

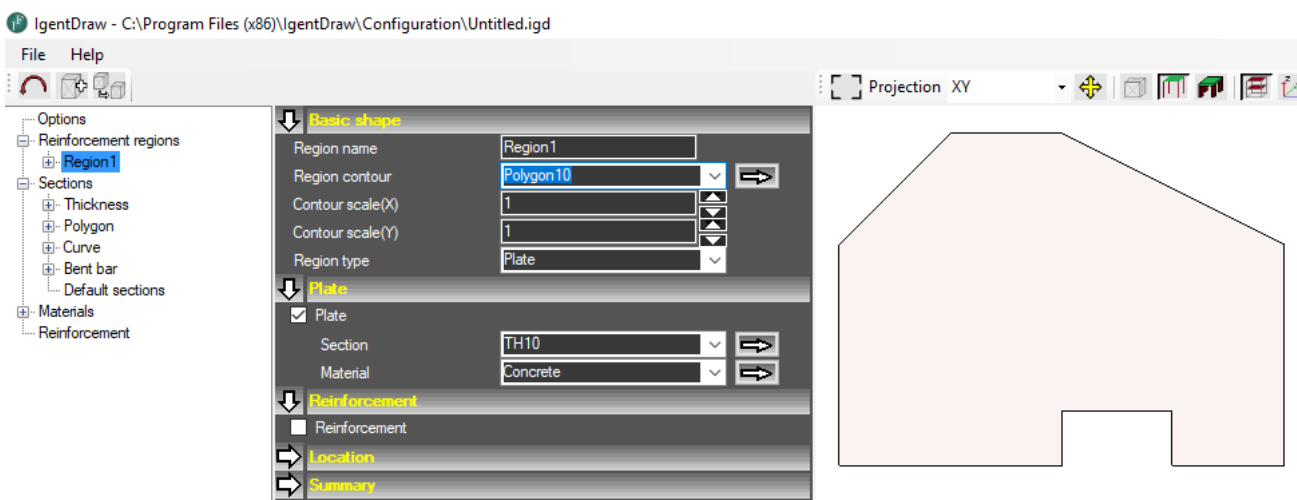
IgentDraw program enables parametric drawing of reinforcement of plates and export to DXF format.

IgentDraw interface is based on IgentForm program interface. Work in the program basically takes up 3 windows - **the inspector window**, which contains all the information about the project, **the parameter window**, which allows parameterization of all used objects and **the view window** for presentation of results.

Equivalent to IgentForm masses are regions where the reinforcement is defined. The region can have any contour (contour sides can be defined using straight lines or curves). It can be defined manually or based on the DXF. For columns, rectangular, circular and L-shape are supported. In the drawing, the L shape is always positioned in such a way that the cut-out is in the upper right corner.

4 types of regions are available:

- a) Plate
- b) Opening
- c) Polyline – type used for edges reinforcement with stirrups
- d) Column



Reinforcement generation is done by activating the Reinforcement option. The following parameters can be defined:

- a) **Type** - bottom and top reinforcement for Plate, diagonal or parallel bars for Opening and open or closed stirrups for Polyline.
- b) **Symmetric reinforcement** - enabling this option automatically generates identical reinforcement on both sides
- c) **Cover** - Vertical bar cover measured from the edge of the plate to the face of the rebar
- d) **Side cover** - distance of the rebar end from the side edge of the plate
- e) **Neglect on drawing** - bars defined in a given region will be included in the summary table, but they will not be visible in the drawing
- f) **Diameter** - the diameter of the bars in the region (in the case of plates, this and the following parameters are defined independently for the X and Y directions
- g) **Spacing** - spacing of bars in a given region
- h) **Bar shape** - selection of the reinforcing bar shape. If bar with hooks is selected, a different hook length than the standard one can be defined
- i) **Left hook length** - entering length 0 disables the hook generation. Entering a length shorter than the standard length generates a hook of the standard length
- j) **Right hook length** - entering length 0 disables the hook generation. Entering a length shorter than the standard length generates a hook of the standard length
- k) **Offset** - the distance of the first rebar from the edge of the region. When this option is not enabled, this distance is calculated automatically

- l) **Division of bars** - a list of coordinates in which the rebars will be split taking into account lap length. Coordinate 0.0 is the smallest coordinate of a given region. When this option is not enabled, the rebars are split due to the maximum length of the rebar.
- m) **Bent bar** - generation of bent bars. The user can assign a rebar from the base of the sections (Sections / Bars). When this option is off, a straight rebar is created for which hooks can be set later.
- n) **Reinforcement angle** - value of the reinforcement angle relative to the coordinate system axis
- o) **Number of rebars** - the number of reinforcing bars in one corner (applies to the type Opening or Plate for assembly reinforcement)
- p) **Length beyond the edge** - length of the rods beyond the edge of the hole (applies to the Opening type)

Reinforcement, reinforcement drawing, and summary table are generated automatically when any parameter is changed. The program cuts all the bars into a given region, including openings.

