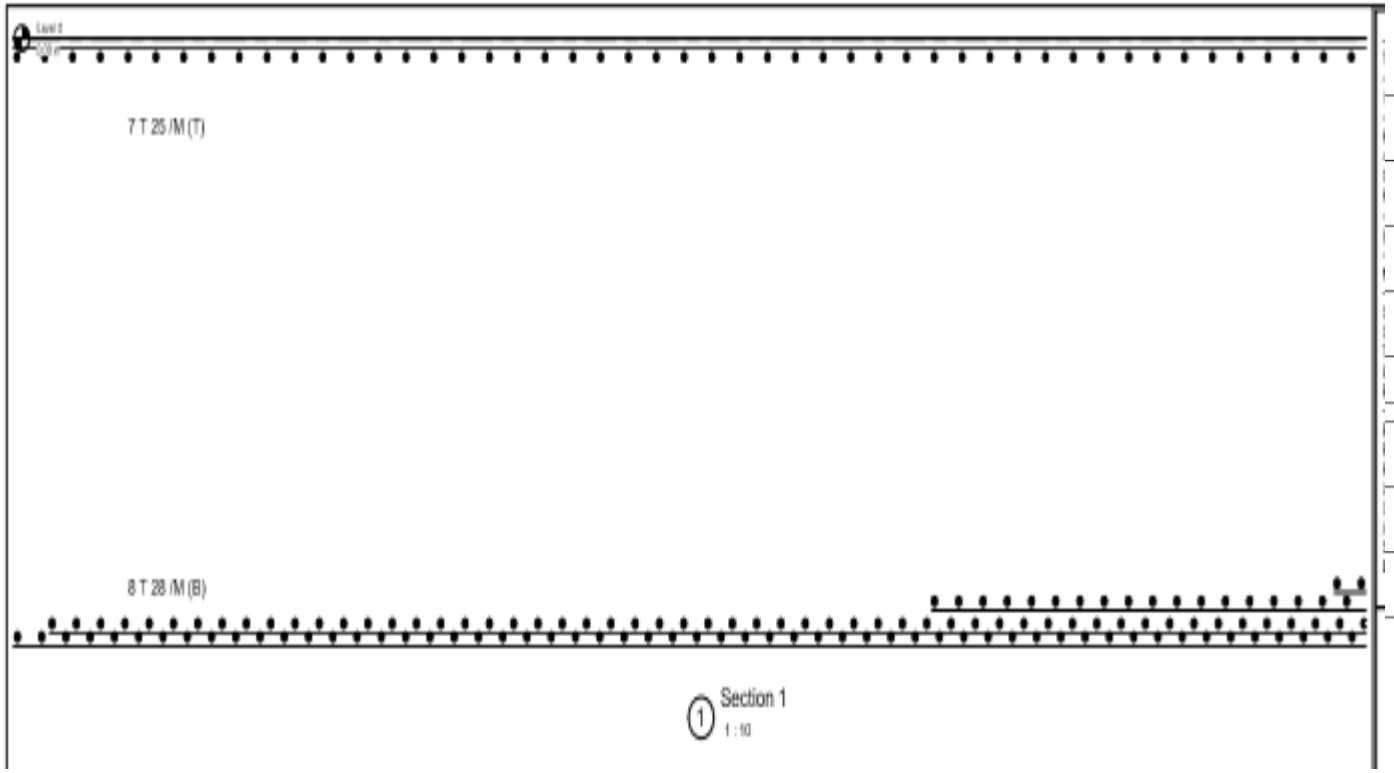
Moment about X-X axis using p-p interaction.

