Example 27. Design of monolithic columns and beams (with SAPFIR-RC module)

In this lesson you will learn how to:
– import analysis results of reinforcement to SAPFIR-RC module; analysis was carried out in VISOR-SAPR module;
– unify columns;
– create plan and sectional view (with tags) for vertical elements;
– design unified column of rectangular section;
– generate the sheet of drawing for the unified column;
– unify beams;
– design unified beam of rectangular section;
– edit model of reinforcement for the beam;
– generate the sheet of drawing for the beam.

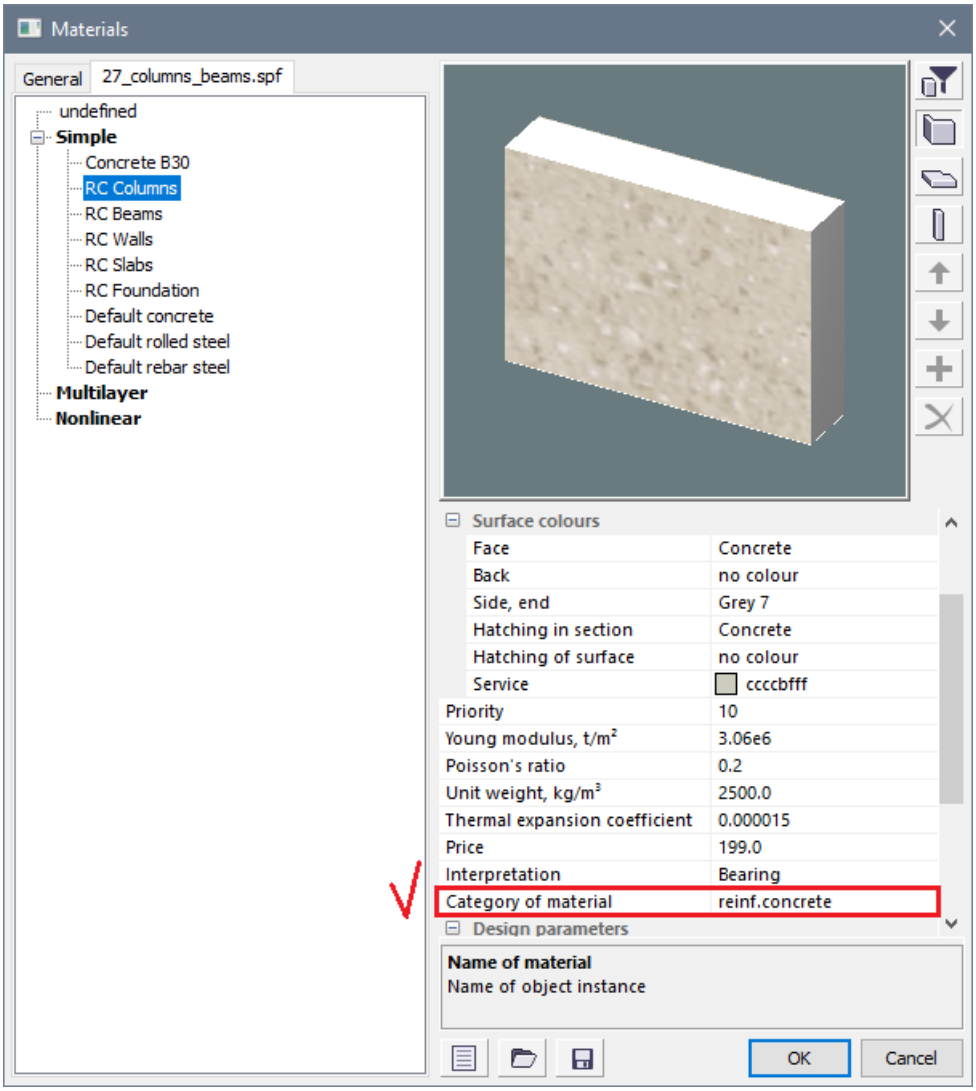
Description:
To work with this example, you should open file *27_columns_beams.spf* with defined geometry for the model. By default, all files of examples are provided during installation of the program.

On the taskbar, click the **Start** button, and then point to **All Programs**. Point to the folder that contains **LIRA-SAPR 2020** and then click **SAPFIR-3D 2020**.
Open the *27_columns_beams.spf* file from the above-mentioned path.

*The meshed model has been already generated for this example. To evaluate analysis results in VISOR-SAPR module, double-click the **Meshed model variant 1** row in the **Structure** window. The new tab named **27_columns_beams.spf: Meshed model variant 1** will be displayed on the screen. On the **Analytics** ribbon tab, on the **Analysis in LIRA-SAPR** panel, point to appropriate drop-down list and click the **Open in VISOR-SAPR** button . The VISOR-SAPR module will be activated and this meshed model will be displayed on the screen. To carry out FEA of the model, in VISOR-SAPR window, on the **Analysis** ribbon tab, on the **Analysis** panel, point to **Analyse** drop-down list and click **Complete analysis** button . To evaluate analysis results, use the commands on the **Results** tab (static analysis) and **Design** tab (analysis of reinforcement).*

Step 1. Required min data to analyse reinforcement and design columns and beams

To design columns, the model should satisfy the following requirements:
1. SAPFIR model should contain columns and beams;
2. For columns and beams, **Interpretation** should be defined as **Bearing** structure;
3. **Material** for columns and beams should be defined as **Reinforced concrete** (it is defined in the **Materials** dialog box - see Fig.27.1);
4. Design parameters of materials should be assigned to columns and beams, analysis of reinforcement should be carried out in VISOR-SAPR module.



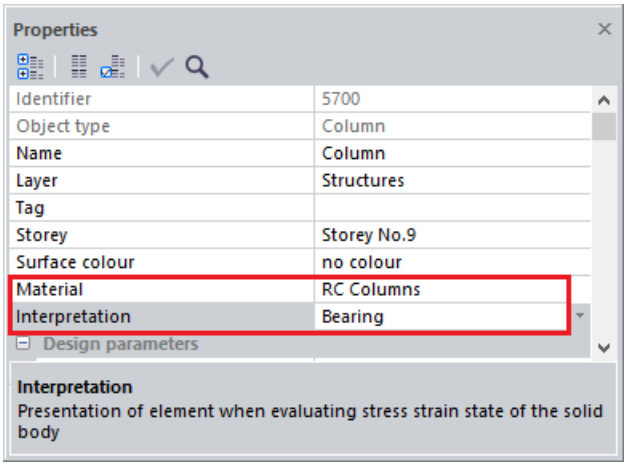


Figure 27.1. Required min data to analyse reinforcement and design columns and beams

Step 2. Import results for reinforcement

- When the **3D view** tab is active, on the **Reinforcement** ribbon tab, on the **Results** panel, click the **Show results for reinforcement** button .

*If no results were previously connected with this file, then the **Select file** dialog box will appear on the screen (see Fig. 27.2). In this dialog box, specify appropriate file with analysis results and click **Open**. When the program is installed, file with analysis results for this example is stored at C:\Users\Public\Documents\SAPFIR\Sapfir 2020\Samples\en. File with analysis results (*.asp) generated in VISOR-SAPR module should be saved to the folder where initial file of the model (*.spf) with the same name is stored. Then in SAPFIR module, results will be displayed automatically when you click the **Show** button (on the **Create** ribbon tab, on the **Project** panel, click **Project properties**; in the dialog box the **Auto download results** option is defined as **yes**). To generate the file with results of reinforcement, carry out analysis of reinforcement in VISOR-SAPR module and then on the Application menu, click **Export reinforcement results to SAPFIR** button .*

- In the **Service** information window, on the **Process** tab, you will see information about the import procedure: building code by which analysis was carried out, type of analysis (DCF, DCL, Forces), number of FE that are geometrically related with the reinforced diaphragms, number of columns and beams that should be reinforced.

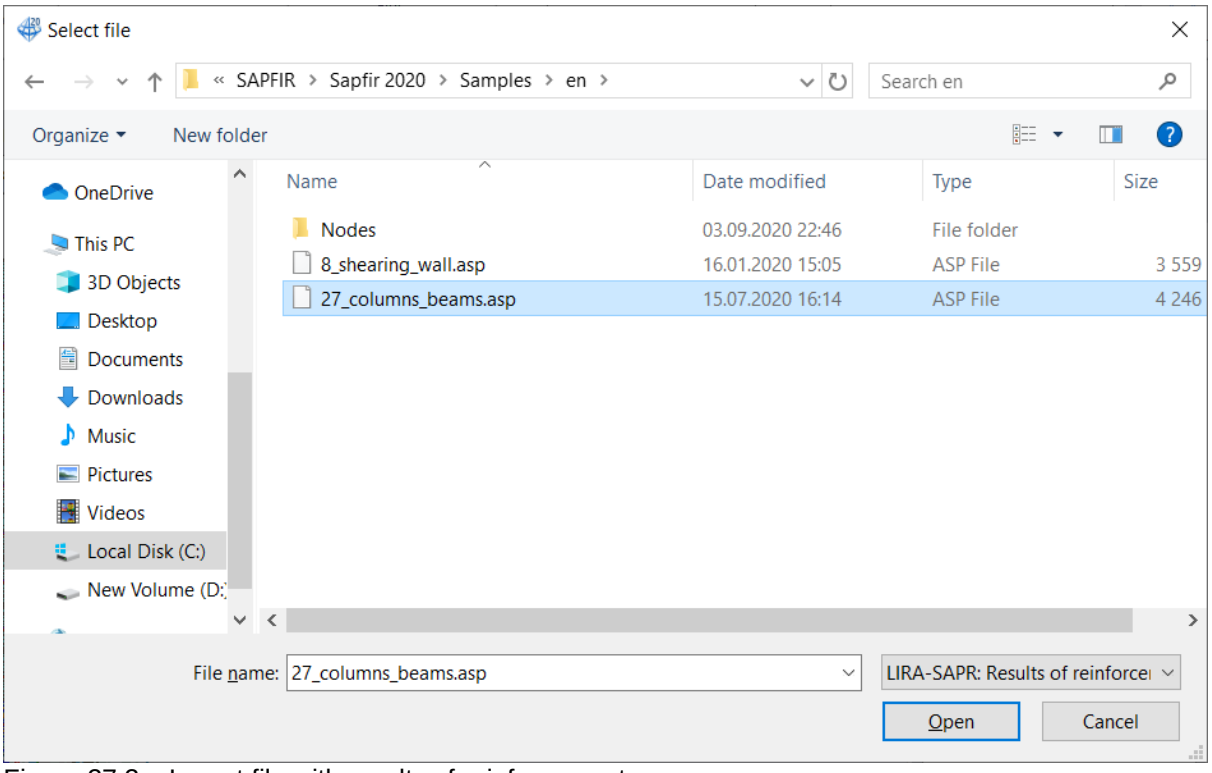


Figure 27.2. Import file with results of reinforcement

Step 3. Unify columns

To create reinforcement patterns (types of reinforcement) for columns:

- On the **Reinforcement** tab, on the **Main reinforcement** panel, click the **Unify columns** button .

With Filter option, columns may be organized by section dimensions, storeys and by height. In the ***Unify columns*** *dialog box that is displayed on the screen, columns are displayed by sections. Sections are organized in the descending order of their area. In the name of the section, the greatest dimension will be always the first one, for example, columns 60x40 and 40x60 will be displayed in the same list. Columns 40x60 will be denoted with an asterisk (*) to which there will be a note at the bottom of the dialog box. Columns are arranged in the descending order of their percentage of reinforcement. For the symmetric reinforcement, the following data will be displayed for every column: percentage of reinforcement required by analysis, design area of reinforcement, values for corner reinforcement (AU1), reinforcement distributed along the edge (AS1, AS3) and transverse reinforcement in two directions (ASW1, ASW2). In the right part of the dialog box you will see the diagram: design area of reinforcement is measured along the X-axis and number of columns - along the Y-axis.*