The reinforcement, the reinforcement drawing and the summary table are displayed using the buttons above the view.

IgentDraw - C:\Program Files (x86)\IgentDraw\Configuration\Untitled.igd

The screenshot displays the IgentDraw software interface. On the left is a navigation tree with categories: Options, Reinforcement regions (Region 1), Sections (Thickness, Polygon, Curve, Bent bar), Default sections, Materials, and Reinforcement. The main panel is divided into sections: Basic shape, Plate, and Reinforcement. The Reinforcement section is currently active, showing the following settings:

- Reinforcement**
  - Type: Lower reinforcement
  - Diameter(X): 12 [mm]
  - Spacing(X): 20 [cm]
  - Offset(X): [ ]
  - Bars division(X)
    - Divisions number: 2
    - Divisions coordinates table:

Value
8
6
  - Bent bar(X): [ ]
  - Diameter(Y): 10 [mm]
  - Spacing(Y): 20 [cm]
  - Offset(Y): [ ]
  - Bars division(Y): [ ]
  - Bent bar(Y): [ ]
  - Cover: 2 [cm]
  - Lateral cover: 3 [cm]

At the bottom of the panel are buttons for Location and Summary. On the right, a 2D drawing of a reinforced concrete slab with a rectangular opening is shown. The drawing includes a grid of reinforcement bars and a summary table for the divisions. The table is as follows:

Value
8
6

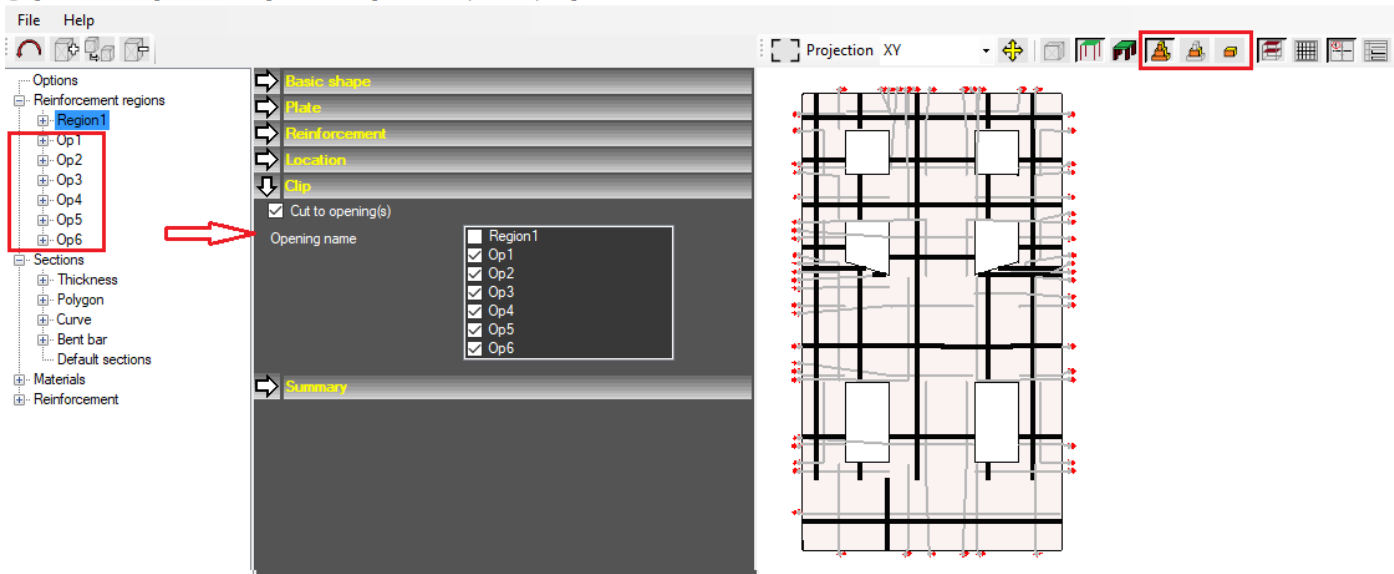
Red arrows point from the software interface to the drawing, indicating the application of the settings. A red circle highlights the number '201' in the drawing, and a red arrow points to it from the software interface. A red arrow also points to the 'Summary' button in the software interface.



