

TOPIC 5

ANALYSIS OF THE MUTUAL INFLUENCE OF ADJACENT BUILDING FOUNDATIONS

In the CROSS program, we will increase the site in the direction of Y by 30 m.

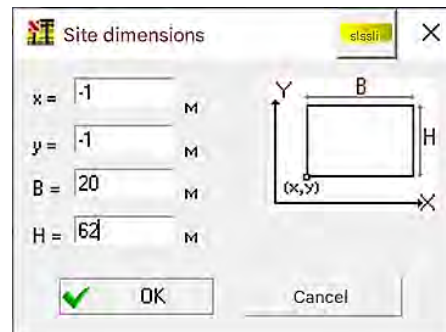


Figure 5.1 – Increasing the site by 30 m

Use the Existing Building tool to draw an outline of an adjacent existing building next to the building you are designing.

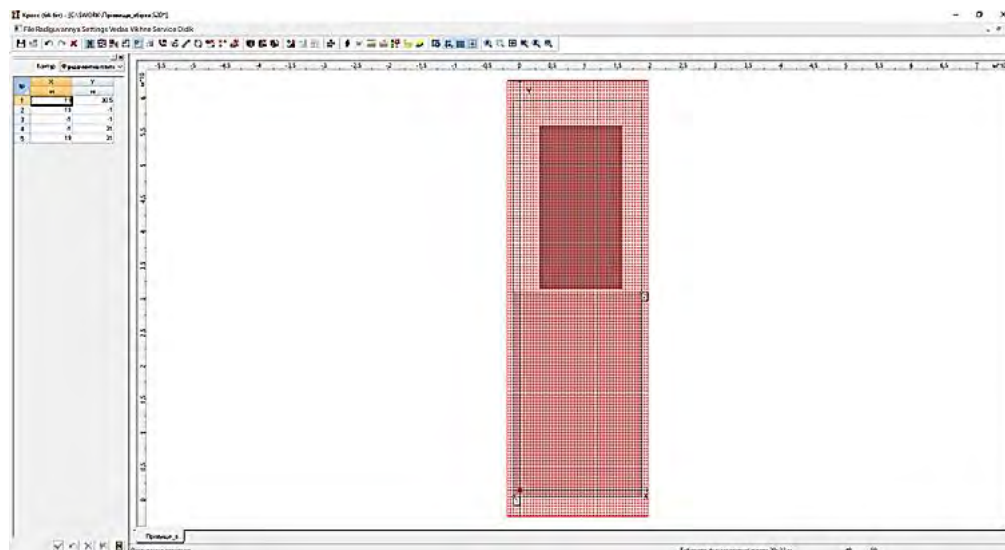


Figure 5.2 – Entering the outline of an adjacent existing building

Assign the load from the neighboring building and the mark of the sole of its foundation.

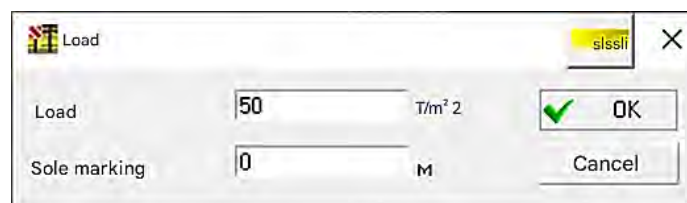


Figure 5.3 – Assignment of load from a neighboring building

Perform the calculation and analyze the bedding coefficients, taking into account the presence of a neighboring building.

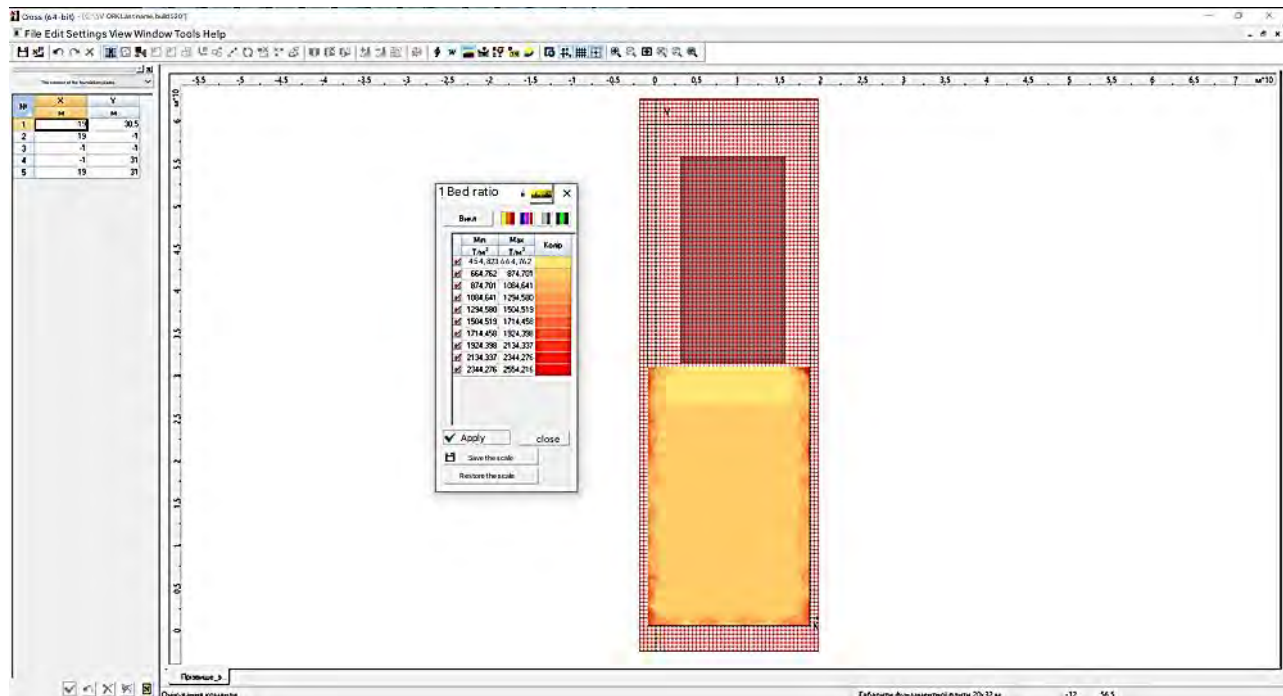
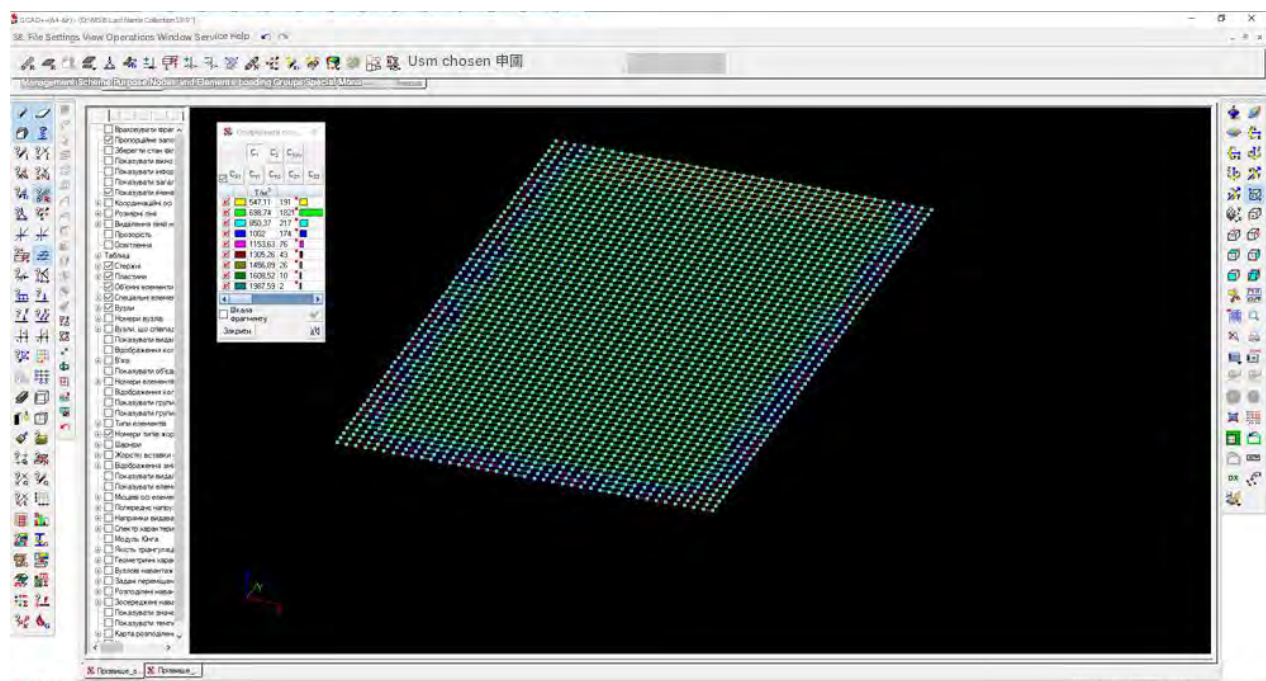


Figure 5.4 – Isopoles of bed coefficients taking into account the presence of a neighboring building

Import the calculated bedding coefficients into SCAD++ and make sure that they are applied correctly using the filter panel.



