

ABeam

Quick dimensioning program version 2.1

User manual

1.0 Quick dimensioning program

1.1 Purpose of the program.

Civil engineer can perform the preliminary strength calculation of the ABeam with this quick dimensioning program. Program cannot perform the final strength calculation of ABeam, because the program will not display all details about the structure of ABeam.

The program will also perform shear resistance calculations of the web of hollow core slab.

1.2 Calculation code used by the program

The program calculates ABeam in accordance with the following codes:

- Finland national RakMK B4, concrete code 2004, BY 50
- Finland eurocode SFS-EN 1992-1-1:2005(+NA 2007)
- General eurocode EN 1992-1-1:2004 (Eurocode 2)

The program calculates the resistance of the head of hollow core slab in accordance with Finnish concrete standard no. 18 (1.8.2007).

When calculation code is eurocode composite action is calculated with VTT-S-06422-08 New Kcd values for BNK 18.

2.0 Calculation file management

2.1 General information

The program uses project folder for data files, which means that for each project can be found own folder for calculation files. In the folder is stored also calculation code to be used.

When calculation file is opened the calculation code in the folder becomes automatically in effect in the program. Calculation files that are in the same folder will use the same calculation code. Current calculation code is also visible as a flag symbol on the left lower corner of the main window. Used calculation codes have been presented in chapter 1.2.

2.2 Choosing the project folder

- Open file/project folder
- Choose folder
- Press OK-button and the program moves to the folder in question, calculation code is set and the window is closed.
- Now you can calculate the old files in this folder or you can produce new ones at which point the calculation code is compatible with the folder.

2.3 Creating new project folder

- Open file/project folder
- Choose folder
- Name the folder
- Accept folder name by pressing OK-button
- Program will request conformation about the new folder. Press OK-button to accept the new folder.
- Close folder window by pressing OK-button
- Choose calculation code used in the folder from the calculation code menu.

2.4 Project information

Insert project name and descriptive calculation information which will be printed as headlines for all calculation prints.

2.5 New calculation

This resets all previous calculation data and restores default values.

2.6 Using old file

This will import the old calculation file.

2.7 Save calculation file

This will save the data values to a new file already in use or requests a new name for the calculation file.

2.8 Save as

This saves data values of the calculation under new name in the project folder.

2.9 Preview and print

With preview and print you can view the printout and send it to the printer.

3.0 General information of Abeam

3.1 General information

- *Calculation information*
Calculation information is a name that describes the beam. It is printed on the printout.
- *Reliability class*
RC2 is consistent factor according to SFS-EN 1990 that has an effect on loading combination.
- *Exposure class*
Beam environment class consistent of concrete standard B4 and eurocode 3
- *Fire class of beam*
Program can calculate beam up to 180 minutes fire class without separate fire protection.
- *Allowable width of crack*
Allowable width of crack on bottom surface of hollow core slab when calculating the head of hollow core slab.
- *Span of beam*
Enter the calculation length of beam. Beam is always calculated as one-spanned and freely supported structure.

3.2 Location of beam

Program can calculate two different kinds of beam structures depending on how hollow core slabs are located in different sides of beam.

- *Intermediate beam* has on both sides of beam same or different height hollow core slab and the length of slab can also be different.
- *Edge beam* has hollow core slab only on the other side of beam and at the other side of beam can be casted short (<1500 mm) edge concrete.

Changing the location of the beam will also change the starting values of other windows.

3.3 Erection style in erection phase

When erecting hollow core slabs the following options are available:

- *Erection in turn*

Hollow core slabs are erected in turn on the both sides of intermediate beam. This option minimizes torsion in the beam in erection phase.

- *One-sided erection*

All hollow core slabs are first erected on the other side of intermediate beam and then on the other side.

These choices have an effect on the value of torsion moment of A-Beam. A-beam is rigid enough to endure the torsion caused by one-sided erection but torsion resistance of end connections must be checked.

- *Erection support*

In erection phase the web of beam is supported on both heads of beam to prevent torsion moment going from beam to support.

3.4 Distance between beams/distance from edge

User must provide the distance of adjacent beams for calculating loads.

4.0 Floor system information

4.1 Type of hollow core slab

- Program can be given same or different height hollow core slab on the both sides of beam.
- Program uses hollow core slabs that are type approved in Finland. The slab types that are chosen are always filtered by the program according to the chosen calculation code.
User can choose between RakMK B4 and eurocode 2 hollow core slabs that are type approved.
- Program will automatically insert the standard concrete strength to the hollow core slab. User can change it if necessary.
- Type marking -X of the hollow core slab uses 9.3 mm cords and hollow core slab without type marking -X uses 12.5 mm cords. There are three cording choices and the program will display the number of cords in the slab.
- Pre-stress and the loss of stress of cords can be changed if necessary. Starting values are standard.
- The standard length of hollow core filling is 50 mm and changing it will have an effect on shear resistance of the head of hollow core slab.