No.	Ø [mm]	Steel class	Bars number	Length [m]	Weight [kg]	Total length [m]	Total weight [kg]	Bar shape
100	12	B500A	10	7.94	7.05	79.4	70.49	<u>780</u>
101	12	B500A	10	1.97	1.75	19.7	17.49	<u>1870</u>
102	12	B500A	10	2.57	2.28	25.7	22.82	<u>2570</u>
103	12	B500A	30	7.97	7.08	239.1	212.28	<u>7870</u>
104	12	B500A	35	6.6	5.86	231	205.09	<u>8830</u>
105	12	B500A	30	2.57	2.28	77.1	68.45	<u>2570</u>
106	12	B500A	20	7.858*	6.98*	119.151	105.78	<u>788</u>
107	12	B500A	5	2.333*	2.07*	7.665	6.81	<u>233</u>
108	12	B500A	15	6.333*	5.62*	52.994	47.05	<u>833</u>
200	10	B500A	20	11.828*	7.29*	198.551	122.41	<u>1828</u>
201	10	B500A	20	11.94	7.36	238.8	147.23	<u>1840</u>
202	10	B500A	20	9.886*	6.1*	178.729	110.19	<u>886</u>
203	10	B500A	20	9.886*	6.1*	178.729	110.19	<u>886</u>
Weight all [kg]							1246.28	

Many regions can be defined in the project, in particular a plate with any number of openings. In the case of a number of regions larger than 1, the toolbar above the view displays icons that allow to view all regions, selected regions on the background of all regions, or only selected regions.

IgentDraw - C:\Program Files (x86)\IgentDraw\Configuration\Examples\Example2.igd



In the case of columns, reinforcement parameters are set by selecting the appropriate longitudinal and transversal reinforcement patterns. The following parameters can be defined for longitudinal reinforcement:

a) **Section name** - name of the reinforcement pattern

a) **Diameter (corner bars)** - diameter of corner bars for type R (rectangular) and L and diameter of bars for section C (circular)

b) **Rebar shape** - selection of the reinforcing bar shape. If bar with hooks is selected, a different hook length than the standard one can be defined

c) **Length of the lower hook** - entering length 0 turns off the hook generation. Entering a length shorter than the standard length generates a hook of the standard length

d) **Top hook length** - entering length 0 turns off hook generation. Entering a length shorter than the standard length generates a hook of the standard length

e) **Number of bars (X)** - number of bars on the side X (applies to cross-sections R and L). For the L section, the bars are generated on the side of the vertical rectangle

f) **Diameter (X)** - diameter of the bars on the side X. The option is active when the number of bars is greater than 0

g) **Number of bars (Y)** - number of bars on the side Y (applies to cross-section types R and L). For the L section, the bars are generated on the side of the horizontal rectangle

h) **Diameter (Y)** - diameter of the bars on the side Y. The option is active when the number of bars is greater than 0

i) **Dowel bars** – possibility to generate connection to the top column. If a bar with a top hook is selected, it is automatically generated only for the dowel bar. The program automatically generates additional bars equal to the number of bars in the column

j) **Extend column bars** - no additional bars are generated, while all the bars from the column are lengthened

k) **Bend bars** - if the "Extend column bars" option is selected, selecting this option automatically bends the bars at the top of the column inwards by the diameter to avoid collision with the bars of a higher story

l) **Diameter** - diameter of dowel bars. If it is not enabled, the dowel bars will have the same diameter as the corresponding bars from the column

m) **Overlap length** - extension of the bar depending on the diameter. In the case of column bars extension, it is the distance of the bar end from the upper surface of the plate, in the case of dowel bars, the distance of the bar ends from the upper surface of the plate

n) **Starter bars** - possibility to generate connection to the element below (column, foundation slab). If a bar with a lower hook is selected, it is automatically generated only for starter bars. The program automatically generates additional bars equal to the number of bars in the column

o) **Diameter** - diameter of starter bars. If it is not enabled, starter bars will have the same diameter as the corresponding bars from column

p) **Length** - downward extension of the bar. If the option is not enabled, this length will be equal to the overlap length

q) **Overlap length** - bar elongation depending on diameter. This is the distance of the bar ends from the bottom surface of the plate

r) **Number of bars (X1) - Column L** - number of bars on the side X (applies to L-section). Bars are generated in the right part of the horizontal rectangle

s) **Number of bars (Y1) - Column L** - number of bars on the side Y (applies to L-section). Bars are generated in the upper part of the vertical rectangle

t) **Number of bars - Column O** - number of bars for circular section

The following parameters can be defined for transversal reinforcement:

a) **Section name** - name of the reinforcement pattern

b) **Type** - type of stirrup distribution in the column. There are 4 types of distribution:

- fixed spacing along the entire height

- concentrated zone at the bottom of the column

- concentrated zones at the bottom and top of the column (same parameters)

- concentrated zones at the bottom and top of the column (various parameters)

c) **s1** - stirrup spacing in the central zone

d) **s2** - stirrup spacing at the bottom of the column (for types 2, 3, 4)

e) **s3** - stirrup spacing at the top of the column (for type 4)

f) **n2** - number of stirrups at the bottom of the column (for types 2, 3, 4)

g) **n3** - number of stirrups at the top of the column (for type 4)

h) **Diameter (stirrups)** - diameter of external and internal stirrups

i) **Beam height** - beam height at the top of the column

j) **Number of stirrups in the beam** - number of stirrups between the bottom edge of the beam and the upper surface of the plate. The option is active when a non-zero beam height has been defined