Assign the coefficients of the C2 bedding obtained from the CROSS.

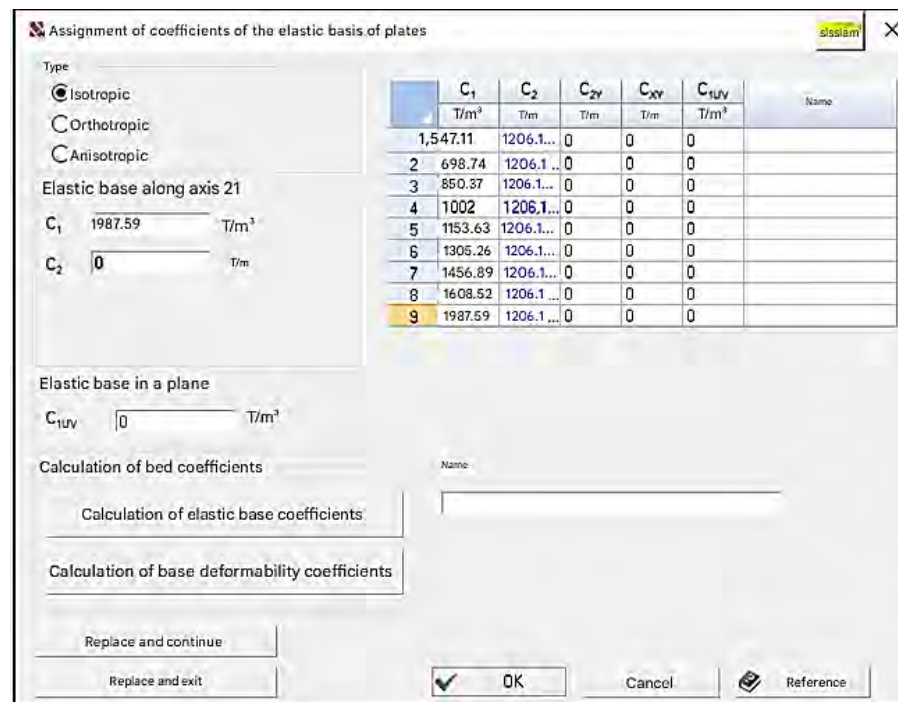


Figure 5.6 – Assignment of bed coefficients C2

Perform a linear calculation.

Go to the graphical analysis tab and analyze the changes in the stress-strain state of the building elements and the need to make adjustments to the accepted sections and reinforcement based on the results of the impact of the neighboring building.

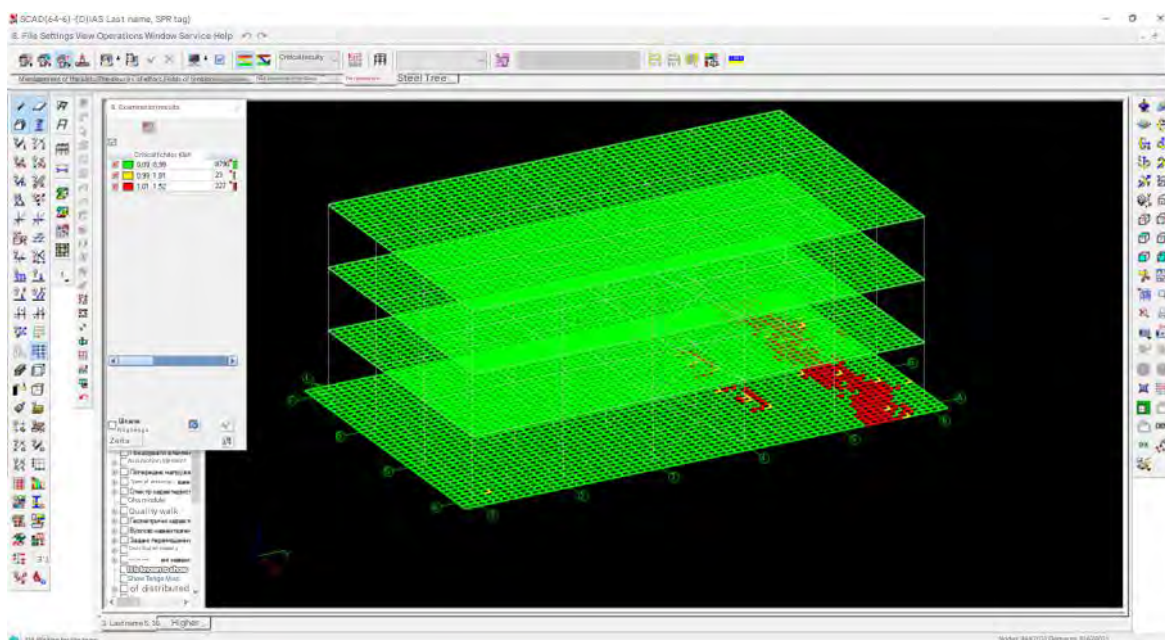


Figure 5.7 – Results of calculating the strength of the foundation slab, taking into account the presence of a neighboring building

Analyze the deformed state of the building on the "Displacement" tab from the applied combination of forces, taking into account the presence of a neighboring building.

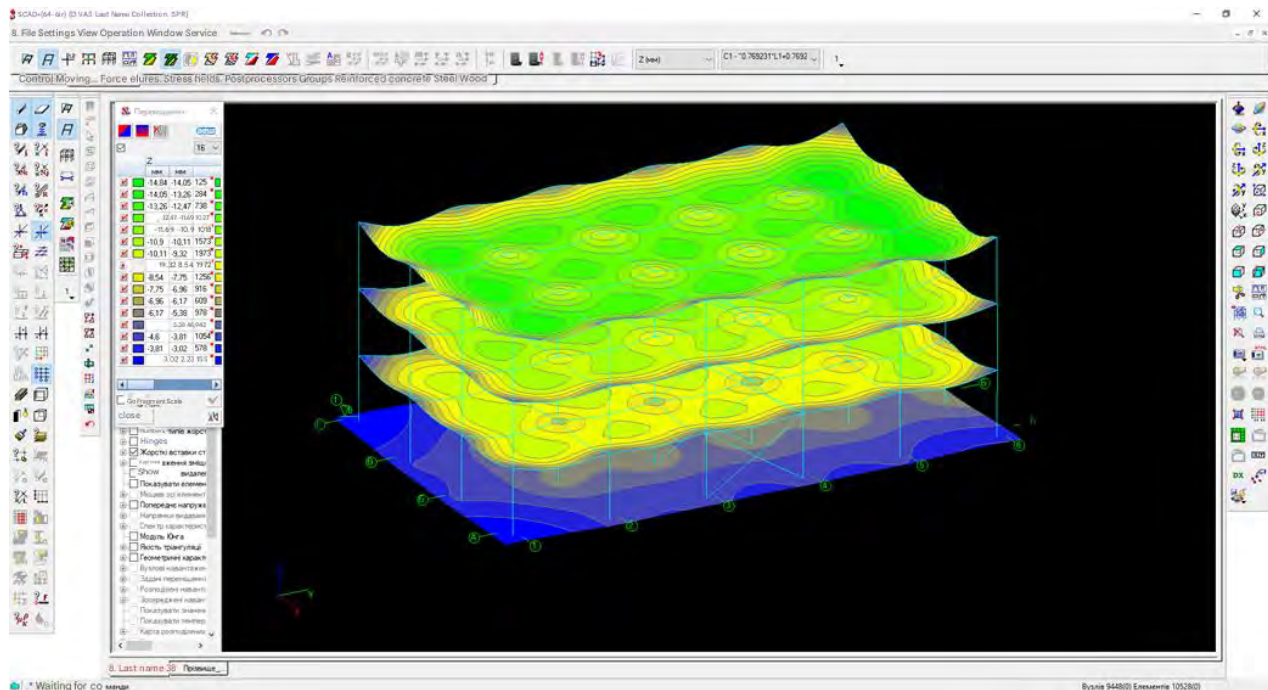


Figure 5.8 – Deformed condition of the building as a whole, taking into account the neighboring building

Separately, pay attention to the deformed state of the foundation slab.

