INGNOVA

HEC-RAS River Analysis System

1 BRIDGE

1.2 ENTERING GEOMETRIC DATA

1.2.3 Bridge data

Before proceeding to enter bridge data we will make a description for every essential element that it has. So bridges can be divided in 2 basic parts:

The **structure** that saves the openings located inside the supports. Every structure section is made up by a deck, one or more supporting frame and the lateral braces. Deck supports dynamic loading and, using frames, it transmits tensions to piers and abutments.

The **infrastructure** formed by:

- **Piers**; that are the most important supporting structures. They must support permanent loading and being unaffected by natural agent's actions (wind, overflows, etc…)
- **Abutments** located at both sides; they support the embankments that run to the bridge. Sometimes they are replaced by driven piers that allow ground displacement. They must resist all types of efforts so they have different shapes and they are usually built in reinforced cement.
- The foundations or **abutments and pier supports** that transmit all efforts to ground. They are formed by rocks, ground or piles that support abutment and piers weight.

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Now we will introduce the bridge data; then click on ***Bridge and Culvert data*** and go to ***Options → Add a Bridge and/or Culvert***.

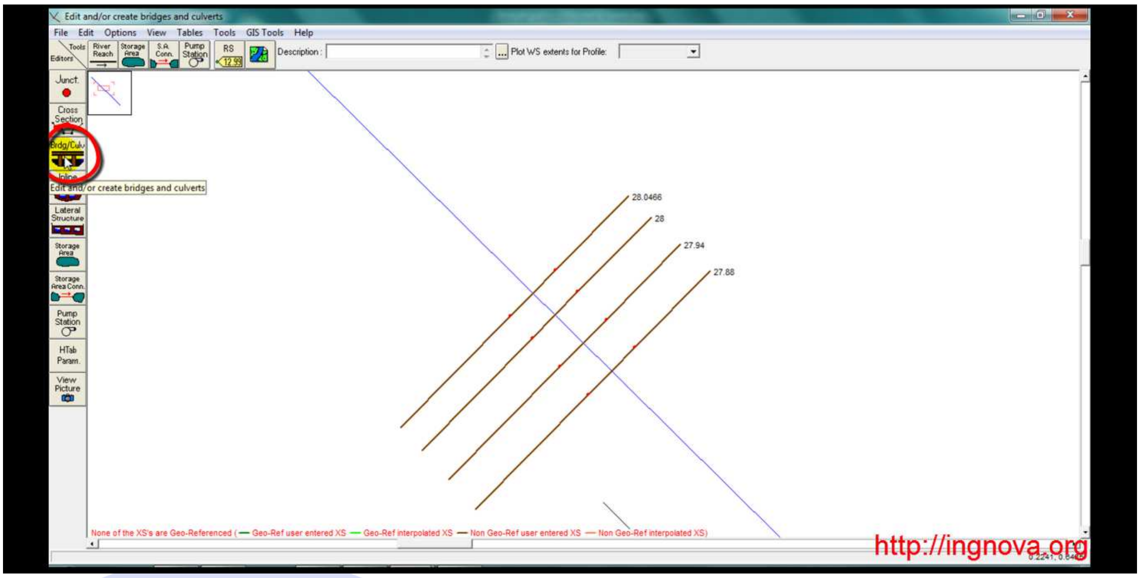

Figure 1. Enter a bridge

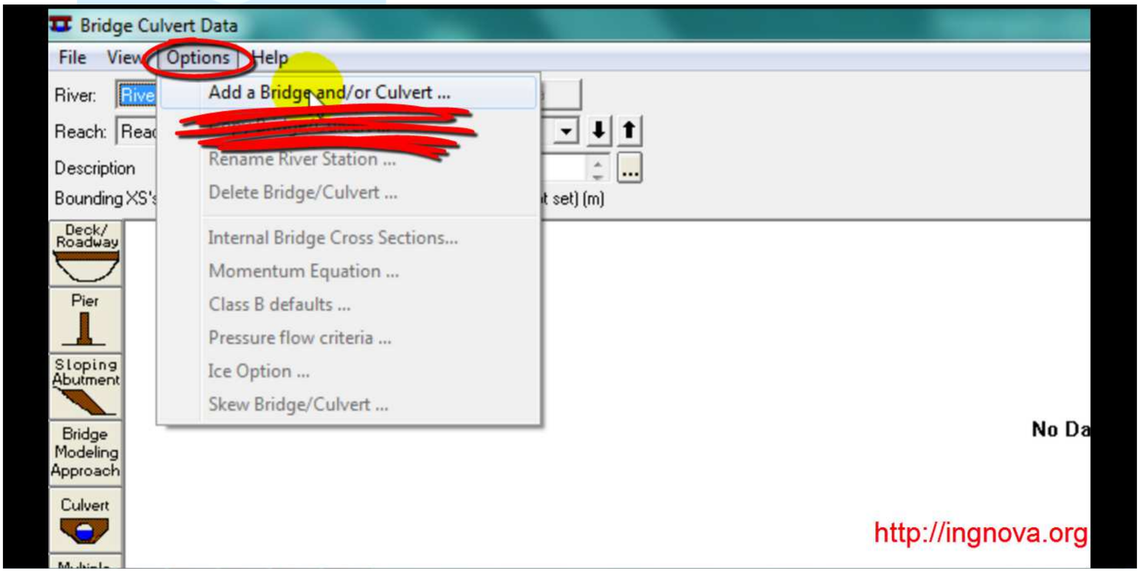

Figure 2. Add a bridge

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A new window appears where we must ***introduce the station*** where we want to introduce the bridge. In this case, **the bridge is contained between section 28 (section 3) and section 27.94 (section 2) so we can enter a value between those two sections**, for example 27.97. Then a new window appears where it is drawn the upstream side of the bridge and the downstream side.