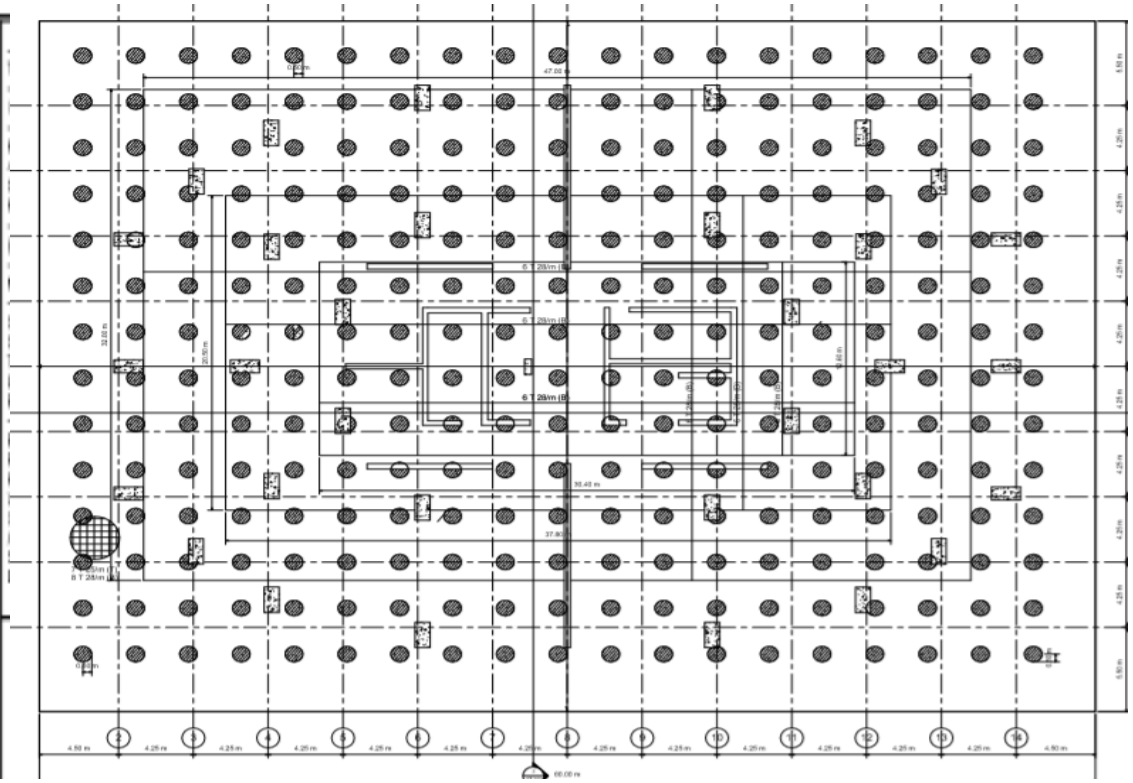
CUFE-BE

www.be4e.com

Cairo University

8. Overall building package (ОБЪАК)



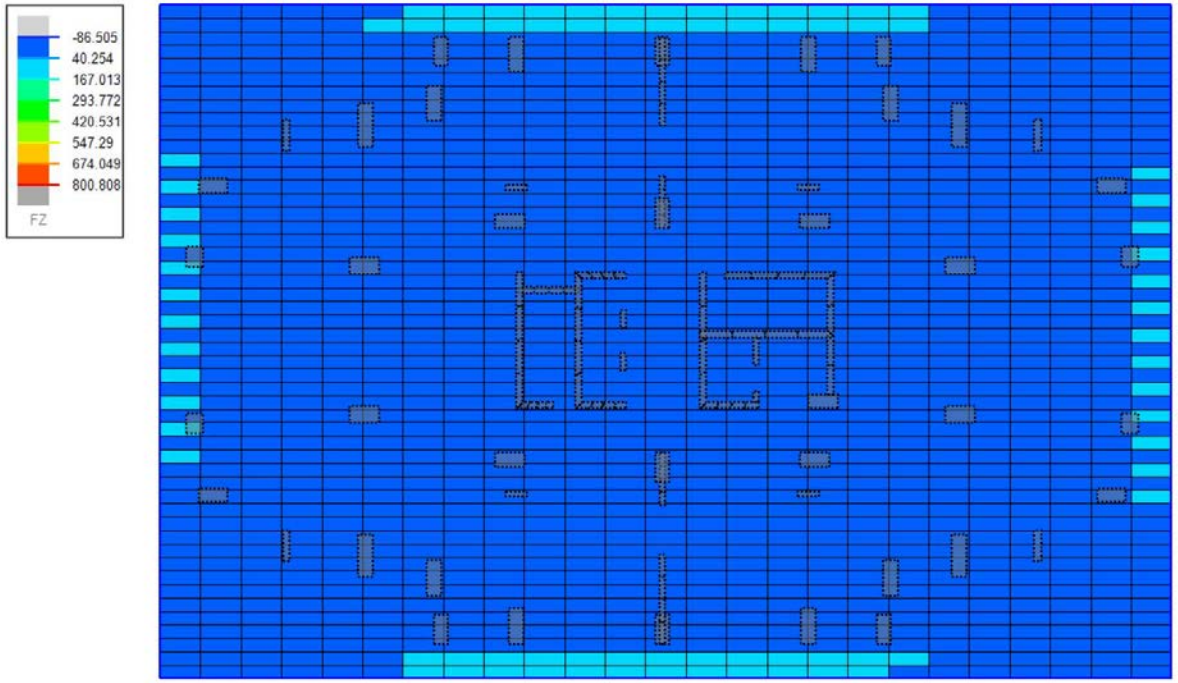


CUFE-BE

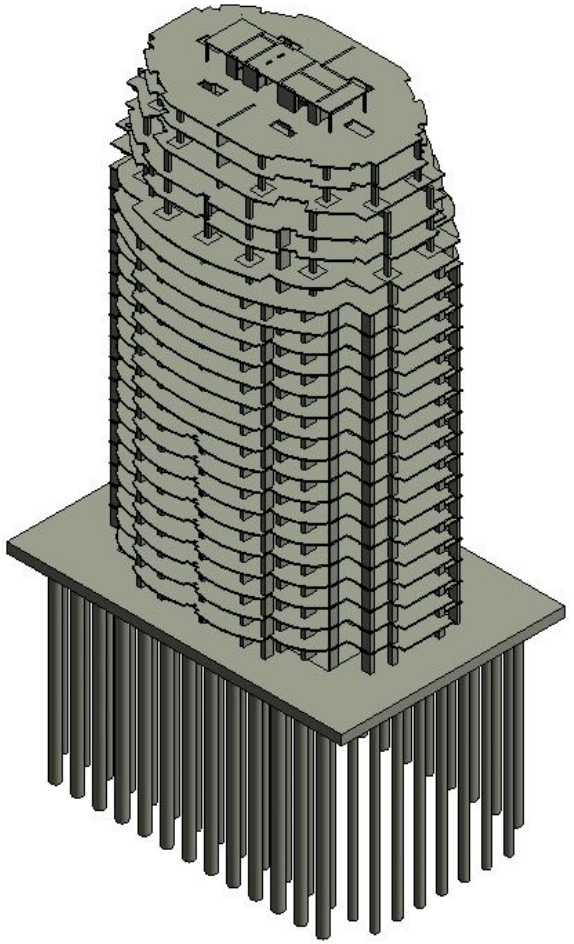
www.be4e.com

Cairo University

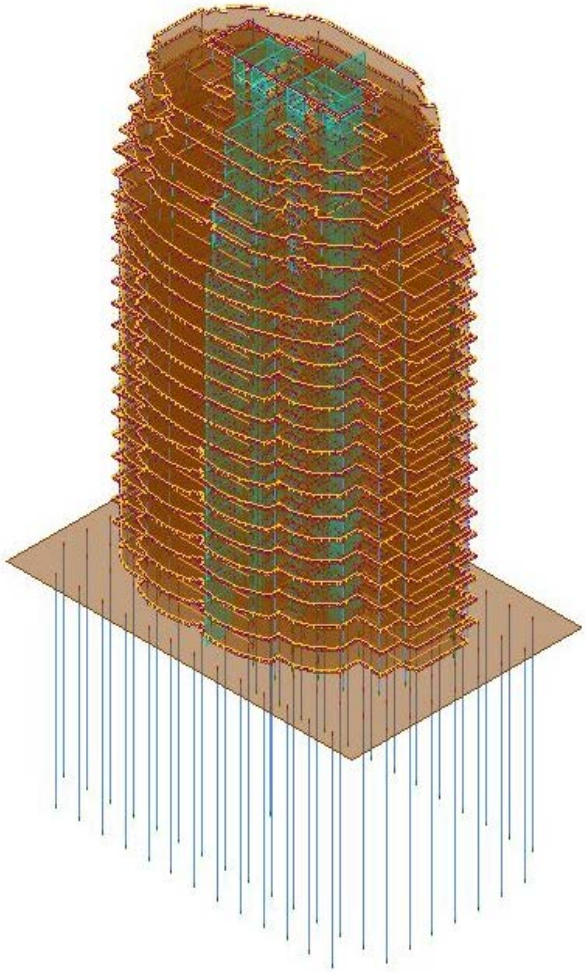
8. Overall building package (ОБЪЕКТ)



A 38x57 raft fails for the Bearing capacity.