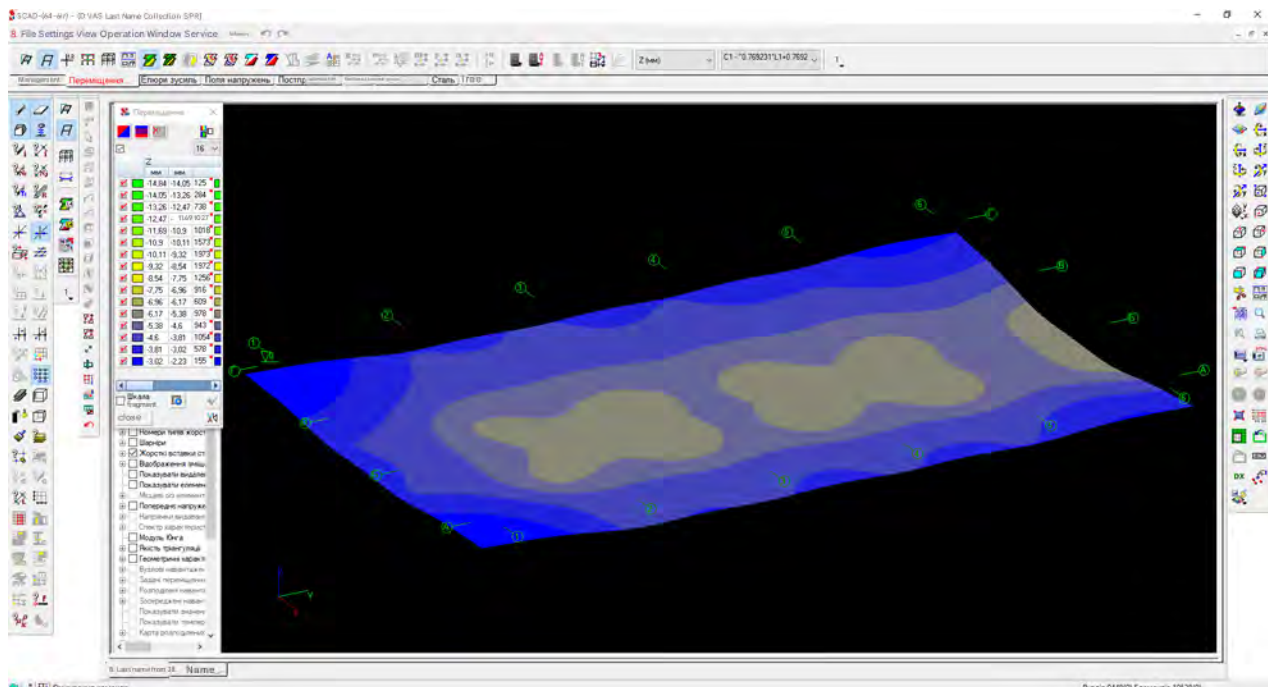


Figure 5.9 – Deformed state of the foundation slab, taking into account the neighboring building

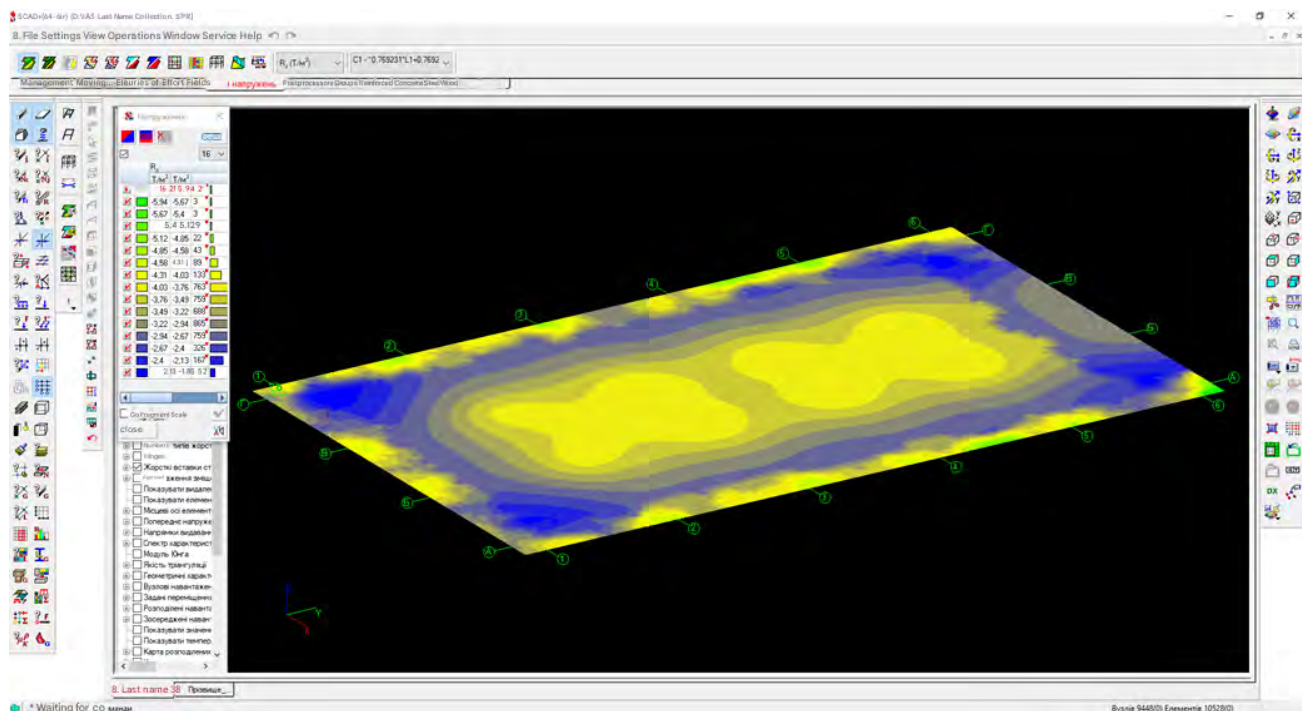


Figure 5.10 – Isopole stresses Rz of the foundation slab, taking into account the adjacent building

Compare the isopoles of the deformed state and stresses Rz of the foundation slab, taking into account the neighboring building and without it. Draw conclusions.

Perform the necessary selection and calculation iterations to meet the requirements of regulatory documents.

Modeling of the soil base with volumetric elements.

Return to the calculation diagram through the project management screen.

Remove the bedding coefficients previously assigned to the foundation plate plates using the bedding coefficient assignment function, assigning their value equal to 0 for all plates of the foundation slab model

Figure 5.11 – Removing previously assigned bedding coefficients

Remove the previously assigned fasteners of the two nodes of the foundation slab using the "Knitting Node Information" tool. Turn off all the elms on the corresponding nodes and save the changes.

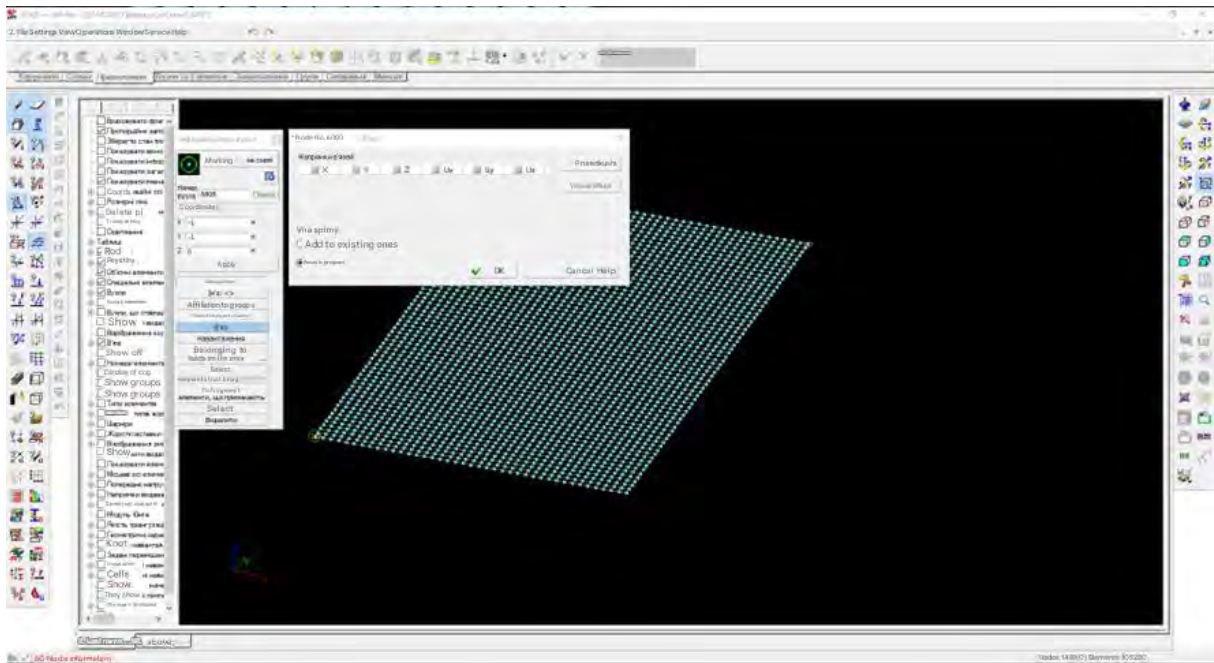


Figure 5.12 – Removing previously assigned bedding coefficients

Select the entire slab using the Mark Items tool on the Groups tab.