k) **Number of pins (X)** - number of pins in the X direction. The actual number of pins will not be greater than the number of longitudinal reinforcement bars in the X direction defined in the longitudinal reinforcement pattern assigned to a given column and additionally reduced by the number of bars captured by internal stirrups. The program automatically generates a symmetrical arrangement of pins

l) **Diameter (X)** - diameter of the pins in the X direction

m) **Number of pins (Y)** - number of pins in the Y direction. The actual number as in the X direction

n) **Diameter (Y)** - diameter of the pins in the Y direction

o) **Stirrup shape** - the shape of outer and inner stirrups. Standard stirrups (hooks on the same longitudinal bar) and torsion stirrups (hooks on adjacent bars for C section, hooks on adjacent corner bars for R and L sections) are possible

p) **Pin shape**

q) **External stirrups** - enabling the generation of external stirrups

r) **Number of stirrups (X)** - number of internal stirrups in the X direction. If the external stirrup generation is switched off, then chain stirrups will be generated. The program automatically generates a symmetrical arrangement of stirrups

s) **Number of stirrups (Y)** - number of internal stirrups in the Y direction. If the external stirrups generation is switched off and no internal stirrups are defined in the X direction, then chain stirrups will be generated

After selecting the Reinforcement option in the Inspector window, general options for reinforcement generation can be set:

- a) **Font / description** – font size of description reinforcement in the drawing
- b) **Font / position number** – font size of reinforcement position number
- c) **Font / reinforcement table** - font size in the reinforcement table
- d) **Reinforcement description / (Bottom/Upper) Reinforcement (X / Y)** - Initial position number for reinforcement types
- e) **Reinforcement description/Stirrups** - initial position number for stirrups
- f) **Reinforcement description/Basic text** - reinforcement description, according to defined patterns
- g) **Description of bar shape** – choice of unit for bar shape description in reinforcement table
- h) **Reinforcement description / Dimension rounding** - selection of the method for calculating the length of bars (up to mm or cm)
- i) **Reinforcement description/Join the same bars** - an option that allows the grouping of rebars of the same shape under one number. Same rebars from different groups (f.ex. Lower Reinforcement X, Lower Reinforcement Y) will be described with different numbers.
- j) **Reinforcement description / Dot diameter** - enables automatic drawing of a dot at the intersection of the description line with a representative bar
- k) **Reinforcement options / Code** – national code used for reinforcement generation. It affects parameters such as available steel classes, hook lengths, and bending radii. The program supports **PN 2002**, **EN 1992-1-1** and **ACI 318-08** (metric) standards.
- l) **Reinforcement options/Main direction** – choice of X or Y direction
- m) **Reinforcement options/Maximum bar length** - maximum total rebar length including hooks. In the case of the generation of bars longer than this, the program will automatically split the bars and generate lap lengths.
- n) **Reinforcement options/Lap length** - The relative length of laps depending on the diameter
- o) **Reinforcement options / Lap shift** - length of shift of bar overlaps relative to the adjacent layer
- p) **Reinforcement options/Steel class** - reinforcement steel class. Applies to all main bars in the project
- q) **Reinforcement options/Steel class (stirrups)** - reinforcement steel class for stirrups
- r) **Reinforcement options/Hook length(stirrup)** - minimum hook length for stirrups. When this option is not enabled, the program automatically generates hooks of standard length
- s) **Reinforcement options / Additional reinforcement** - this option enables adding reinforcing bars to the project, which will be included in the summary table and will not be visible in the drawing
- t) **Reinforcement options / Diameter** - additional reinforcement diameter
- u) **Reinforcement options / Length** - additional reinforcement length
- v) **Reinforcement options / Count** - number of additional reinforcements

File Help

Options

- Reinforcement regions
  - Region1
- Sections
  - Thickness
  - Polygon
  - Curve
  - Bar 3D
  - Longitudinal mf.(Column)
  - Transversal mf.(Column)
  - Default sections
- Materials
  - Reinforcement**

**Font**

Reinforcement description 3 [mm]

Position number 4 [mm]

Table 3 [mm]

**Reinforcement description**

Lower reinforcement(X) 100

Lower reinforcement(Y) 200

Upper reinforcement(X) 300

Upper reinforcement(Y) 400

Stirups 1

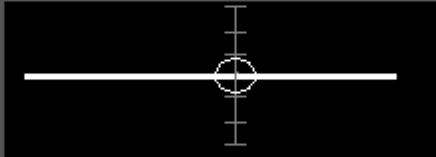
Basic text 5Ø10, l = 3000, e = 20

Bar shape description mm

Dimension rounding mm

Join the same bars

Dot diameter 100 [mm]



**Reinforcement options**

Code EN 1992-1-1

Main direction X

Maximum bar length 12 [m]

Overlap length 50 [∅]

Lap shift

Steel class B500A

Steel class(Stirups) B500A

Hook length(stirup)

