

WORK INSTRUCTION

1. General

Programme is made in Excel with support of VBA (Visual basic) module. The input data is entered in six Forms.

These instruction and text in Comments of cells in sheet **Analysis and dimensioning** give enough explanation for using the programme. For additional information the author is always at disposal.

2. The Analysis of Stability

- 2.1. The programme enables the analysis of stability: Retaining wall, revetment wall, retaining-revetment wall, and gravity retaining wall, with or without cantilever, with or without anchors (up to five rows of anchor), wall with three possible ground layers behind the wall (foundation soil is the fourth layer) and different kind of loading (traffic, foundation, linear and spot loading). Instead of Foundation load, you can enter any kind of loading (for example, specialised vehicle).

Except the loadings above described, you can enter level of ground water (GWL) behind the wall and the data about GWL is entered into Analysis and stability and the calculation of Project foundation solidity.

After choosing Project access and entering all the cells in blue colour, the result is the final Factor of safety on turning overs, foundation sliding and bearing capacity of the foundation (Project foundation solidity - EC-7) i.e. the level of efficiency.

Very important: If you're not using the Eurocode, there is an option to enter partial factors according to your local regulations in the appropriate cells (N18 to N41) in sheet **Analysis and dimensioning**.

- 2.2. **Revetment wall:** If you perform revetment wall, for example in front of the layer 2 and 3, the angles of friction for these layer are - fictive (φ^*), i.e. the angles which in value $\Theta=45+\varphi^*/2$ give the inclination of natural terrain Θ i.e. sliding surface - active wedge For example: Natural inclination (also the sliding surface has the angle $\Theta=80^\circ$. Calculation - fictive angle: $\varphi^* = (80-45)*2=70^\circ$. If the revetment wall is along its whole height, then his kind of fictive angles of inner friction are entered for all three layer.

- 2.3. **Gravity wall:** It is formed according to the Swiss regulations, where besides designed height, designer determines the width in the wall crown. After determination of wall height and choosing wall in the crown, it is **obligatory to do the recalculation**. After that, enter the dimensions of the gravity wall into the appropriate place in the Form 3 - **Wall dimensions**. Surely, if the subsidence factors, roll-over factors and terrain solidity factors are not satisfactory, it is necessary to repeat the same procedure with increased width of the wall in the crown.

3. Cantilever (it is not performed along the massive wall)

In case the wall has the cantilever, choose YES, and if there is no cantilever, chose NO. If the cantilever is performed on the retain-revetment wall, the greatest efficiency is achieved if the edge of the cantilever is touching the sliding surface on the friction where there is revetment and retaining wall, because in this case the stability on turn over is significantly higher and the bending moment in the heel of the wall is reduced.

4. Anchors (it is not performed along the massive wall)

The calculation of bearing capacity of anchors and determination of free and anchor section

If the wall is designed with anchors, choose **YES** and if there are no anchors, choose **NO**. The default forces in the anchors are the pre-stressing forces. The guiding bearing capacity of anchors is calculated automatically after entering information about anchors while using one of the usual ways.

If the predicted free section for certain anchor is too short, it is followed by warning of minimal length of free section. This value (slightly increased) needs to be entered in the place where the value of free section is entered.

Note: The first row of anchors is always the highest row, the second row is beneath the first row etc.

5. Counterforts

If the counterfort is foreseen, in **Form 5. Counterforts**, choose YES and if there is no counterfoil, choose NO.

6. Material properties

The class of concrete and reinforcement, especially for the foundations, especially for the wall, console and the counterfort, is chosen by the designer in Form 6. With this program the foundation and wall armature is provided with a ribbed reinforcement, and it is possible to choose a ribbed reinforcement or reinforcement mesh for the wall. The choice of ribbed reinforcement is possible through the drop down menu.

7. Dimensioning (for the massive wall - not necessary)

Dimensioning of the reinforced concrete wall is performed according to the Method of borderline state (EC 2), in five programmed cross section through across the wall and foundation (cross section from I-I until V-V) and the cross section across the cantilever. The cross section IV-IV is at the wall height where the bending moment is minimal (Mmin), along the cross section III-III which is always minimal when there is no cantilever. The cross section V-V is at the wall height where the bending moment is at the maximum (Max), i.e. the first one greater than 0. The designer can perform the testing of reinforcement in any of the cross section, by using the value of moments and longitudinal forces from the cells T43 until AI51 in the sheet Analysis and dimensioning.

8. Moment Diagram

Is shown in the sheet **Moment Diagram**. Except for the cross section from I-I until V-V, for which was dimensioning performed, bending moments are calculated in twentieth of cross section height. With this density of cross section positioning for drawing a diagram of bending moments, the exact height of the anchors are not always right, although the values are very close to the cross sections.

9. Reinforcement and Anchor Statement

Reinforcement schema is shown in the worksheet **Analysis and dimensioning**, and reinforcement and Anchors Statement in **Reinforcement Statement** worksheet. The sheet provides amounts and shape of reinforcement and anchors (for massive wall only item 5 need from the Reinforcement statement)

10. Bill of Quantities (for gravity wall, item 3. and 4.2. in sheet Coast estimate no necessary)

Amount of concrete, reinforcement and drainage enter the sheet **Coast estimate** automatically. In order to calculate excavation and backfill amounts it is necessary to populate blue coloured cells. In case these values are not updated, in the sheet **Coast estimate** will enter correct data only for amounts of concrete, reinforcement and drainage. Data on excavation and backfill will be from prior calculation, i.e. will be incorrect.

11. Coast Estimate (for gravity wall, item 3. and 4.2. in sheet Coast estimate no necessary)

Sheet **Coast estimate** shows, after inputting unit prices, full supporting wall construction expenses amount. Unlike in other worksheets, here it is possible to change the text (blue and black coloured cells). The cells linked to other worksheets are protected (e.g. units, excavation amount, concrete, armature, anchors etc.)

12. Calculation and Printing of the document

After entering new data, by pressing the Calculate button, the result based on currently entered data is presented. After filling of all blue coloured cells and after pressing the Recalculation button the calculation is complete. The procedure can be repeated unlimited number of times before exiting the program. Printout are encompasses the following: Analysis and Dimensioning (9 pages) or with Conterforts (10 pages), Cross section of the wall (1 page), Moment diagram (1), Reinforcement statement (1 or 2 pages) and Coast estimate (2).

13. Most Unfavourable Load Combination Basic + Earthquake

14. Note:

- 14.1. Each New Calculation Can be Performed Only With Original CD.
- 14.2. Program Retaining wall-ver.13.0 was created on version ver.11.0, but compared to that version, the program was upgraded with a counterforts wall analysis. With this program it is possible to create a stability analysis and dimensioning of ALL types of walls regardless of the shape and dimensions of the wall and the type of load.
- 14.3. The programme can be activated only with password chosen by the buyer, at the moment of concluding **The agreement on copyright works**, and the same can be used only within the company - buyer of the programme.
- 14.4. If the wall's cantilever is too big and/or the anchor are too stressed, tensile zone is possible even on the face of the wall. Therefore, along with every dimensioned cross section there is always a note about the position of the main reinforcement. The above mentioned is in the design of reinforcement shown at the right spot, i.e. in tensile zone.
- 14.5. The program was tested and its calculations are proven to be valid for "all" possible shapes, sizes and functions of the supporting wall and the foundations. However, if users encounter a problem (an error) in calculations which was not identified during the testing phase, they can notify me via enclosed e-mail address and I will provide a solution to the problem as soon as possible.

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