On the Diagram tab, select the Copy Diagram tool. Select "Copy visible part of the diagram" from the drop-down menu.

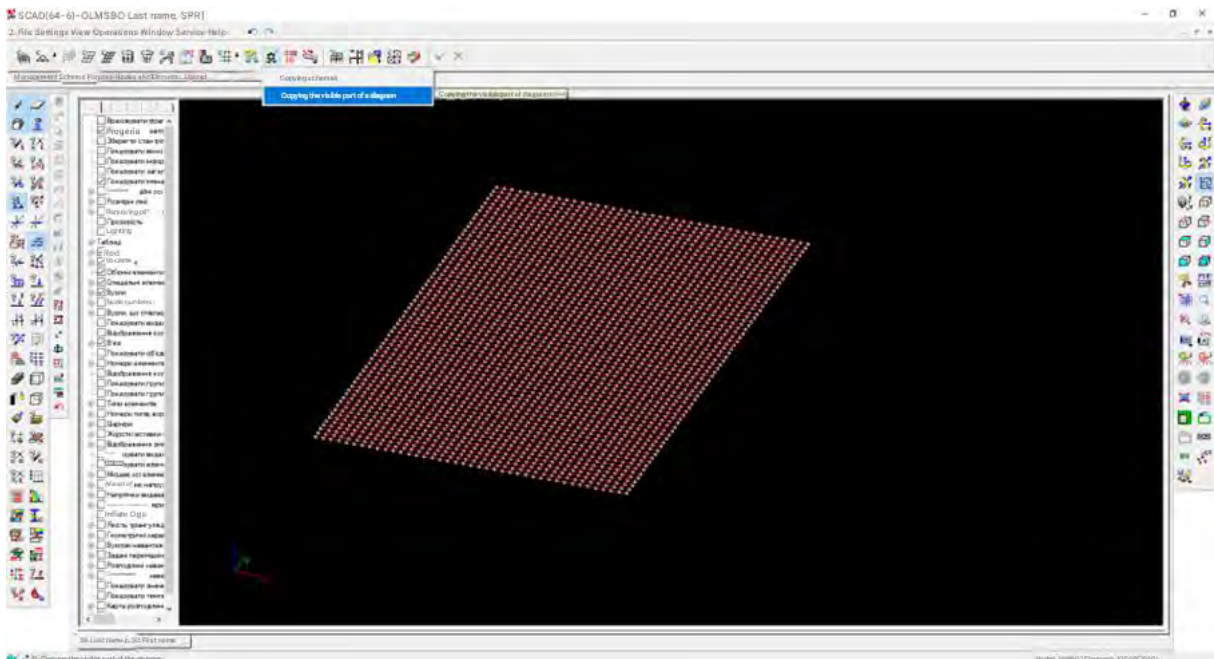


Figure 5.13 – Preparation for the creation of volumetric elements

Configure the copy settings as shown in Figure 5.14 and click OK.



Figure 5.14 – Plate copy options for creating volumetric elements

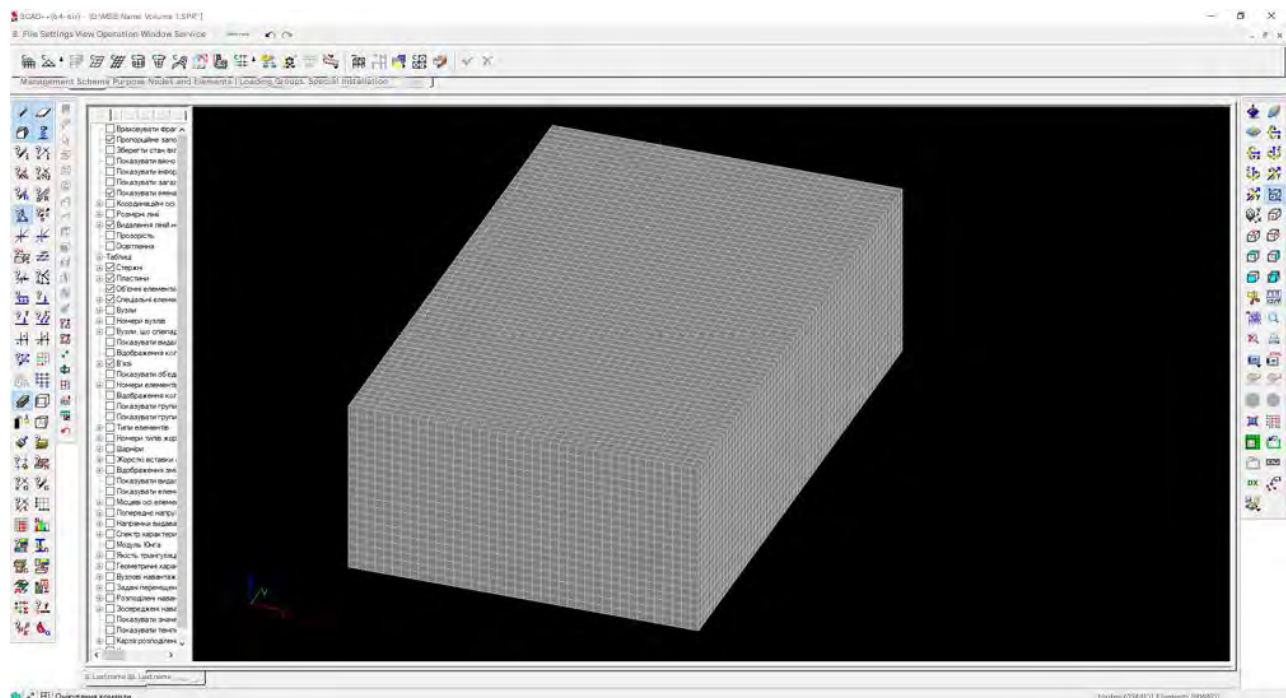


Figure 5.15 – Created soil mass with volumetric elements

Enable the initial display of the design diagram and the display of element profiles in the filter panel.

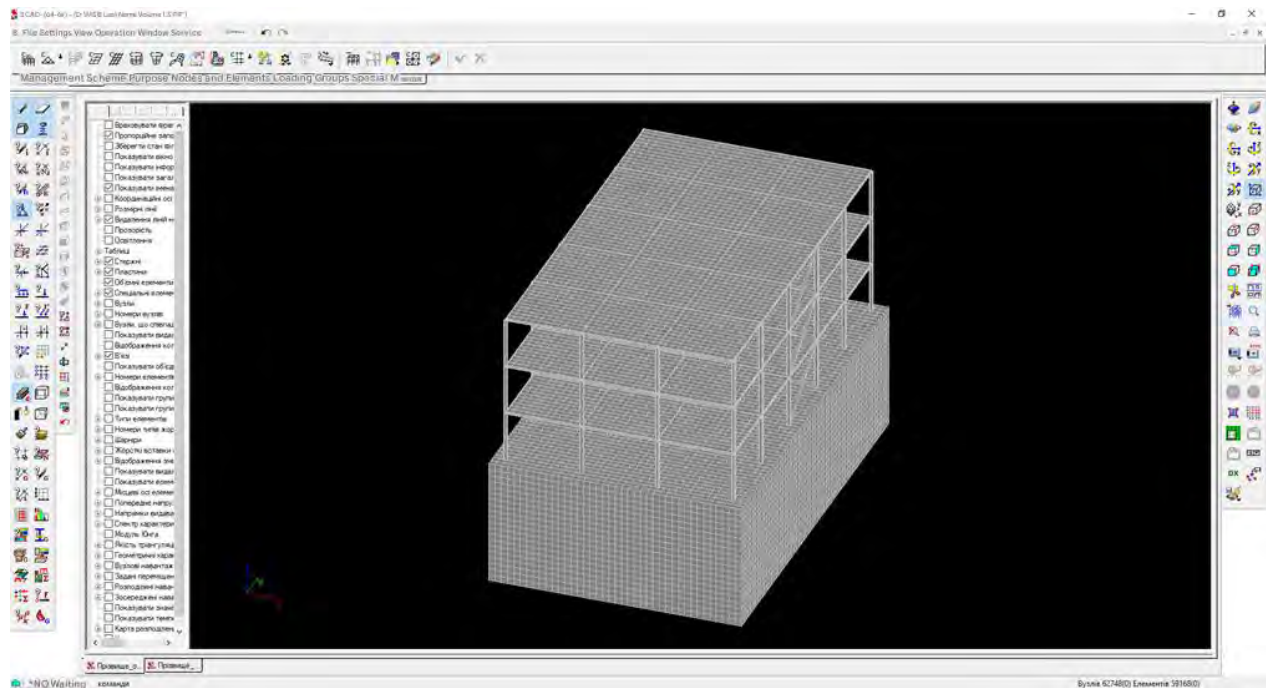


Figure 5.16 – Initial display of the design scheme

Fragment the top edge of the soil mass using the render panel and enable axis mapping.