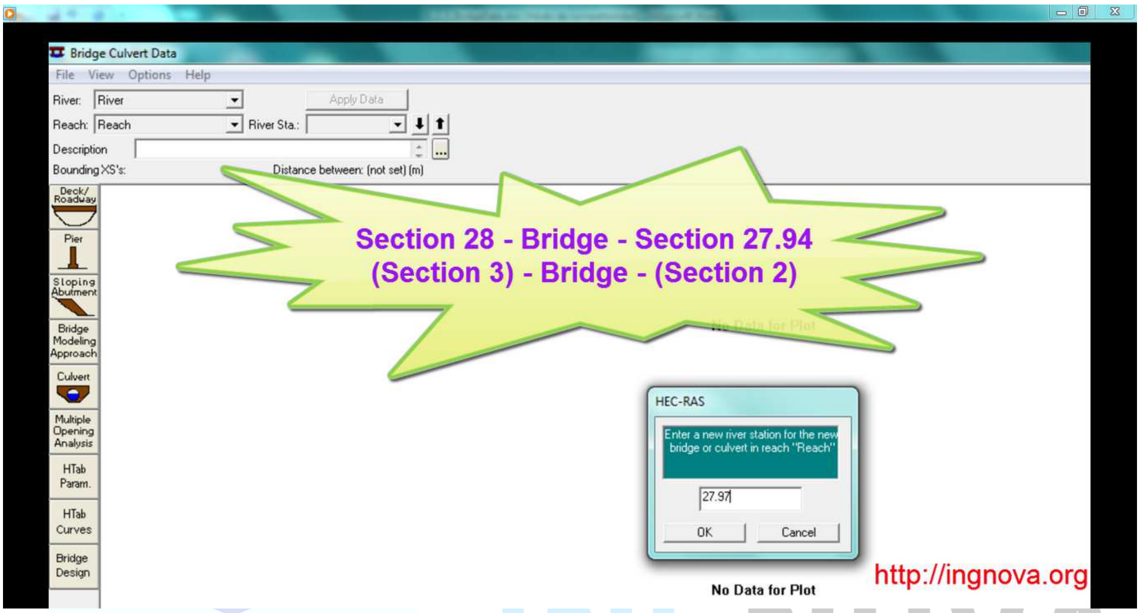

Figure 3. Bridge station

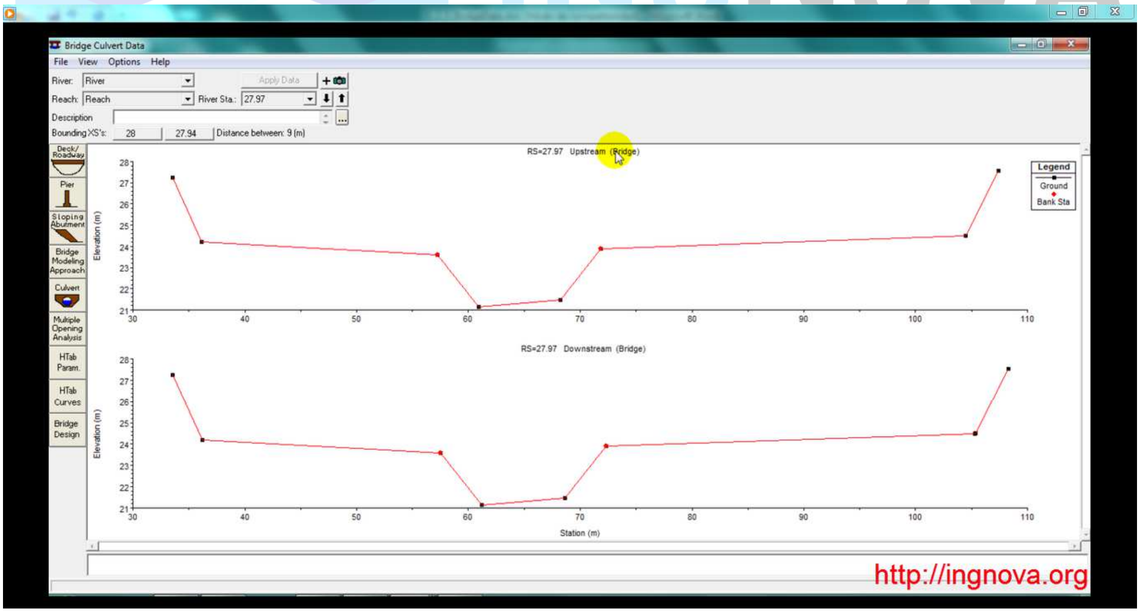

Figure 4. Bridge station shape

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➢ *Deck*

So the first thing to do is to enter the **deck** so click on the icon.

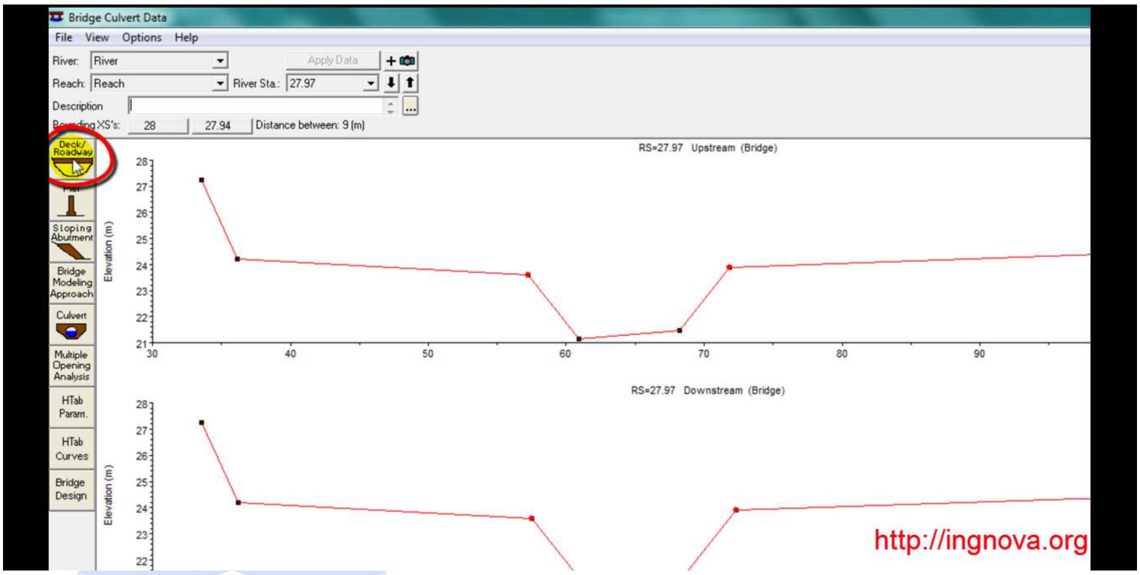

Figure 5. Enter deck data

Now we must introduce all data for the deck. The first box refers to the **distance** from the upstream cross section to the deck. In this case it is 1 meter. The **width** is 7 meters and the **weir coefficient** is the one that the program will apply when the water reaches the top of the bridge so it will work as a weir. So it is not necessary to change this value unless you really know the value you must use.

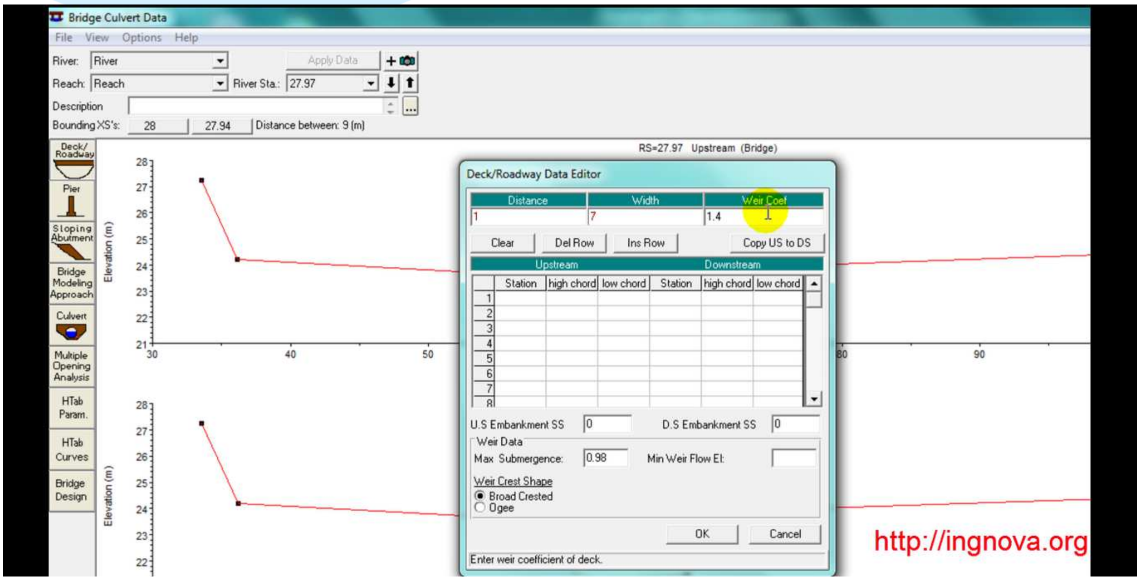

Figure 6. Distance, width an weir coefficient

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Now it is necessary to introduce the **coordinates for the representative points of the high chord and the low chord, both upstream and downstream.**