Revit 3D geometric Model

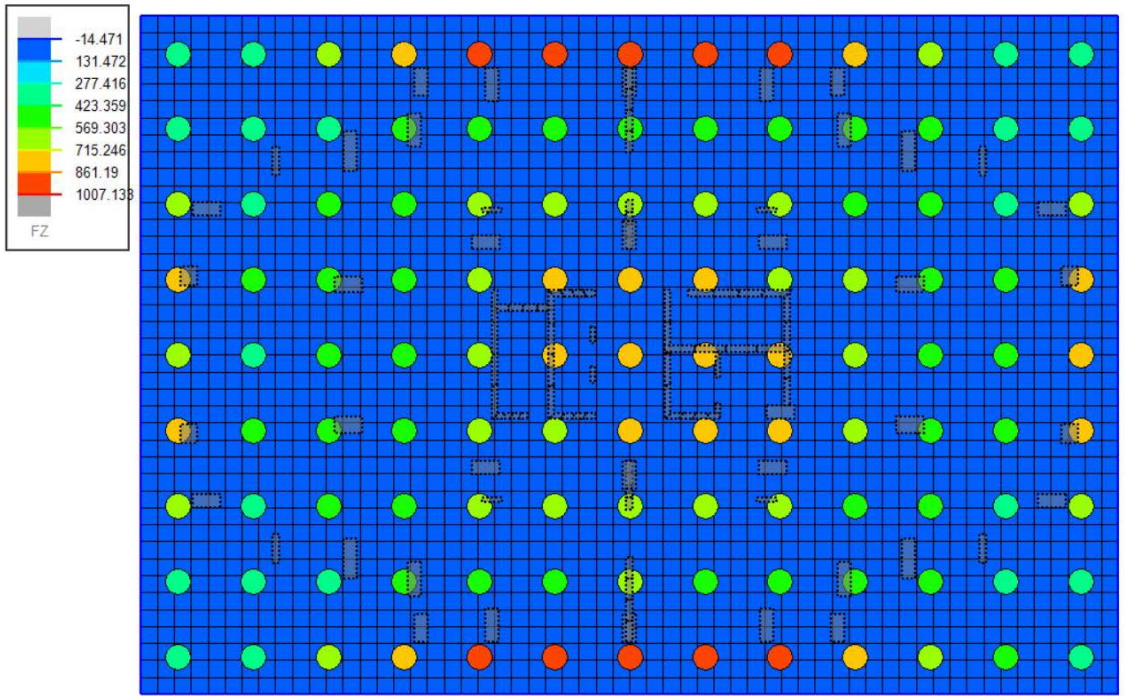


Revit 3D analytical Model

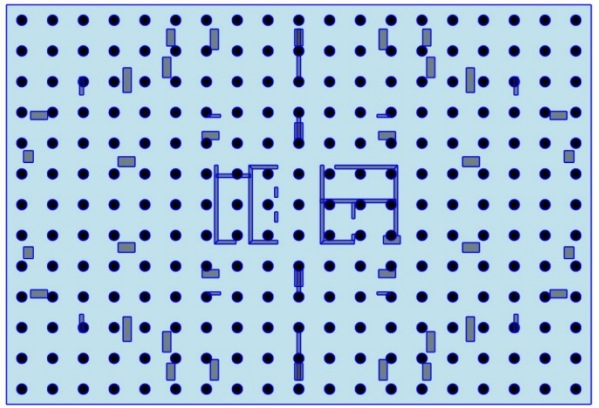
CUFE-BE

Cairo University

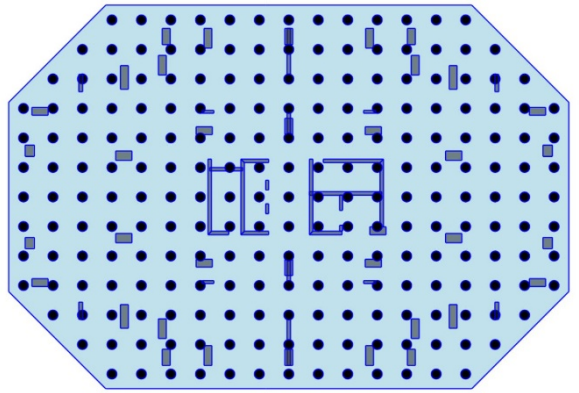
8. Overall building package (ОБЪАК)



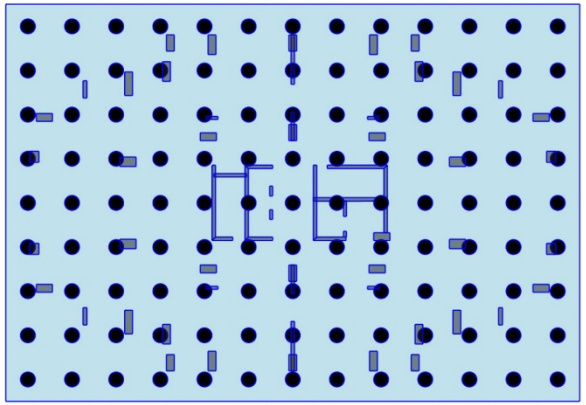
Considering P-P and P-S interactions A piled raft with 117 piles fails against the bearing capacity



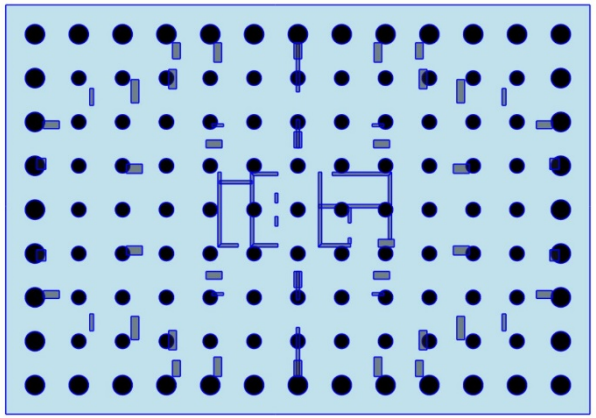
a piled raft with 247 piles.



a raft with 223 piles.

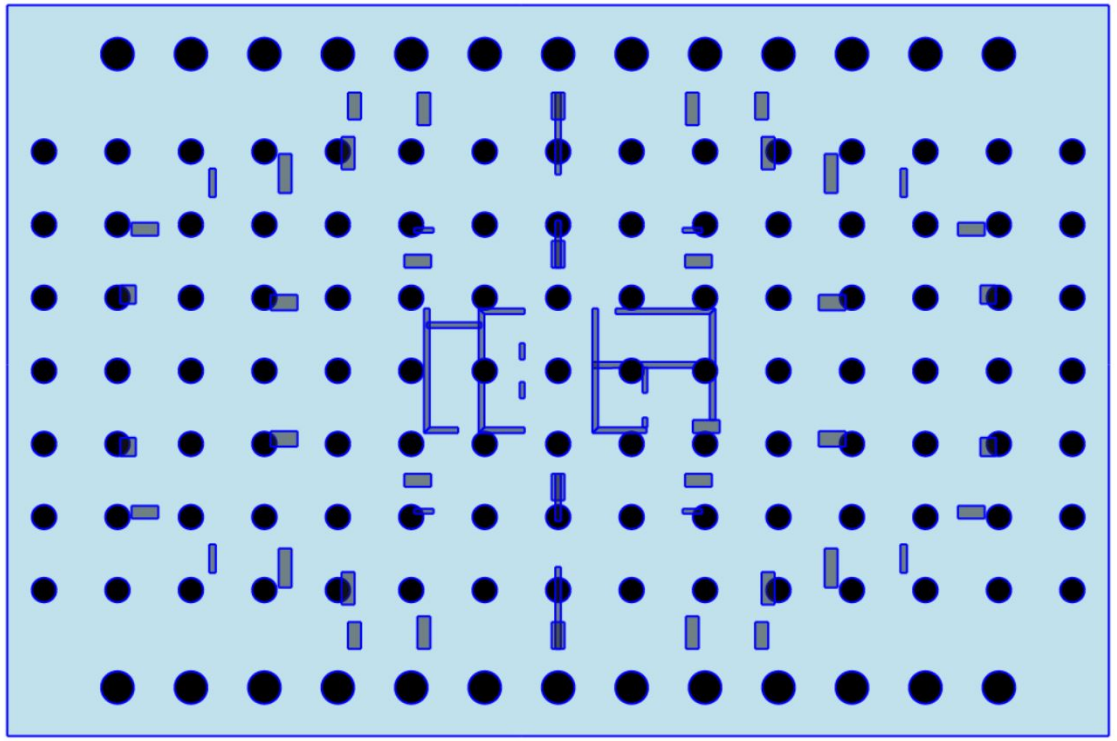


a raft with 117 piles having the same diameter.

