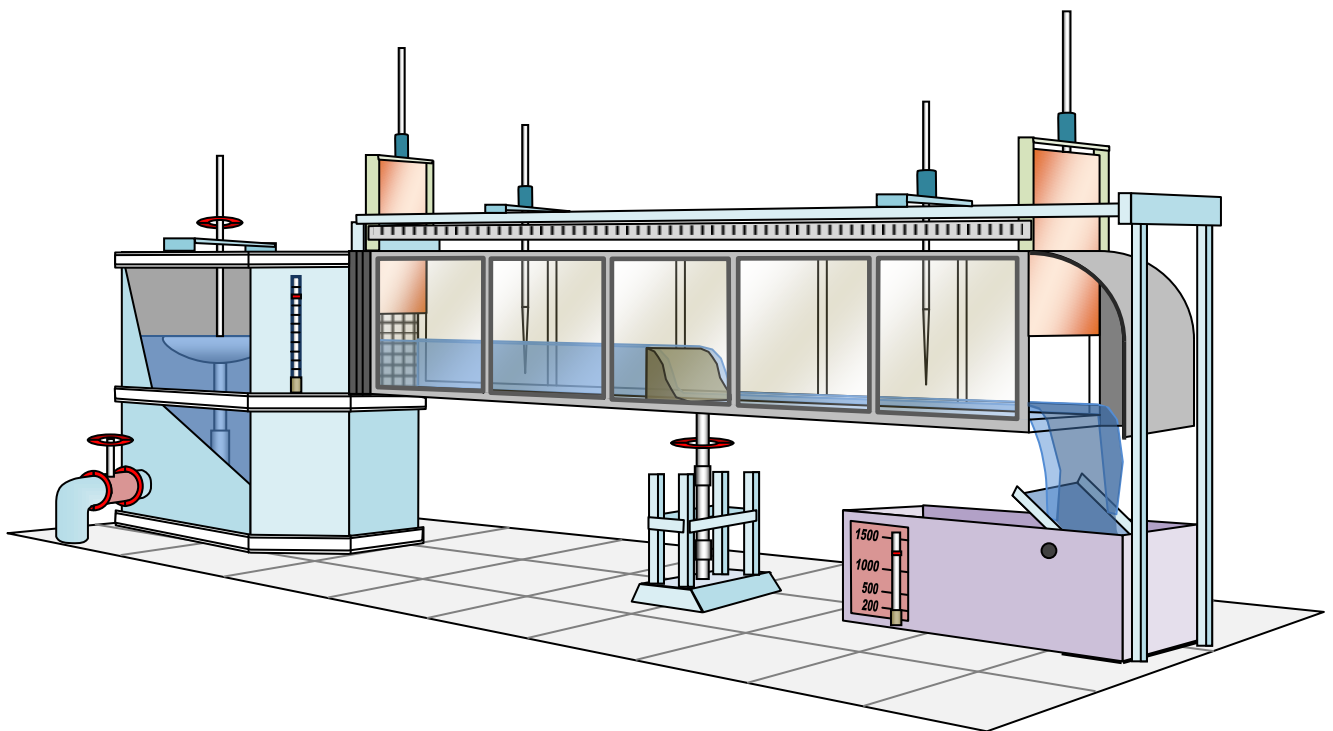


# **VIRTUAL LAB «OPEN CHANNEL HYDRAULICS»**

## **Labwork Module User Manual**



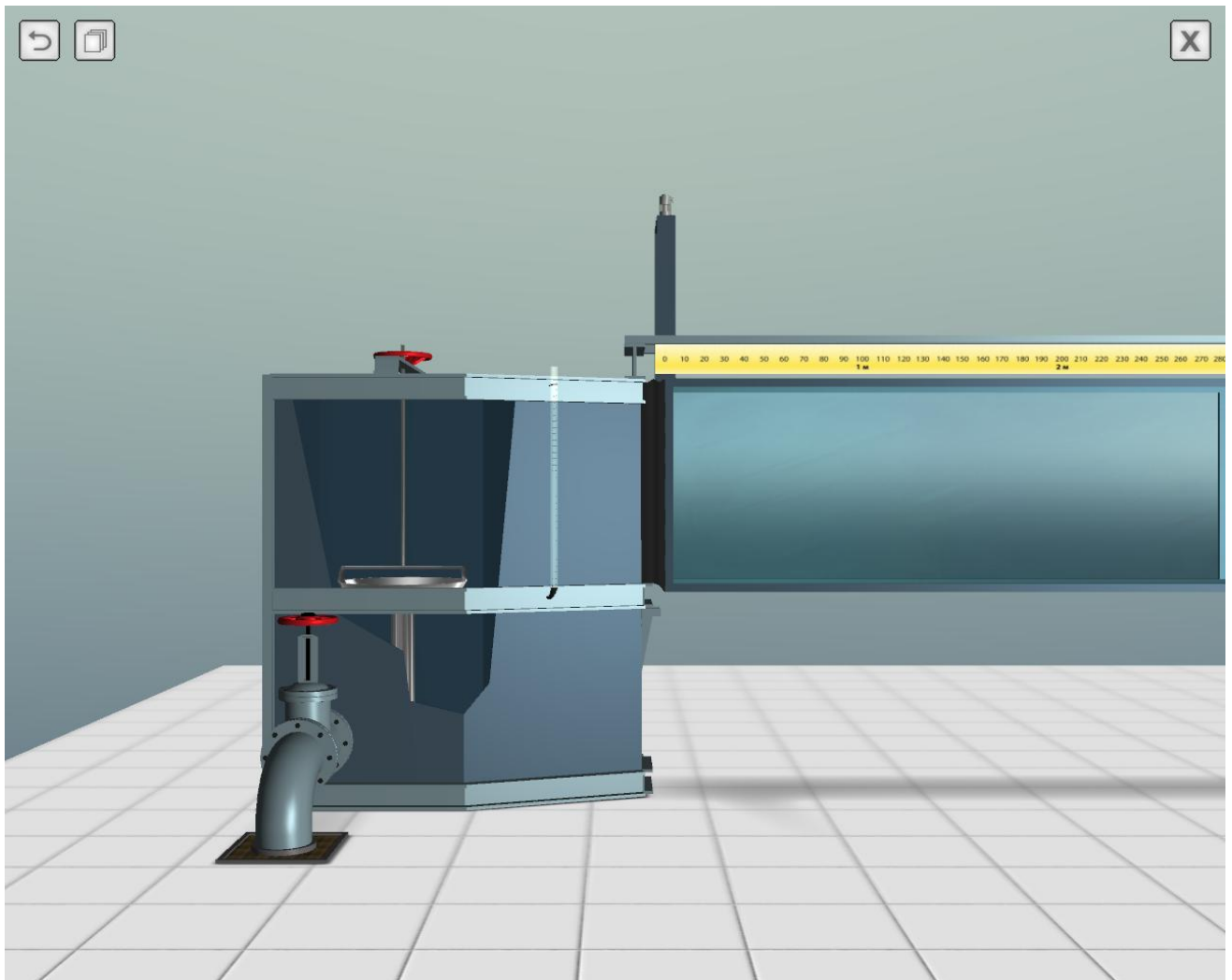
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## THE PROCEDURE FOR WORKING WITH THE MODULE

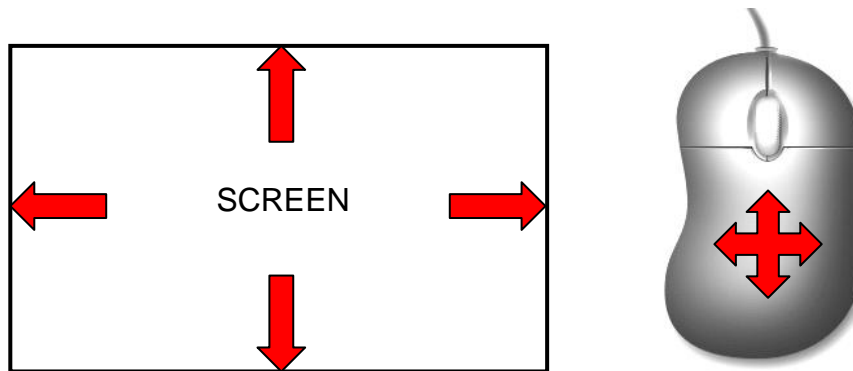
The main component of the software package is the interactive simulator of the water flow in the open channel itself. The simulator is made in the form of a three-dimensional simulation program that provides a visual representation of the models of water flow in the hydraulic channel.

Upon completion of the process of loading the program to the computer's RAM, a three-dimensional scene will be displayed on the screen (Figure 1). At the top of the screen are the function buttons (from left to right): the button «Reset Parameters», «Open Model File», «Exit Program».