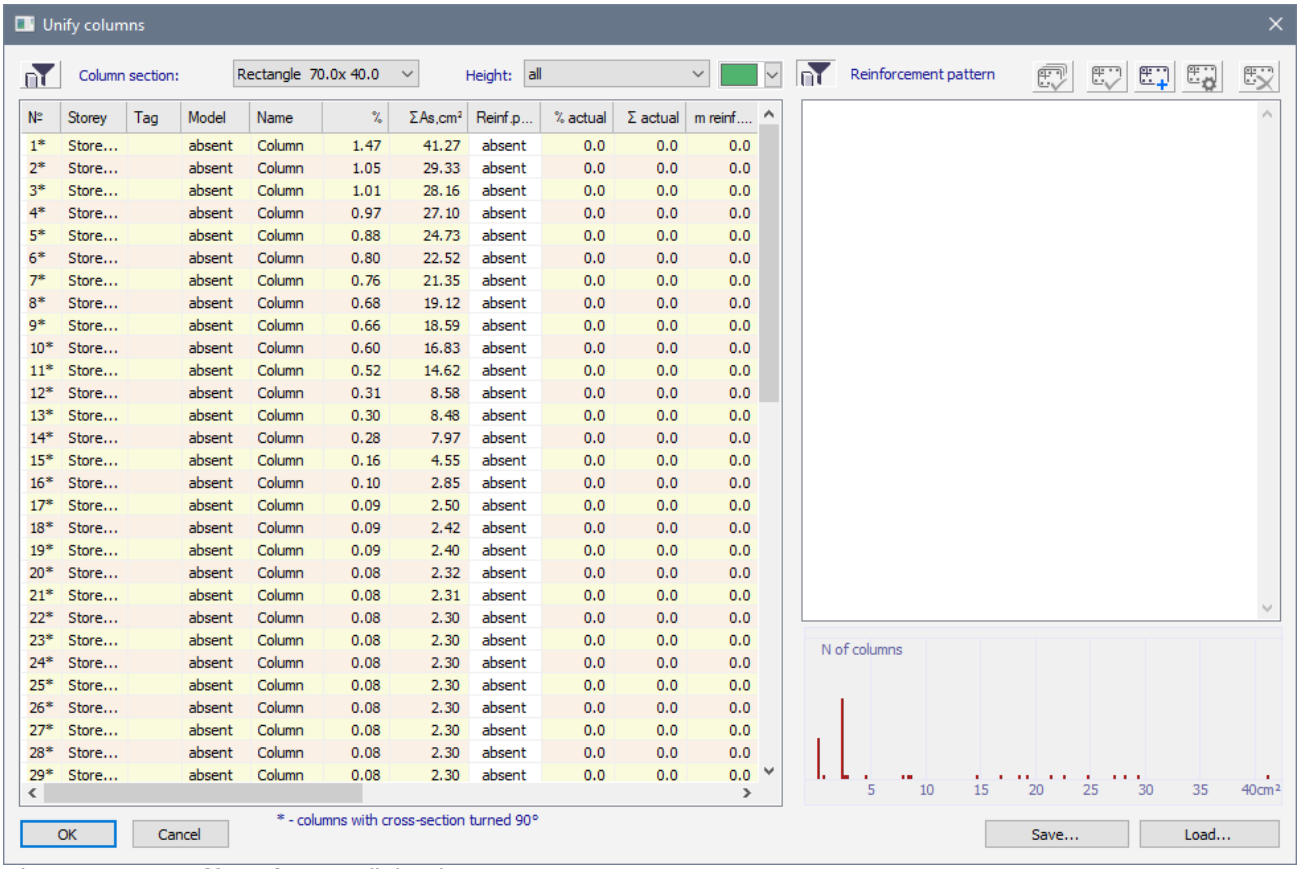


Figure 27.3. **Unify columns** dialog box

- In the **Unify columns** dialog box (see Fig.27.3), to hide the table columns with the same values, right-click the column list in the dialog box and select the **Symmetric reinforcement** command on the shortcut menu.
- For columns with the section 70x40, select the column with percentage of reinforcement equal to 1.47 (the first row in the list).
- Click the **Create new reinforcement pattern** button in the right part of the dialog box.
- To modify the certain reinforcement pattern, select it in the list to the right and click the **Edit reinforcement pattern** button or double-click the reinforcement pattern in the list.
- In the **Reinforcement pattern AT-001** dialog box (see Fig. 27.4), in the drop-down list **Along Y**, select Ø16.
- Click **OK**.

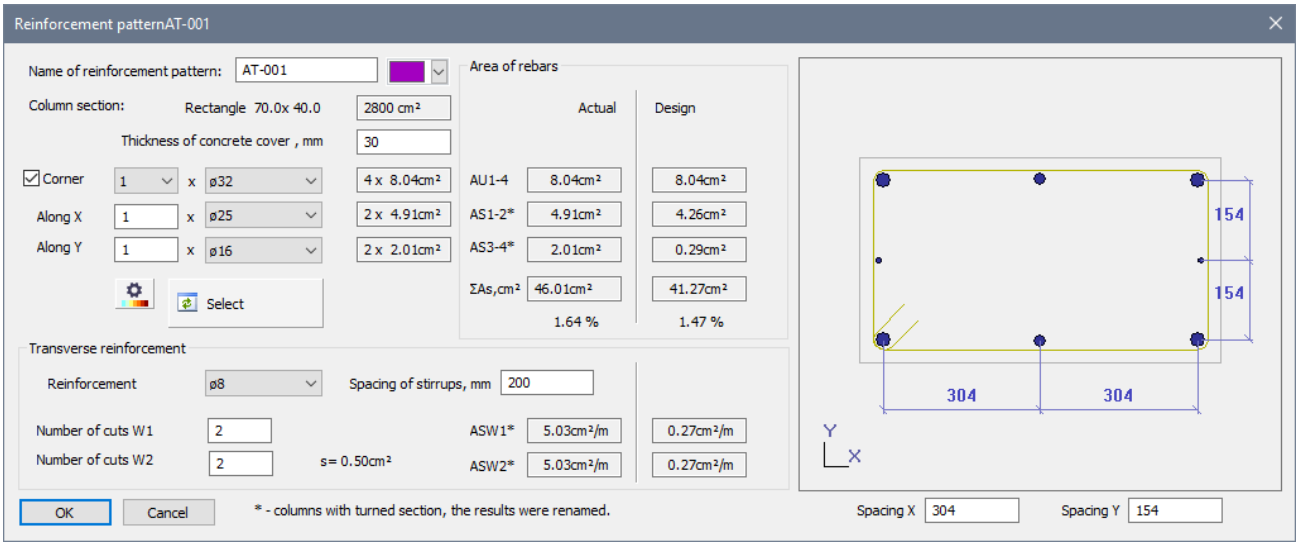


Figure 27.4. **Reinforcement pattern** dialog box

*In the **Reinforcement pattern AT-001** dialog box, it is possible to compare areas of rebars by analysis results (design values) and selected by the program (actual values), check and edit, if required, number of rebars along X, along Y and corner rebars. If the **Select corner rebars** check box is not defined in general parameters (see Fig. 27.5) used in design procedure, then in the **Reinforcement pattern for column** dialog box this check box is also not selected and results will contain only areas distributed along the edges.*

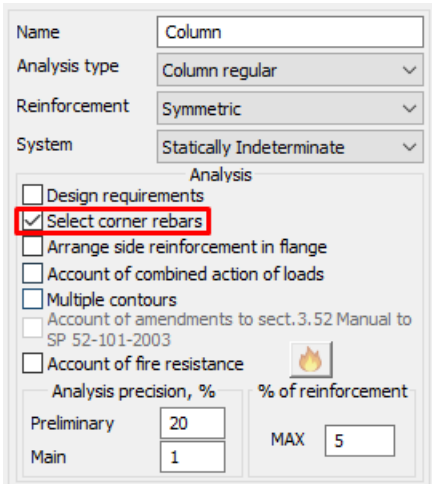


Figure 27.5 **Material properties for analysis of RC structures** dialog box (fragment with general parameters)

⇨ Select columns with percentage of reinforcement equal to 1.05 - 0.8 (the next five columns in the list). To do this, hold down the **Shift** key. Then click the **Create new reinforcement pattern** button .

Selected reinforcement pattern provides the strength for all selected columns and also provides required area of corner reinforcement, area of reinforcement along the edge, area of transverse reinforcement and total area of reinforcement in the section.
*If the reinforcement for selected columns is adequate in the selected reinforcement pattern, then the column number in the list will be coloured green and there will be **Adequate reinforcement** note in the **Summary** (the last table column in the **Unify columns** dialog box).*
If the reinforcement is not adequate in the selected reinforcement pattern, then the column number in the list will be coloured red.

*If selected percentage of reinforcement is more than double the required by analysis, then the column number will be coloured dark-blue and the **More reinforcement than adequate** note will be displayed.*

- Select columns with percentage of reinforcement equal to 0.76 - 0.52 (the next five columns in the list).

  To do this, hold down the **Shift** key. Then click the **Create new reinforcement pattern** button .
- Hold down the **Shift** key to select the rest of the columns with percentage of reinforcement from 0.32 (from the 11th up to 63rd) and create new reinforcement pattern for them.
- In the **Reinforcement** dialog box, click any colour in the list. In the **Colours** dialog box (see Fig. 27.6), click the **Select** button.
- Select the red colour for the section 70x40 and click **OK**.

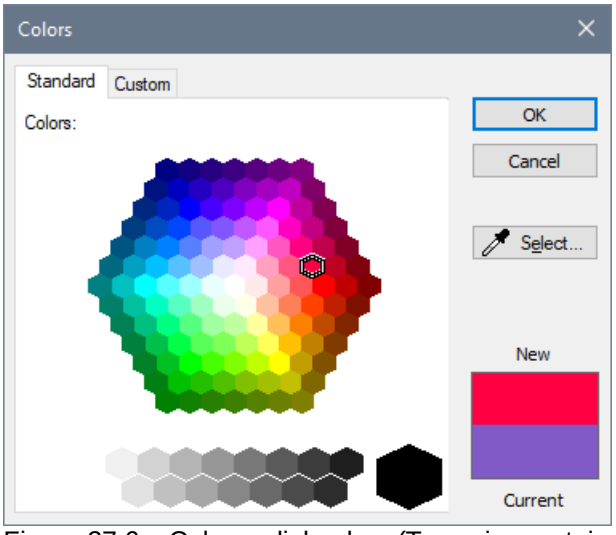


Figure 27.6. Colours dialog box (To assign certain colour for the section)

All reinforcement patterns will be coloured in different way depending on intensity of total area of the main reinforcement in the section. Columns with the greater percentage of reinforcement will be presented in bright colours while columns with less percentage of reinforcement – in pale colours.

- In the **Unify columns** dialog box, in the **Column section** drop-down list, select **Rectangle 60.0x40.0**. Create several reinforcement patterns for this section as described above.
- In the **Colours** dialog box, select the blue colour for the section **Rectangle 60.0x40.0**.
- To renumber columns, right-click in the list of columns and select the **Renumber patterns of reinforcement** command on the shortcut menu.

To assign tags for columns:

- To assign tags to columns, right-click in the list of columns and select the **Assign tags** command on the shortcut menu.
- In the **Tags for elements of structure** dialog box (see Fig. 27.7), define the following data:
  - tag nature: cross-section type – reinforcement pattern – column height;
  - select the **Retag all columns** check box.
- Click **OK**.

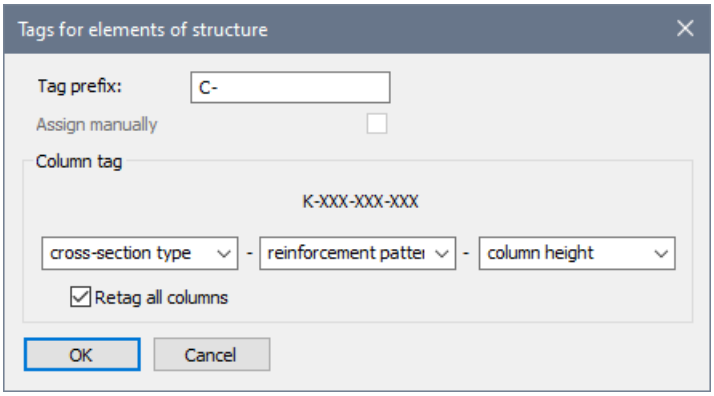


Figure 27.7. **Tags for elements of structure** dialog box

- In the SAPFIR 10.0 message box (see Fig. 27.8), to assign new tags to all columns of all cross-sections, click **Yes**. The tags will be displayed in the **Tag** table column.

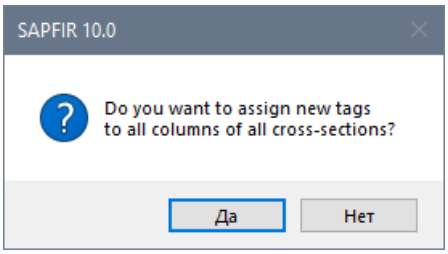


Figure 27.8. SAPFIR 10.0 message box

Based on the specified tag nature, all columns with the same section, the same height and that have common reinforcement pattern will obtain the same tag. Every column will obtain its own model of reinforcement. The same reinforcement pattern may correspond to several tags. For example, if columns have the same location of rebars but different height. Every tag has only one model of reinforcement.

- Click **OK**.
- To display columns in colour according to selected reinforcement pattern, on the **Reinforcement** ribbon tab, on the **Main reinforcement** panel, click the **Colour by reinforcement pattern** button .
- To hide mosaic plot of reinforcement, on the **Reinforcement** ribbon tab, on the **Results** panel, click the **Show results for reinforcement** button to make this command inactive.

Step 4. Create the plan (with tags) of vertical elements

To define dimensions and leader lines for column tags:

- In the **Structure** window, right-click the **Storey No.1** row Storey No.1 .
- Select the **Floor plan** command on the shortcut menu. The new tab **27_columns_beams.spf:Plan. 1st storey** is displayed in the window.
- Select the grid.
- To automatically display dimensions between grid lines, on the **Grid** Options Bar, click the **Specify dimensions** button .
- To unselect the grid lines, press **Esc**.

*To display storey elevations, in the **Structure** window, click the first button below the window title bar and select the **Storey elevations** command in the drop-down list.*

- In the **Structure** window, unfold the **Storey No.1 0.000** group, right-click the **Column** group.
- On the shortcut menu, click **Select** (see Fig. 27.9).