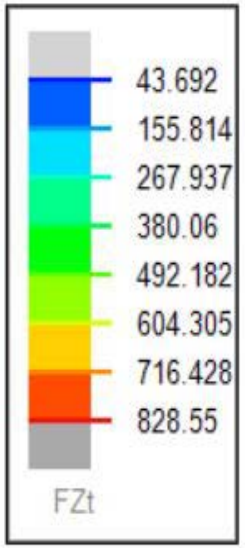


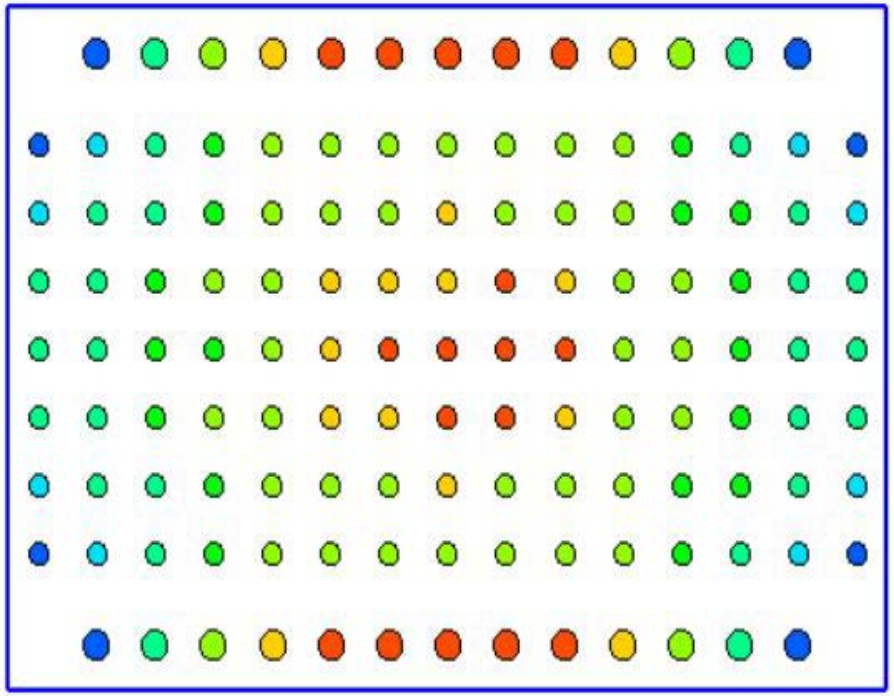
a raft with 117 piles having different diameter

8. Overall building package (UK)



The best configuration for the piled raft with 131 piles having different diameters considering pp only.



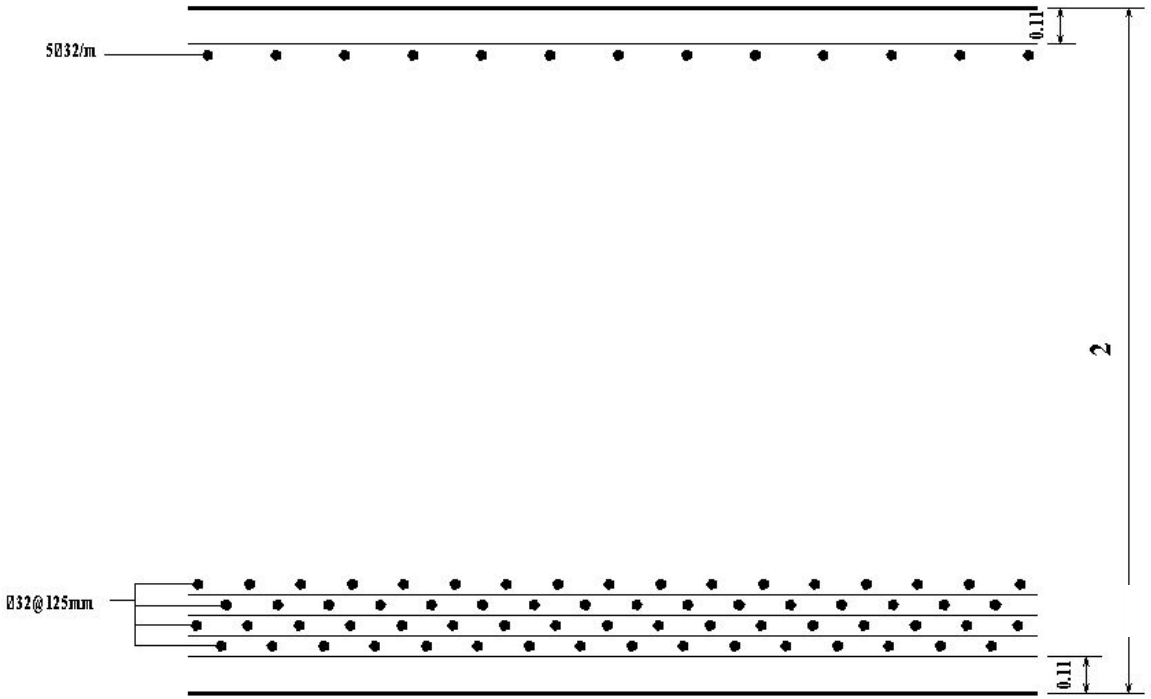


The axial compression straining actions of the piles.