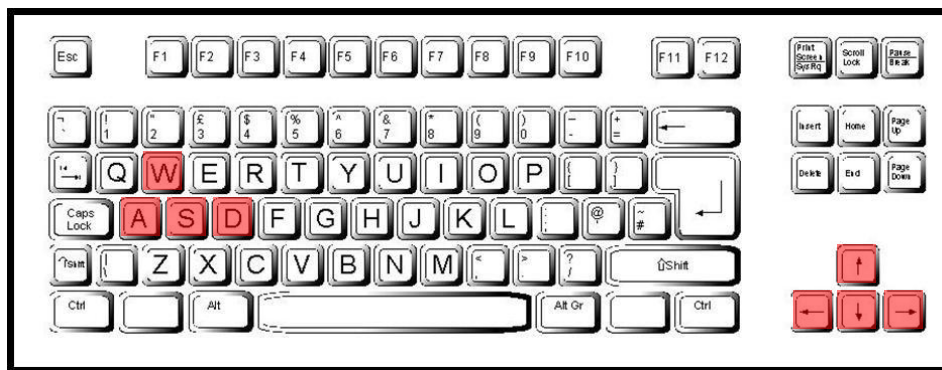


**Figure 1** – The Screen of the Interactive Three-Dimensional Simulator

Moving a view (virtual camera) is carried out using the mouse or keyboard. To move the view in the plane of the screen, you must move the mouse pointer to the edges of the screen (Figure 2). Also, the camera can be moved in the plane of the screen using the cursor keys (arrow keys) or the text keys «W», «A», «S», «D» (Figure 3).

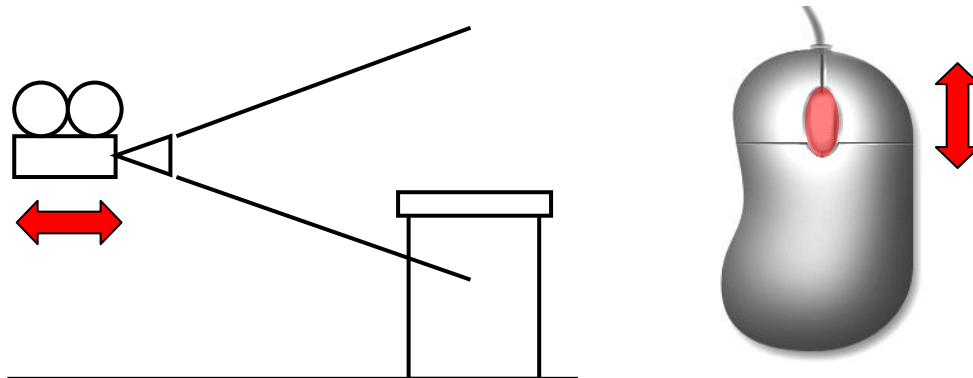


**Figure 2** – Move the Virtual Camera in the Plane of the Screen with the Mouse



**Figure 3** – Use the Keys to Move the Virtual Camera in the Plane of the Screen

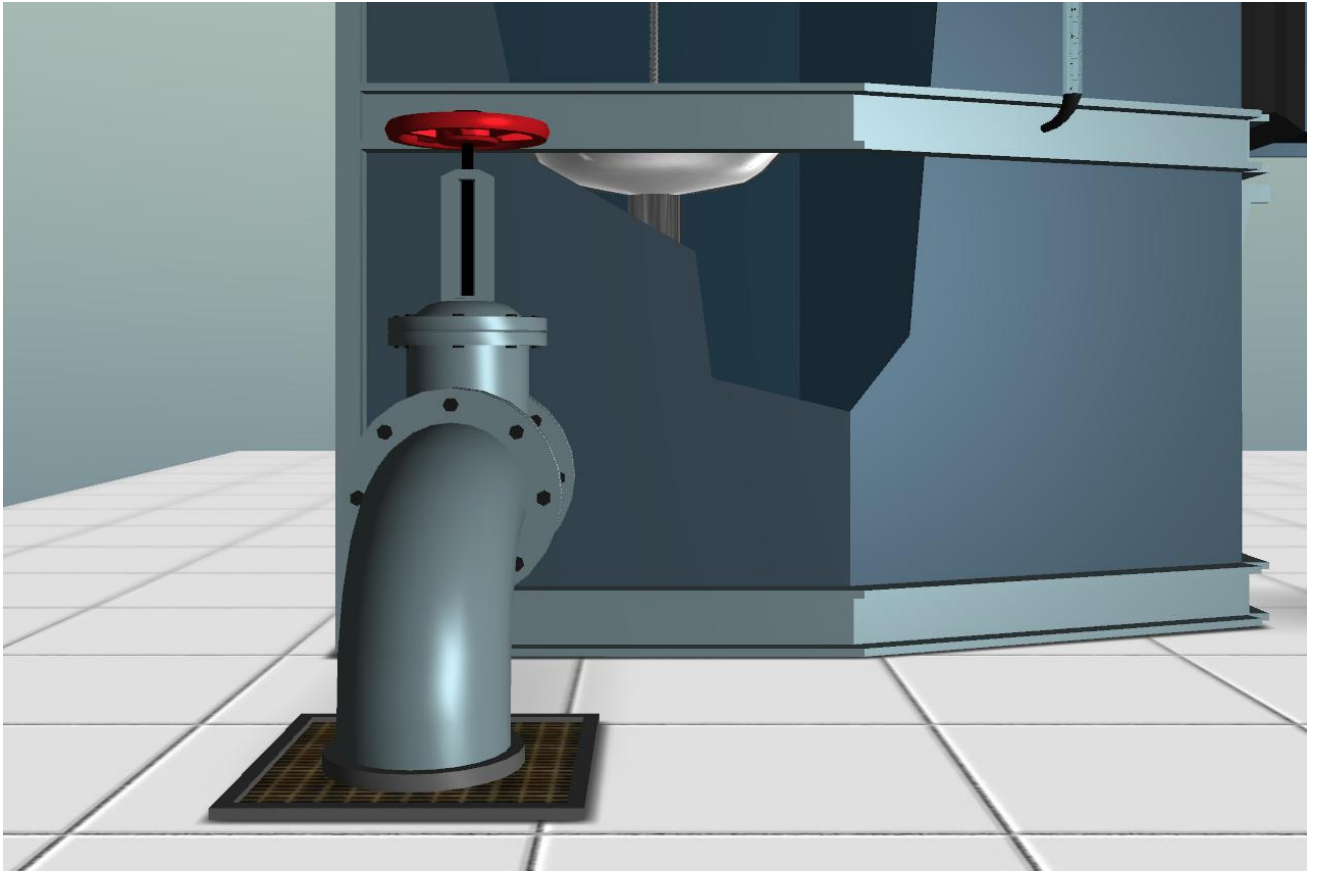
The virtual camera is zoomed in/out using the mouse wheel or the «+» and «-» keys. Rotating the wheel forward brings the camera closer to the laboratory stand, and rotating the wheel in the opposite direction moves the camera away from the stand (Figure 4).



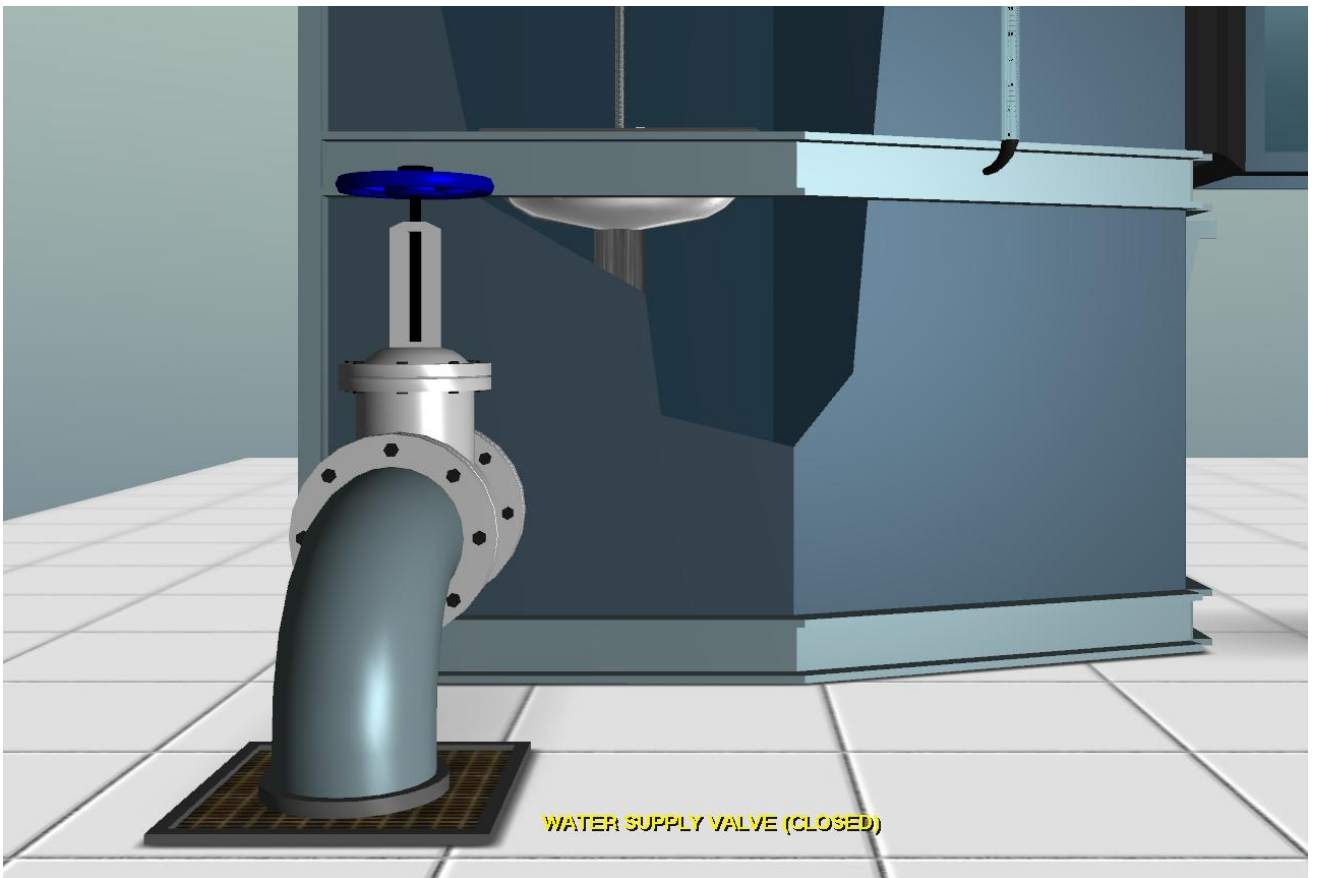
**Figure 4** – Move the Virtual Camera Perpendicular to the Screen Plane with the Mouse Wheel