Additional reinforcement

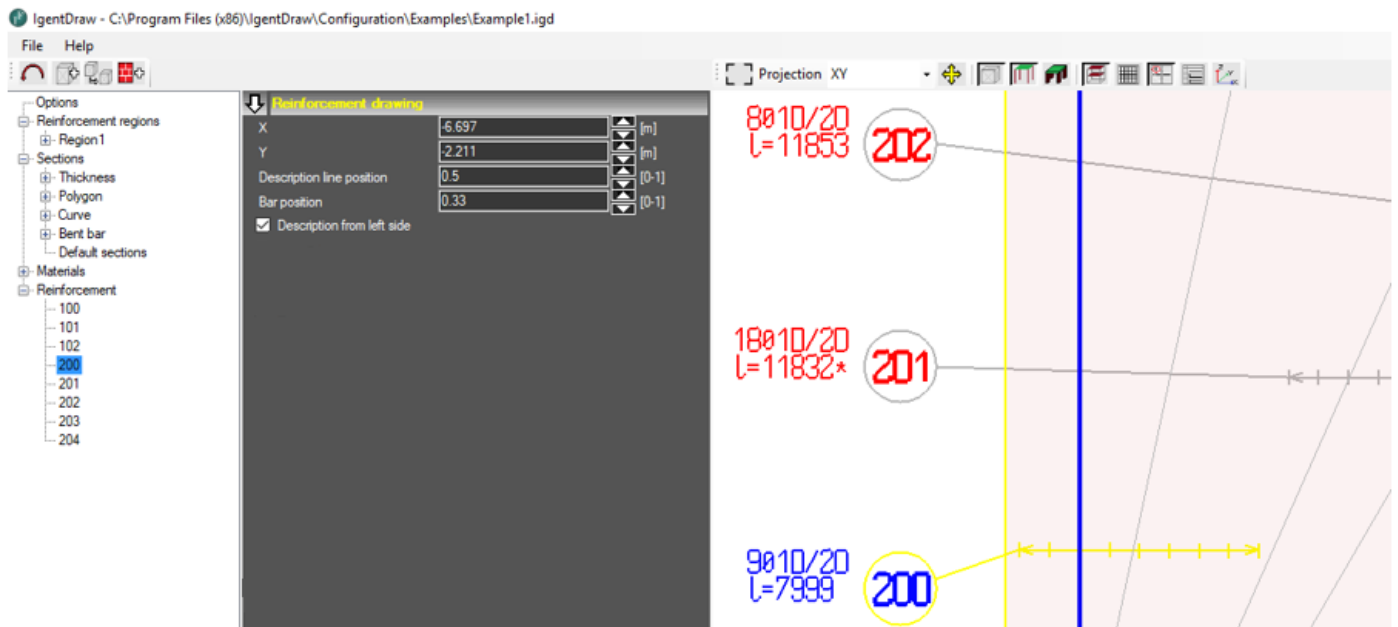
Diameter 8 [mm]

Length 100 [m]