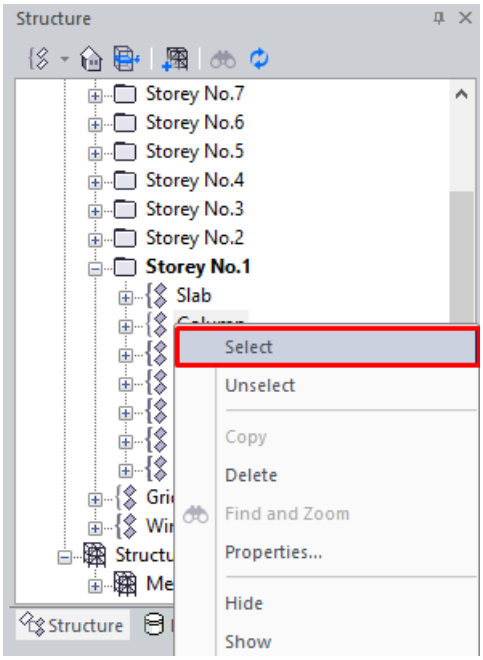


Figure 27.9. Select columns using the tree-structure of the project

- To display dimensions of columns and the snap to grid lines, on the **Annotation** ribbon tab, on the **Dimensions** panel, click the **Place dimensions automatically** button .
- To display tags for elements on the plan, on the **Annotation** ribbon tab, on the **Tags** panel, click the **Leaders with tags** button .
- To unselect columns, press the **Esc**.
- To edit location of dimensions and leaders, on the **Annotation** ribbon tab, on the **Modify** panel, use the **Move vertex** command .

<u>To display information about reinforcement in columns:</u>

- To customize information about reinforcement in columns, on the **Reinforcement** ribbon tab, on the **Main reinforcement** panel, point to appropriate drop-down list and click the **Reinforcement in columns: customize info** button .

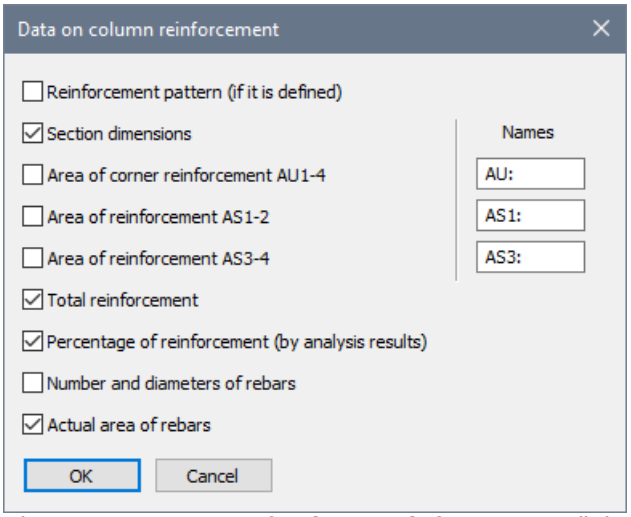


Figure 27.10. **Data of column reinforcement** dialog box

- In the **Data of column reinforcement** dialog box (see Fig. 27.10), define the following:
  - select the **Section dimensions**, **Total area of reinforcement**, **Percentage of reinforcement (by analysis results)**, **Actual area of rebars** check boxes.
- Click **OK**.
- On the **Reinforcement** ribbon tab, on the **Main reinforcement** panel, point to the same drop-down list and click the **Reinforcement in columns: info** button  . On the screen you will see the plan of the first storey with column tags, column dimensions, snap from columns to grid lines and information about column reinforcement (see Fig.27.11).

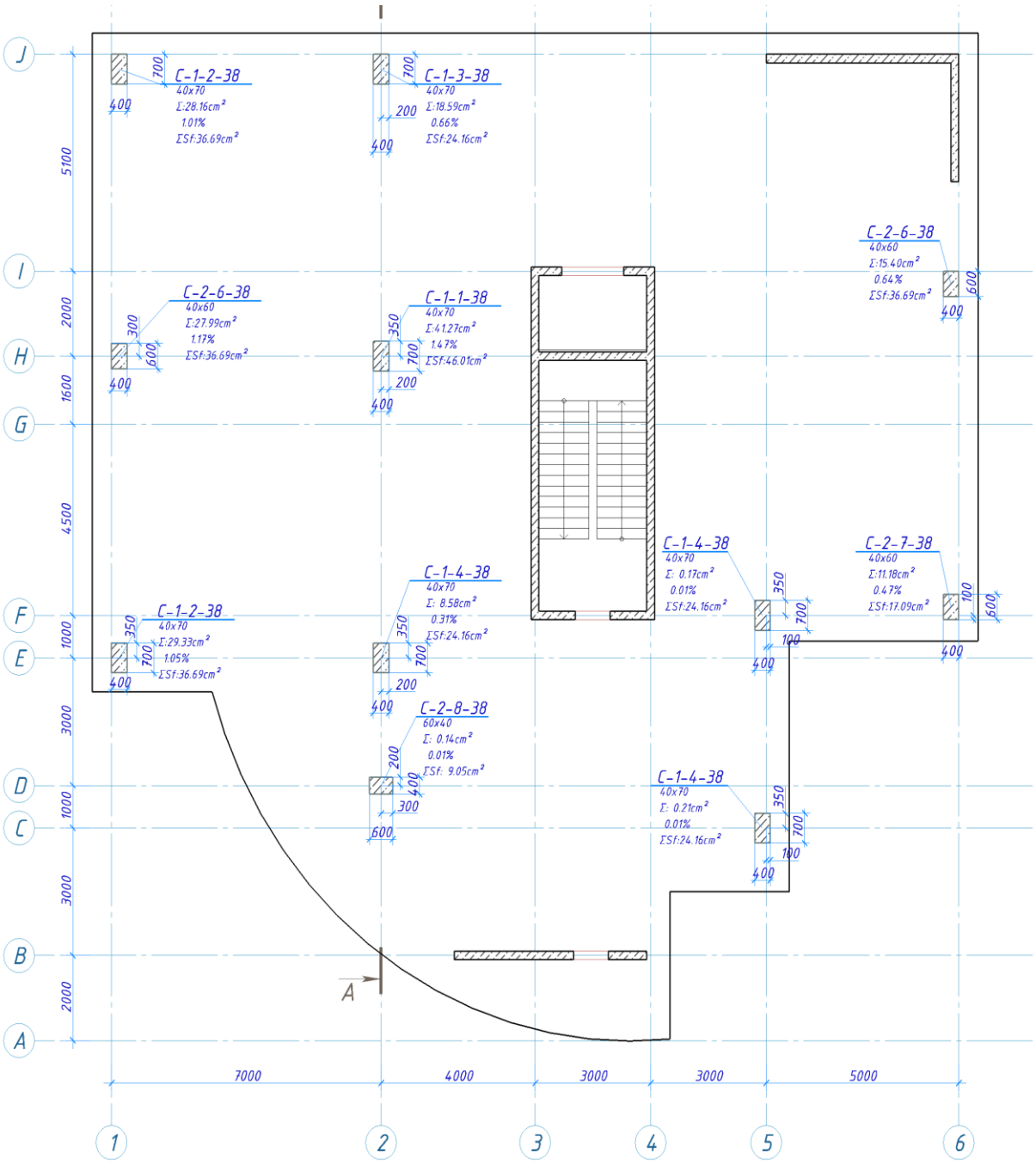


Figure 27.11. Plan of the first storey with column tags, column dimensions and snap from columns to grid lines

Step 5. Create the section view (with tags) of vertical elements

To create the section view:

- On the **View** ribbon tab, on the **Views** panel, click the **Create section** button .
- On the **Create section** Options Bar, click the **Section** button .
- Define the section A-A along the grid line 2. Direction from left to right.
- In the **Views** window (see Fig. 27.12), double-click the **Storey No.1: Section A-A** row in the **Sections** folder.

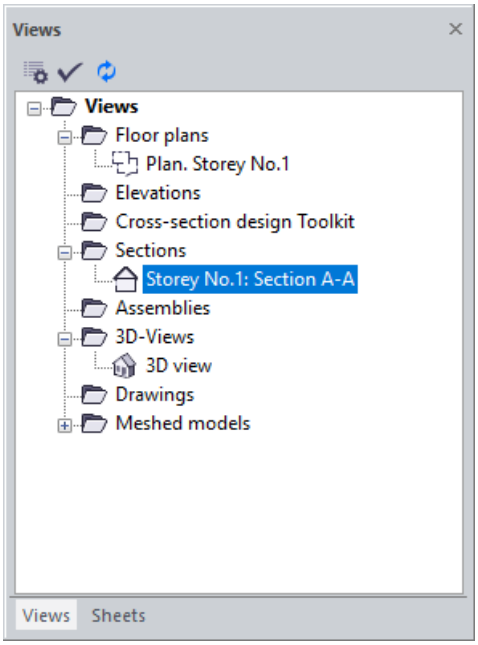


Figure 27.12. How to open the section A-A

To display element tags on the section view:

- On the **Visualization** toolbar, select the **Filter to select objects** button .

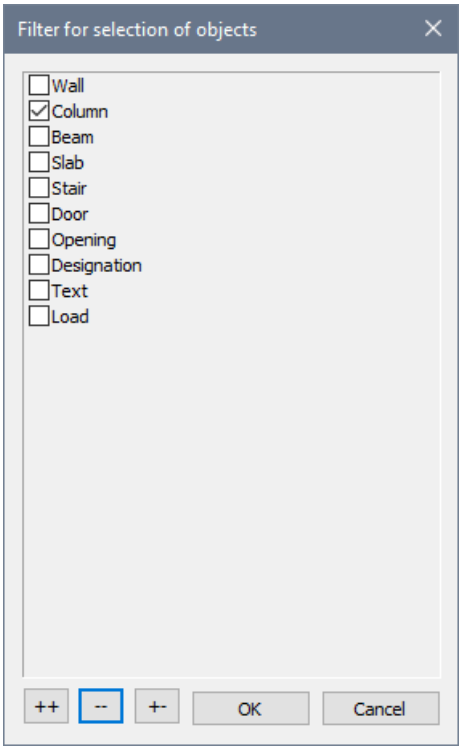


Figure 27.13. **Filter for selection of objects** dialog box

- In the **Filter for selection of objects** dialog box (see Fig. 27.13), do the following:
  - click the **Clear all** button ;

- select the **Column** check box.
- click **OK**.

➪ With the selection window, select all columns of the structure.

➪ On the **Annotation** ribbon tab, on the **Tags** panel, click the **Leaders with tags** button .

➪ To unselect the columns, press **Esc**.

*As the **Reinforcement in columns: info** command (button) is active, then information about reinforcement will be displayed under every column tag. To hide this kind of additional information, click the **Reinforcement in columns: info** button once again to make this command not active. To manage the boundaries of the section view, use the **Cut visible presentation** option (in the **Properties** window) and the **Move vertex** command .*

➪ On the **Annotations** ribbon tab, on the **Dimensions** panel, click the **Place elevations automatically** button .

➪ To edit location of tags and elevations, on the **Annotation** ribbon tab, on the **Modify** panel, use the **Move** command and the **Move vertex** command .