The system is started using the water supply valve (Figure 5). To open the valve, move the mouse over the object (the valve is displayed in white) and left-click.

a

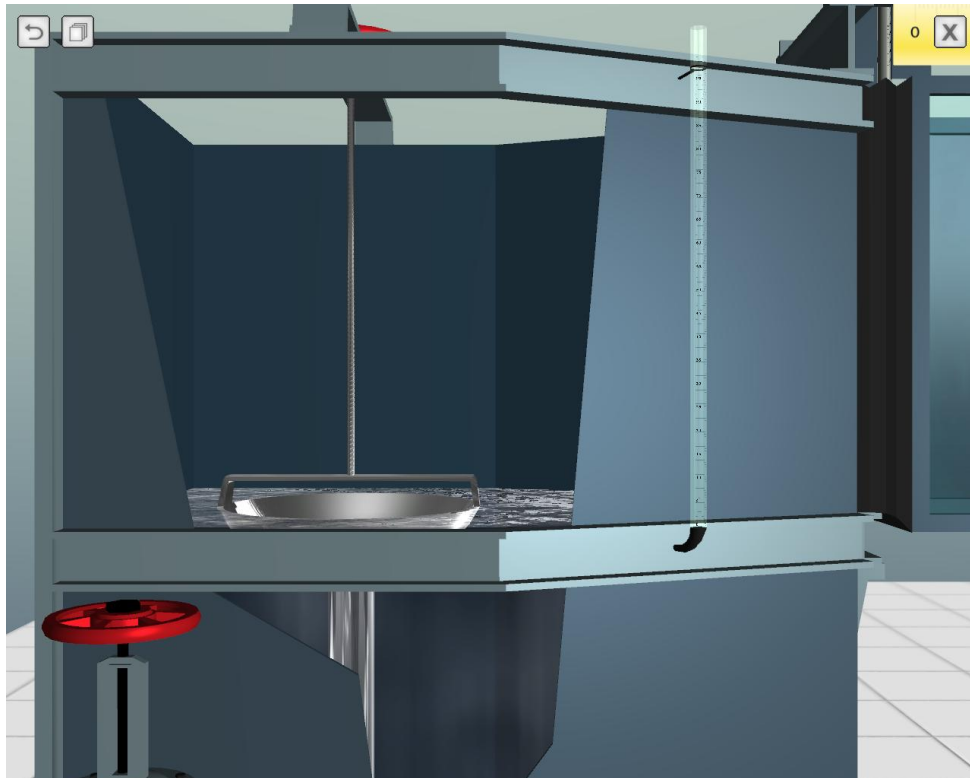


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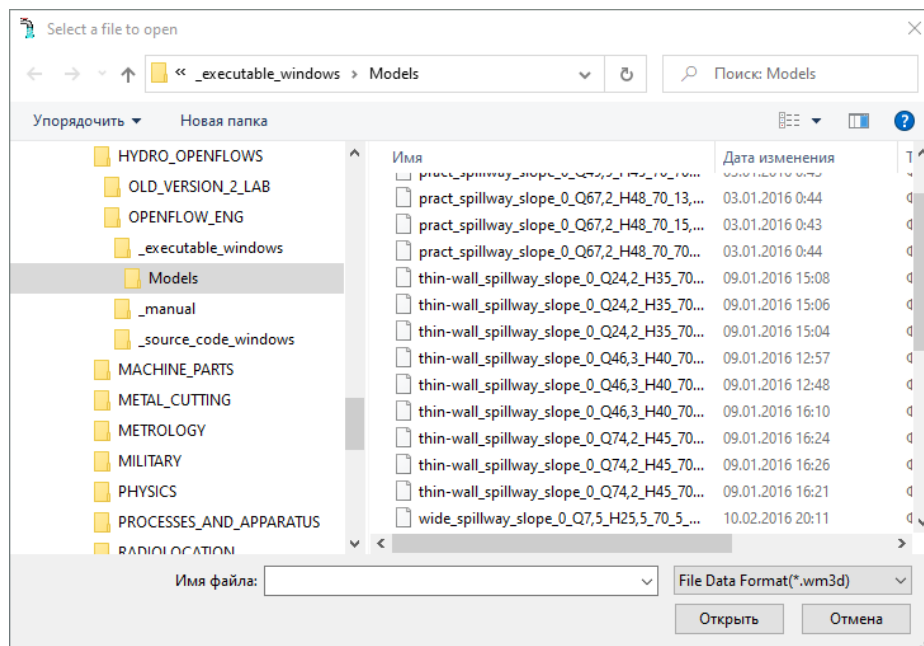
**Figure 5 – Turn On the Water Valve**

After turning on the water supply, the pressure tank will be filled to the zero level of the channel (to the level of the bottom of the channel). Further filling of the equipment will occur when opening the simulation model file.



**Figure 6** – Initial Filling of the Pressure Tank with Water

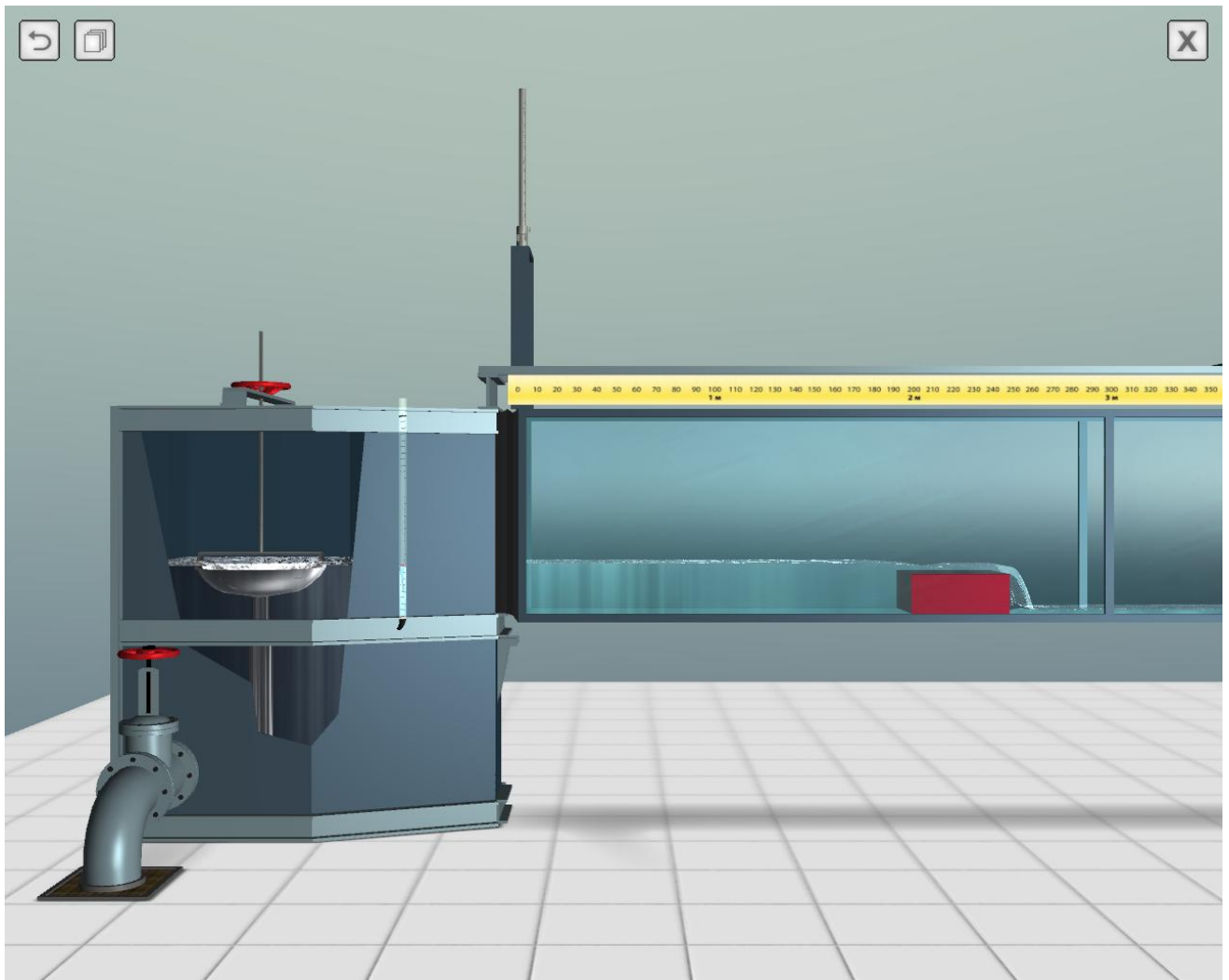
To open the simulation model file, hover over the second functional button at the top of the screen and left-click once. When performing this action, the dialog box for selecting the file to open will open (Figure 7).