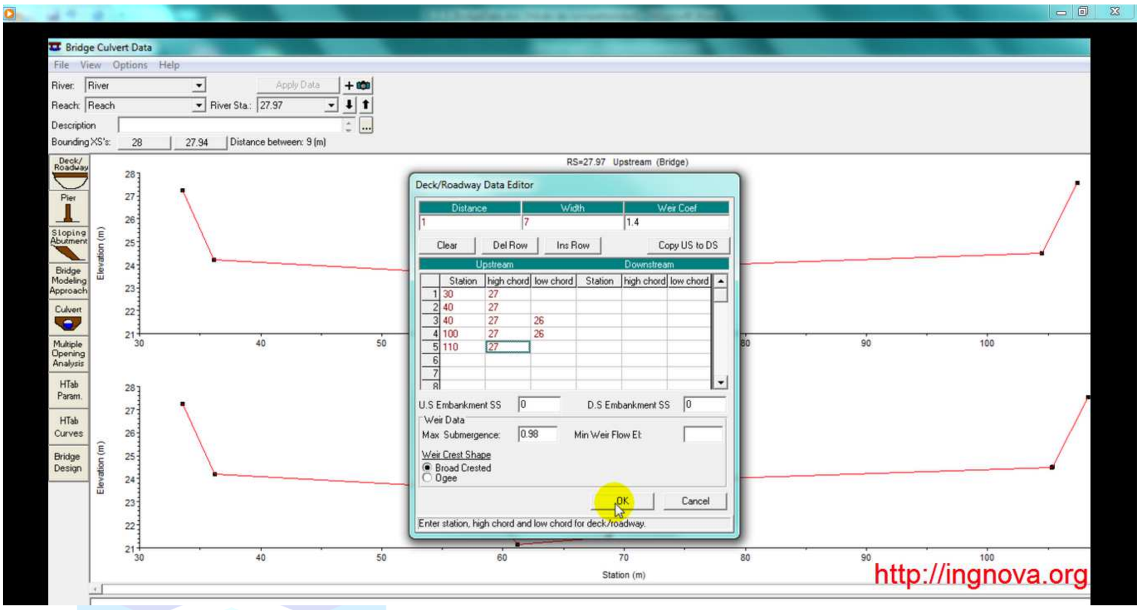

Figure 7. Deck upstream coordinates

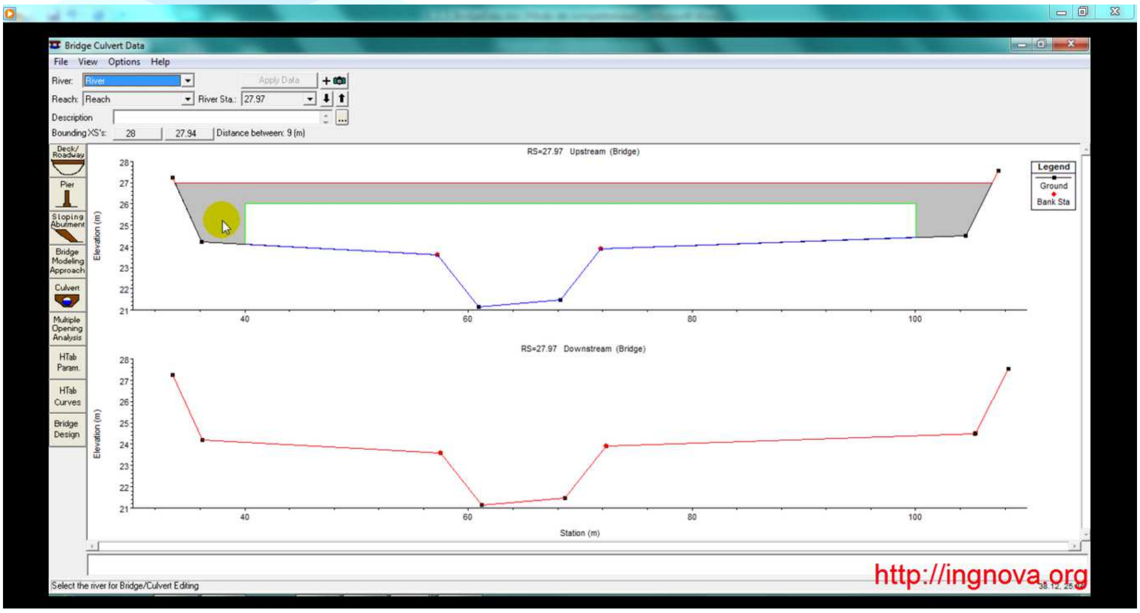

Figure 8. Upstream deck

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On the other hand, if we remove the low chord coordinates, the program fills the entire channel with the deck.

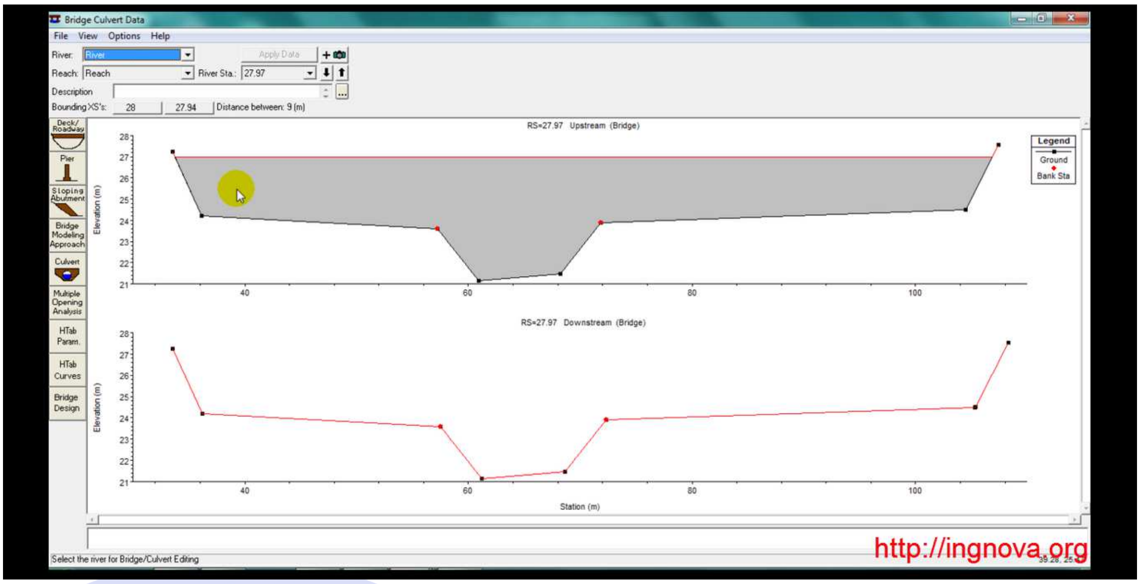

Figure 9. Upstream deck (no low chord coordinates)

The first X value doesn't correspond to the intersection point of the deck with the ground, it is at the left of this point but it's correct because the program makes a scan from that point to the ground and then draws the line.

So now we must enter the same geometry for the downstream side; we can copy these entire values y clicking on ***Copy US to DS.***

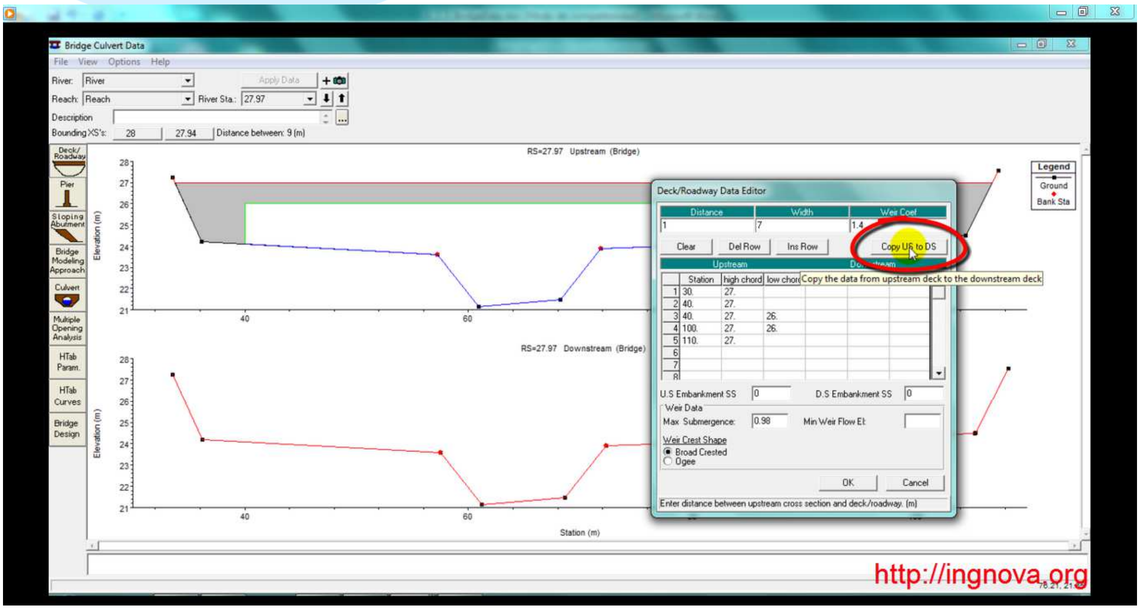

Figure 10. Copy upstream deck coordinates to downstream

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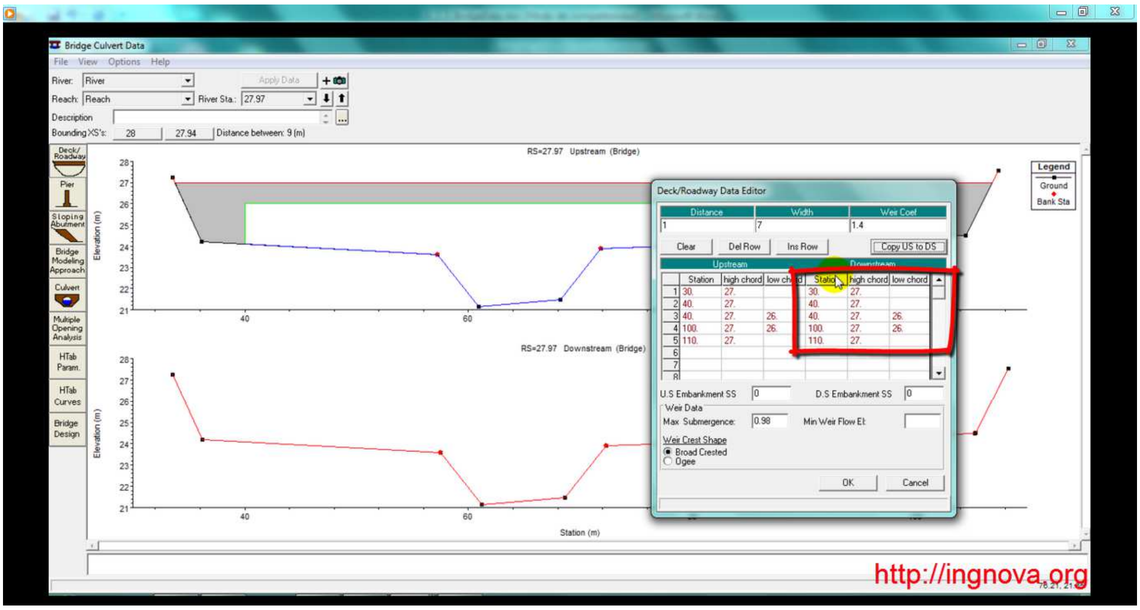

