

## Installing and running Prob2BDemo

In order to install this program you need to have Admin rights on your computer. You need also Java on your computer.

1. Installing Prob2B
  - a. Copy the file Prob2BDemo.zip onto a location on your computer, e.g. on your desktop and unzip. This creates an unzipped folder \Prob2bDemo.
  - b. Copy (or cut+paste) this unzipped folder into the directory C:\ProgramFiles\  
**NB:** experience has learned that executing this procedure the other way around, i.e. first manually create a folder C:\Program Files\Prob2BDemo \and then unzipping the program files into this folder, may lead to problems in running the program.
  - c. Go to the new folder C:\Program Files\Prob2BDemo
  - d. Go to the subfolder .\reglib and doubleclick on VFRUN66BI.exe. This will install a Fortran compiler on your computer. You need to reply several times "Yes".
  - e. In the subfolder .\manual\General\_and\_Excel you find a pdf with a detailed manual of this package.
  - f. You can start the program by running the Prob2BDemo.bat file.

Important notice:

Prob2B is a 32bit program. If you are running a 64 bit computer you must place the program in the directory C:\ProgramFiles (x86)\ instead. Although the Prob2BDemo.bat can be started from anywhere on your computer, you need to execute VFRUN66BI in the folder C:\ProgramFiles (or C:\ Program Files (x86)). For the execution of VFRUN66BI you need administrator rights. For running Prob2b.bat you don't need these rights. On some computers it may take some time after starting VFRUN66BI before you get a reaction. Be patient.

2. Prepare your calculation, we follow the example from chapter 10 of the book on Bed, bank and shore protection (dimensions).
  - a. We first define the Z-function (which is in fact the Van der Meer equation):

$$Z = c_{pl} P^{0.18} \left( \frac{S}{\sqrt{N}} \right)^{0.2} \left( \frac{\tan \alpha}{\sqrt{s}} \right)^{-0.5} - \frac{H_{sc}}{\Delta d_{n50}}$$

- b. Then we make a table with all variables, type of distribution and values:

$H_s$	m	Exponential	$\lambda=3.83$	$\varepsilon=1$
$\rho_s$	kg/m <sup>3</sup>	Normal	2600	100
$\rho_w$	kg/m <sup>3</sup>	Normal	1030	5
$d_{n50}$	m	Normal	0.6	0.05
S	-	Deterministic	2	
N	-	Deterministic	7000	

P	-	Lognormal	0.1	0.05
s	-	Normal	0.05	0.005
tan $\alpha$	-	Normal	0.25	0.0125
c <sub>pl</sub>	-	Normal	6.2	0.45

Note: for the exponential distribution, use parameters ( $\lambda=3.83$  and  $\varepsilon=1$ ). For the lognormal distribution use moments with mean=0.1 and standard deviation = 0.05. Leave  $\varepsilon=0$

3. Start the program by double click on Prob2BDemo.bat. A black (dos-prompt) window will appear. Wait for some time, and then the start screen of Prob2B appears .
4. You can now enter the variables and your model, do this with the button with a M on top of the triangle.
  - a. First you enter the variables, click on “variable”, and then on “add”.
  - b. In the next screen you fill in the name, unit, type and value of the variable. You should leave the switch “on”. For most variables select “parameters”. Only for the lognormal select “moments”
  - c. After you have entered all variables, you click on expression, and you enter the Z function. Under Output variable name you type Z. Under Expression you enter the expression. Because the spelling of the variables has to be exactly the same as in the input, the most safest way is not typing the variable name, but select the variable from the list of input variables and then click on “insert”. Note that the computer gives directly the average (expected) value.  
In this example the z-function is:  
$$Z = c_{pl} * P^{0.18} * (S/\sqrt{N})^{0.2} * (\tan\alpha/\sqrt{\text{steep}})^{-0.5} - H_s / (\delta * d_n 50)$$
  - d. Because “delta” is not an input variable, you should also enter an expression with output variable name “delta” and expression  $(\text{RhoS}-\text{RhoW})/\text{RhoW}$ .
  - e. Double-click on a variable or expression allows you to change the input.
  - f. You may also add a name of your model
  - g. When everything is ready, click on ok and return to the main screen.
  - h. It might be wise to save your project now (via the tab “file”).
5. Next you have to define the limit state function. In fact you have already defined that with your z-function. Click on L above the triangle, add a limit state function and type in the “expression” box only “Z”.
6. You should select a reliability method, do this via the button with hammer and key. Recommended is to use Form and MonteCarlo
7. Then run the model using the button with the running man.

relevant output: P<sub>f</sub> is the probability of failure of this example, it is 0.115 for Form, and approximately 0.114 for MonteCarlo. This means a probability of failure of 11%.

After a MonteCarlo calculation you can make a plot of Z-values. Click on the graph logo (or go there via “post”). Select “histograms” and parameter “Lsf(0)”. The histogram shows how many z-values were negative, from which the failure probability was calculated.

The model also gives so-called alfa values. The absolute value of the alfa-value gives the contribution of that variable to the uncertainty of the final answer. In our example the  $H_s$  has the highest alfa value. This means that this is an important uncertainty. But also have a look to the alfa-value of  $c_{pl}$ . This value is not negligible. And this is due to the fact that the constant is not really "constant".

The selected value of  $S=2$  means "some damage". So, on average every 10 years you have to do some repair works.  $S=10$  means total destruction. The probability of this is 1.5 % per year; this seems quite small

Because we have entered to probability of the waves in exceedance per year, this is the failure per year. Using a design life time of 50 years and the Poisson distribution, this implies a failure probability of:

$$P_{f50} = 1 - (1 - P_{f1.5})^{50} = 0.53$$

Thus, this revetment will fail with a probability of 53% during the lifetime of the construction. This is too much. Therefore it is recommended to increase the stone size somewhat.

#### **The most common errors:**

*"Illegal dependency Evaluation; Invalid Argument; Error during evaluation"*

This error appears usually in the MonteCarlo option, and not in the Form option. It is usually caused by the fact that in MonteCarlo you try to calculate something which is impossible.

Realise that in MonteCarlo a large number of cases are generated on the basis of the given mean and standard deviation of your variable.

For example you have a grainsize with a mean of 200 micron and you assume a standard deviation of 60 micron. You make a MC calculation with 10000 cases. The smallest value of your set of cases has a probability of  $10^{-4}$ . Using a normal distribution smallest value in your set will have a  $d_{50}$  of -1 or something in that order.

When you calculate for example the Chézy value with  $18^{10} \log(12h/k)$  you try to calculate the log of a negative number (because  $k=2d_{50}$  is negative). And that is not possible. You may solve this by changing your standard deviation or changing the type of distribution.

Be aware that it is not always obvious that you will have something like this. When you have a threshold in for example a stability formula it goes wrong when  $(u-u_*) < 0$ . So when in your set there is accidentally a small value for  $u$  and a large value for  $u_*$ , you may get a negative value, although both  $u$  and  $u_*$  may always be positive (and realistic). In this case the solution is forcing a positive answer using the `max2((u-u*),0)`.