**Figure 7** – Simulation Model File Open Dialog Box

In the dialog box for opening the file, the last path to access the folder in which the files of simulation models are stored will be set. If the file is opened for the first time, you need to find the folder on the hard drive with (using the folder tree in the opening dialog box).

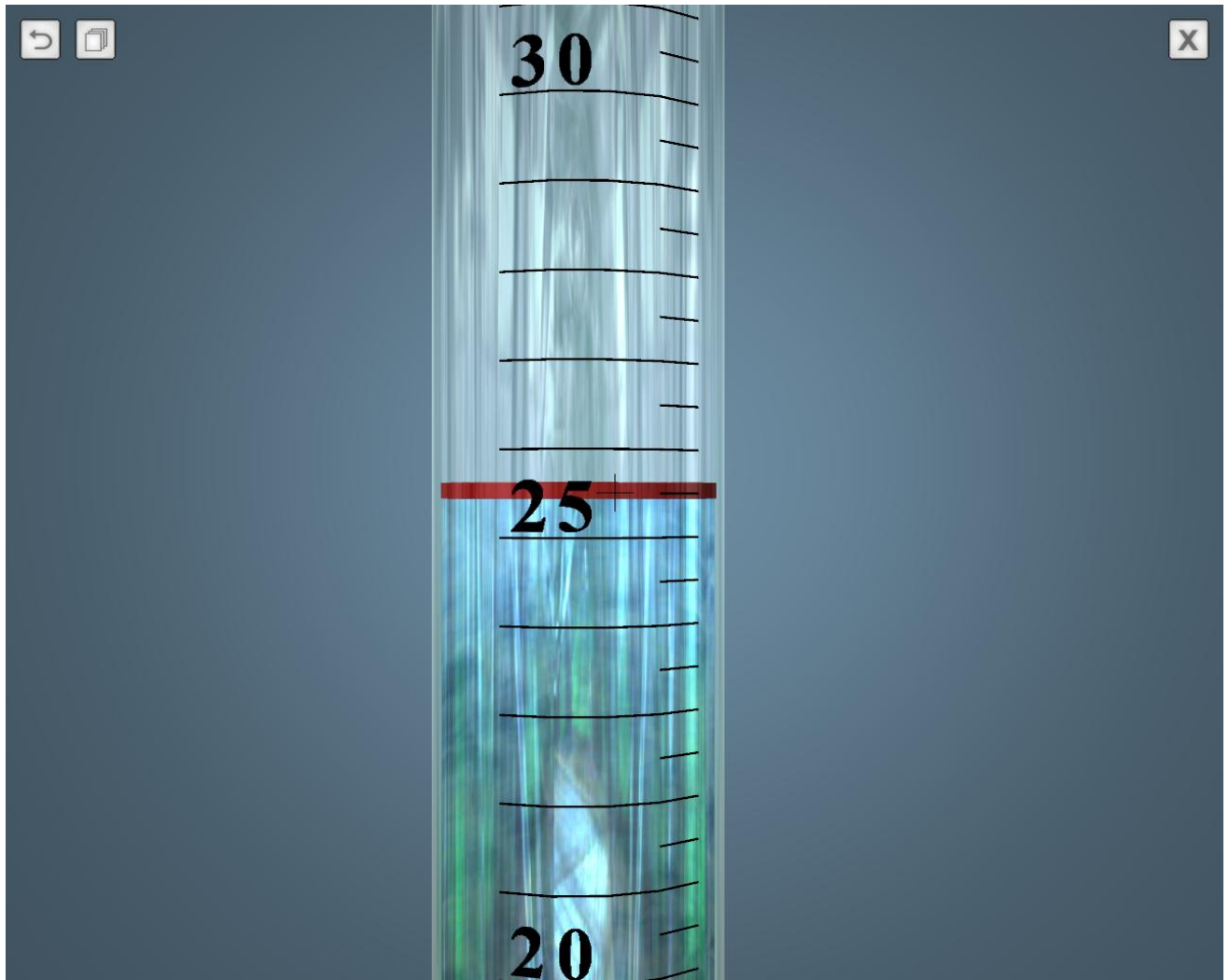
After opening the model file, all equipment parameters, namely, the initial water pressure, the position of the spillway bowl in the pressure tank, the opening of the shutters, the slope of the bottom of the channel, the construction of the spillway, and the shape of the water flow in the channel will line up in accordance with the parameters specified in the model file. Figure 8 shows a view of a laboratory equipment after opening a simulation model file (a flow model for a spillway with a wide threshold is specified).



**Figure 8** – Equipment View with a Loaded Simulation Flow Model

Next, measurements are made of the main hydraulic characteristics. The relative head in the tank is fixed by the position of the float of the measuring tube (piezometer) of the pressure tank. In order to bring the camera closer to the piezometer of the pressure tank, move the center of the screen to the object and turn the mouse scroll away from you to approach the location of the float (Figure 9). When the camera is

located near the measuring scales, an auxiliary cross (sight) is displayed in the center of the screen, allowing accurate measurements of the marks on the scales.