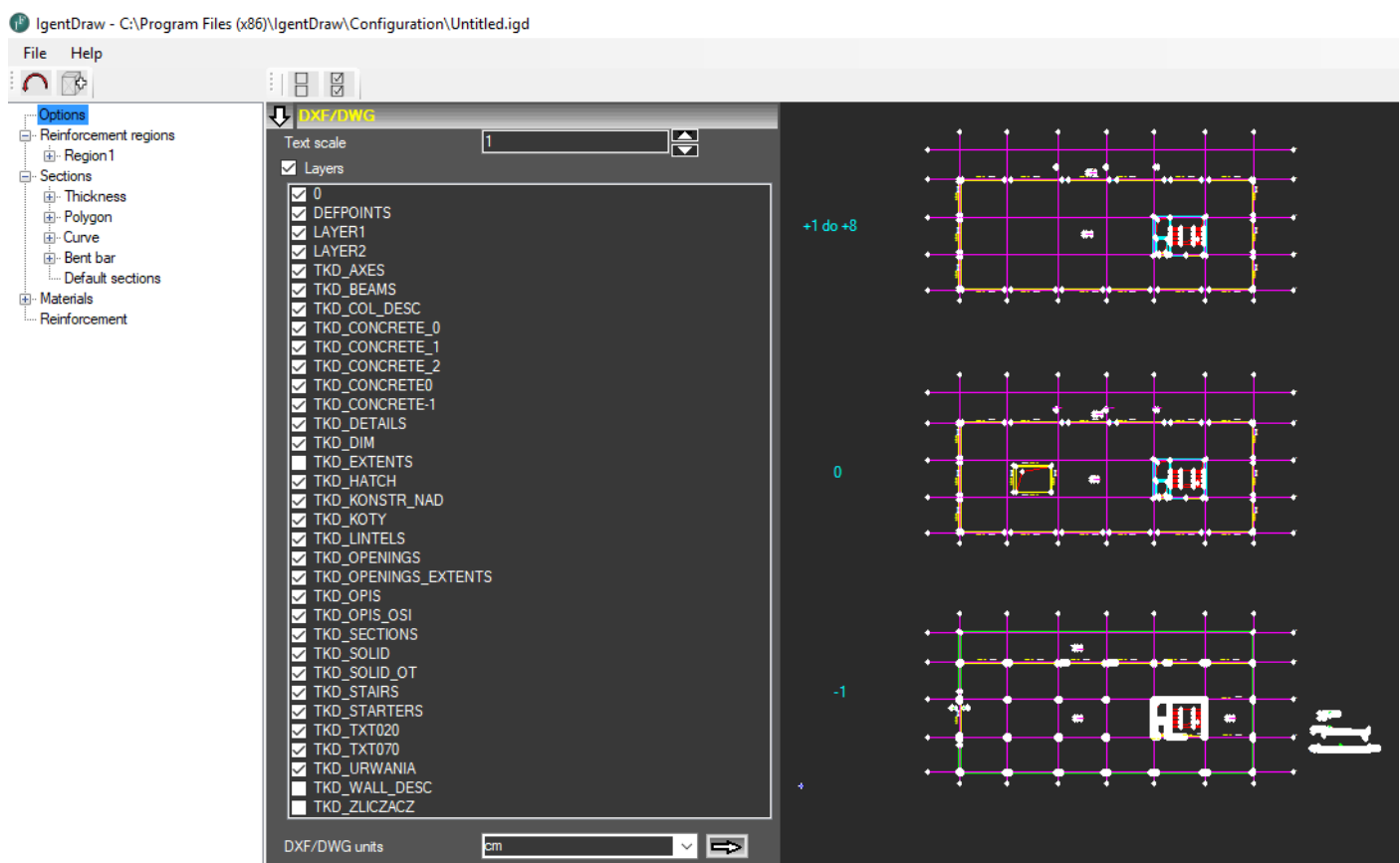
Count 1

All generated reinforcement positions are available in the inspector window. Once selected, it is highlighted on the view. For each item the following parameters in the group **Reinforcement drawing** can be set:

- X, Y coordinates** - this option allows to change the location of the description of the item
- Position of the description line** - relative position of the line representing the range of bars for given position
- Bar position** – choice of a bar representing the bars from a given position
- Description on the left** - This option allows to change the drawing position of the position number relative to the description







The program provides support for definition of reinforcement regions based on DXF background. The first step is to load the DXF file (**File / Import**). The DXF 12 file format is required at the moment. The program allows to load all or selected layers of a drawing. Once the drawing is loaded, layers visibility can be switched on / off freely. (**Options / Layers**). During DXF file loading, the unit of length in which the drawing is defined should be chosen.



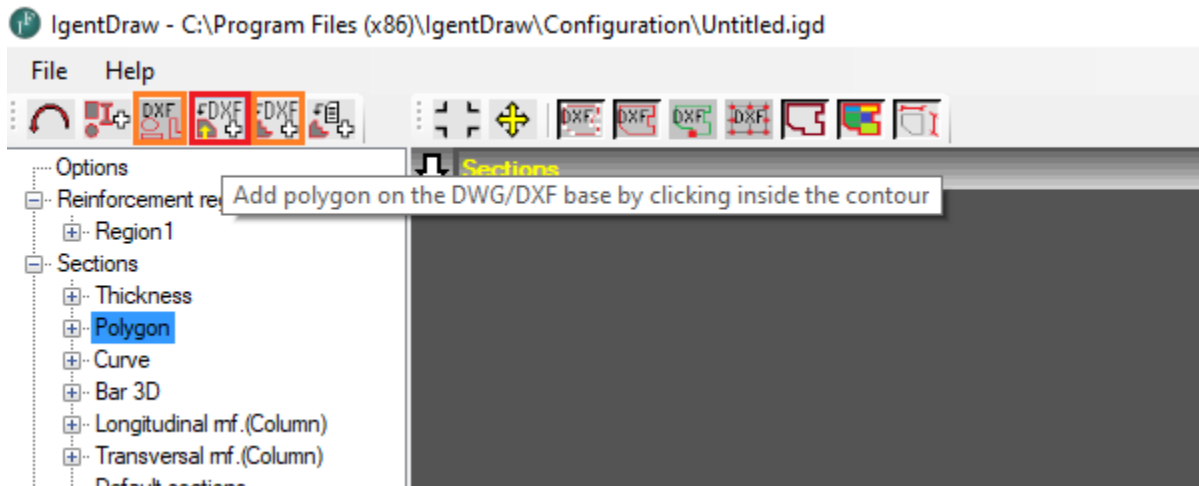
The regions are entered by clicking the **Polygon** in the **Sections** branch in the inspector window and selecting one of the two icons on the toolbar. These options allow to define the region by choosing a layer from the DXF file (automatic detection of closed contours), clicking inside the closed contour or by sequentially selecting the next contour vertices (clicking on the first or last point completes the edit).