Figure 11. Downstream deck coordinates

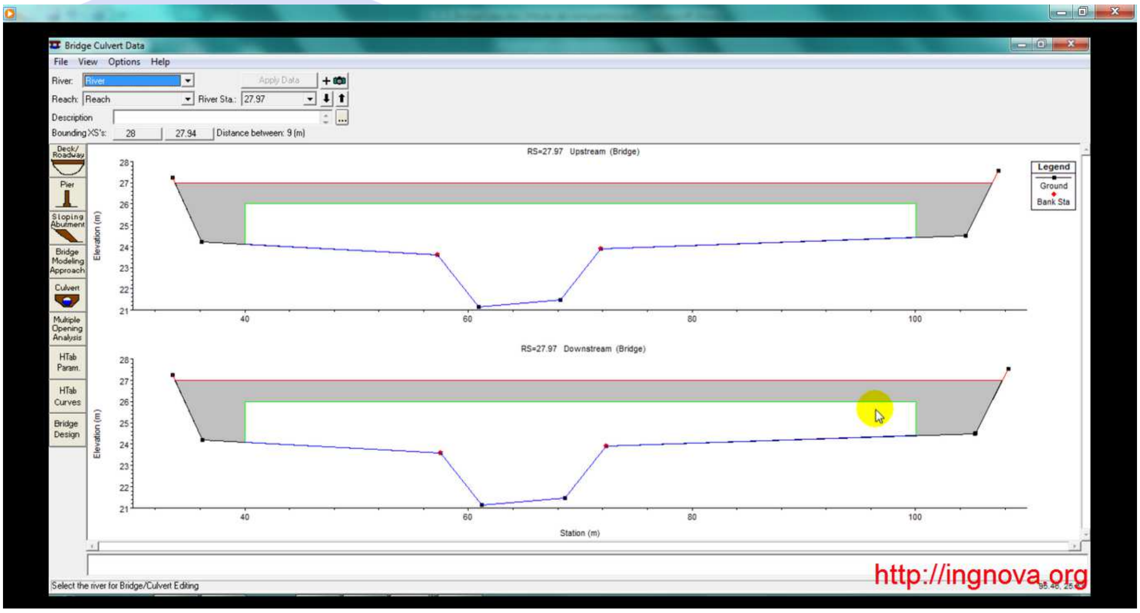

Figure 12. Downstream deck

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Now we should enter the **upstream and downstream embankment slope**, for this example we will set 2 and 2.

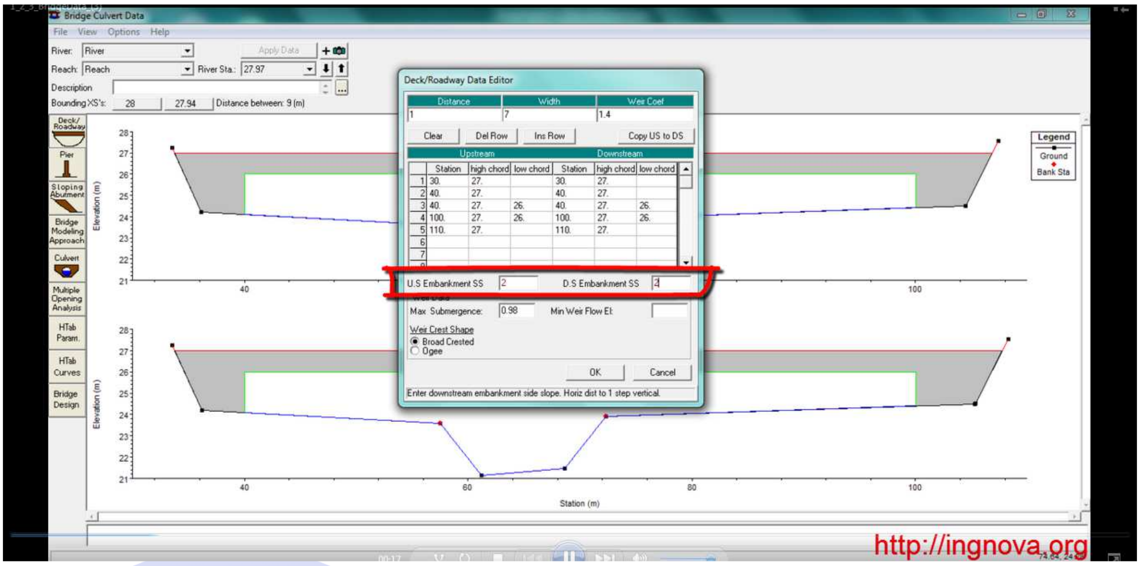

Figure 13. Upstream, and downstream embankment slope

Finally we must set the **__weir data__**. "**Max submergence"** means the maximum submergence (from 0 to 1) that the program has to consider in order to simulating a weir behavior. So as the water level increases, there will be a moment when it will cover the hole and touch the low chord, then if the flow increases, the water will reach the high chord and the bridge will work as a weir. Then we can enter an equivalent parameter as a minimum **__elevation__**, we will enter 27, it means that the bridge will work as a weir when the water elevation is similar to the high chord elevation.

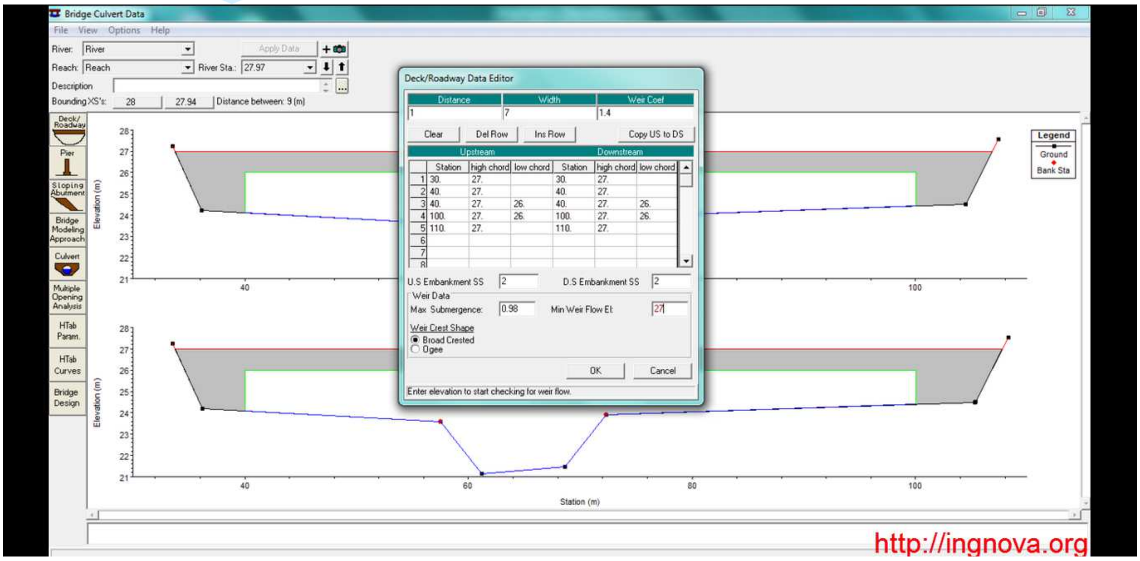

Figure 14. Weir crest shape

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Finally we must select the **weir crest shape** as a broad crested (typical case for bridges) or ogee; so ***select broad crested***. In the case you select ogee you will have to enter two different coefficients.