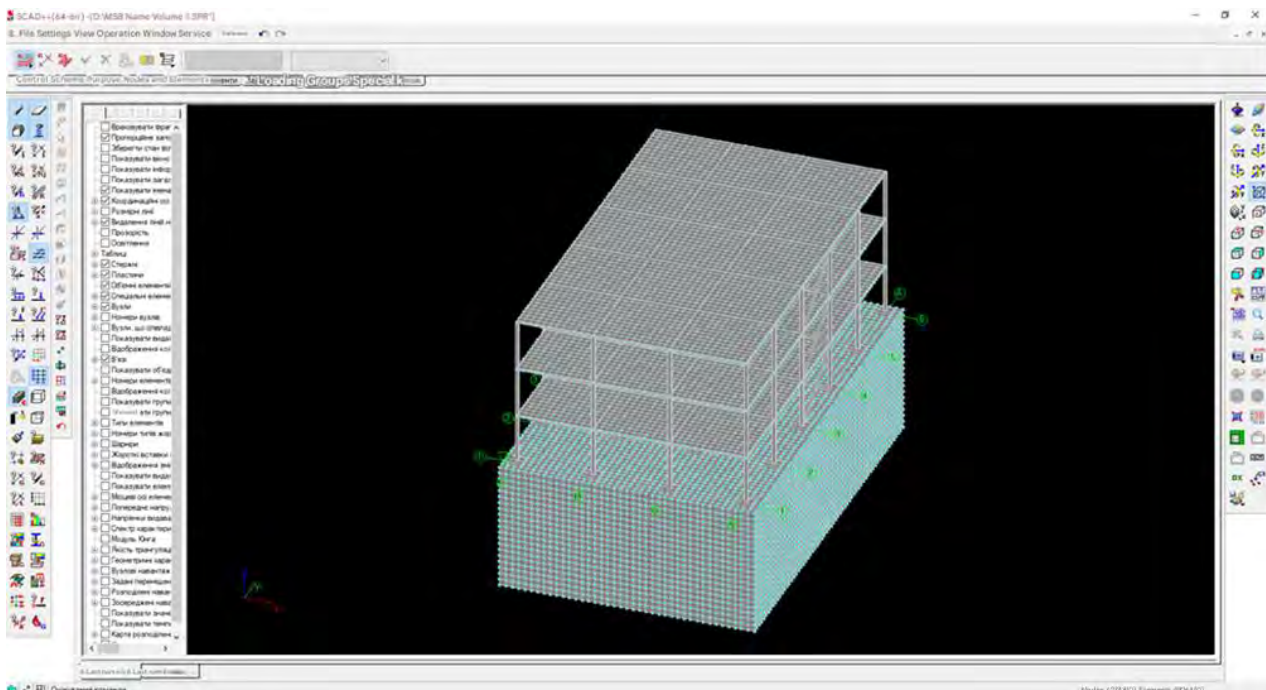


Figure 5.17 – Fragmentation of the upper edge of the soil mass

Using the Plate Element Input tool, create models of individual foundations for columns measuring 1 m × 1 m with the rigidity of a foundation slab.

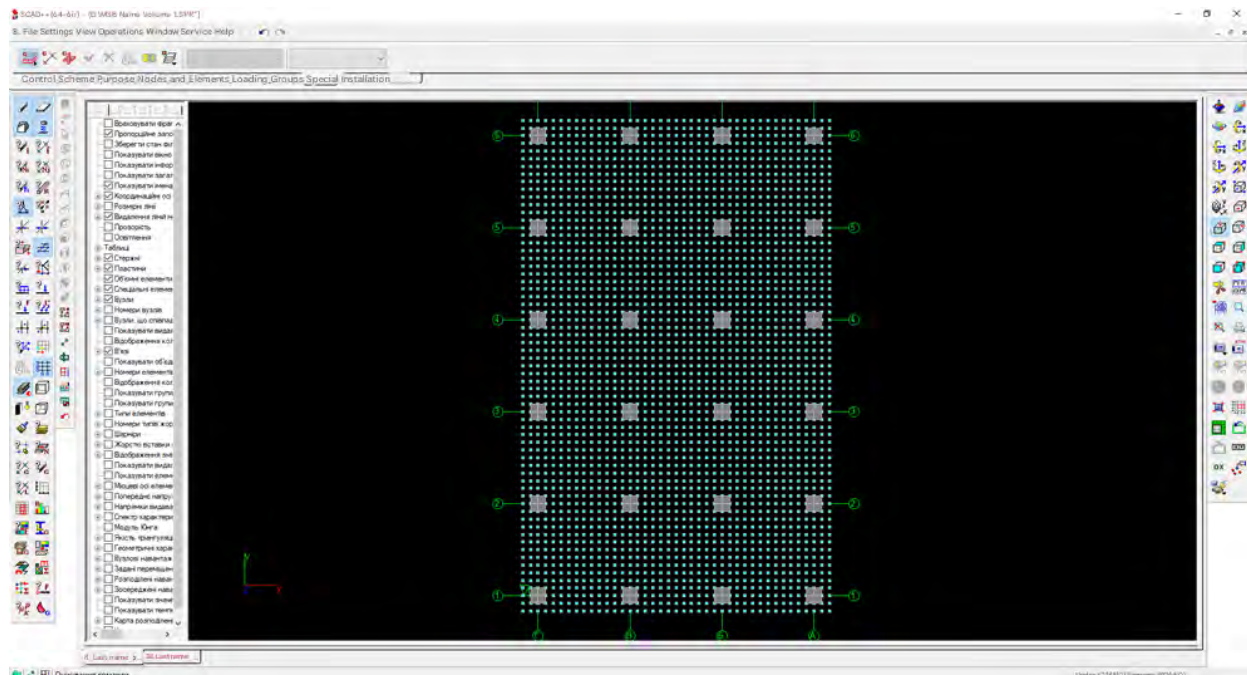


Figure 5.18 – Creating separate foundations for columns

Return to the display of the original scheme to control the correctness of creating foundations for columns.

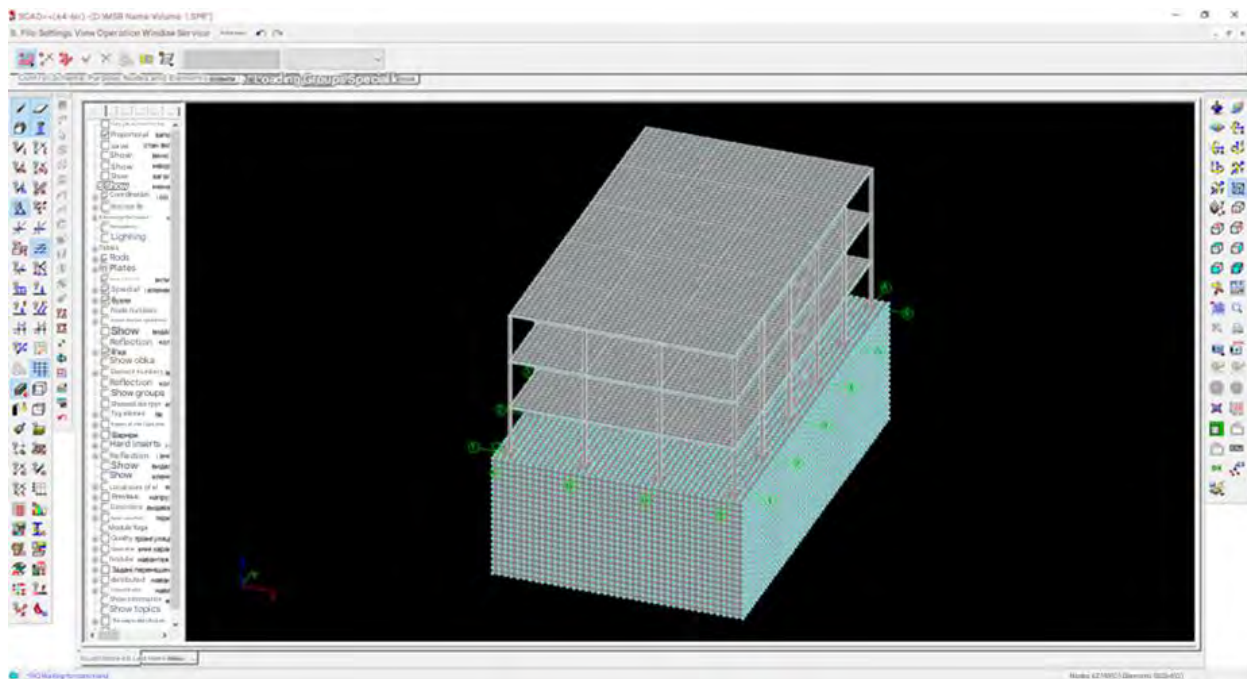


Figure 5.19 – Initial display of the scheme with foundations for columns

Apply the stiffness settings to the created volumetric elements. We take the volumetric weight, modulus of elasticity and Poisson's ratio from the CROSS program for IGE 1. The rest of the soil layers are conditionally ignored to simplify the calculation scheme.