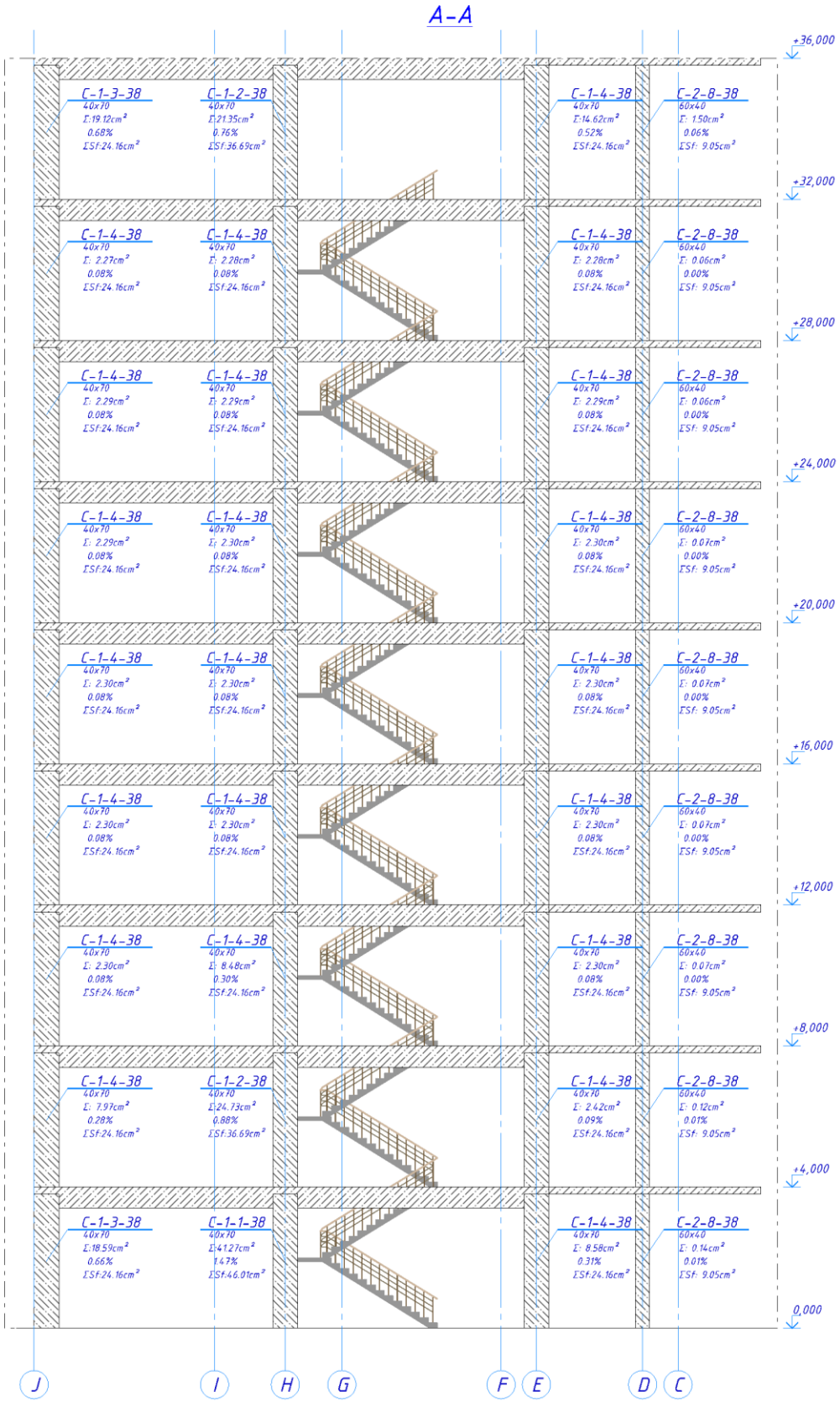


Figure 27.14. Section view with column tags and information about column reinforcement

- Open the **Filter for selection of objects** dialog box and click the **Select all** button ++ so it will be possible to select all objects.
- Click **OK**.

Step 6. Generate sheet of drawing that contains plan and section view with tags

To generate the sheet of drawing:

- In the **Views** window, double-click the **Plan. Storey No.1** row.
- To generate new sheet of drawing, on the **View** ribbon tab, on the **Sheet** panel, click the **Drawing** button .
- In the **Generate new sheet of drawing** dialog box (see Fig. 27.15), define the following data:
  - name of drawing – Plan with tags: Storey No.1;
  - sheet size – A1;
  - select the **Place view on a sheet** check box **Plan: Storey No.1**.
- Click **OK**.

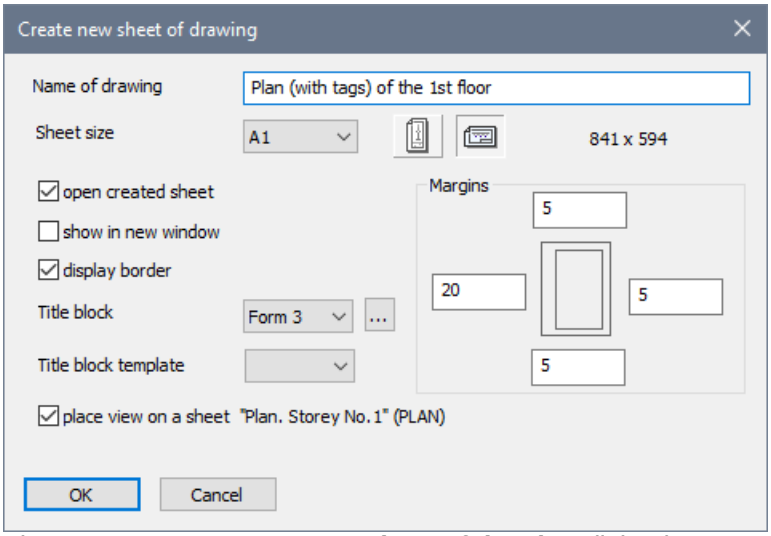


Figure 27.15. **Generate new sheet of drawing** dialog box

- Select the plan image on the sheet and edit its location. To do this, on the **Annotation** ribbon tab, on the **Modify** panel, use the **Move** command .
- To unselect the plan image, press **Esc**.
- In the **Views** window, in the **Section** group, select the **Storey No.1: Section A-A** row. Drag the section view to the sheet.

To add the schedule to the sheet of drawing:

- On the **View** ribbon tab, on the **Settings** panel, point to the **Schedule** drop-down list and click the **Schedule** button .

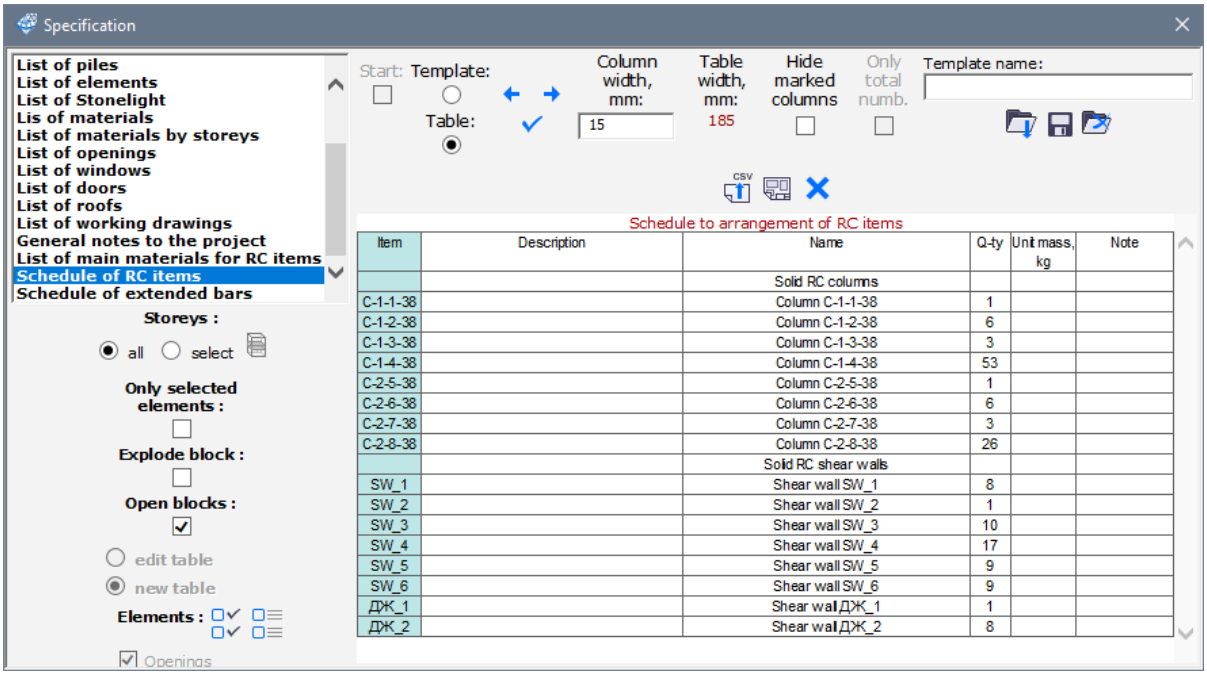


Figure 27.16. **Schedule** dialog box

- In the **Schedule** dialog box (see Fig. 27.16), define the following data:
  - select the **Schedule of RC items** row in the list;
  - click the **Place table to sheet** button ;

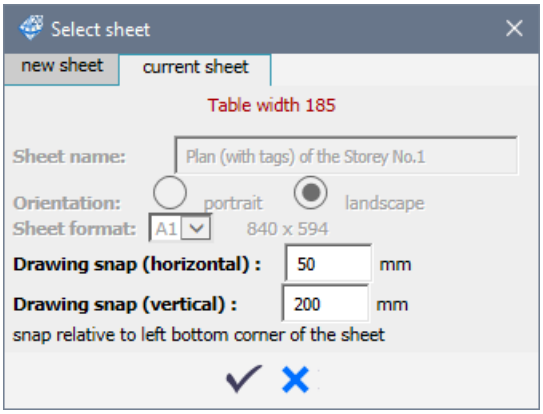


Figure 27.17. **Select sheet** dialog box

  - in the **Select sheet** dialog box (see Fig. 27.17), define the snap for the schedule table (horizontal – 50mm, vertical – 200mm) and click **Select** .
- Close the **Schedule** dialog box (Fig. 27.16). The schedule will be displayed on the sheet of drawing together with plan and section view (see Fig.27.18).

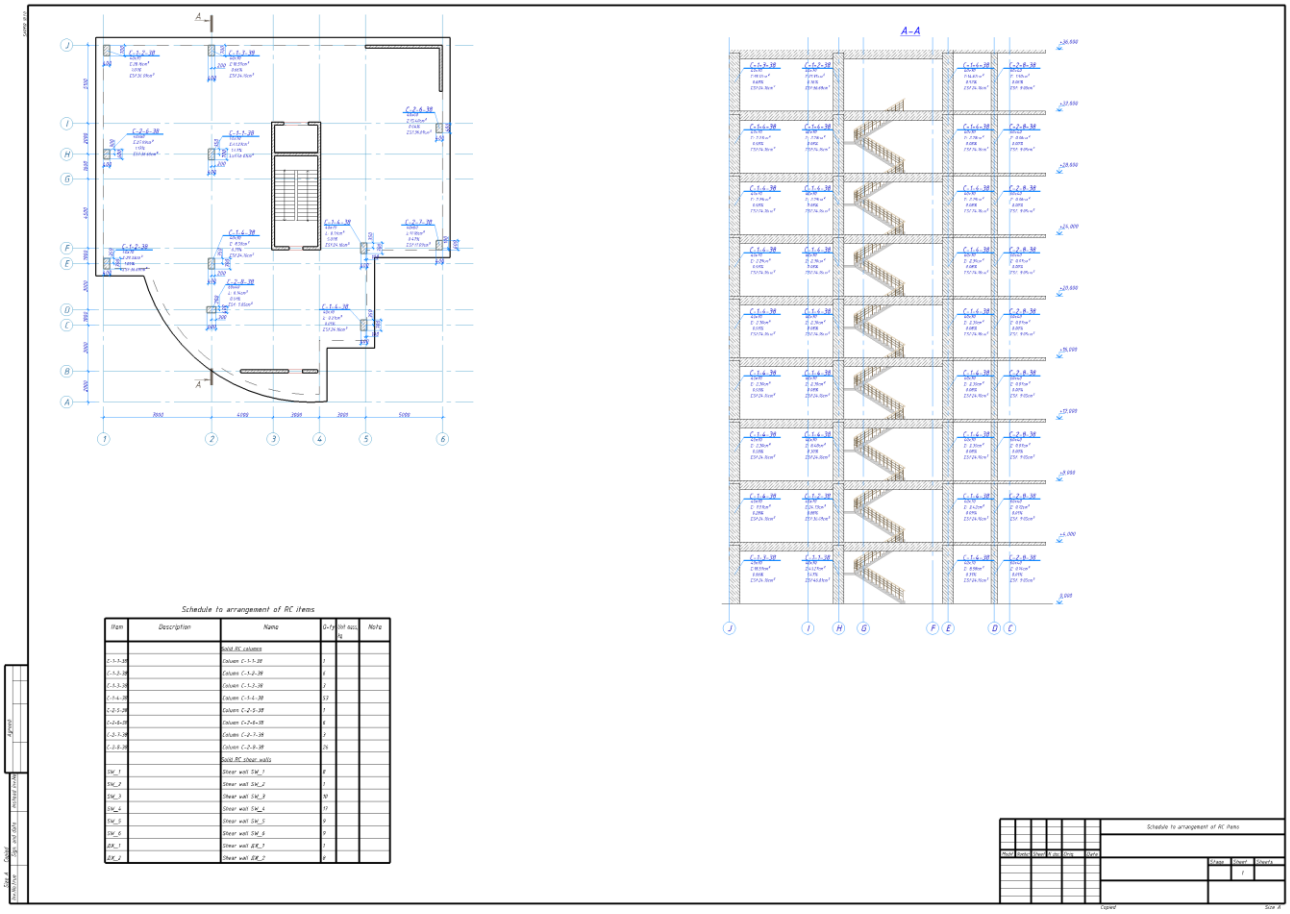


Figure 27.18. Sheet of drawing that contains plan and section view with tags as well as schedule

Step7. Design unified monolithic RC column

To generate the model of reinforcement for the column:

- In the **Views** window, double-click the **3D views** row.
- In the **Structure** window, make sure that **storey No.1** is selected as the current one (name of the current storey in indicated in bold type).
- On the **Visualization** toolbar, click the **Active storey** button .
- Select the floor slab of the first storey.
- On the **Visualization** toolbar, click the **Hide selected** button .
- Select the column at the intersection of the grid lines H-2.
- On the **Reinforcement** ribbon tab, on the **Main reinforcement** panel, click the **Arrange reinforcement** button .