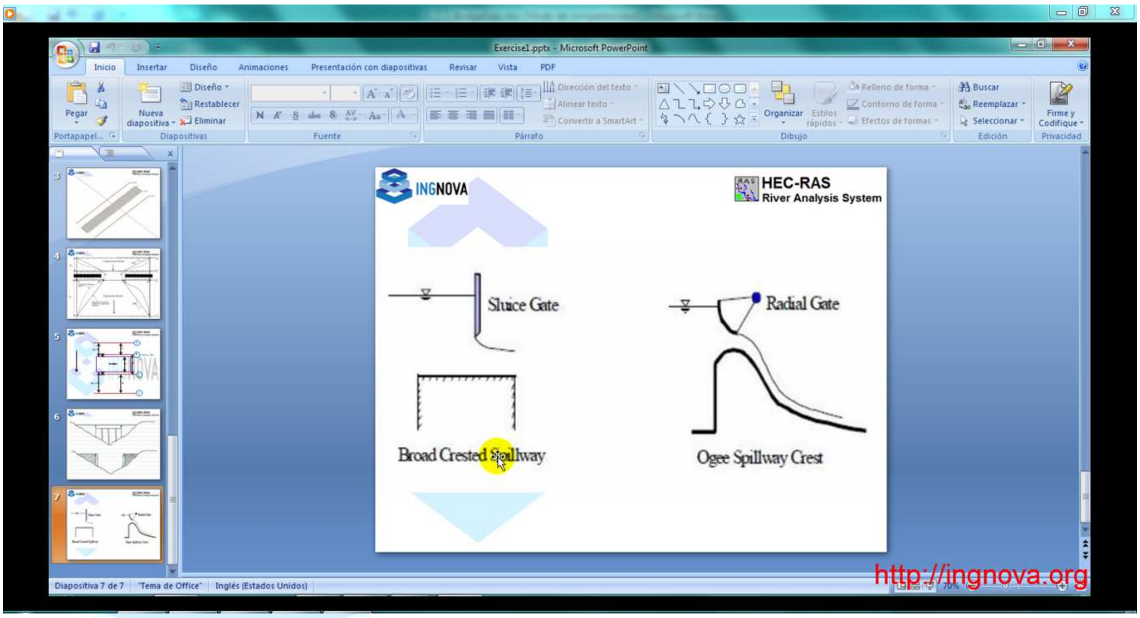

Figure 15. Weir crest types

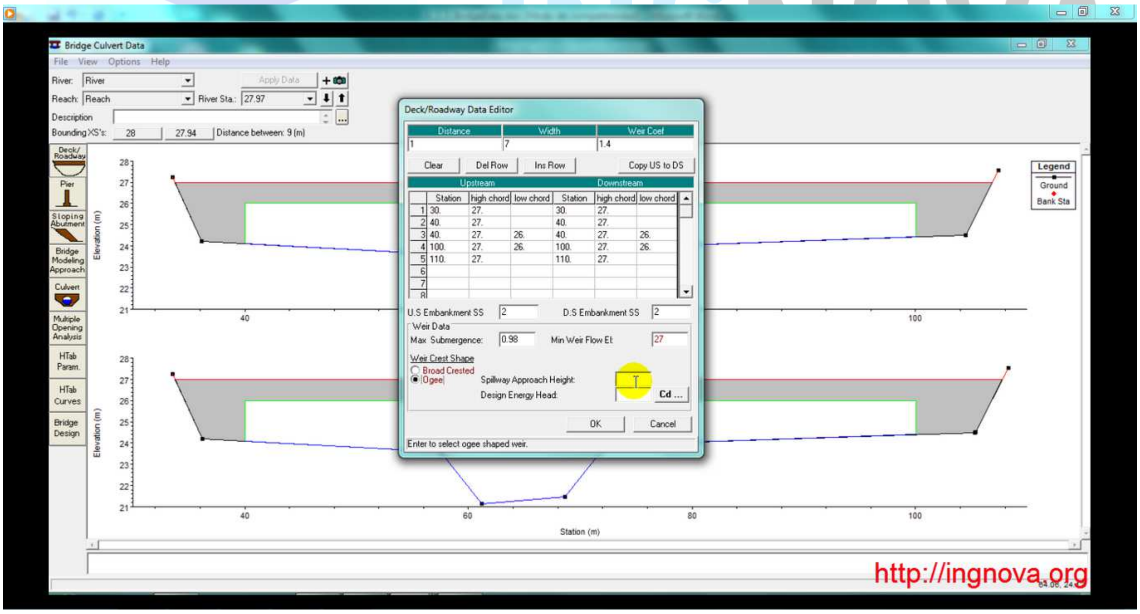

Figure 16. Weir crest Ogee options

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➢ ***Pier***

Now we will enter the **piers.**

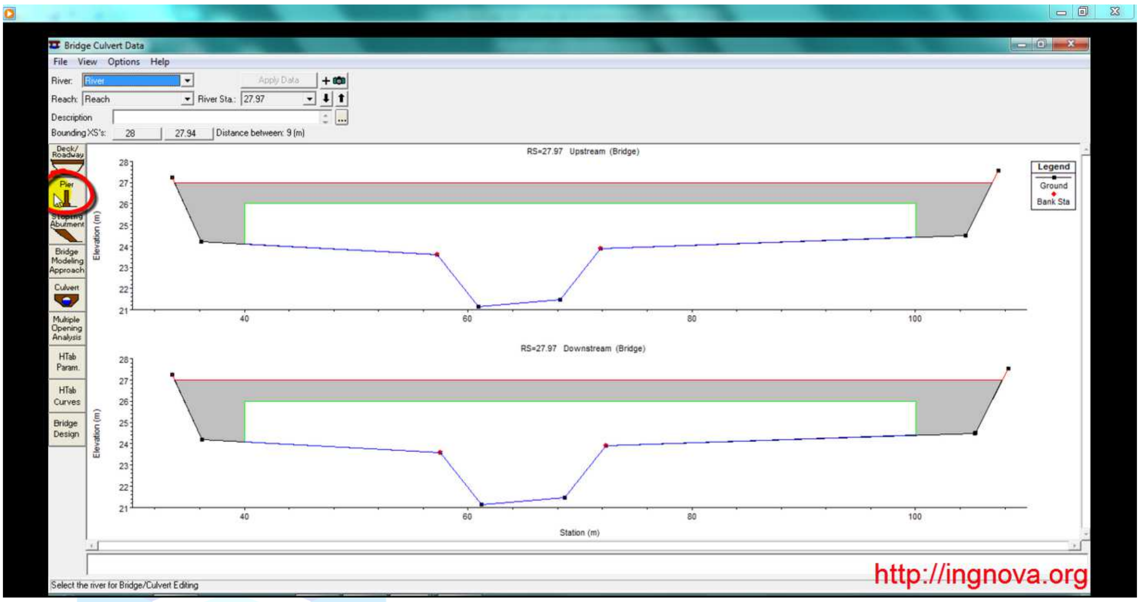

Figure 17. Enter pier

The first boxes refer to the **X value for the pier location** both upstream and downstream;

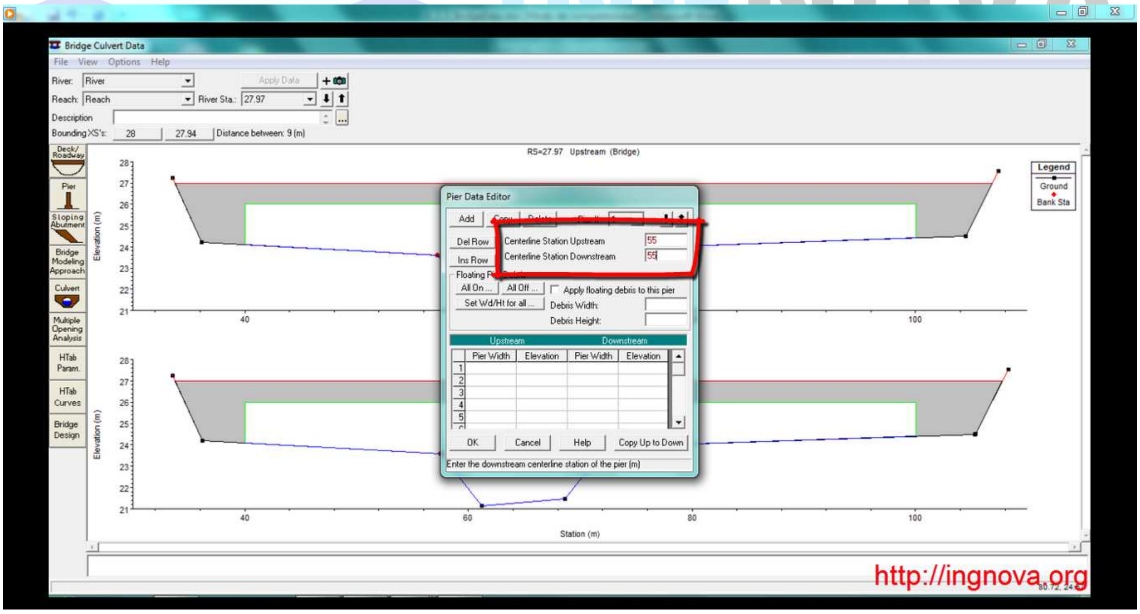

Figure 18. Centerline stations (Pier 1)

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Then we must enter ***width and elevation***. So as the lower elevation it must be a value similar or lower than the ground elevation, and as the higher elevation it must be similar or greater than the low chord elevation.