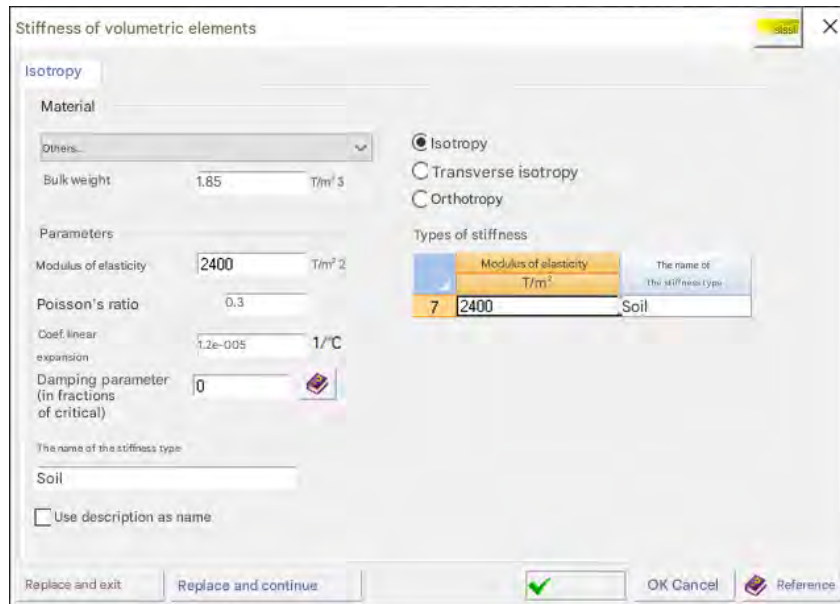


Figure 5.20 – Assignment of stiffness parameters for the soil model

Select all the volumetric elements and press the confirm button.

Next, we set the conditions for the adjoining of the soil massif.

We cut off the lower horizontal plane of the soil mass and assign fixing to all nodes of this plane along the Z axis.

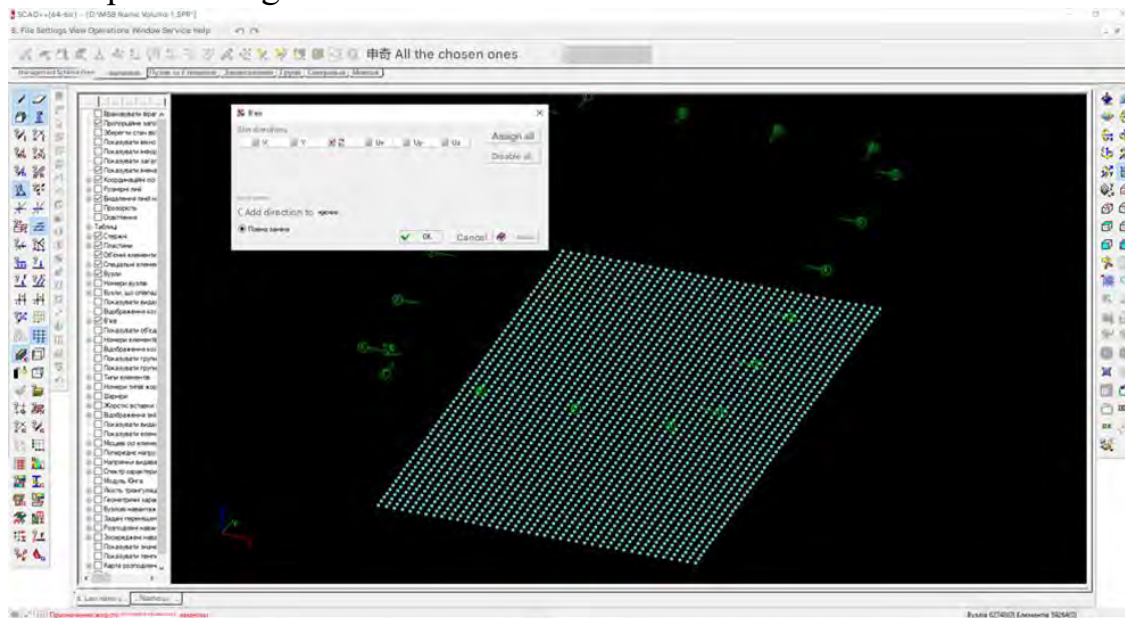


Figure 5.21 – Assignment of boundary conditions of the soil mass

We return to the original display of the diagram and assign fixings for the left and right faces along the X axis, and for the front and rear faces along the Y axis, fragmenting them alternately. When assigning boundary conditions to side faces, rearrange the checkbox to "Add direction to existing".