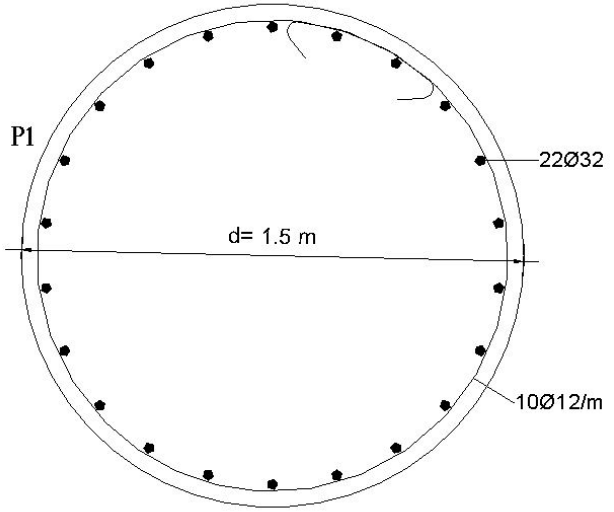
CUFE-BE

Cairo University

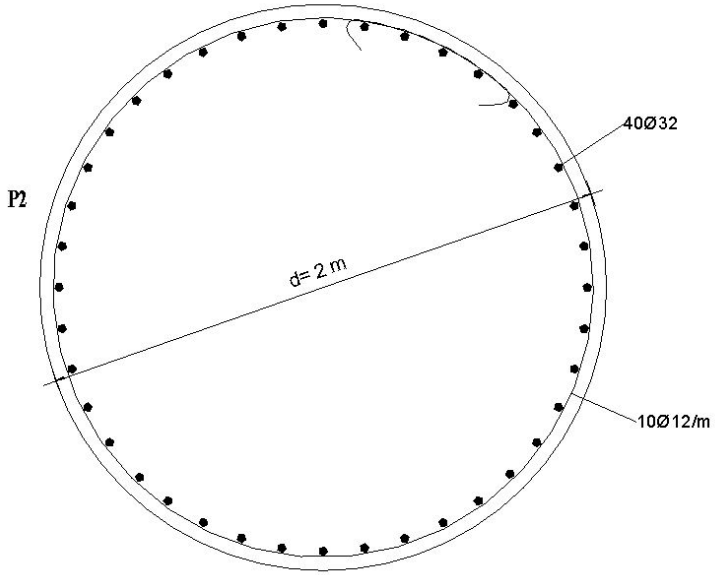
8. Overall building package (ОБЪАК)



x-section for the piled raft showing the RFT layers.



pile#1 x-section with RFT.

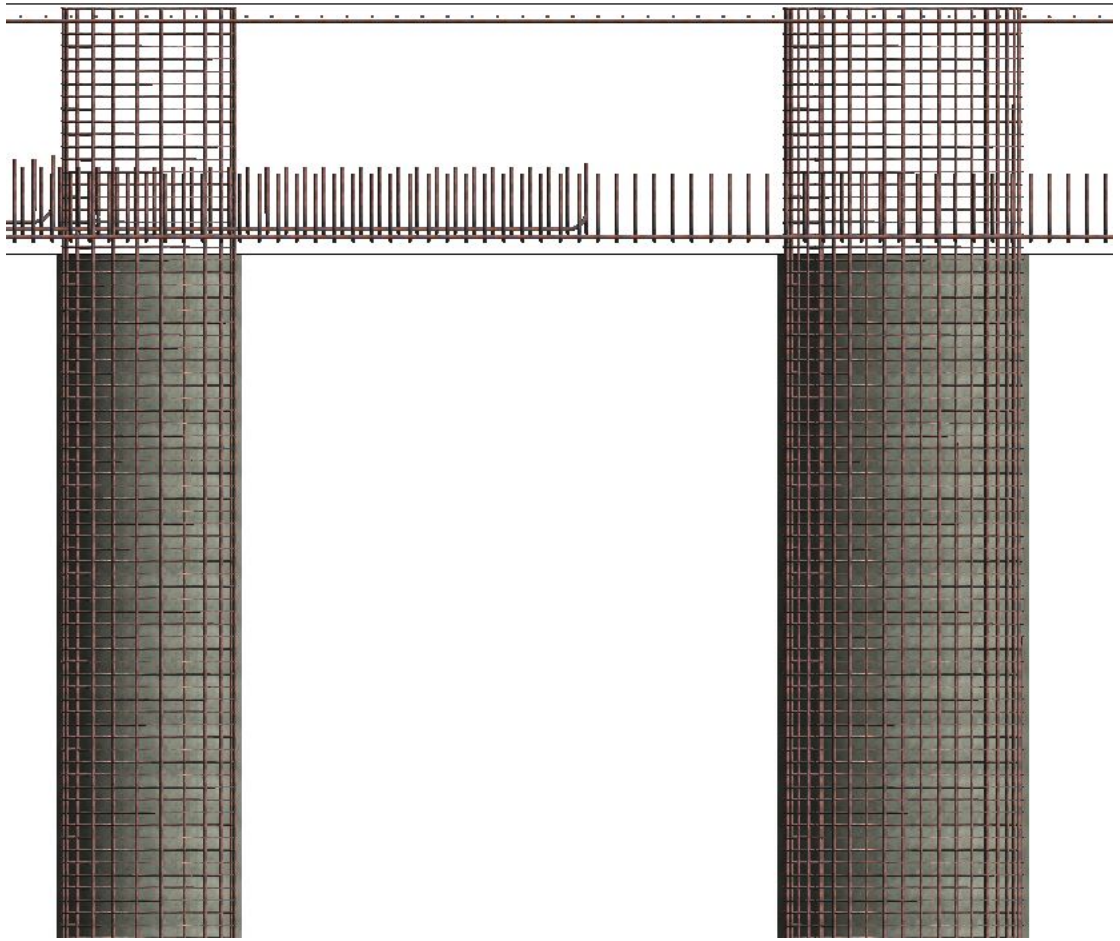


pile#2 x-section with RFT.

CUFE-BE

Cairo University

8. Overall building package (OBPAK)



Graphical elevation for piles x-sec.