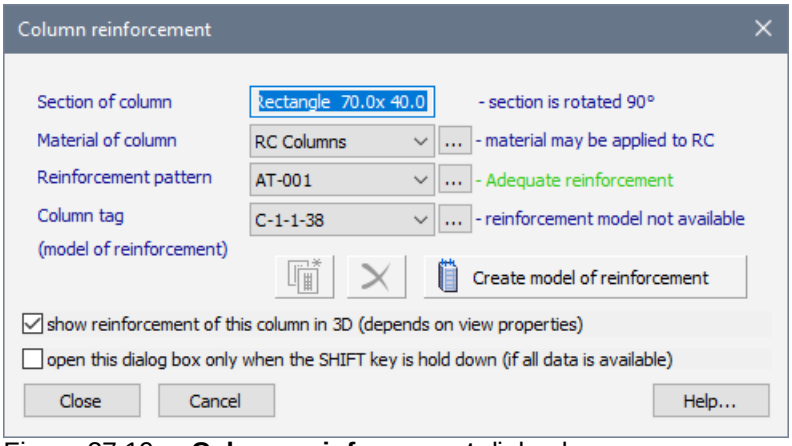


Figure 27.19. **Column reinforcement** dialog box

- In the **Column reinforcement** dialog box (see Fig. 27.19), click the **Create model of reinforcement** button.
- In the SAPFIR message box (see Fig. 27.20), click **Yes**. New tab will be displayed with the model of reinforcement for the column (sectional elevation and two cross sections), arranged according to selected type of reinforcement.

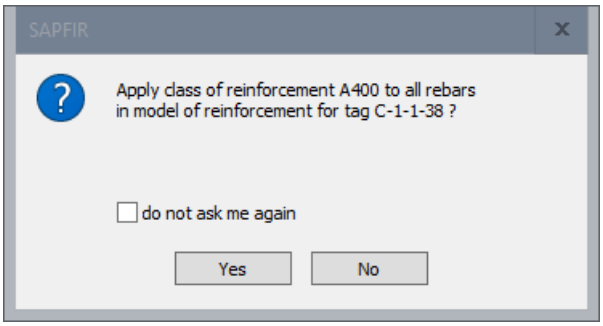


Figure 27.20. SAPFIR message box

*On the **Column reinforcement** Options Bar you will see the tag for this column, type of reinforcement, number of tags based on this type of reinforcement, number of columns with this tag.*

- To bend the dowels of rebars, on the **Column reinforcement** Options Bar, click the **Bend rebar dowels** button .

*Dowels are presented conventionally at the column bottom. Diameter of dowels coincides with diameter of the main reinforcement in the column. To hide or show dowels, use the **joint** check box on the **Column reinforcement** Options Bar. Spacing for stirrups in the zone of joint, spacing for stirrups in the middle part of the column and spacing for stirrups in the upper part of the column may be modified in appropriate fields on the same Options Bar* 

.

- To exit the mode of column reinforcement, press **Esc**.
- To display the rebar schedule, on the **Reinforcement** ribbon tab, on the **Documentation** panel, point to the appropriate drop-down list and click **Schedule: Reinforcement** command .

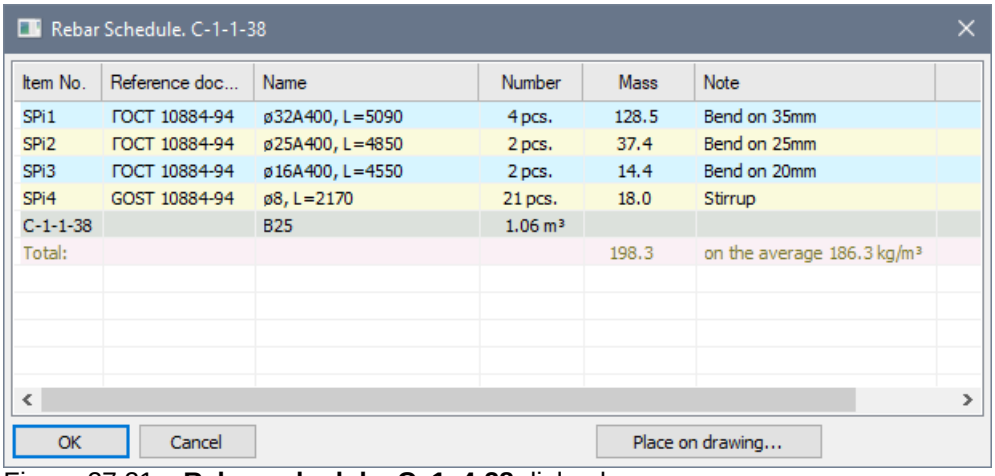


Figure 27.21. **Rebar schedule. C–1–4-38** dialog box

- In the **Rebar schedule. C–1–4-38** dialog box (see Fig. 27.21), click **OK**.
- To edit location of dimensions and leader lines for tags, on the **Annotation** ribbon tab, on the **Modify** panel, use the **Move vertex** command .

*To edit location of rebars in the section, open the column section (just double-click appropriate section views in the **Views** window **C-1-5-38: Section 1-1** and **C-1-5-38: Section 2-2**) and use the **Move** command (on the **Reinforcement** ribbon tab, on the **Modify** panel). To return to initial location of rebars in the section, on the **Column** Options Bar, click the **Edit reinforcement pattern** button . In the **Reinforcement pattern** dialog box (see Fig. 27.4), click **OK**.*

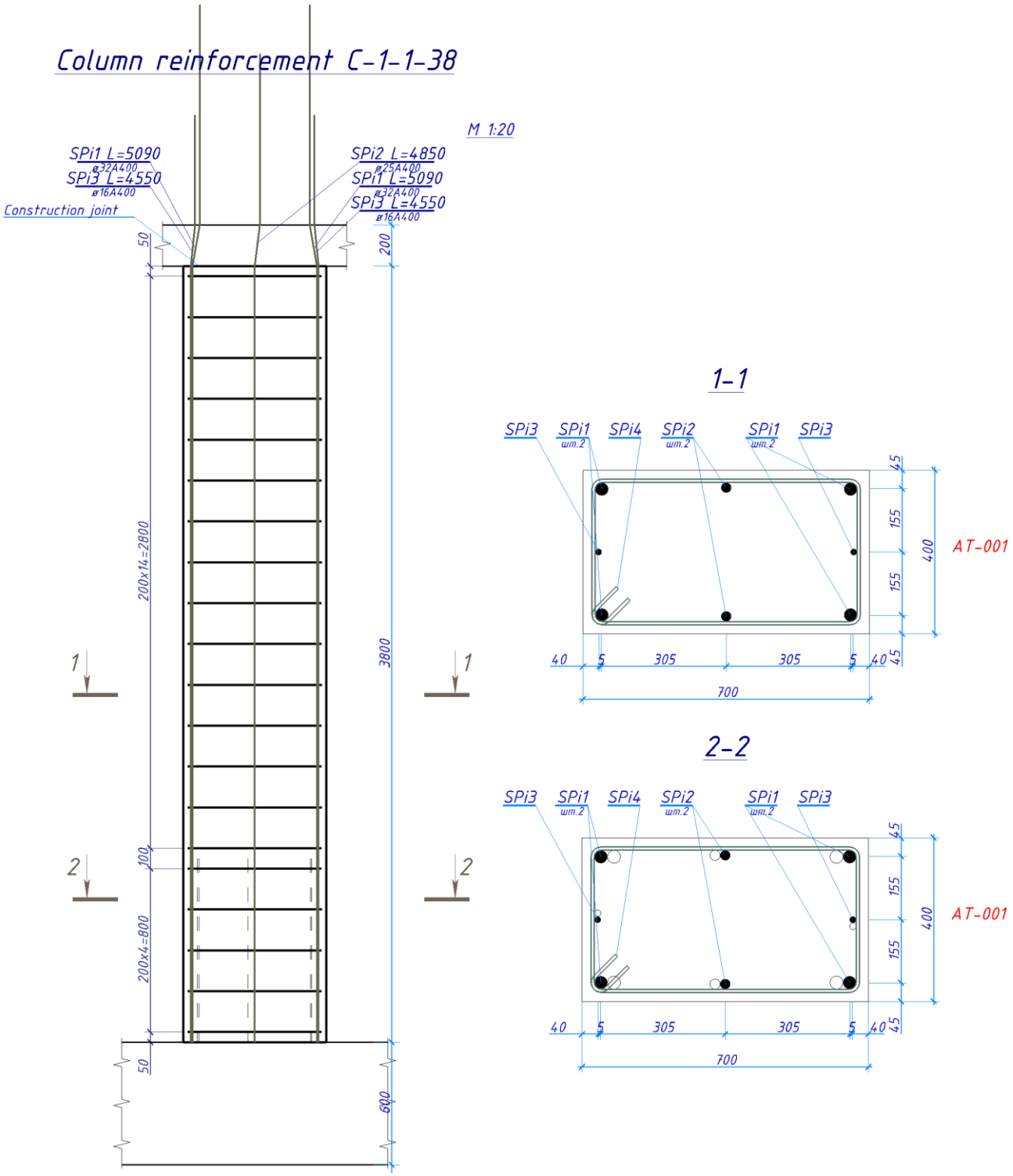


Figure 27.22. Model of reinforcement for the column

To arrange model of reinforcement for the column on the drawing:

- On the **Reinforcement** ribbon tab, on the **Documentation** panel, click the **Schedule: Reinforcement** button .
- In the **Rebar schedule** dialog box (see Fig. 27.21), click the **Place on drawing** button.
- In the **Draw schedules and rebar lists** dialog box (see Fig. 27.23), define the following data:

- name of the sheet – Reinforcement in column C-1-4-38 (for the name, define the tag of the column for which design procedure was carried out);
- sheet size – A3;
- necessary values for the snap of the upper right corner of the table;
- click the **Draw selected tables and notes** button .

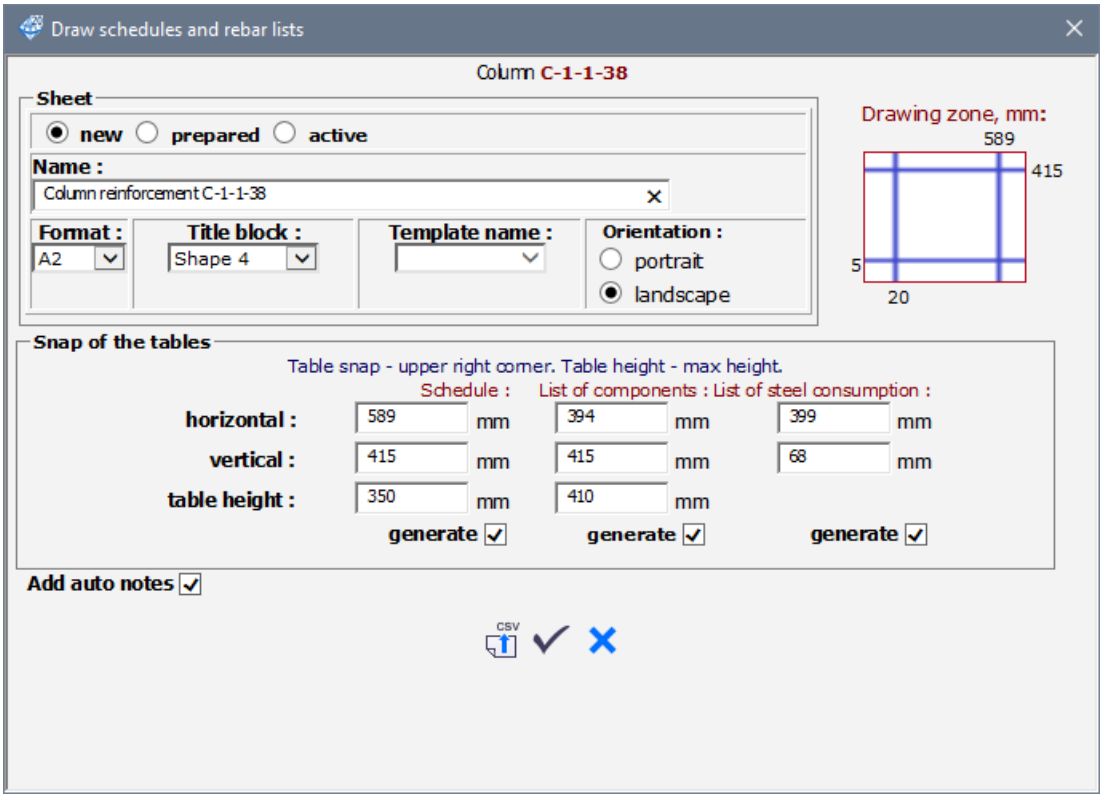


Figure 27.23. **Draw schedules and rebar lists** dialog box

➪ In the **Views** window, select the C-1-4-38 row in the **Assemblies** folder, then drag the model of column reinforcement to the sheet (see Fig. 27.25).