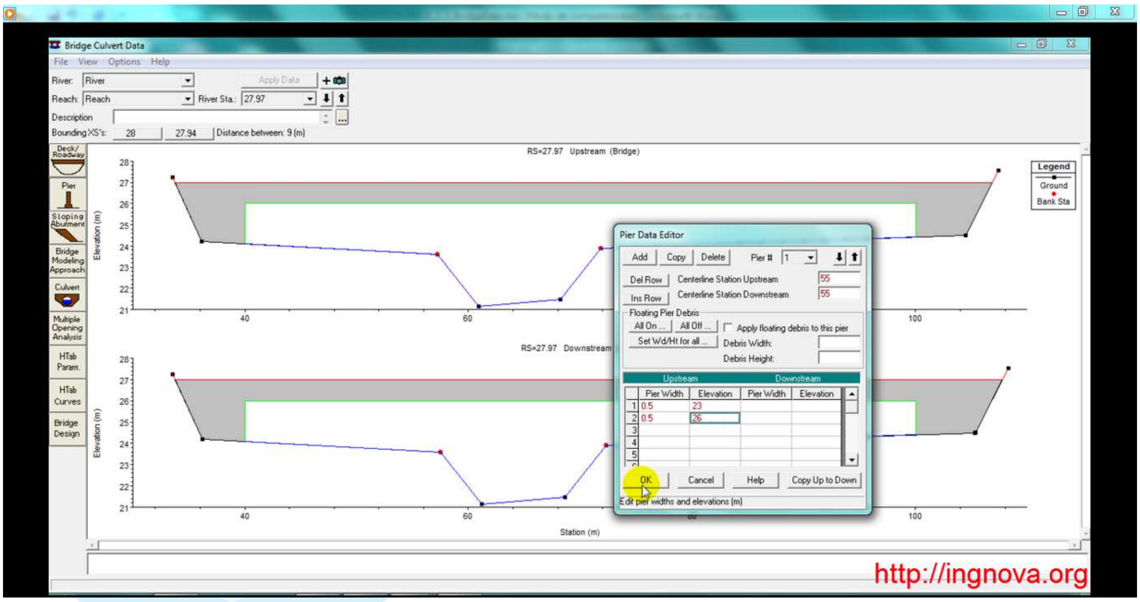

Figure 19. Pier 1 upstream coordinates

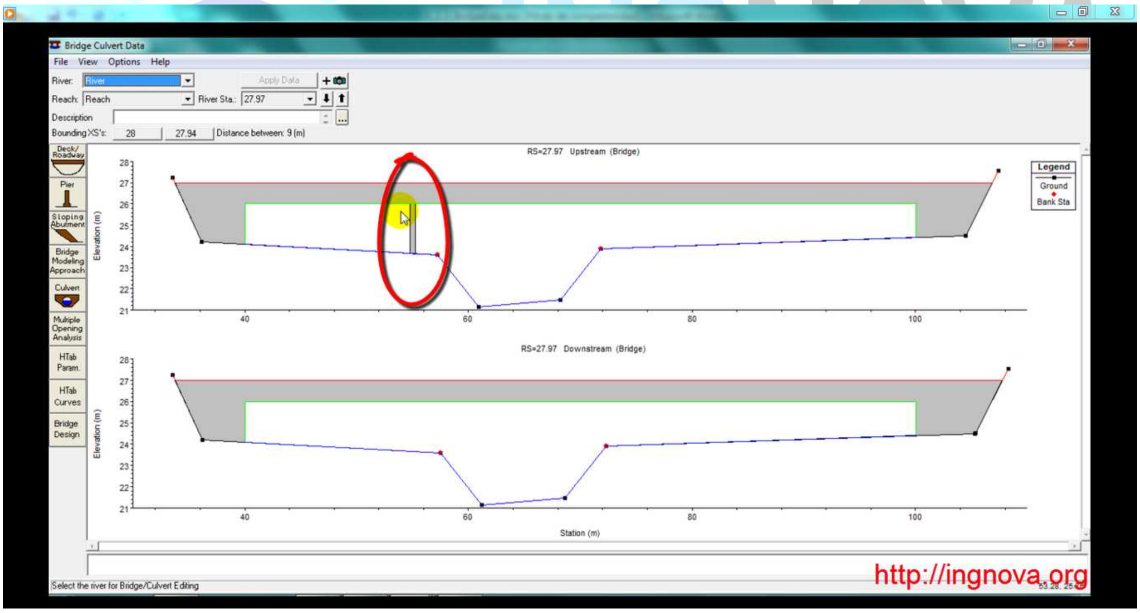

Figure 20. Pier 1 upstream

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We can also copy from upstream to downstream (***Copy US to Down***).

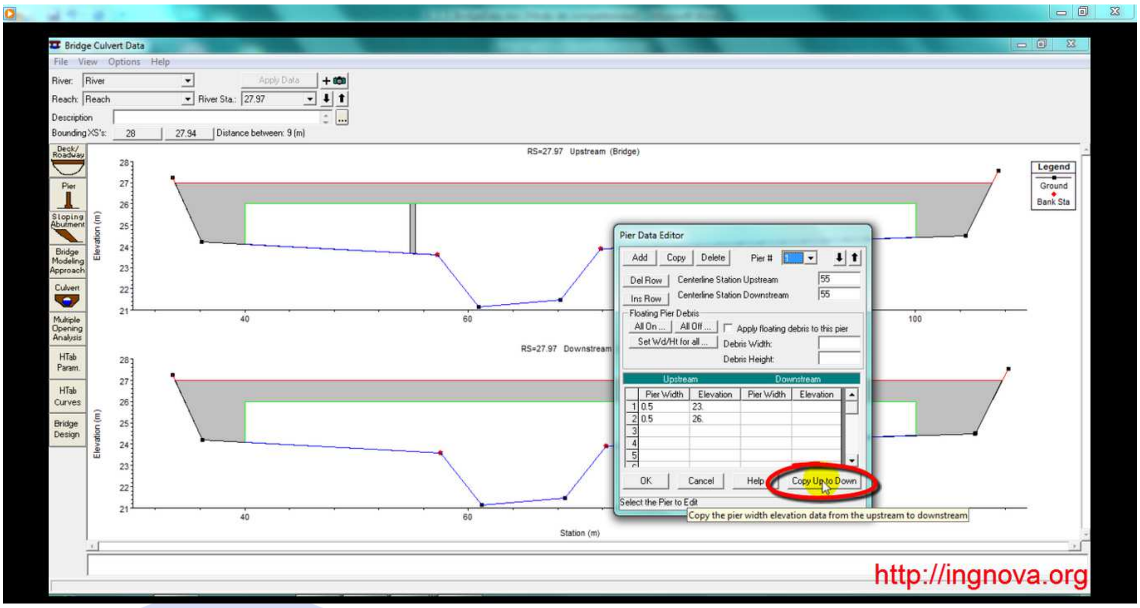

Figure 21. Copy pier 1 coordinates from US to DS

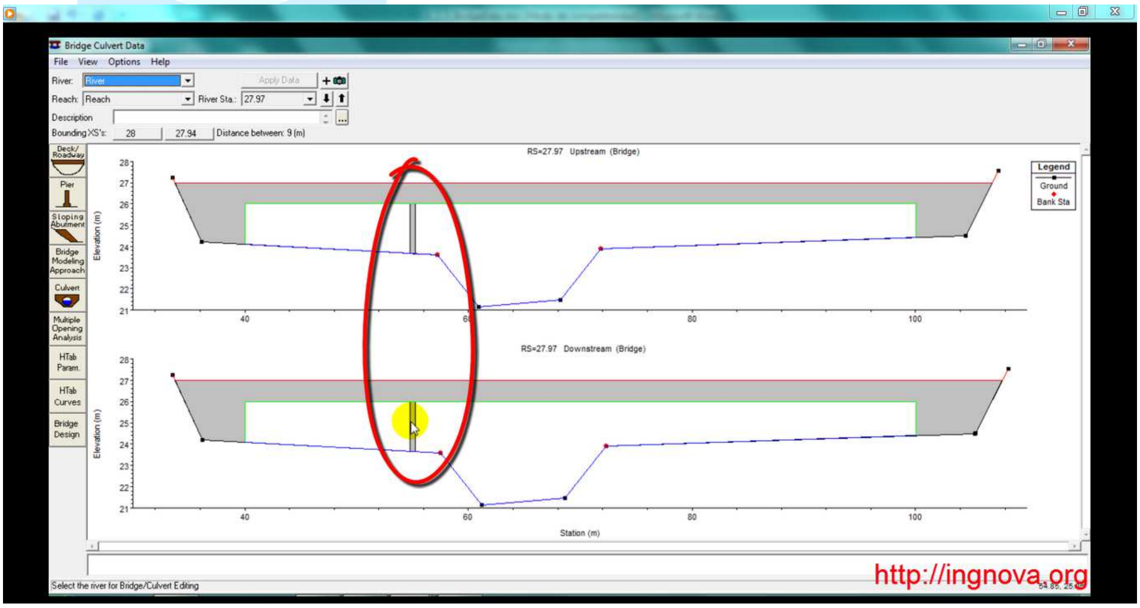

Figure 22. Pier 1 (upstream and downstream)

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Enter the second one so click on ***Add*** and enter the data:

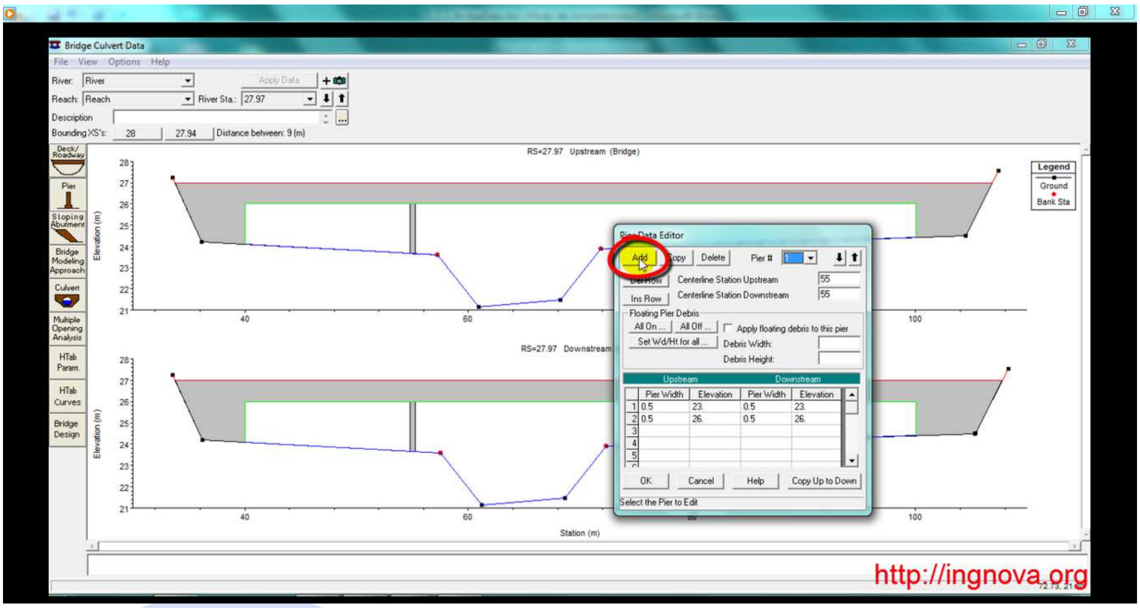

Figure 23. Add a new pier

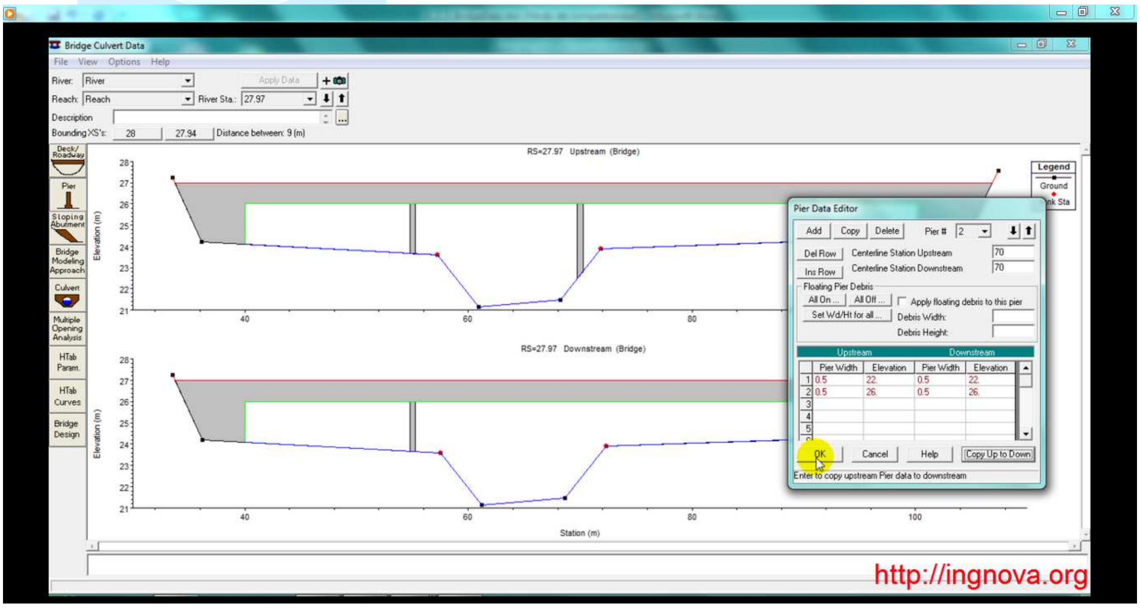

Figure 24. Pier 2 data

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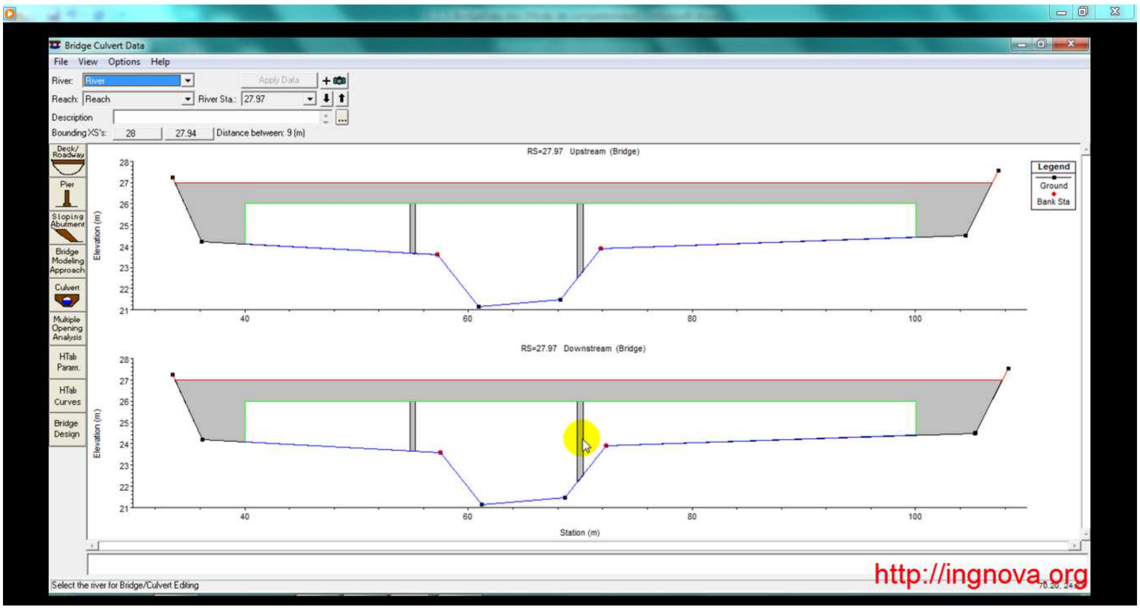

Figure 25. Pier 2

And the last one; click on ***Add***, ***enter the data*** and ***copy from upstream to downstream***.

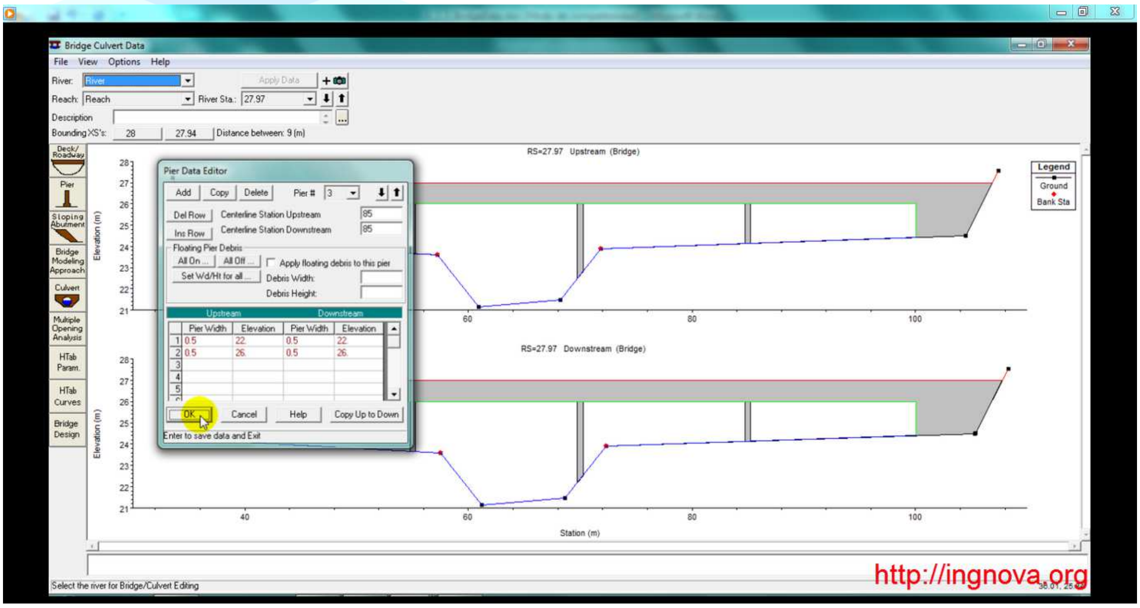

Figure 26. Pier 3 data

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Abutments

Finally we have to enter the **abutments;** then click on ***Sloping abutment***.