CUFE-BE

www.be4e.com

Cairo University

Table of contents

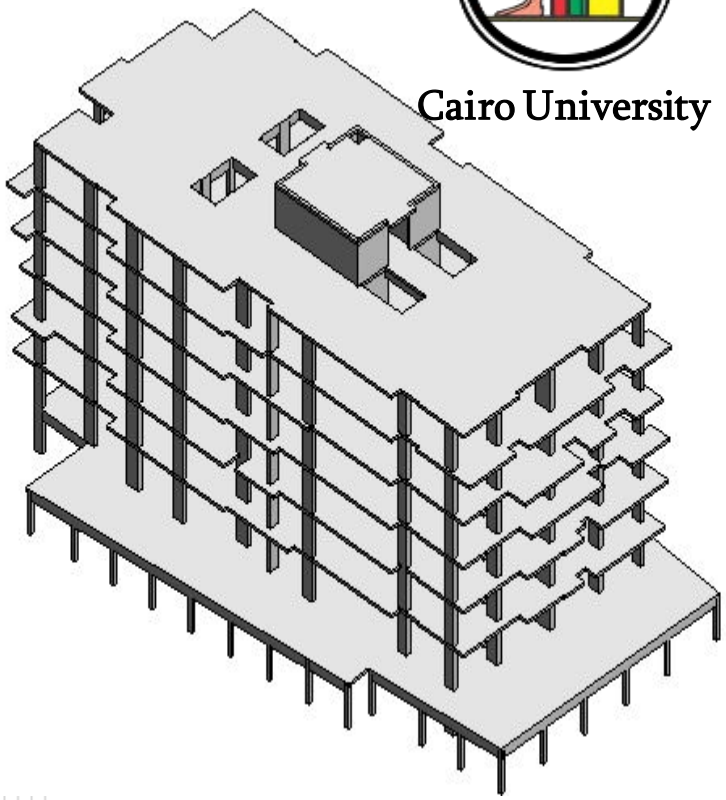
CUFE-BE

www.be4e.com

Cairo University

9. 4D and 5D analysis

الدور	TASK	Duration	START	END
Ground	الاعمدة			
	Formwork preparin	12	9/12/19	9/23/19
	Steel cut	12	9/12/19	9/23/19
	Steel installation	8	9/24/19	10/1/19
	Formwork shutterir	4	10/2/19	10/5/19
	Concrete Pouring	4	10/6/19	10/9/19
	Formwork Remove	2	10/10/19	10/11/19
	السقف			
	Formwork preparin	28	10/11/19	11/7/19
	Steel cut	28	10/11/19	11/7/19
	Steel installation	8	11/8/19	11/15/19
	formwork strengthe	8	11/8/19	11/15/19
	Concrete Pouring	4	11/16/19	11/19/19
	Formwork Remove	13	11/20/19	12/2/19