When entering points, you can use several input modes that you can change at any time:

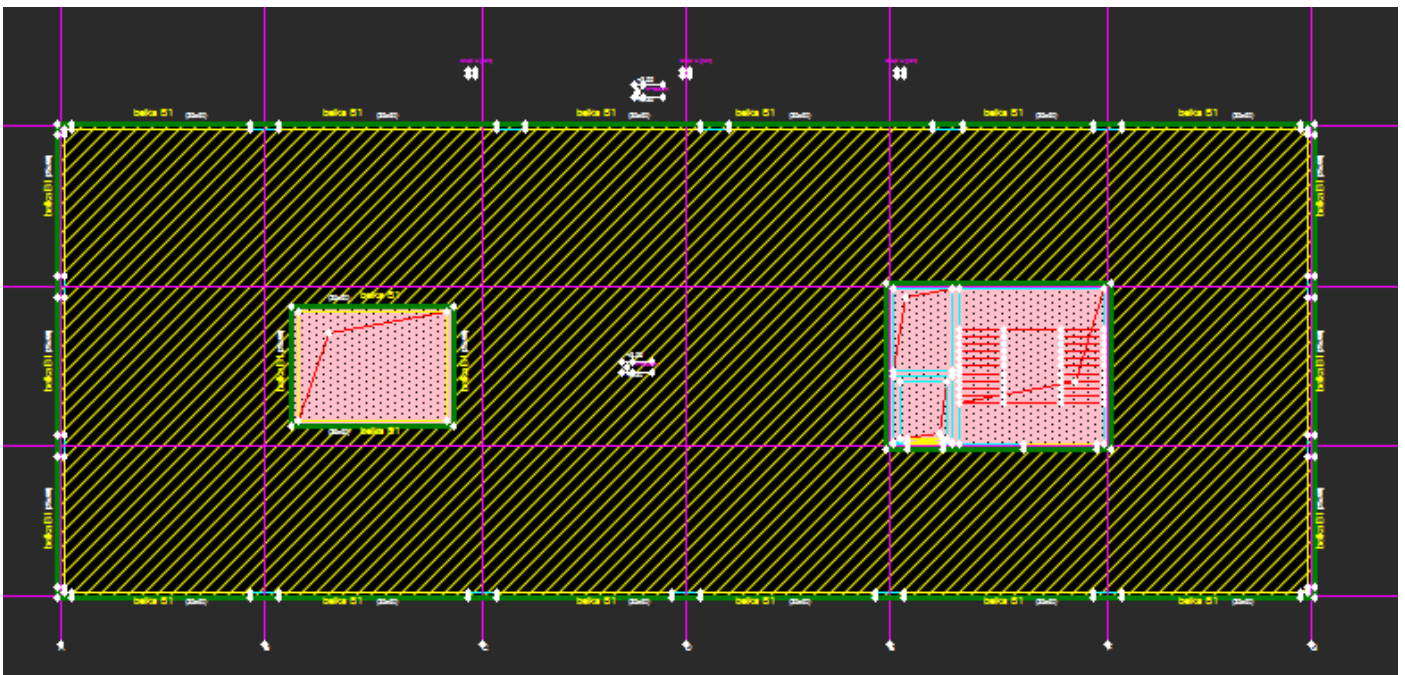


-  - The program automatically snaps the cursor to DXF points.
-  - The program calculates coordinates based on the point selected with the mouse.
-  - The program creates a point in the middle between the two points clicked.
-  - The program creates a point at the intersection of two lines or two pairs of lines.

If one of the above options is selected, a new section is automatically added to the Polygon branch. Editing of the section can be interrupted (for example, by changing the visibility of layers in Options / Layers) - clicking on the just defined section again reverts it to edit mode.



After entering the region, the user selects its type (Plate, Opening or Polyline) in the dialog. When selecting the opening and the region in which this opening is to be cut, the program automatically sets the appropriate cuttings relationship. By default, the program proposes sequential insertion of further regions. After input, they are visualized by hatching. Bent bars can be added to the sections database by clicking the **Bent bar** in the **Sections** branch in the inspector window and selecting the icon "Add section on the DXF base" on the toolbar.



After switching on the Reinforcement option in the parameter window, we automatically get a drawing which, after setting the selected parameters (f. ex. hooks for bars), becomes the final drawing. The DXF background can be presented in a small scale in the parameter window as well as in the view window after selecting the icon "Full window viewer" on the toolbar. The project can be saved in the internal **igd** format. The last step is to export the

reinforcement drawing and the summary table to DXF 12 (**File / Export**) for final editing, f. ex. in AutoCAD (it is recommended to convert to newer format with the help of widely available converters).