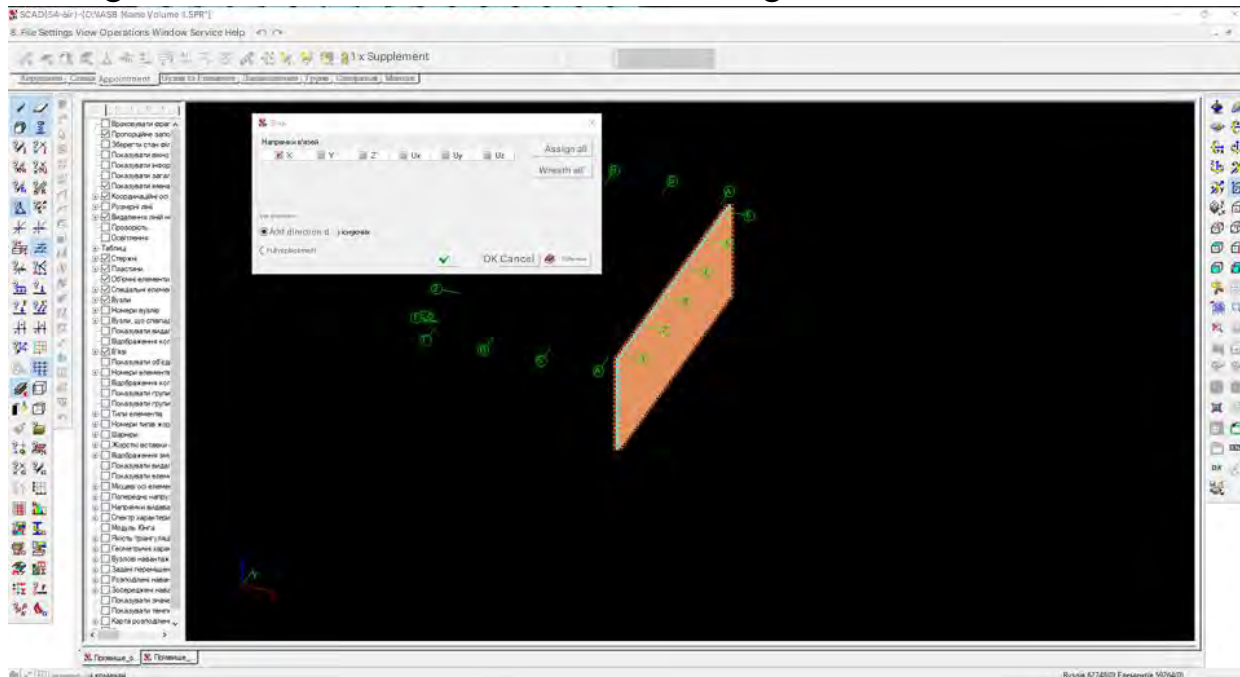


Figure 5.22 – Assignment of boundary conditions of the soil mass

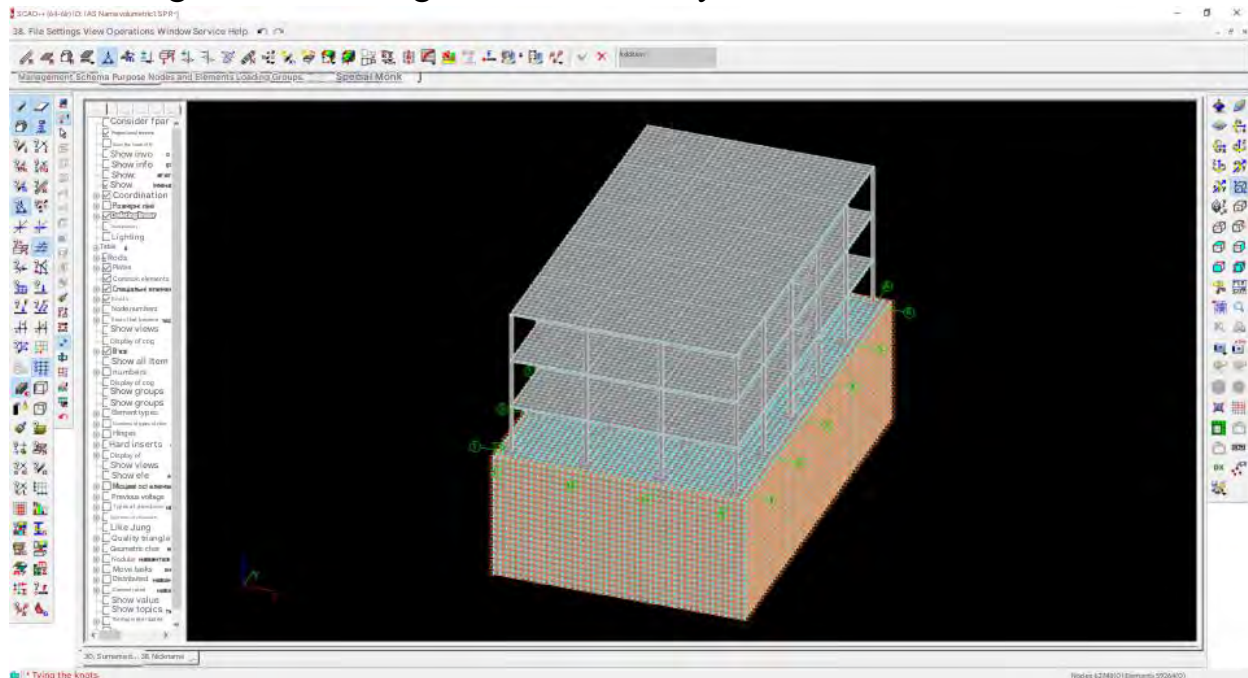


Figure 5.23 – Initial display of the circuit with assigned boundary conditions

We perform a linear calculation. But let's move on to graphical analysis.

We analyze possible changes in the selection of steel and reinforced concrete elements of the building frame.

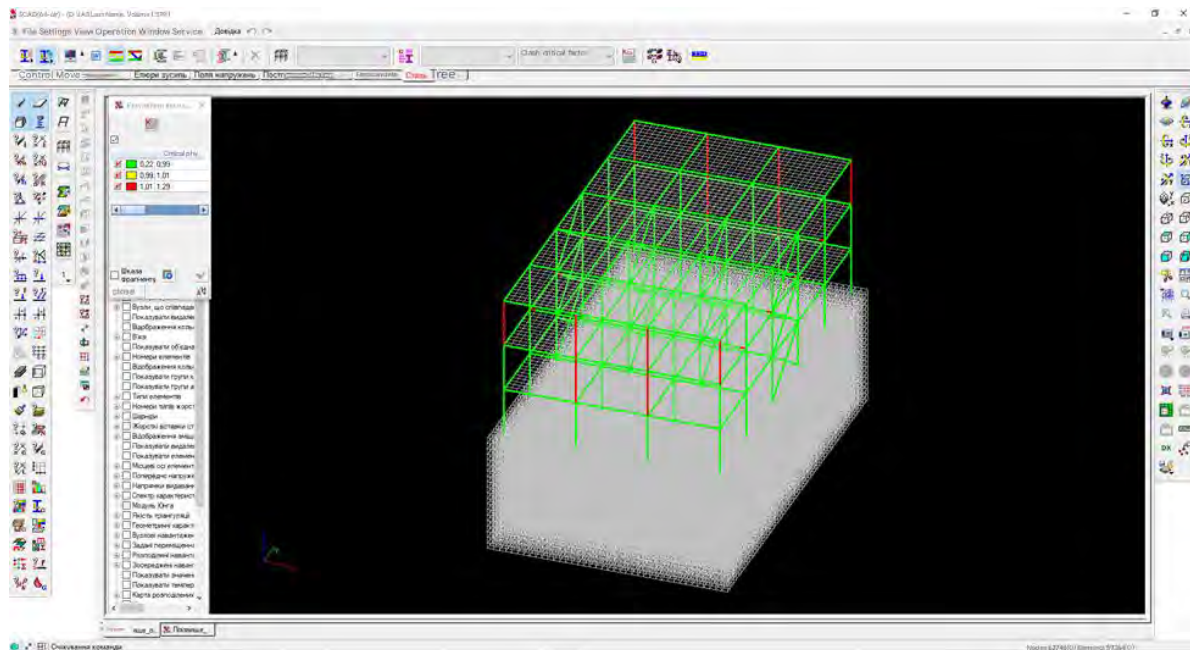


Figure 5.24 – Results of the calculation of the bearing capacity of the previously selected elements of the steel frame of the building, taking into account the joint operation of the "building-foundation" system

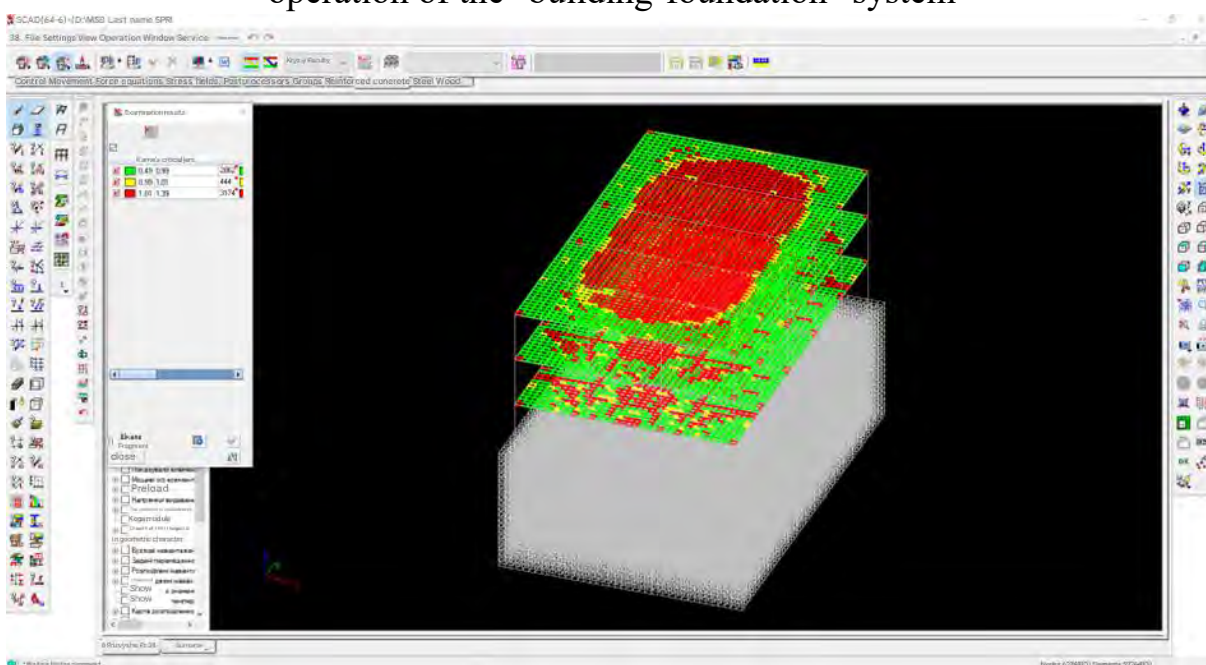


Figure 5.25 – Results of calculating the load-bearing capacity of reinforced concrete floors and building coverings, taking into account the joint operation of the "building-foundation" system

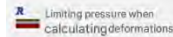
The screenshot displays the SCAD (64-bit) software interface. The main window shows a 3D model of a reinforced concrete slab, represented by a grid of yellow stars on a dark blue background. The software window includes a top menu bar, a toolbar, and a command line. A 'Properties' panel on the left shows various settings for the selected object, including a list of points with their coordinates. The status bar at the bottom indicates 'Waiting for co-solver'.

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Calculate the unevenness of deformation of adjacent foundations using the formula, $\frac{\Delta S}{L}$ compare it with the permissible according to DBN B2.1.10-2018. Help on deformation limit values can be found in the REQUEST program.

Make a conclusion about the compliance of the maximum absolute S and the relative difference of subsidence (unevenness) with the requirements of DBN B2.1.10-2018.