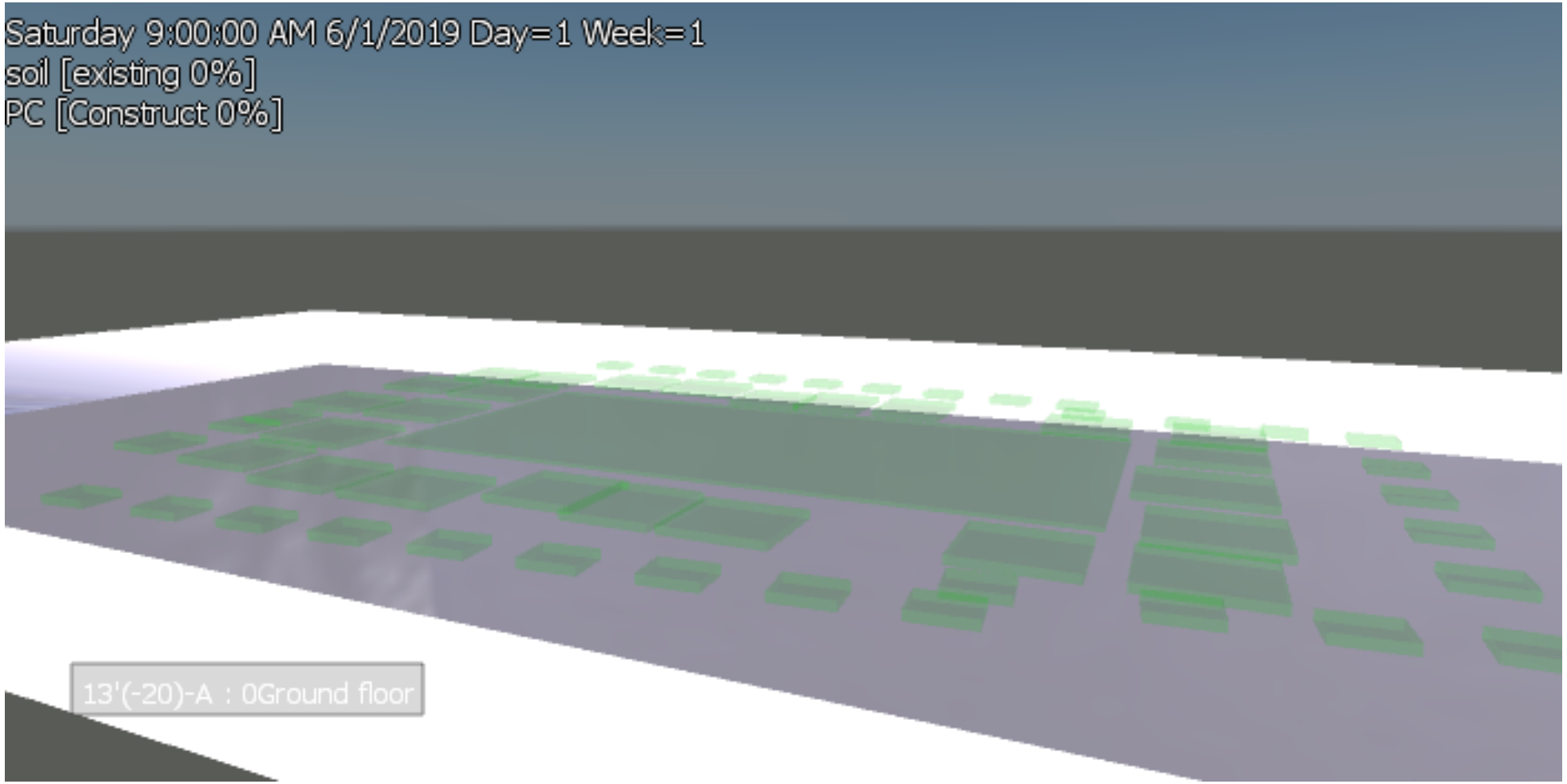


CUFE-BE

www.be4e.com

Cairo University

9. 4D and 5D analysis



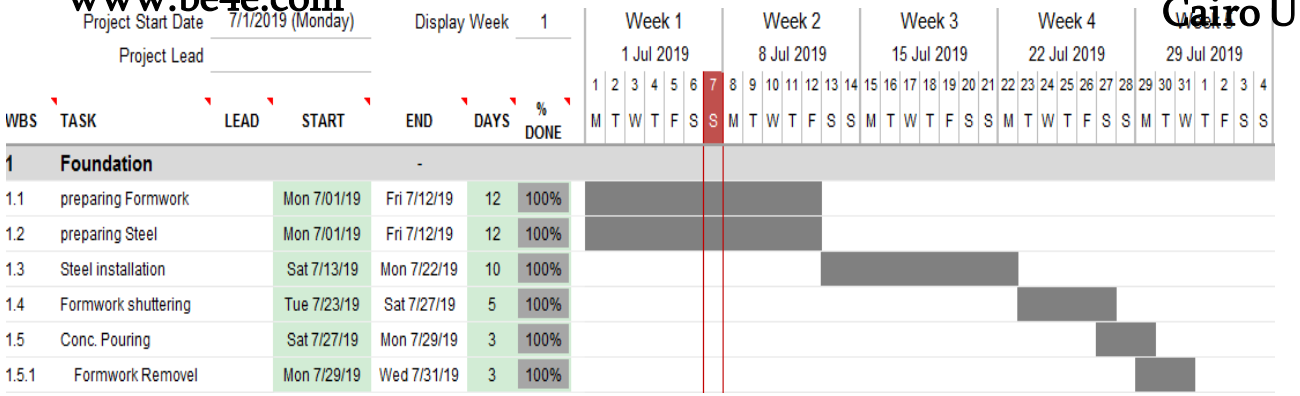
CUFE-BE

www.be4e.com

Cairo University

9. 4D and 5D analysis

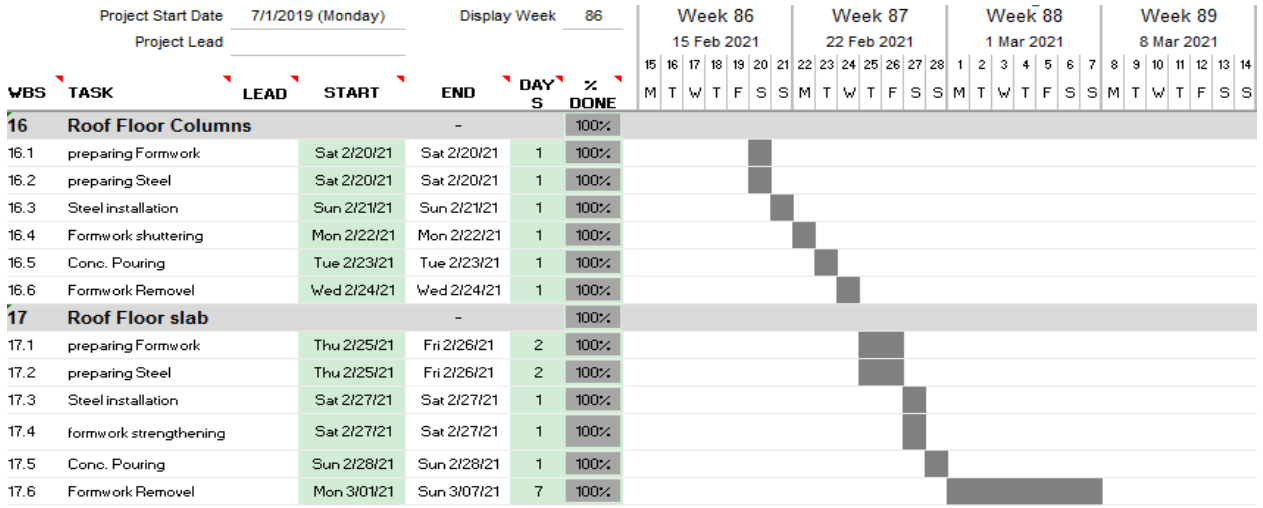
- Gantt chart was used in scheduling
- Logical Construction sequence
- After 88 weeks starting form 7/1/2019 till 3/7/2021 The project was finally delivered .



Project Start Date 7/1/2019 (Monday) Display Week 1

Project Lead

WBS	TASK	LEAD	START	END	DAYS	% DONE
1	Foundation			-		
1.1	preparing Formwork		Mon 7/01/19	Fri 7/12/19	12	100%
1.2	preparing Steel		Mon 7/01/19	Fri 7/12/19	12	100%
1.3	Steel installation		Sat 7/13/19	Mon 7/22/19	10	100%
1.4	Formwork shuttering		Tue 7/23/19	Sat 7/27/19	5	100%
1.5	Conc. Pouring		Sat 7/27/19	Mon 7/29/19	3	100%
1.5.1	Formwork Removel		Mon 7/29/19	Wed 7/31/19	3	100%



Project Start Date 7/1/2019 (Monday) Display Week 86

Project Lead

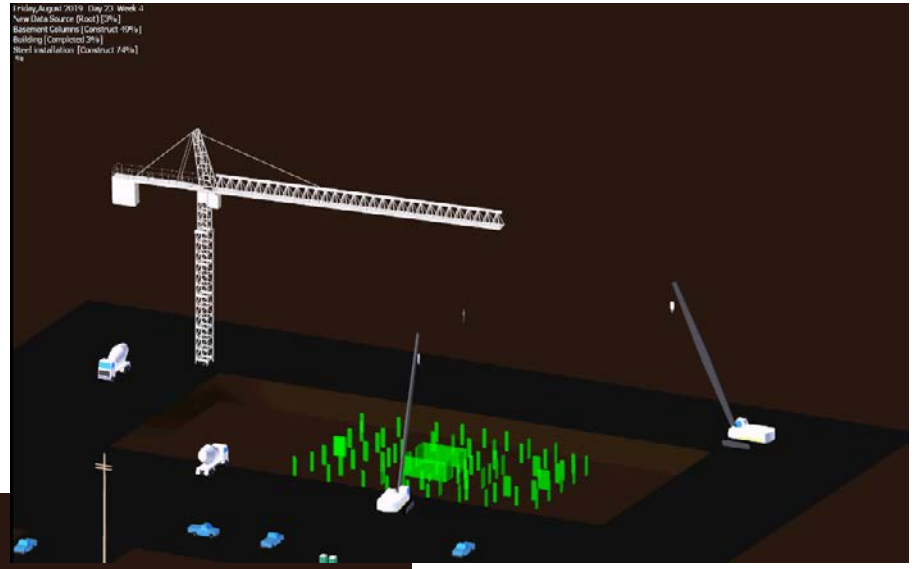
WBS	TASK	LEAD	START	END	DAYS	% DONE
16	Roof Floor Columns			-		100%
16.1	preparing Formwork		Sat 2/20/21	Sat 2/20/21	1	100%
16.2	preparing Steel		Sat 2/20/21	Sat 2/20/21	1	100%
16.3	Steel installation		Sun 2/21/21	Sun 2/21/21	1	100%
16.4	Formwork shuttering		Mon 2/22/21	Mon 2/22/21	1	100%
16.5	Conc. Pouring		Tue 2/23/21	Tue 2/23/21	1	100%
16.6	Formwork Removel		Wed 2/24/21	Wed 2/24/21	1	100%
17	Roof Floor slab			-		100%
17.1	preparing Formwork		Thu 2/25/21	Fri 2/26/21	2	100%
17.2	preparing Steel		Thu 2/25/21	Fri 2/26/21	2	100%
17.3	Steel installation		Sat 2/27/21	Sat 2/27/21	1	100%
17.4	formwork strengthening		Sat 2/27/21	Sat 2/27/21	1	100%
17.5	Conc. Pouring		Sun 2/28/21	Sun 2/28/21	1	100%
17.6	Formwork Removel		Mon 3/01/21	Sun 3/07/21	7	100%