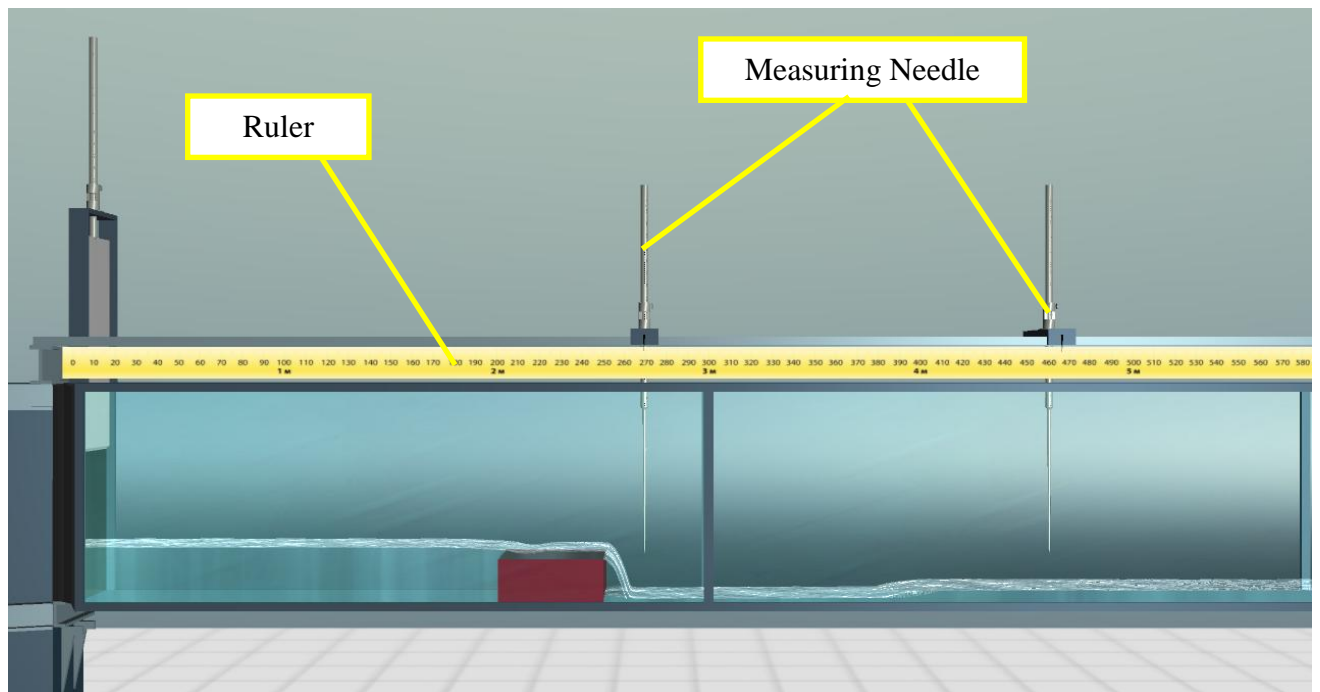


**Figure 9** – Reading from a Pressure Tank Piezometer

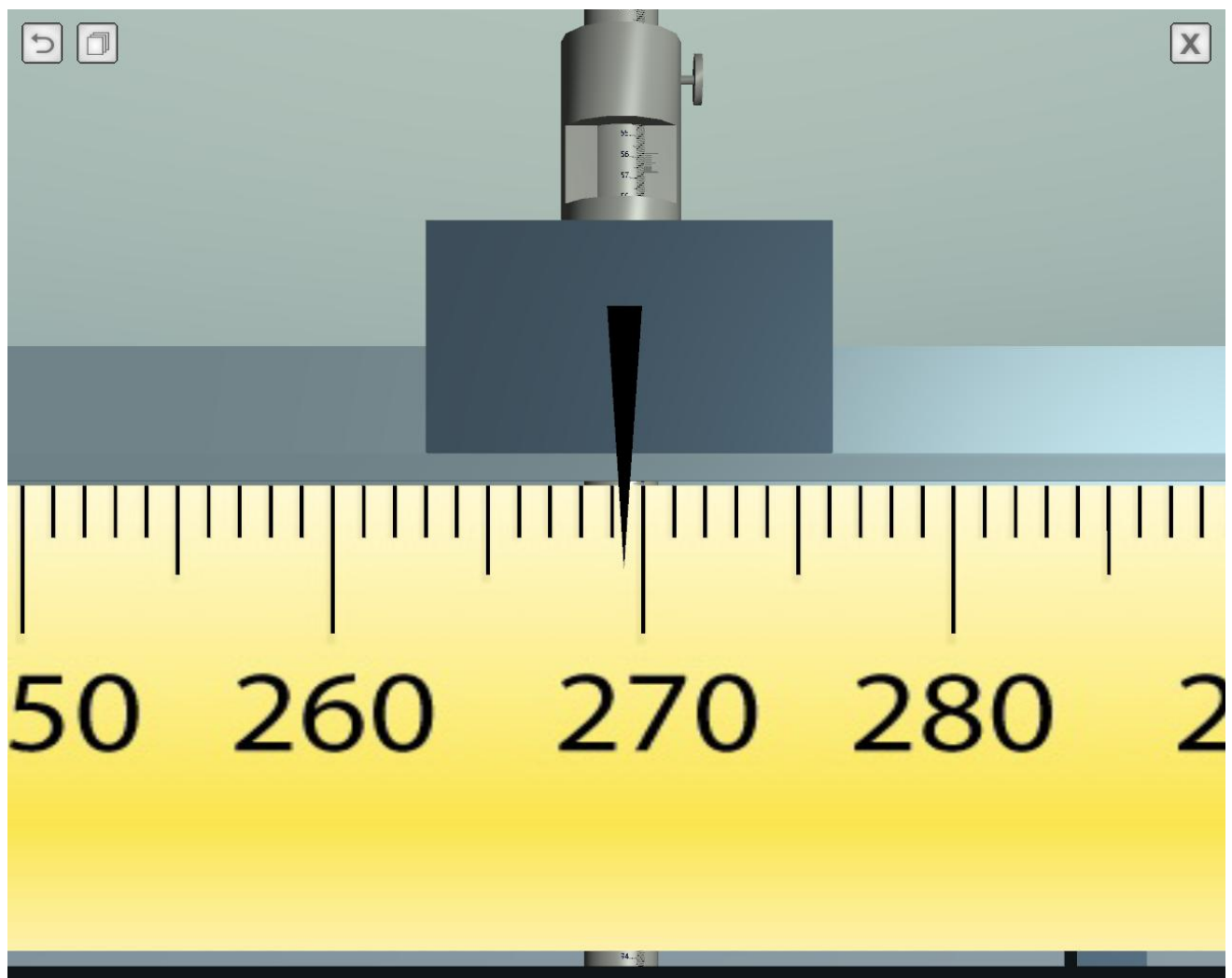
Measurements of water surface levels in the channel are made with the aid of a measuring needles (Figure 10). Since the length of the channel is 15 meters, in order to accelerate the measurement process in the channel, there are two measuring needles. The horizontal position of the measuring needle is estimated by the horizontal ruler located above the channel.

To get closer to the horizontal mark of the scale axis, move the center of the screen to the points of approximation and rotate the mouse scroll to zoom in (Figure 11).





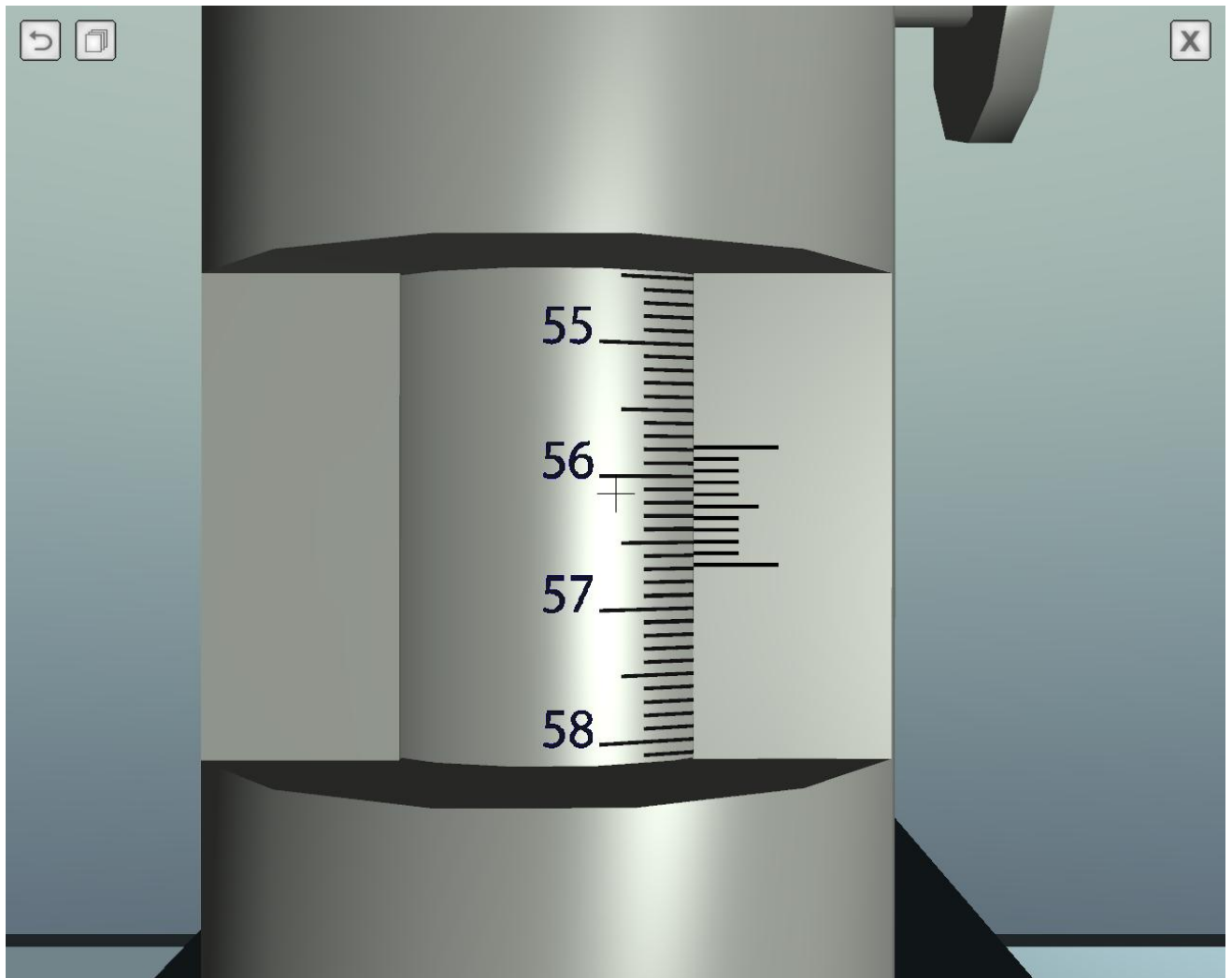
**Figure 10** – Devices for Measuring Water Surface Levels in the Channel



**Figure 11** – Horizontal Scale Mark



The vertical position of the needle of the measuring needle is monitored by a special measuring device in the upper part of the measuring needle (above the channel), equipped with a measuring nonius (Figure 12).