*To edit location for the model of column reinforcement more easily, open the model of column reinforcement and the drawing in parallel views. To do this, right-click the title bar of the tab and on the shortcut menu, select the **Vertical group** command (see Fig. 27.24). All modifications should be made in model of reinforcement for the column. The results before the printing option will be displayed on the drawing.*

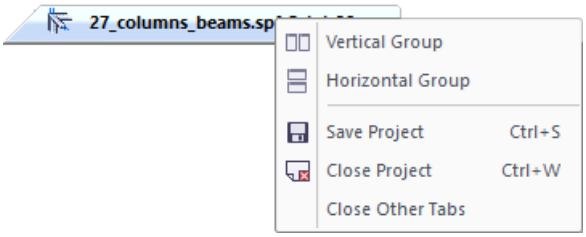


Figure 27.24. Vertical group of tabs

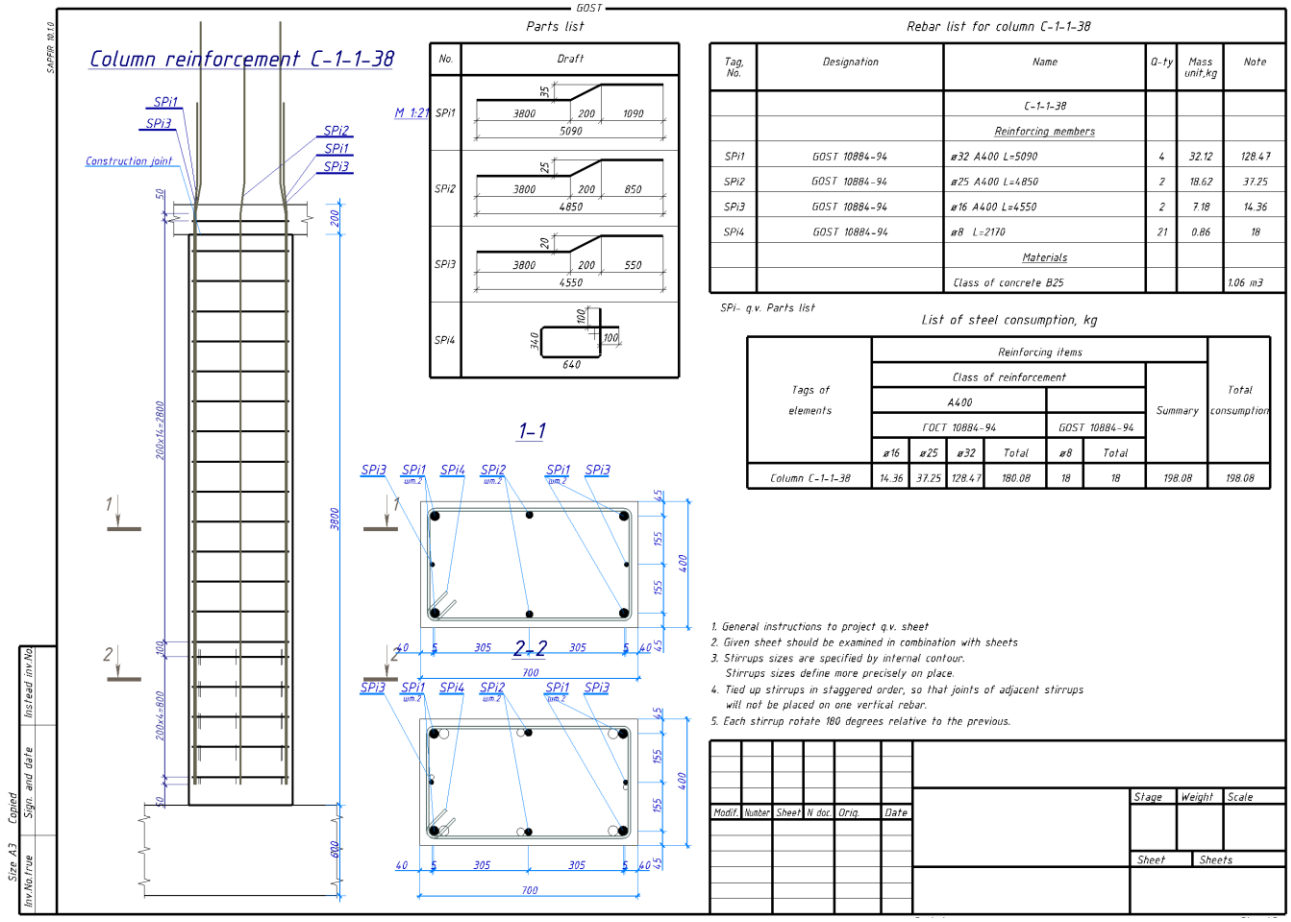


Figure 27.25. Drawing with reinforcement in column

Step 8. Unify beams

To exclude diameters from design procedure:

- To exclude certain diameters from design procedure (let's suppose, there is list of diameters that are not used in design procedure), on the **Reinforcement** ribbon tab, on the **Settings** panel, click the **Reinforcement** button .

*In the **Reinforcement** dialog box you will see diameters of rebars, computed anchorage/overlap lengths for the SNIP 2.03.01–84* for concrete class B25 and reinforcement class A-III. These lengths for anchorage and overlap are automatically applied to rebars in slabs, columns, beams and walls. If required, this table with lengths of anchorage may be saved as default one. Then lengths of anchorage and overlap may be modified depending on applied classes of concrete and reinforcement as well as building code. Moreover, you could always modify the anchorage length in the properties of the reinforced object (beam, column, slab, wall).*

- In the **Reinforcement** dialog box (see Fig. 7.26), define the following data:
  - in the **Longitudinal reinforcement** column of the table, double-click the cell for diameters 14, 18, 22 (*no* value will be displayed there);
  - click **OK**.

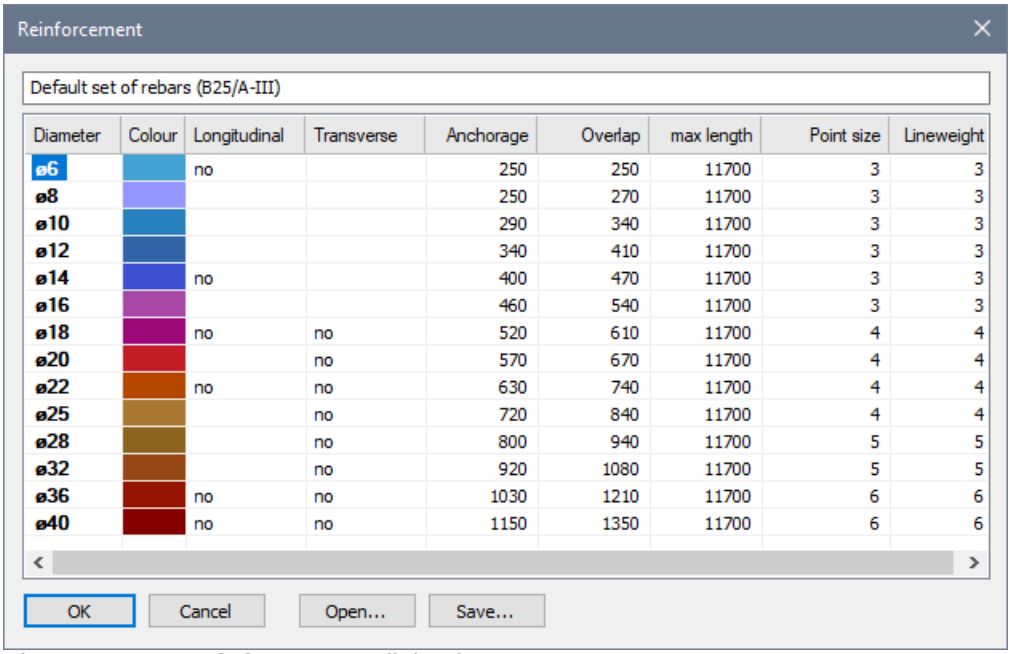


Figure 27.26. **Reinforcement** dialog box

To create unification groups:

- On the **Reinforcement** ribbon tab, on the **Main reinforcement** panel, click the **Unify beams** button .

With Filter option, beams may be organized by section dimensions or by length. Beams are organized in the descending order of the total theoretical reinforcement. For every beam you will see total theoretical reinforcement, max design area of upper reinforcement at two points (As(1) u As(2)), max design area of lower reinforcement (As(3)) and transverse reinforcement.

- In the **Unify beams** dialog box, in the **Length** drop-down list, select 8.200.
- Select the check box for the 1st beam in the list.

*For the beam with selected check box, you will see the diagram of required reinforcement. If check boxes are selected for several beams, then the enveloping diagram will be displayed. On the enveloping diagram, contribution of every beam is presented in appropriate colour. To generate the enveloping diagram, only beams with the same length should be selected. To evaluate the reinforcement for the beam in detail, select the beam in the list and click the **Results by sections** button . To move the section or to add new section on the diagram of theoretical reinforcement for selected beam, click the **Add new section on diagram** button . Then click appropriate point on the diagram of reinforcement.*

- Right-click anywhere in the list of beams.
- On the shortcut menu, point to **Tags for** and click the **Beams selected in list** command.
- In the **Tags for elements of structure** dialog box (see Fig. 27.27), input the tag **Bm-1**.
- Click **OK**.

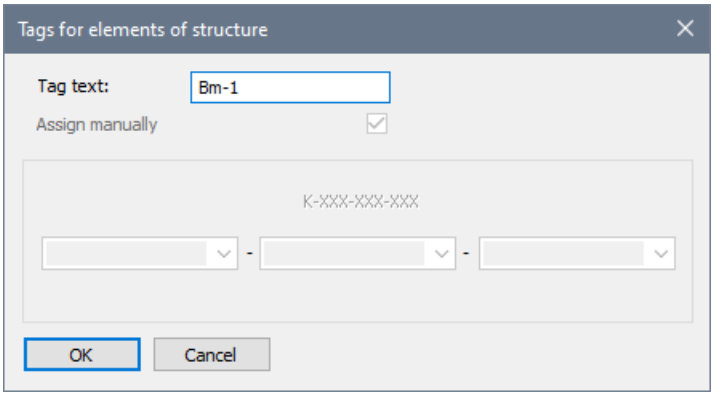


Figure 27.27. **Tags for elements of structure** dialog box

- Select the check boxes for beams from the 2nd up to 9th (see Fig. 27.28) and create the tag **Bm-2** in the above-mentioned way.

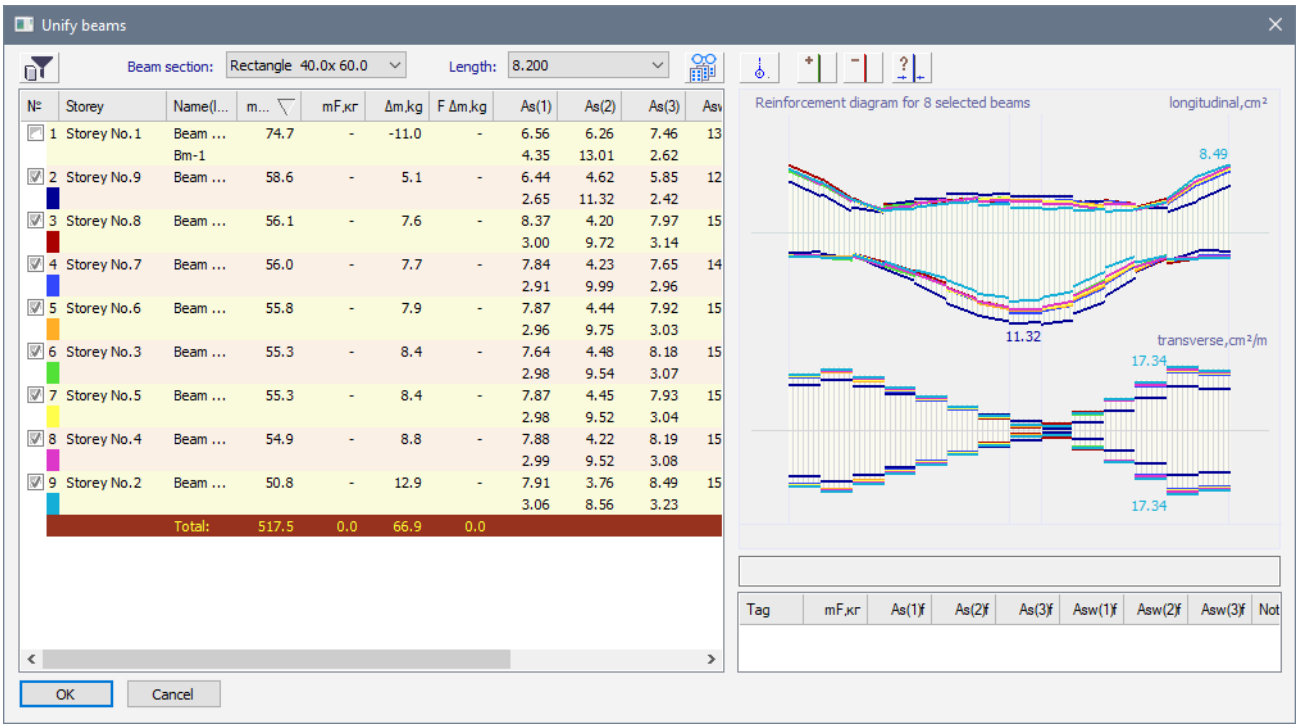


Figure 27.28. **Unify beams** dialog box

- Right-click the first beam in the list and on the shortcut menu, select the **Create model of reinforcement** for the tag.
- In the SAPFIR message box (see Fig. 27.29), select the **do not ask me again** check box and click **OK**.