Draw a conclusion about the effect of uneven subsidence on the redistribution of forces in the building frame by analyzing Figures 5.24–5.27.

Using the REQUEST program, the page  and the formula for calculating the area of the foundation $A = \frac{N}{R}$; by iteration, calculate the correct area of the foundation for each column. Get the force N from the design scheme using the tool "Element Information – DCW". Set the soil conditions in accordance with the task (previously specified in CROSS and REQUEST when calculating the bed coefficients).

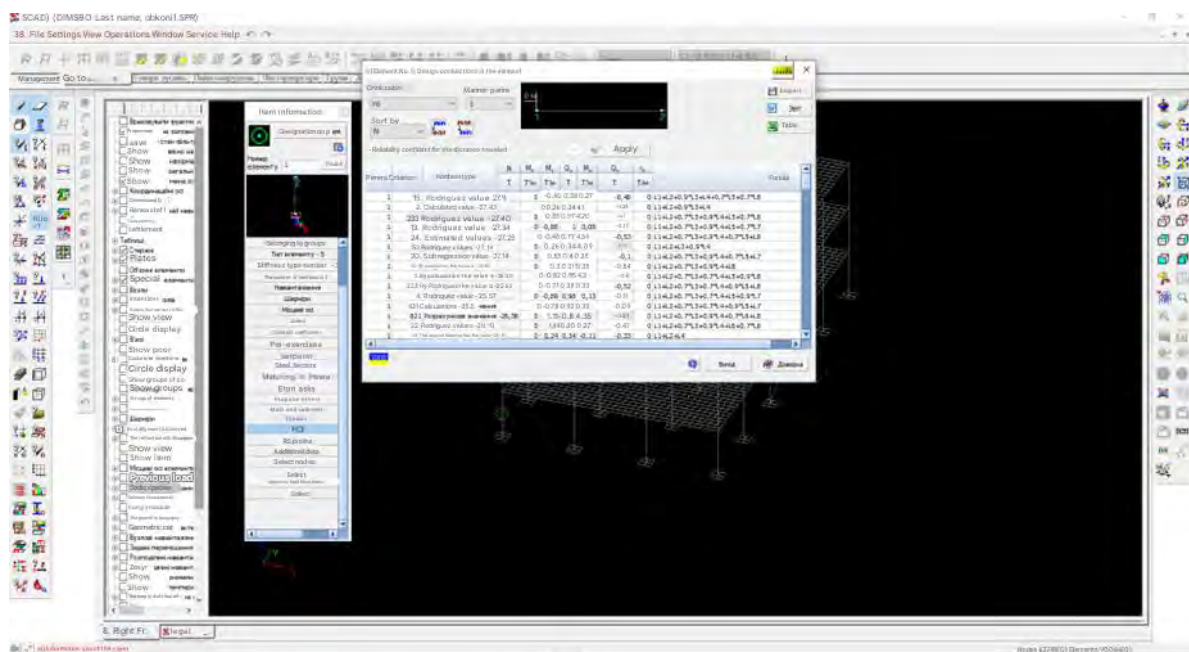


Figure 5.28 – Display of the column DCS to determine the loads on the foundation

Change the dimensions of the foundations in the calculation scheme according to the calculation results. Perform a linear calculation and analyze the results similarly to Figures 5.25–5.27. Achieve the transition of the sections of steel structures assigned according to the previous calculations and reinforcement of reinforced concrete floors and coatings without a new selection of elements by leveling uneven subsidence by correctly calculating and assigning the dimensions of individual foundations for columns.

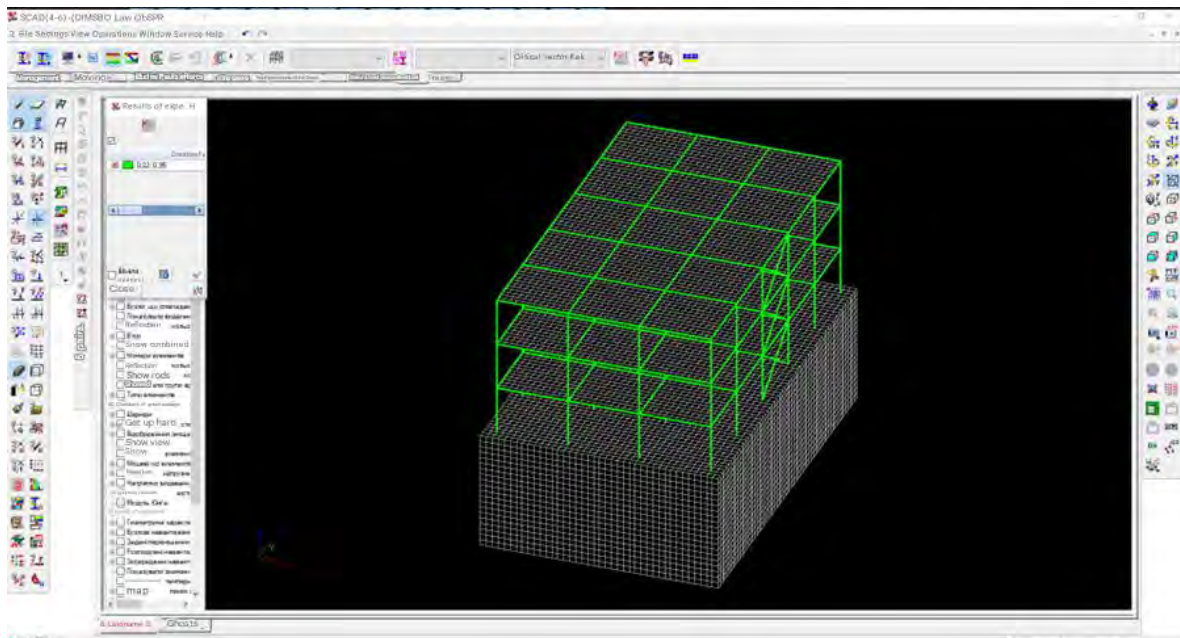


Figure 5.29 – Normalization of the frame operation due to the correct assignment of the dimensions of individual foundations for columns

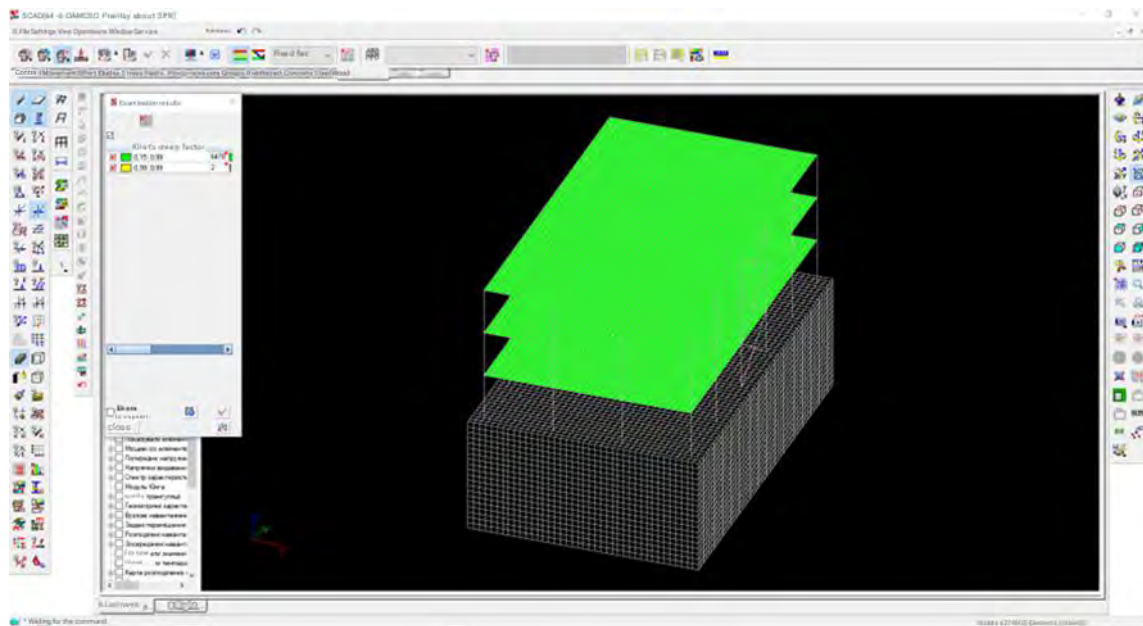


Figure 5.30 – Normalization of the frame operation due to the correct assignment of the dimensions of individual foundations for columns

Tasks for independent work on topic 5.

Perform the calculation of the stress-strain state and the selection of the necessary sections and reinforcement for the previously preserved version with a fully reinforced concrete frame. Compare the results of the calculation of the stress-strain state (in particular, the subsidence of foundations) with the results for a mixed frame. Explain the results obtained.