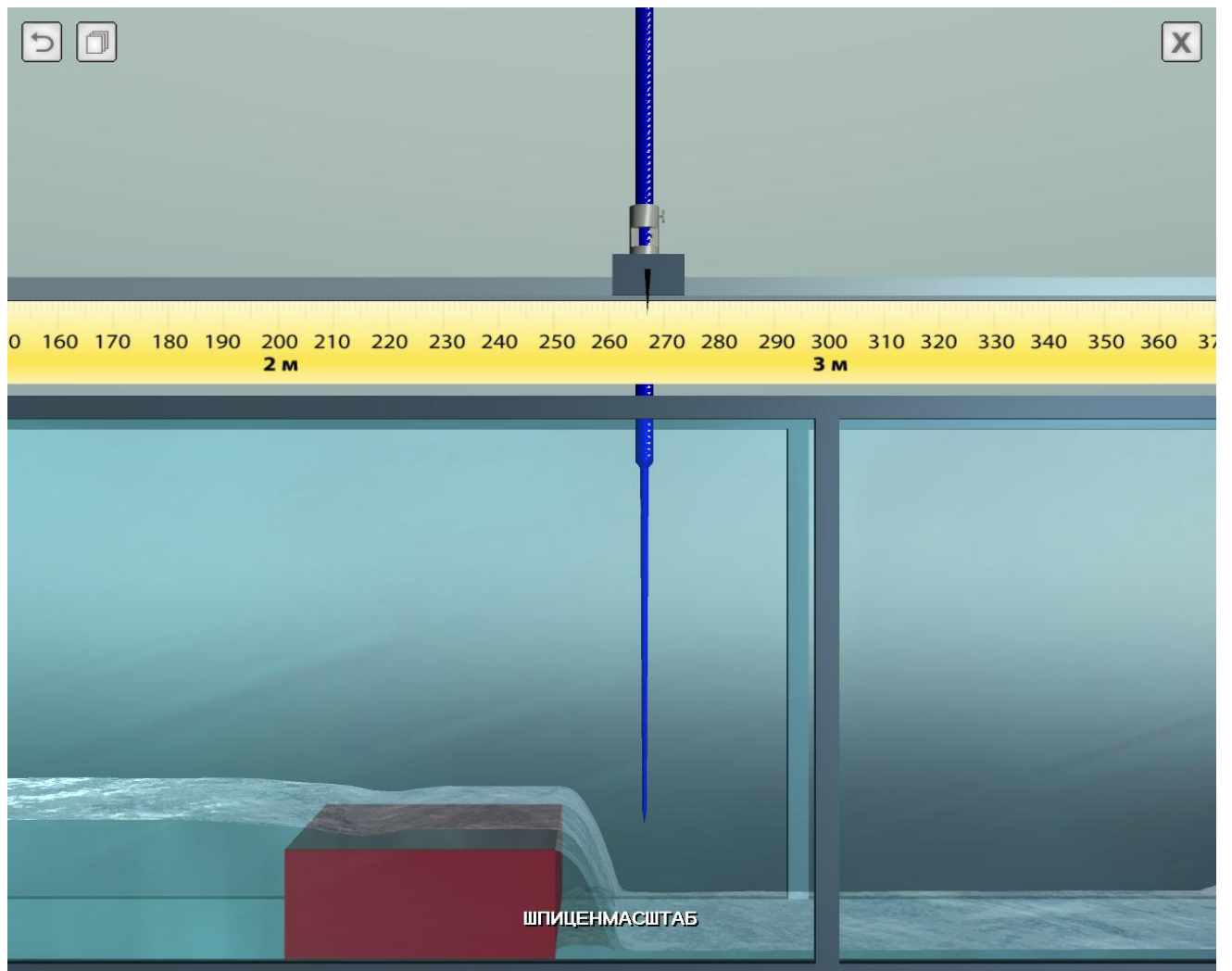


**Figure 12** – Measuring Needle Vernier

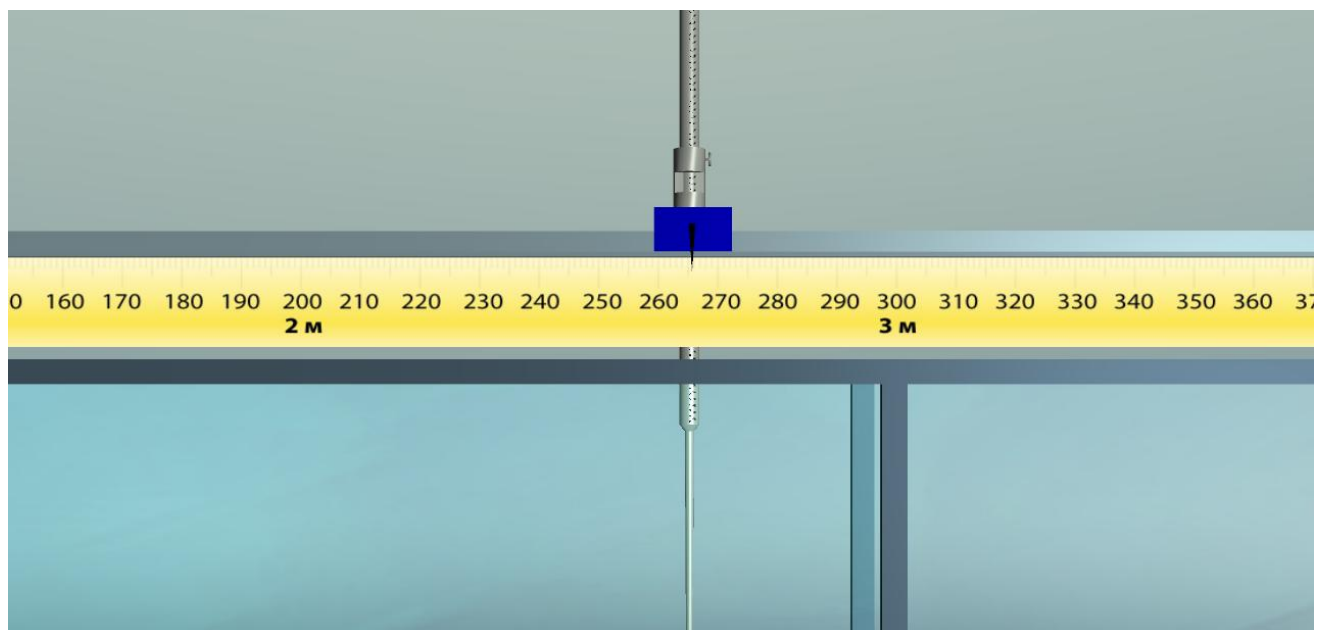
Measuring needle can be moved with the mouse. To move the needle, move the mouse cursor over the needle (the object will be displayed in blue), press and hold the left mouse button, smoothly moving the mouse in the plane of the screen (Figure 13).

If the needle needs to be moved only in the vertical direction, you need to click the right mouse button, and while holding it, move the mouse vertically.

If you need to move the measuring needle only in the horizontal direction, move the mouse pointer over the measuring needle base (Figure 14).