With chosen information the program calculates the shear resistance of the concrete web in the head of hollow core slab in accordance with Finnish concrete standard no. 18.

The program will not calculate bending resistance of the hollow core slab. Information of the strength calculation of the head of hollow core slab is located on page number 3 of the printout.

The head of hollow core slab is only preliminary calculated. The supplier of the hollow core slab will be responsible for the final calculation of the slab.

5.0 Cross-section of Abeam

5.1 Type of top slab

Choose the surface structure of hollow core slab. This will have an effect on all the other values in the window. The following surface structures are available:

- *Top slab (>=40 mm)*

On the top of hollow core can poured concrete slab and it can be also reinforced. Top slab functions as a composite element with the beam. Standard height beam is chosen to A-Beam.

- *Bay of beam* (≥ 40 mm)
Bay is used at roofs and top floors of parking houses, where hollow core slabs doesn't have any other surface concrete.
With bay you can increase bending resistance of the beam. With bay you can use standard height beam and protect hangar steels and the beam itself from corrosion and demanding conditions. Bay also functions as a composite element with Beam.
- *Hollow core slab filling* (10-30 mm)
Filling is only 10-30 mm thick surface concrete that doesn't function as composite element with the beam, but when calculating loads it functions as a load to the slab. Thickness of the filling can be different vary on various sides of beam. Filling can be used on the top surface of the slab as corrosion protection. A-Beam can be low-height or standard height.
- *No surface structure*
There will be no surface concrete or filling on top of the hollow core slab. A low-height beam type is chosen. Grouting of the hollow core slab protects the reinforcements of the top surface of the beam.

5.2 Structure of the top slab

The following data is given about the structure of the top slab and the bay:

- Material partial safety factor for concrete
- Strength of concrete
- Thickness of top slab on the right and left sides of beam. Thickness of the top slab must be bigger or equal than 40 mm. Filling thickness of hollow core slab is 10-30 mm.
- *Take into account in ultimate limit state*
With this selection user can choose is top flange of hollow core slab taken into account when calculating cross-section bending resistance. Filling of the hollow core slab doesn't function as a part of load bearing structure of the beam.
- *Take into account in service limit state*
With this selection user can choose does top flange of hollow core slab function as a composite element when calculating deflection of beam.

5.3 Transverse reinforcements of top slab

Reinforcement can be placed in the top slab and in the bay. Size and spacing can be chosen. Reinforcement will essentially increase composite effect between top slab and the head of hollow core slab. In addition the reinforcement diminishes principal stress level of vertical web in the head of hollow core slab.

5.4 ABeam

Program uses only standard Abeam types. According to users selections the program updates the main window and shows the main dimensions of the beam and other structure.

Beam used in calculation is chosen in the following order:

- *Height of beam*
Standard height ABeam is used when top slab or bay is poured. ABeam functions as a composite element with top slab.
Standard low-height ABeam is used when there is surface filling or no top slab. Beam is low enough that the grouting of the hollow core system creates corrosion protection to the reinforcements and the hangar steels of the beam.

- *Type of beam*
Choose resistance class from three choices: light, normal or heavy. Program will not show the final structure of the beam in different resistance classes.

- *Choose cross-section*
Program displays the beams by their width. The coding of the beams is following:
 - **A265-280** Standard height intermediate beam for 265 mm high hollow core slab and 280 mm wide column.
 - **A265-380m** Low height (m) intermediate beam for 265 mm high hollow core slab and 380 mm wide column.
 - **A400-380R** Standard height edge beam (R) for 400 mm high hollow core slab and 380 mm wide column.
 - **A400-480Rm** Low height edge beam (Rm) for 400 mm high hollow core slab and 480 mm wide column.Program will always display actual dimensions of slab structure interfaces. Program will not display the inner structure of the beam.

- *Elevation parts*
Using elevation parts can the height of the beam be elevated to the next standard beam type and they can also adjust the height differences of hollow core slabs. Program will take elevation parts into account in strength calculations of the beam.

6.0 Loads

6.1 General information

Loads to the beam are given separately as uniform loads on the left and right sides of beam. Program automatically calculates the dead weight of hollow core slab, grouting, top concrete, filling, bay and Beam. So they are not given as loads to the beam.

User only inputs dead load and variable live loads that are on top of the top slab. All load-values are given as nominal loads. Program will then combine calculation loads using combination formula in accordance with Eurocode.

6.2 Dead and live loads

There are two choices when assigning dead and live loads to the slab:

- Uniform load kN/m^2 to the whole surface area of the hollow core slab: permanent g_k and live q_k load to the slab. Program will calculate loads to beam using the spans of hollow core slabs. Program will place the calculated load to the head of hollow core slab where it transfers first to the bottom flange of beam and there on to the beam. Load values are given as nominal loads for m^2 of the slab area (kN/m^2).