The screenshot shows the IgentDraw software interface. On the left is the 'Options' inspector window with the 'Reinforcement' section selected. The main area displays a reinforcement drawing of a column grid. To the right is a summary table with the following data:

No	Ø [mm]	Steel class	Bars number	Length [m]	Weight [kg]	Total length [m]	Total weight [kg]	Bar shape
100	10	B500A	40	12	7.4	480	295.94	
101	10	B500A	40	12	7.4	480	295.94	
102	10	B500A	34	12	7.4	408	251.55	
103	10	B500A	34	8.809	5.43	299.49	184.65	

After selecting the **Options** item in the inspector window, parameters regarding column reinforcement can be set

a) **Level / Storey** - storey number. This option is used for automatic column numbering when they are created on the basis of a DXF background (C / (floor number / (column number))). If columns on lower floors have been defined in the project and reinforcement has been generated for them, the program automatically checks whether the newly added column is a continuation of the column from the previous story. If so, the column will receive the same number (C / 0/01 -> C / + 1/01)

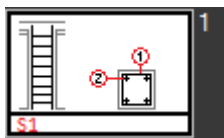
b) **Level / Coordinate** - the coordinate of the upper level of the lower plate

c) **Level/Storey height** - storey height proposed by default when entering subsequent columns

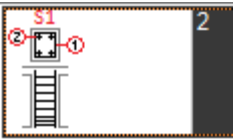
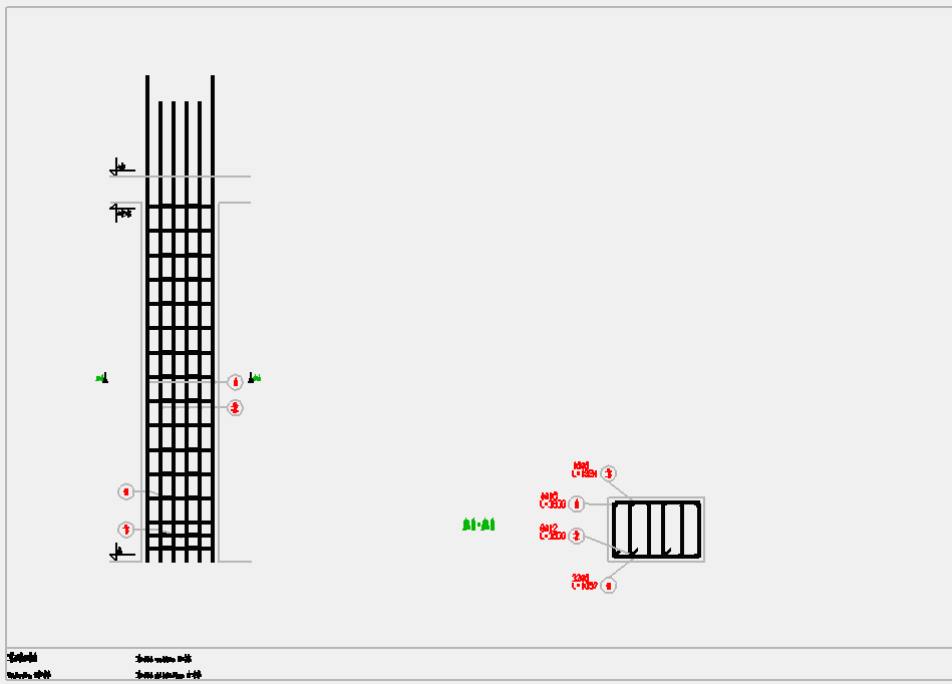
d) **Drawing options (Columns) / Section scale** - column cross-section scale. At the moment, the program automatically selects the cross-section level. It can be the middle section (no dowel bars and no starter bars), the bottom section (starter bars), the top section (dowel bars) or the bottom and top section (starter bars and dowel bars). When set to Auto, the program selects the scale automatically. Scales 1:10, 1:20, 1:25, 1:33, 1:50, 1: 100 are available

e) **Drawing options (Columns) / View scale** - column view scale. Scales 1:10, 1:20, 1:25, 1:33, 1:50, 1: 100 are available

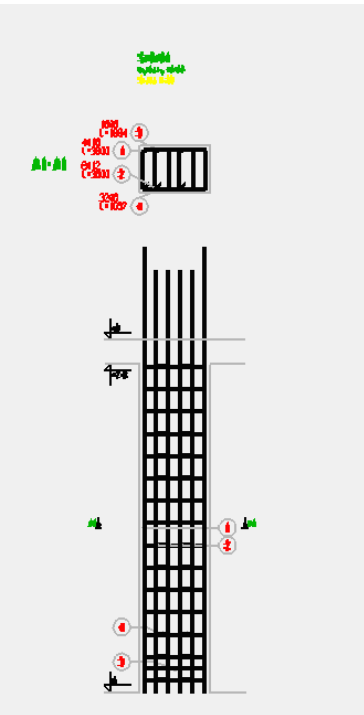
f) **Drawing options (Columns) / Drawing format** - the format of the column drawing. There are 3 possibilities:



- generation of each column independently on A4 format with table. The column cross-section is placed on the right side of the view



generation of each column independently without a table. The pole cross-section is placed above the column view



column chain generation without table. This option is useful when the columns have been defined in one project on subsequent floors