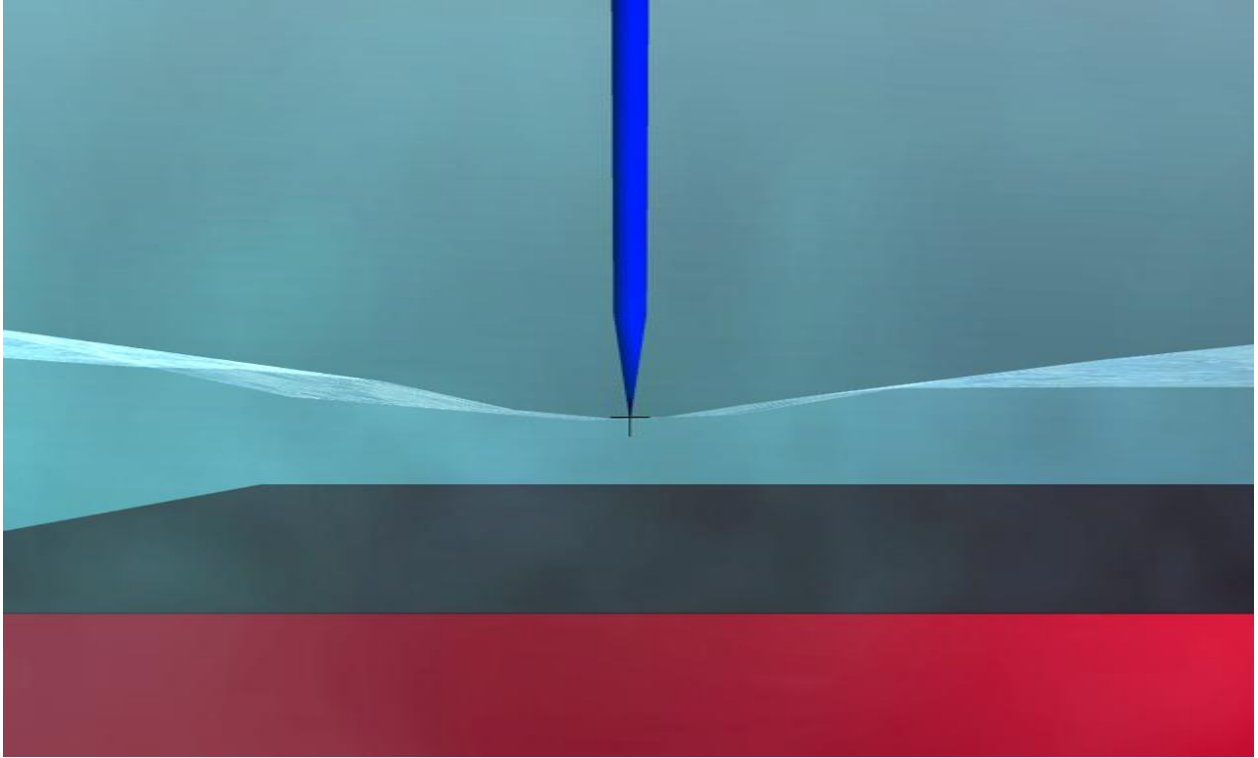


**Figure 13** – Hovering the Mouse Over the Measuring Needle to Move it in the Horizontal and/or Vertical Direction



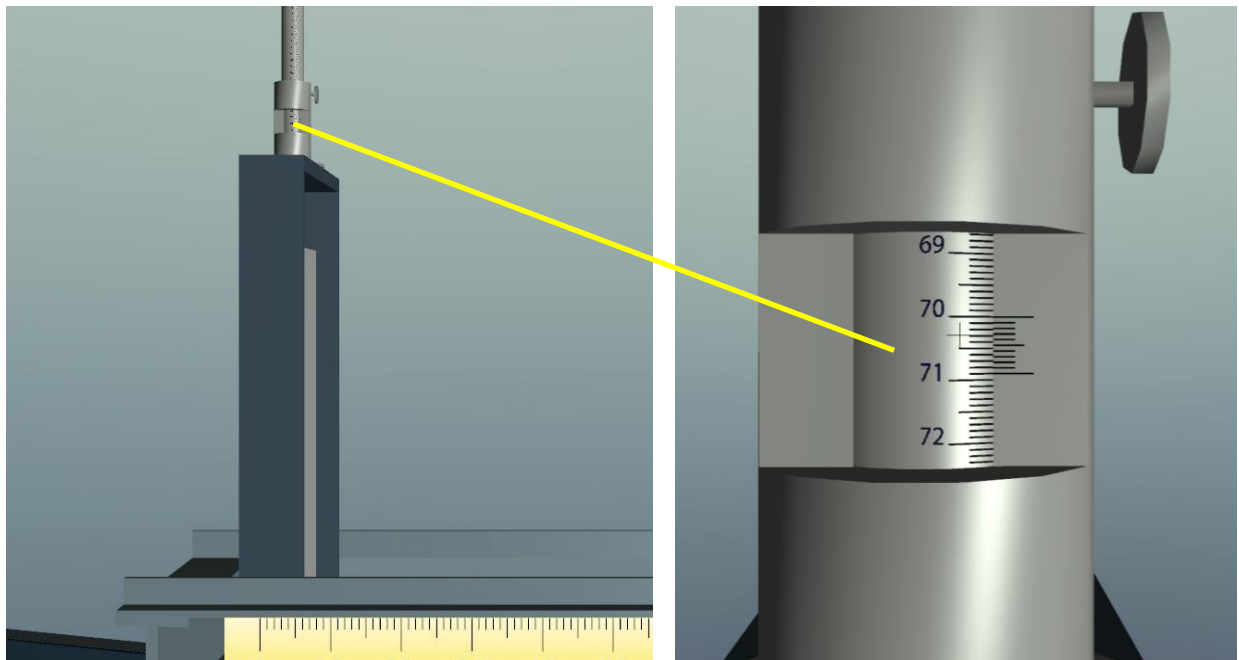
**Figure 14** – Hovering the Mouse Over the Measuring Needle Base to Move it Horizontally

The needle is accurately fed to the required surface point with the camera positioning the measuring point as close as possible (Figure 15). In this case, first you need to point the center point of the screen (sight) to the measuring point, and then use the mouse to bring the needle tip to the same point. Measurement can be done when the tip of the needle and the center of the screen are aligned.



**Figure 15** – Precise Positioning of the Needle Tip to the Measuring Point

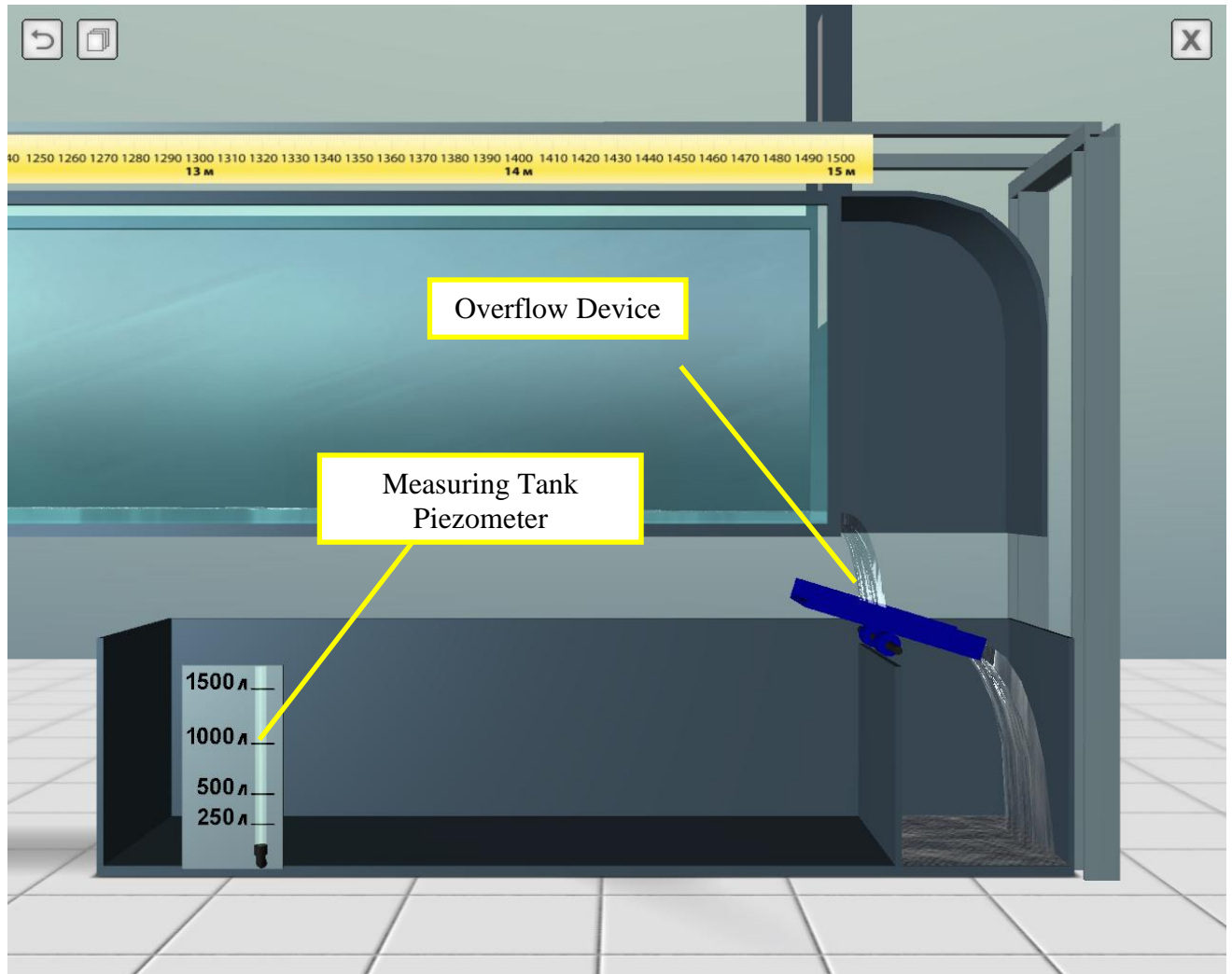
The value of the opening of the shutters is fixed by special measuring devices installed above the shutters (figure 16).



**Figure 16** – Measuring the Value of the Shutter Opening

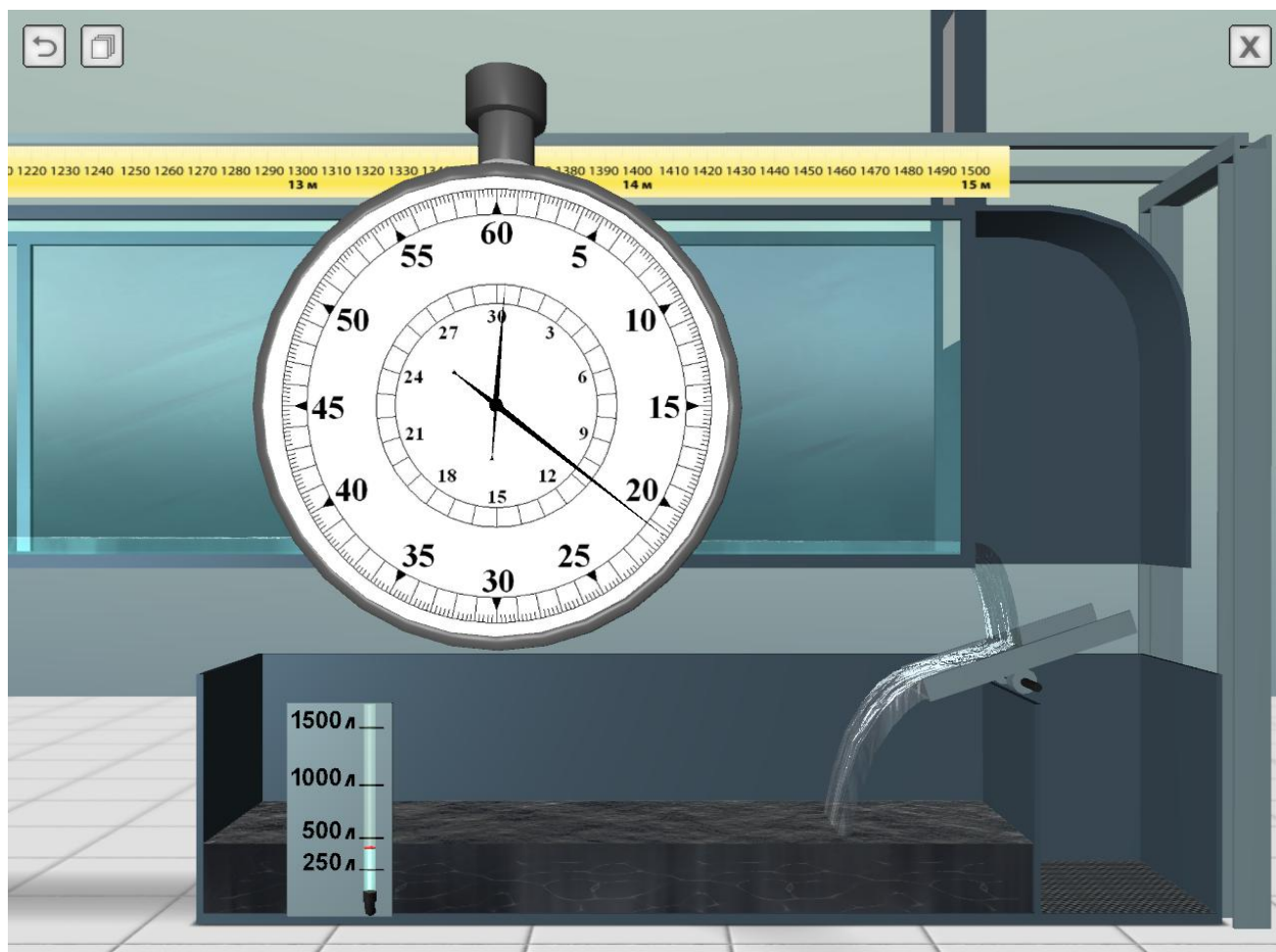
The slope of the channel bottom is determined by measuring the bottom levels at two points along the length of the channel.