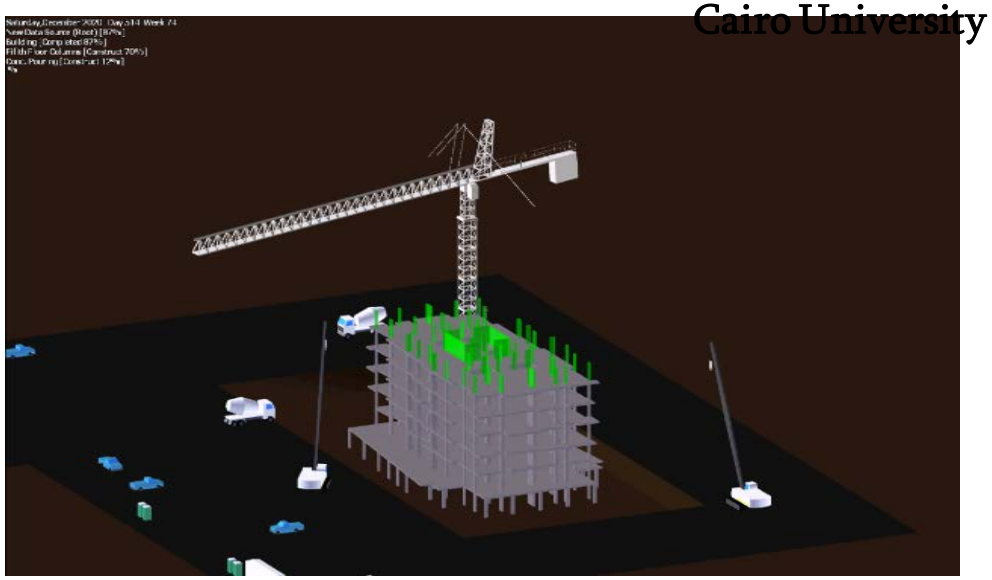
CUFE-BE

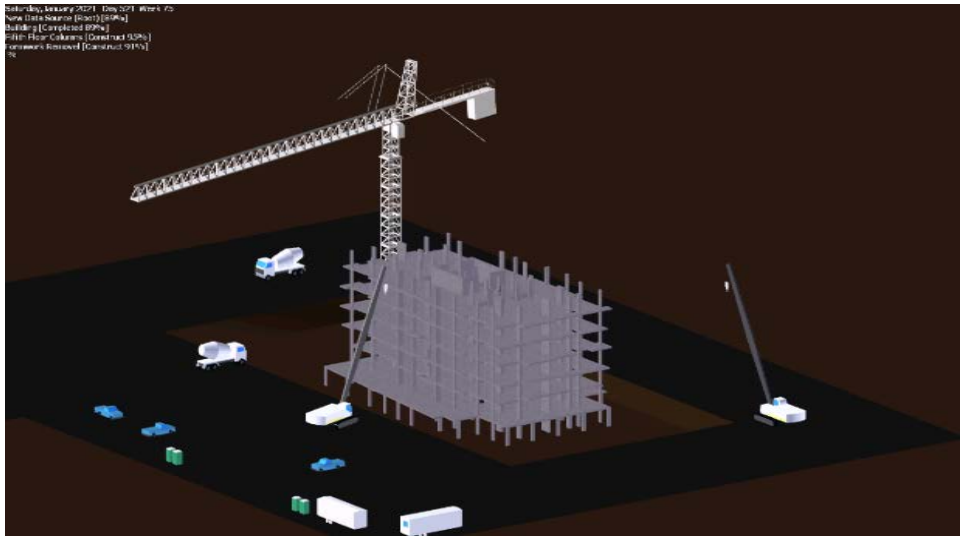
www.be4e.com

Cairo University

9. 4D and 5D analysis





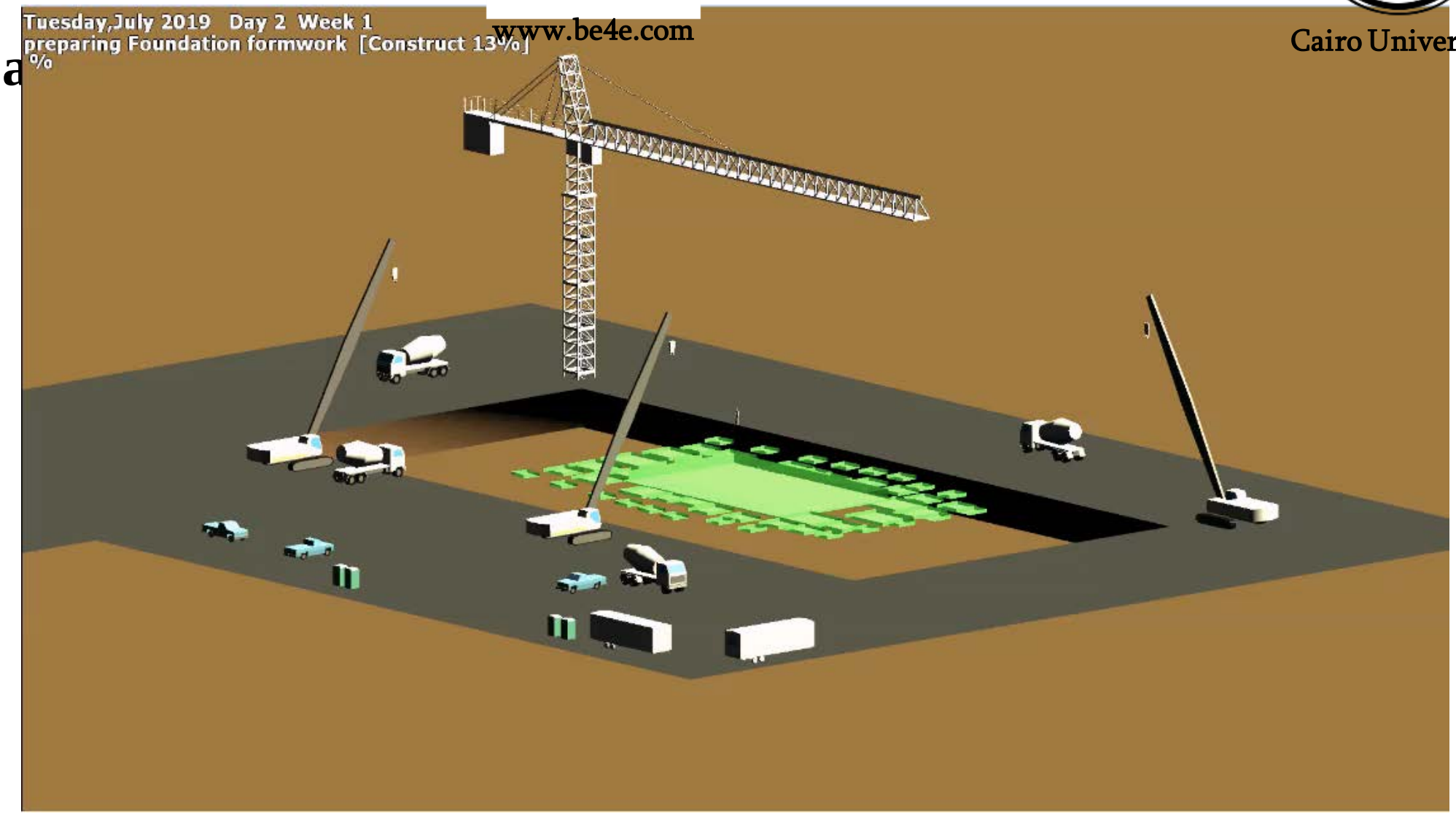


CUFE-BE

www.be4e.com

Cairo University

9. 4D and 5D a



CUFE-BE

www.be4e.com

Cairo University

Table of contents

Thanks Any questions ?