- Local line load kN/m for hollow core slab.
Permanent and live loads can be given to the hollow core slab as line loads. User must first calculate these local loads as line loads to the head of hollow core slab separately on both sides of beam.

Line load can begin at L_1 distance from the head of the beam and the length of the load is L_2 . User can input different values at the beginning and at the end of the line load (kN/m). Program will place the calculated load to the head of the hollow core slab.

User can input a percentage of the live load. This percentage indicates how much of the load is taken into account when calculating fire situation.

7.0 Calculation

7.1 General information

With the program user can always perform complete strength calculation to the structure. Calculation can be performed at any time, but user must ensure that the chosen beam type is functional with the height of hollow core slabs. Beam cannot go through the top slab. If some values have not been changed, the program will use default values.

Therefore the user must check that the default values are suitable for the calculated beam. Program will not always complete calculations if the capacity of the structure is too low for the loads. If this happens, program will notify user with a popup window or with a red cross-logo in the Results-window. In that case user must change the structure of the beam.

7.2 Resistance beams

After calculation the program will display two utilization grades at the left lower corner of the main window:

- *Beam:*
Utilization grade of bending resistance of beam calculated in ultimate limit state.
- *Hollow core slab:*
Utilization grade of main tension stress at the vertical web on the head of hollow core slab calculated in ultimate limit state.
- *Results*
The results window has a green OK-logo. If calculations are in acceptable level the green OK-logo is lit. If a red-cross logo is lit that means that the utilization grade of some value is exceeded.

If calculation variables of the utilization grades exceed, that also changes the value red.

Rest of the calculation results and their utilization grades are displayed at Results window in different calculation situations.

8.0 Results

8.1 General information

Program displays the calculation results in three windows:

- Erection phase
- Service phase
- Hollow core slabs

These windows will divide into two parts. Top part information is same at all windows. Bottom information's are given case by case.

8.2 Erection phase

In erection phase at the window bottom part is printed A-Beams internal forces in ultimate state and their utilization grades for beam structure where hollow core slabs are erected and grouted.

8.3 Service phase

In service phase at the window bottom part is a printed A-beams internal force in ultimate state for structure where top concrete is poured and it is hardened and all loads have been given to ABeam.

In service limit state deflections of the beam are printed.

- Dead loads (=top slab + hollow core slab + the weight of the beam) are always removed by pre-incrementing A-Beam.

- The deflection caused by live loads is represented by a null line. This is the deflection value used in calculations.
- Total deflection can be used to estimate beams elasticity and sensitivity to vibrate. In fire situation the utilization grade of bending moment and shear force are printed for the chosen fire class without external fire shielding of the bottom flange of A-Beam.

8.4 Hollow core slabs

In the bottom part of hollow core slabs-window is printed the preliminary calculation of the head of hollow core slab in accordance with Finnish concrete standard no. 18. Variables that are printed represent the composite effect between A-Beam, hollow core slab and top concrete.

Program will not perform bending resistance calculation of the hollow core slab but it will calculate the composite action with the head of the slab and with the beam. The supplier of the hollow core slab will always be responsible for the final calculation of the slab.

8.5 General information of the beam

Program displays the calculation code, chosen beam and the structures of the hollow core slab in the Results-window.

8.6 Calculating corbel

Program chooses appropriate Anstar AEP-corbel for A-Beam on the basis of calculation data. Calculation is performed on the basis of ABeams support reactions in erection and service phases. Erection method and erection supporting are also taken into account in calculations. The corbel is then chosen. It must function in accordance with the resistance values of AEP-corbel BY user manual no. 313 (BY5 B) and no. 11 (BY 5B-EC 2). Chosen AEP-corbel is now normative and main structural engineer/Anstar will verify the corbel type.

9.0 Info

This window will display structural details about the interface of ABeam and the AEP-corbel. It will also display details about the structure of ABeam

10.0 Printing

Printout contains the following information

- General information of the beam
- General information of the hollow core slab
- Utilization grades and resistances of the beam in erection, service and fire situations.
- Utilisation grade of corbel

11.0 Discharge of responsibility

Anstar will not be responsible for any damages caused by ABeam quick dimensioning program. ABeam program is intended only for preliminary calculation of Anstar ABeam. Program is not meant for calculating any other beams. Anstar will always perform and be responsible for the final strength calculation of ABeam. The Program will not display the internal structure or materials of the beam. It will only display the main dimensions of the beam. The preliminary strength calculation of the head of hollow core slab is performed with a hollow core slab that is manufactured in accordance with Finnish concrete standard no. 18. The supplier of the hollow core slab will always be responsible for the final dimension of the slab. Information calculated by the ABeam program can only be used to create contract inquiry material for turnkey contract. Information given by the program is not allowed to be used in manufacturing any other beam structures.