A flow measuring tank is located on the right side of the laboratory equipment. When you hover over the tank, the front wall of the tank is hidden. To start measuring the water flow, move the mouse cursor over the overflow device (the object will be displayed in blue) and left-click (Figure 17).



**Figure 17** – Going to Measure Water Flow

In the process of measuring the water flow, the analog type stopwatch is displayed on the screen (Figure 18). Filling the tank continues to a certain point (according to the piezometer of the flow tank). After filling the tank, the stopwatch stops, and the overflow device returns to its original position (providing drainage of water into the sewer).



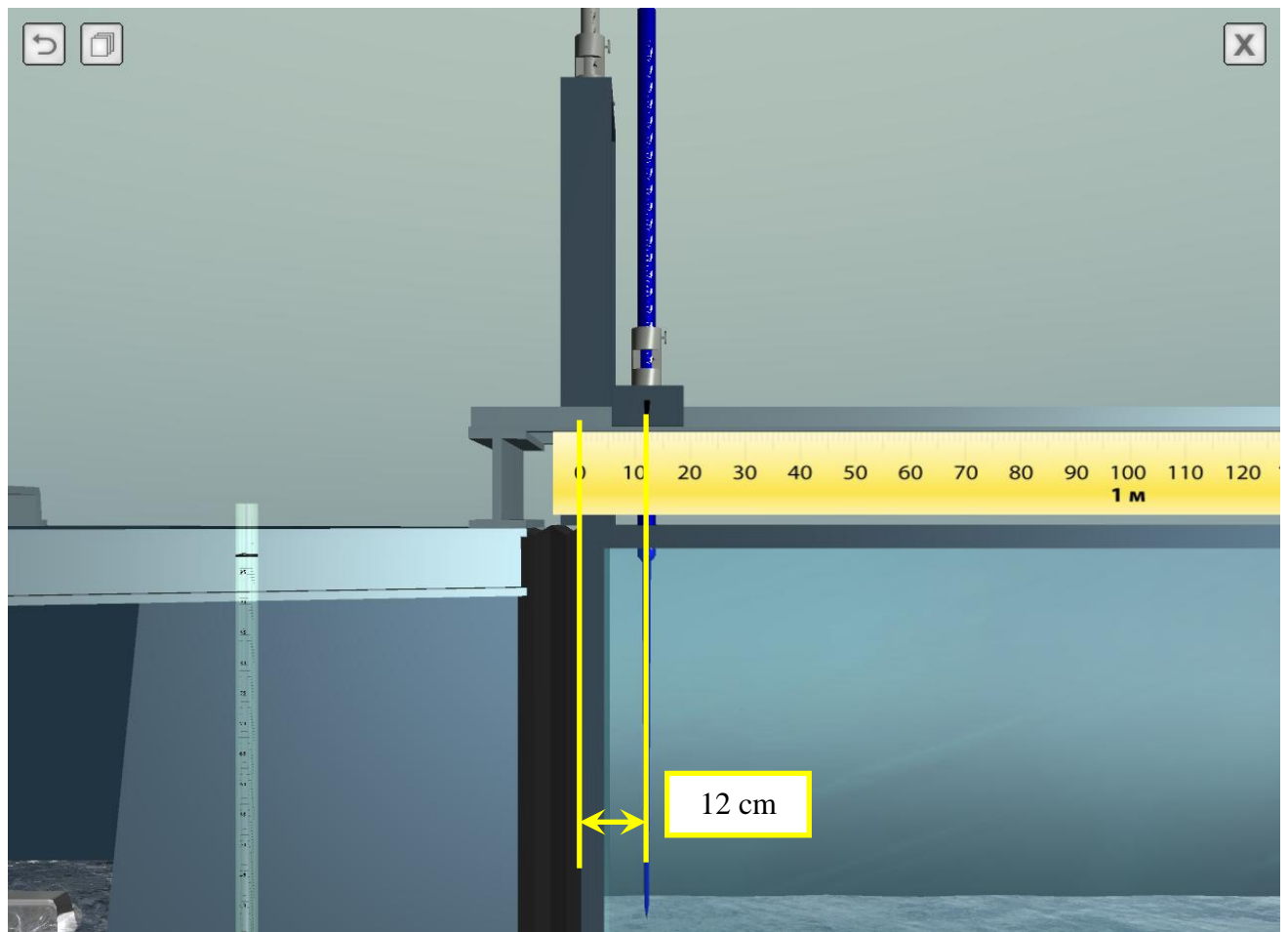
**Figure 18 – The Process of Measuring Water Flow**

To hide the stopwatch after the end of the flow measurement, hover over it and left-click.

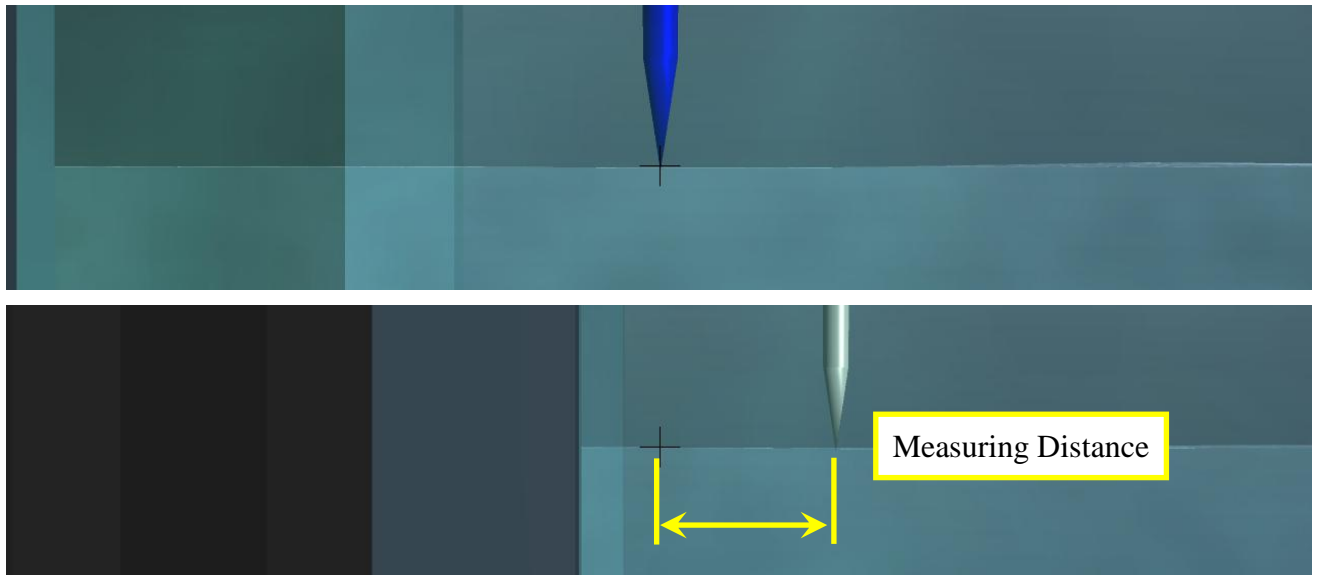
This completes the cycle of work with the simulator.

### **NOTE ON MEASURING WATER SURFACE LEVELS NEAR THE SHUTTERS**

The design features of the equipment do not allow bringing the measuring needle to the upper (and lower) shutter closer than 12 cm (Figure 19). This problem can be solved with the help of an auxiliary sight in the center of the screen. First you need to bring the scale to the maximum possible distance to the shutter. Then align the height of the camera to the needle tip mark, and then gently move the camera to the left using the appropriate keys («LEFT» or «A») (Figure 20). The measurement distance can be determined by the ruler, lifting the camera vertically up to the level of the divisions of the ruler. The same goes for the right-hand scale and the lower shutter.



**Figure 19** – Constructive Restriction of the Movement of the Measuring Needle



**Figure 20** – Measuring Points Near the Shutter with an Auxiliary Sight