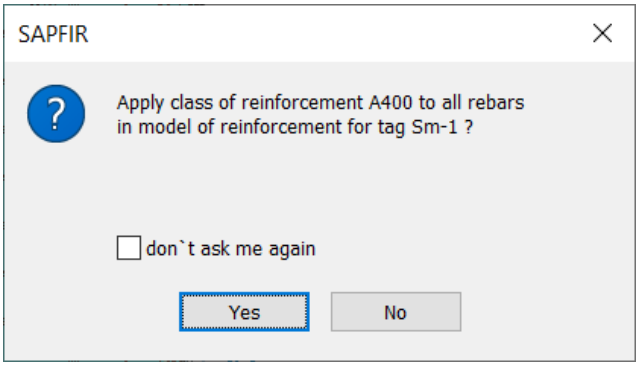


Figure 27.29. SAPFIR message box

*When generating model of reinforcement, the program may display the warning '**The arm of couple of internal forces has decreased compared to the one accepted for upper/lower rebars in analysis of reinforcement in LIRA-SAPR**' in the **Service information** window. It means that snap for gravity centre of rebars in upper/lower reinforcement in the properties of model of reinforcement does not coincide with appropriate data defined in materials for design of beams. In this case, open the view of beam reinforcement and define in properties the following parameters: snap to top 50mm, snap to bottom 50mm.*

- Right-click the second beam in the list or any other beam with Bm-2 tag. On the shortcut menu, select the **Create model of reinforcement** for the tag.
- At the bottom of the right part of the dialog box (see Fig. 27.30) you will see tags Bm-1 and Bm-2. Unified beam Bm-2 satisfies by strength to all 8 beams included into this unification group. In the **Views** window, there will be views of reinforcement **Bm-1** and **Bm-2** in the **Assemblies** folder and several section views in the **Sections** folder.

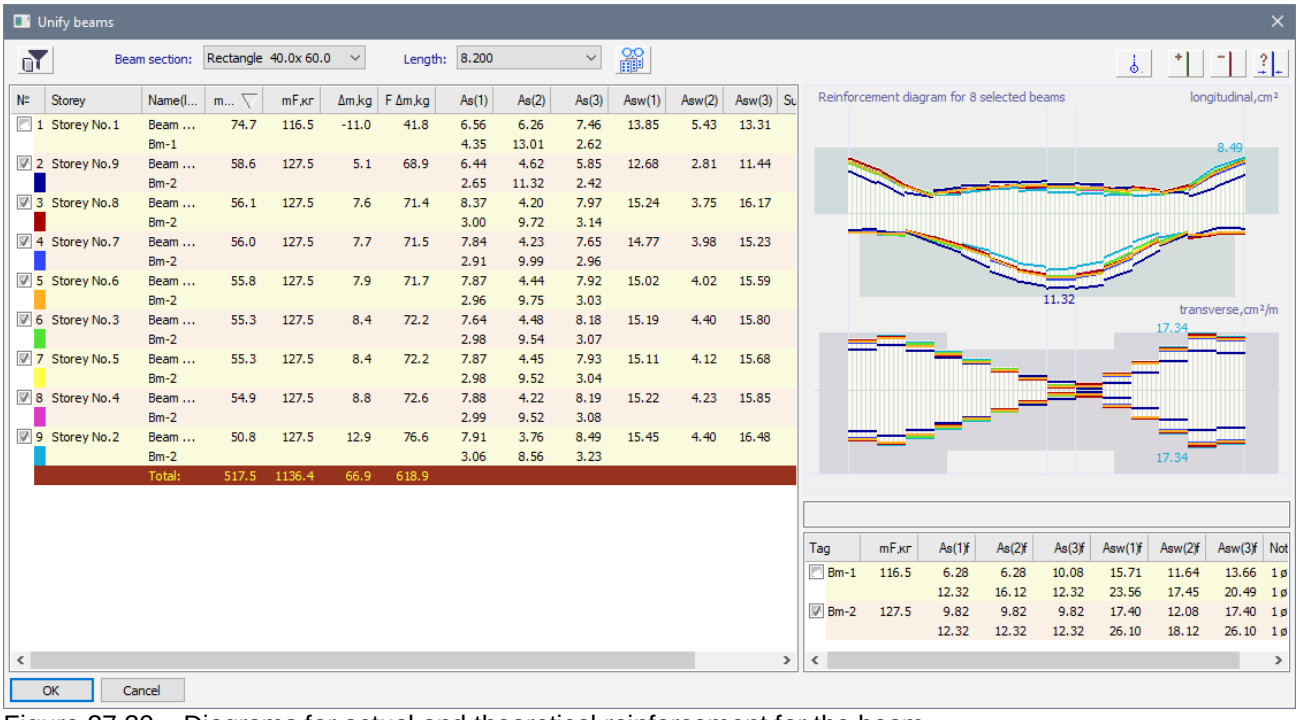


Figure 27.30. Diagrams for actual and theoretical reinforcement for the beam

*For tags there will be areas of actual reinforcement for the 3 sections and in the **Note** column of the table you will see diameters of corner and additional rebars for upper and lower reinforcement.*

To create unification groups for two-span beams:

- In the **Unify beams** dialog box, in the **Length** drop-down list, select 14.550.
- In the similar way, create several unification groups for two-span beams:
  - the 1st and the 2nd beams – Bm-3;
  - from the 3rd up to the 10th beams – Bm-4;
  - from the 11th up to 18th beam – Bm5.
- To create model of reinforcement for every tag, on the shortcut menu, select the **Create model of reinforcement** for the tag.
- Click **OK**.

*When generating model of reinforcement for the two-span beam, the program may display the warning '**Transport length of reinforcement exceeds allowed one. Divide rebar into several parts.**' in the **Service information** window. Double-click the row with the warning to select appropriate rebar on the model. On the **Rebar** Options Bar, click the **Divide rebar** button and define the place on the model where the rebar should be divided. Rebar will be divided into two parts with appropriate overlap (defined in the **Reinforcement** dialog box). If rebars with length more than 11700 are applied in design, then they will be displayed in the schedule in running metres. If rebars are divided and their length is reduced respectively, in the schedule there will be actual value of rebar length.*

Step 9. Edit the automatic design of the beam

To edit model of reinforcement:

- In the **Views** window, double-click the **Bm-1** row in the **Assemblies** folder.
- The new tab will be displayed; there you will see sectional elevation of the beam, several cross sections as well as theoretical and actual diagrams of longitudinal and transverse reinforcement.
- On the **Projections** toolbar, click the **Fit in window** button (or double-click the wheel button on the mouse pointer).
- Make sure that the following parameters are defined in the **Properties** window:
  - Class of concrete – B20;
  - Distance to top, mm – 50
  - Distance to bottom, mm – 50
  - Concrete cover at end, mm – 30
- Click the **Apply** button or press **Enter**.

When the model of reinforcement is generated, the diagram of actual reinforcement may not be displayed below the diagram of theoretical reinforcement. To display the diagram of actual reinforcement, modify parameters for the distance to the top/bottom of the beam and concrete cover at end.

- To edit location of the leader lines for tags of rebars, on the **Reinforcement** ribbon tab, on the **Modify** panel, use the **Move vertex** command .

Diagrams of longitudinal and transverse reinforcement are displayed for the user to check. As diameter or number of rebars is modified, these modifications will be simultaneously displayed on the diagram of actual reinforcement. Red colour on the diagram indicates that arranged reinforcement is not adequate to provide intensity of reinforcement required by analysis.
*To modify diameters and number of selected corner and additional rebars, on the **Reinforcement** ribbon*

*tab, on the **Main reinforcement** panel, click the **Beam reinforcement** button . On the **Beam** Options Bar, in certain drop-down list, it is possible to modify the number and diameters for the upper, medium and lower rebars. You could also assign number of zones and diameter for transverse reinforcement. After such modifications, click the **Rearrange** button for longitudinal and transverse reinforcement. To exit the mode of work with rebars in beam, press **Esc**.*

- Select corner rebars Ø28 in the lower reinforcement on sectional elevation.
- On the **Rebar** Options Bar, define the following data:
  - select the **L-hook** command from the drop-down list for the left and the right parts of rebar;
  - input La= - 300;
  - to confirm, press **Enter**.
- To hide the modified corner rebar, on the **Visualization** toolbar, click the **Hide selected** button .
- Select one more corner rebar Ø28 in the lower reinforcement near support.
- For this rebar, define the same parameters.
- Press **Esc**.
- To visualize the hidden rebar, click the **Show all elements** button .

<u>To update items in the schedule:</u>

- On the **Reinforcement** ribbon tab, on the **Main reinforcement** panel, click the **Beam reinforcement** button .
- In the **Properties** window, define the following data:
  - reference document – GOST 34028-2016;
  - reference document for transverse reinforcement - GOST34028-2016.
- Click the **Apply** button or press **Enter**.
- In the SAPFIR message box (see Fig. 27.31), select the **do not ask me again** check box and click **Yes**.

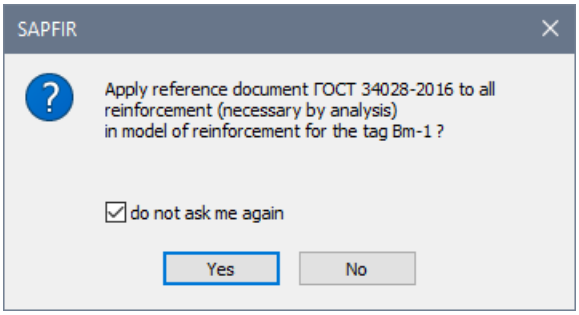


Figure 27.31. SAPFIR message box

- On the **Reinforcement** ribbon tab, on the **Documentation** panel, point to appropriate drop-down list and click **Schedule: Reinforcement** button.

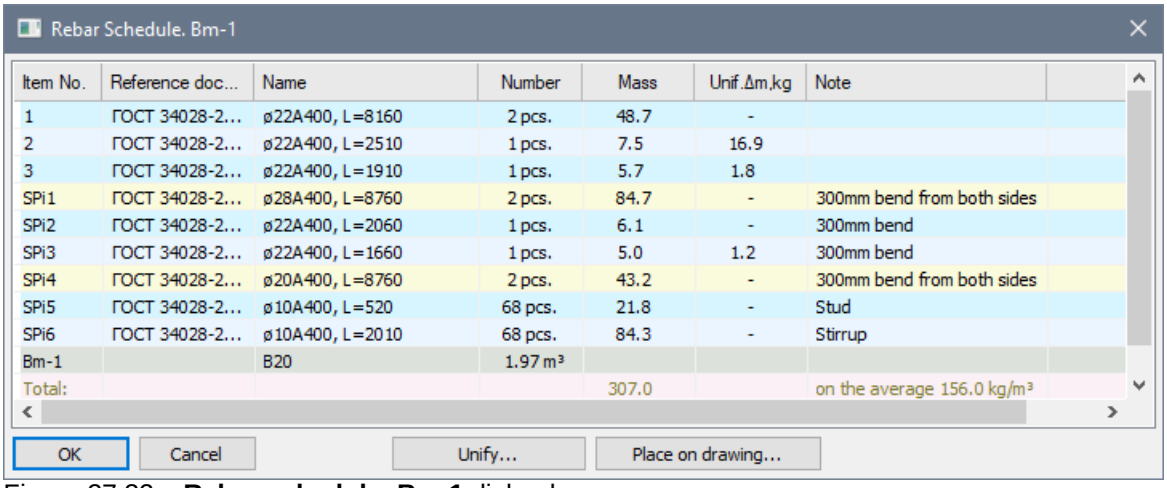


Figure 27.32. **Rebar schedule. Bm-1** dialog box

- In the **Rebar schedule. Bm-1** dialog box (see Fig. 27.32), to update all items in the schedule, click **OK**.

To update tags in the beam section:

- Double-click the image of the beam cross-section 2-2. The new tab with the image of the beam cross-section will be displayed.
- To update the leader lines with tags according to the items in the schedule, on the **Reinforcement** ribbon tab, on the **Annotation** panel, click the **Item tags** button .
- To close the tab, click the **Close** button in the title bar of the tab.

Step 10. Generate the sheet of drawing for the beam

To generate the sheet of drawing:

- In the **Views** window, double-click the **Bm-1** row. The tab with reinforcement view for the beam will be displayed.
- On the **Reinforcement** ribbon tab, on the **Documentation** panel, point to appropriate drop-down list and click **Schedule: Reinforcement** button .
- In the **Rebar schedule. Bm-1** dialog box (see Fig. 27.32), click the **Place on drawing** button.

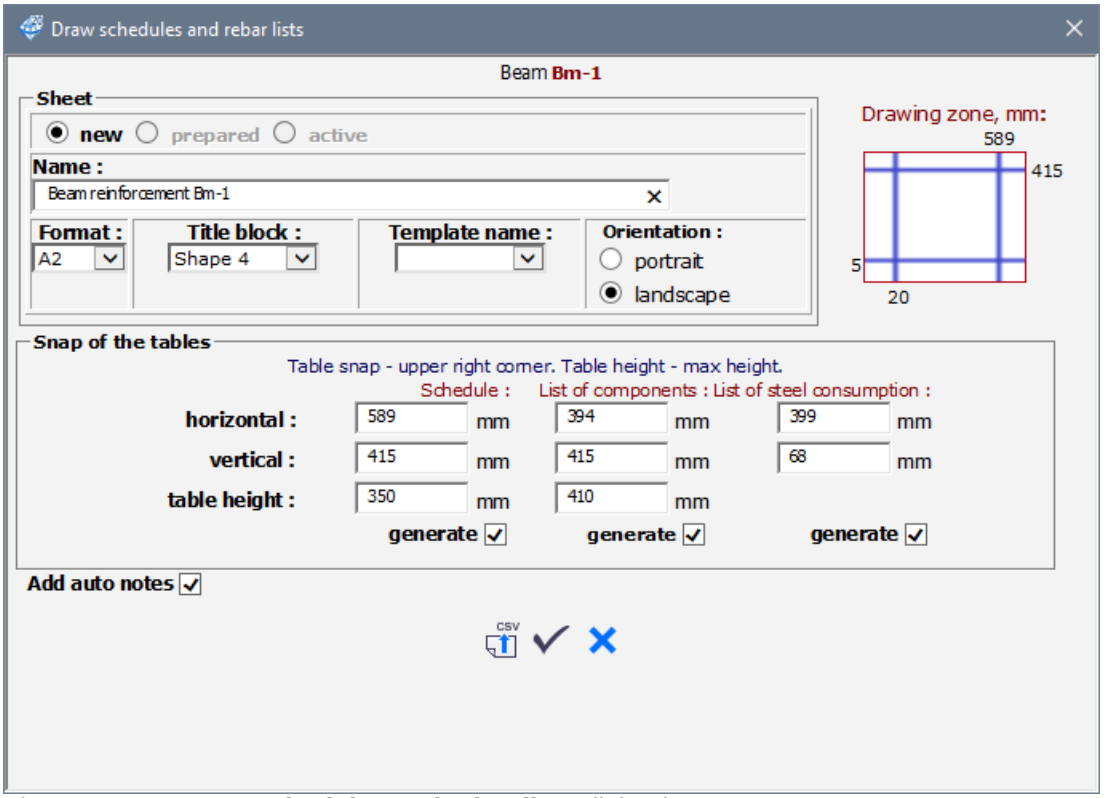


Figure 27.33. **Draw schedules and rebar lists** dialog box

- In the **Draw schedules and rebar lists** dialog box (see Fig. 27.33), define the following data:
  - name of the sheet – **Beam reinforcement Bm-1** (for the name, define the tag of the beam for which design procedure was carried out);
  - sheet size – A2;
  - necessary values for the snap of the upper right corner of the table;
  - click the **Draw selected tables and notes** button . The new tab will be displayed with the sheet of drawing, tables and auto notes.
- In the **Views** window, select the **Bm-1** row in the **Assemblies** folder. Then drag the model of reinforcement for the beam to the sheet (see Fig. 27.34).

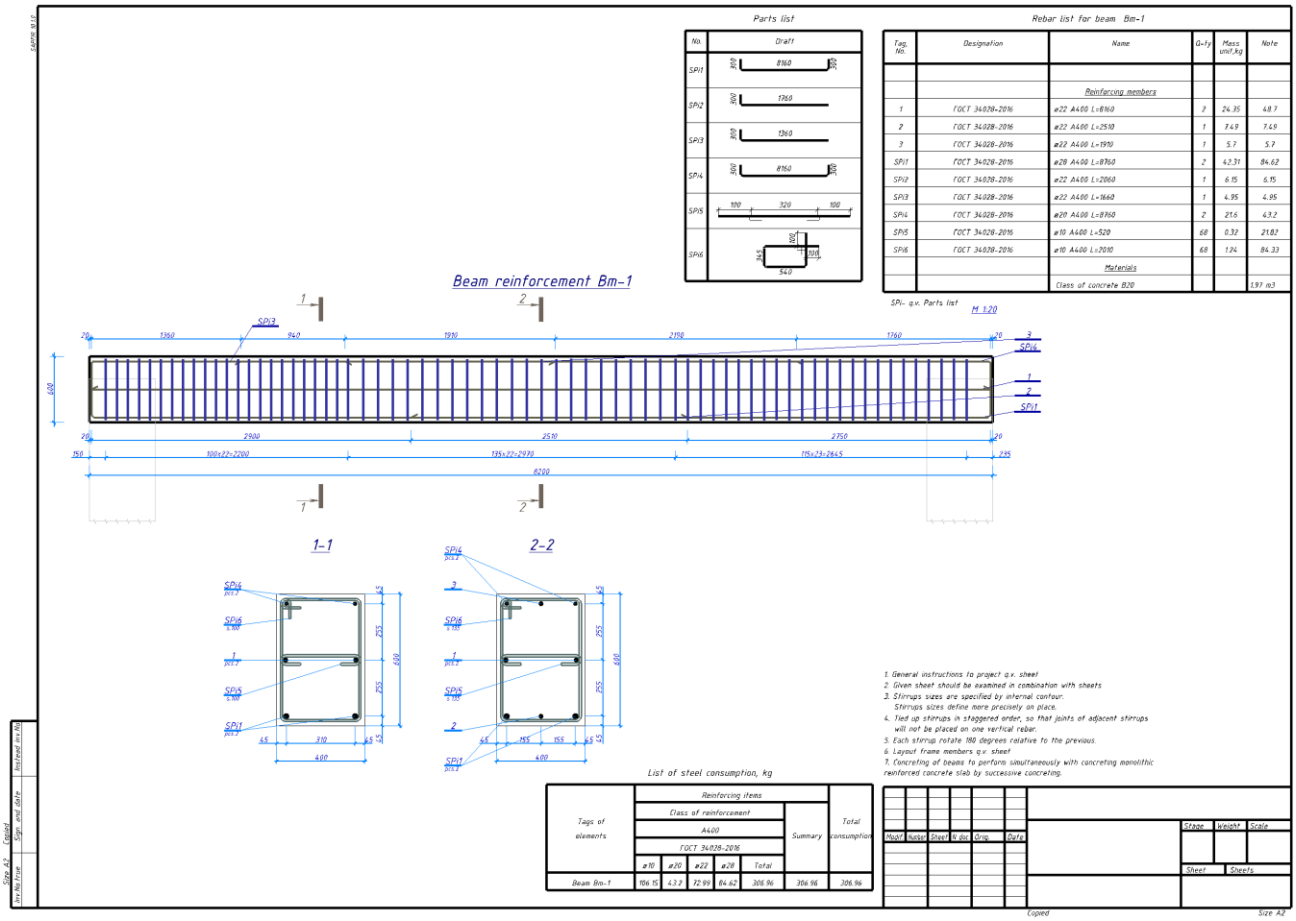


Figure 27.34. Drawing of beam reinforcement

Step 11. 3D visualization of reinforcement in column and beam

- To open the 3D view of the model, in the **Views** window, double-click the **3D view** row.
- On the **Visualization** toolbar, click the **Filter** button .

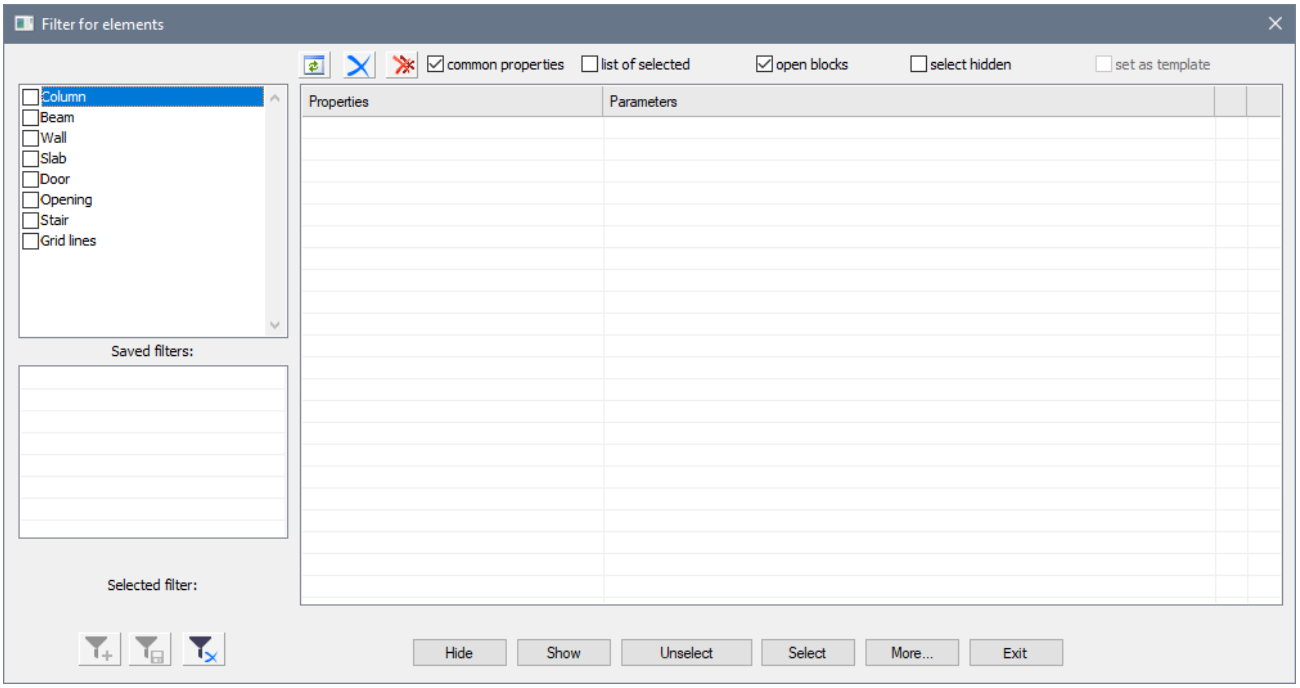


Figure 27.35. **Filter for elements** dialog box

- In the **Filter for elements** dialog box (see Fig. 27.35), define the following data:
  - select the **Column** and **Beam** check boxes;
  - in the **Properties** column at the right part of the dialog box, select the **Tag** row and click the **Browse** button ... ;
  - in the **Select tag** dialog box (see Fig. 27.36), hold down the **Ctrl** key and select tags of the column and beam for which design procedure was carried out. In this example, it is column C-1-4-38 and beam Bm-1.
  - click **Apply**.

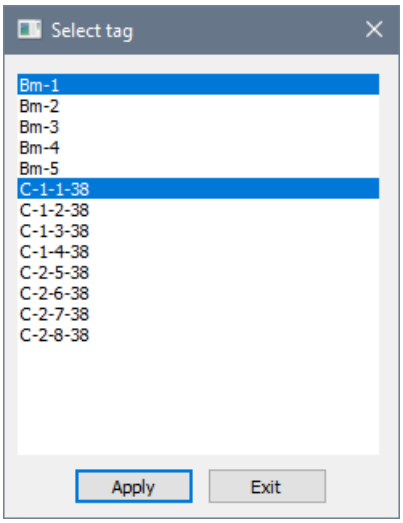


Figure 27.36. **Select tag** dialog box

- In the **Filter for elements** dialog box, click the **Select** button.
- Close the dialog box.

Number of tags for columns and beams may differ from the number defined in example. It depends on the number of created types of reinforcement.

- To visualize reinforcement for columns and beams in 3D view, on the **Visualization** toolbar, click the **Reinforcement** button .
- To unselect column and beam, press **Esc**.
- To present the elements as transparent to visualize the reinforcement in the column body, on the **Reinforcement** ribbon tab, on the **Results** panel, click **Show** button .
- In the **Properties** window, define the following:
  - simplified models – no;
  - click the **Apply to object** button or press **Enter**.
- To visualize reinforcement in colour according to diameter (see Fig. 27.37), on the **Reinforcement** ribbon tab, on the **Settings** panel, click the **Colour by Ø** button .

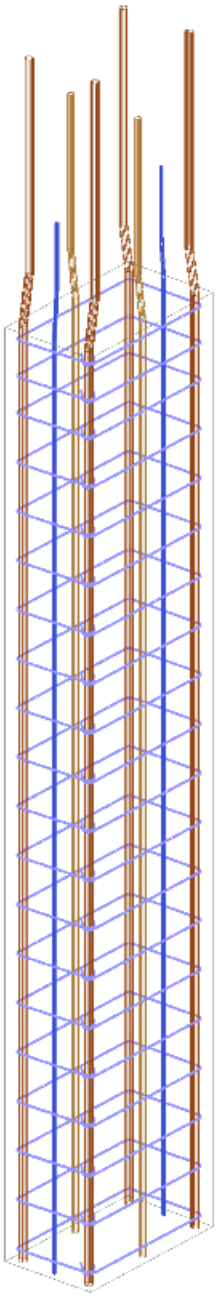


Figure 27.37. Column reinforcement in colour according to diameter

*To define the colours for certain diameter, on the **Reinforcement** ribbon tab, on the **Settings** panel, click the **Reinforcement** button .*