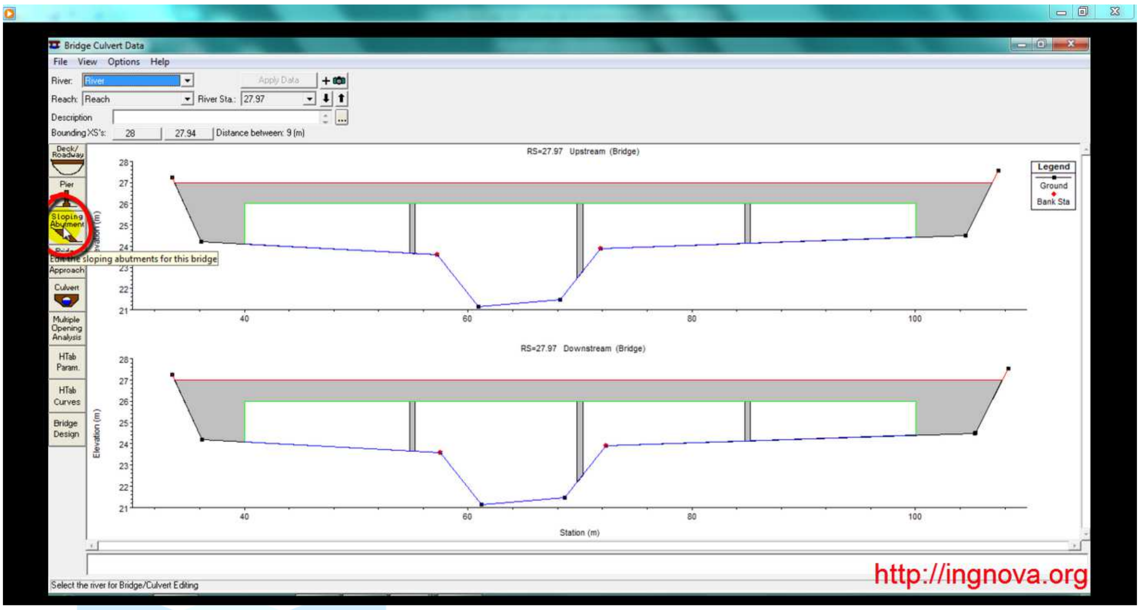

Figure 27. Enter abutments

We must introduce the **X and the Y value for the representative points of the abutments**. Enter coordinates for the left abutment:

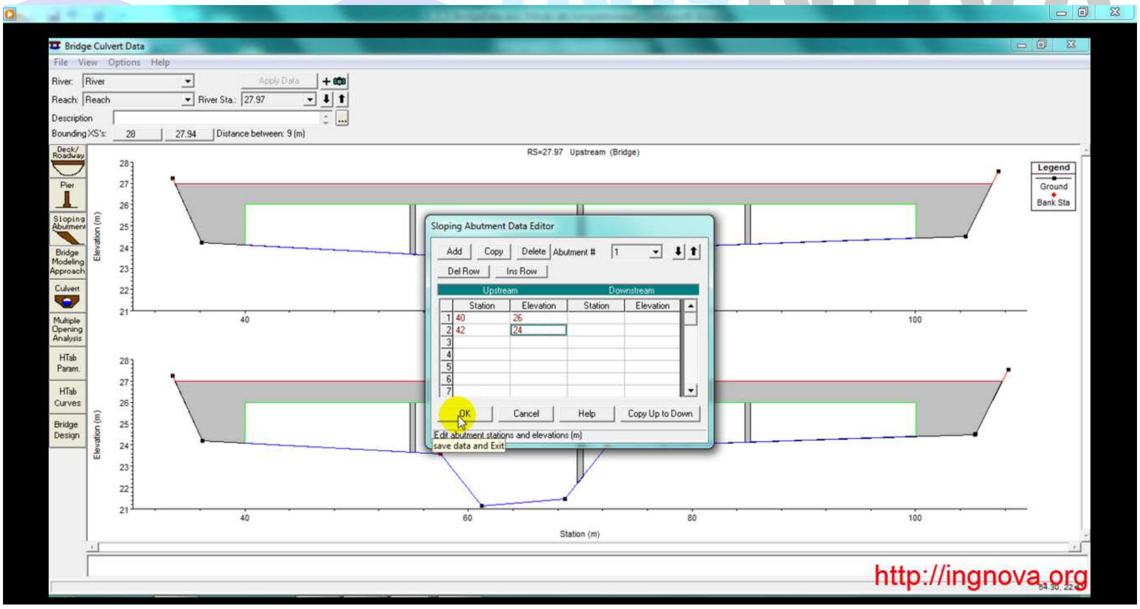

Figure 28. Left abutment upstream coordinates

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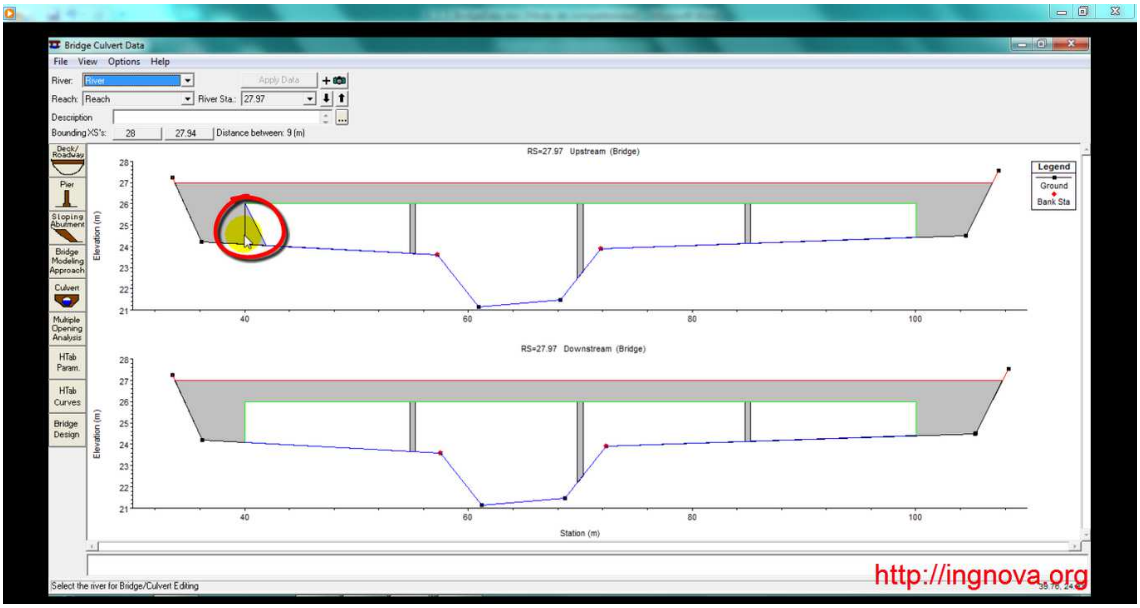

Figure 29. Left upstream abutment

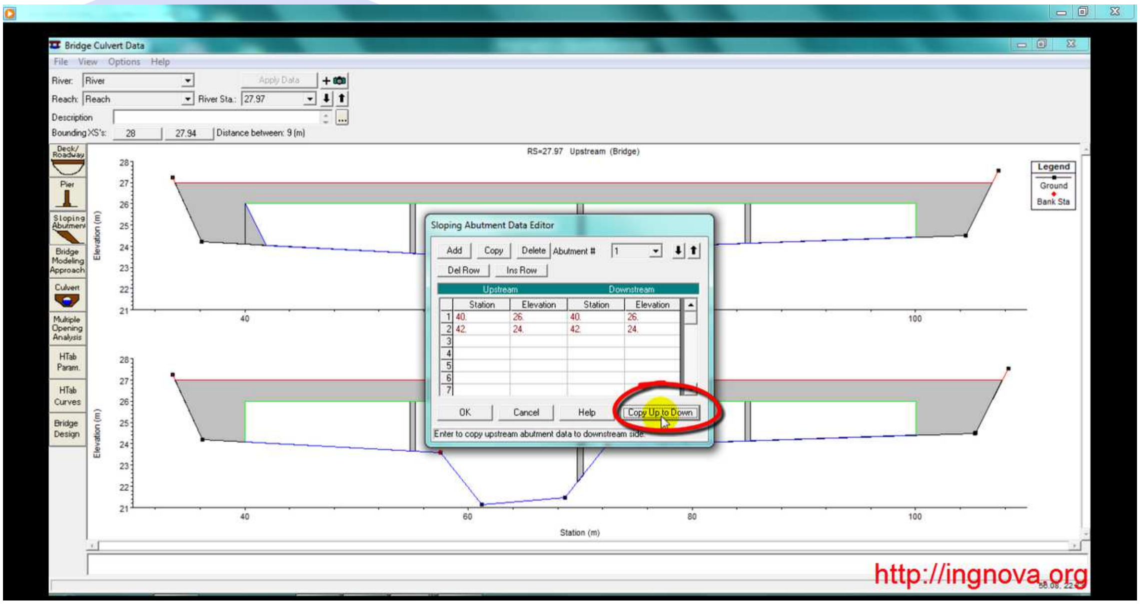

Figure 30. Copy left abutment coordinates from upstream to downstream

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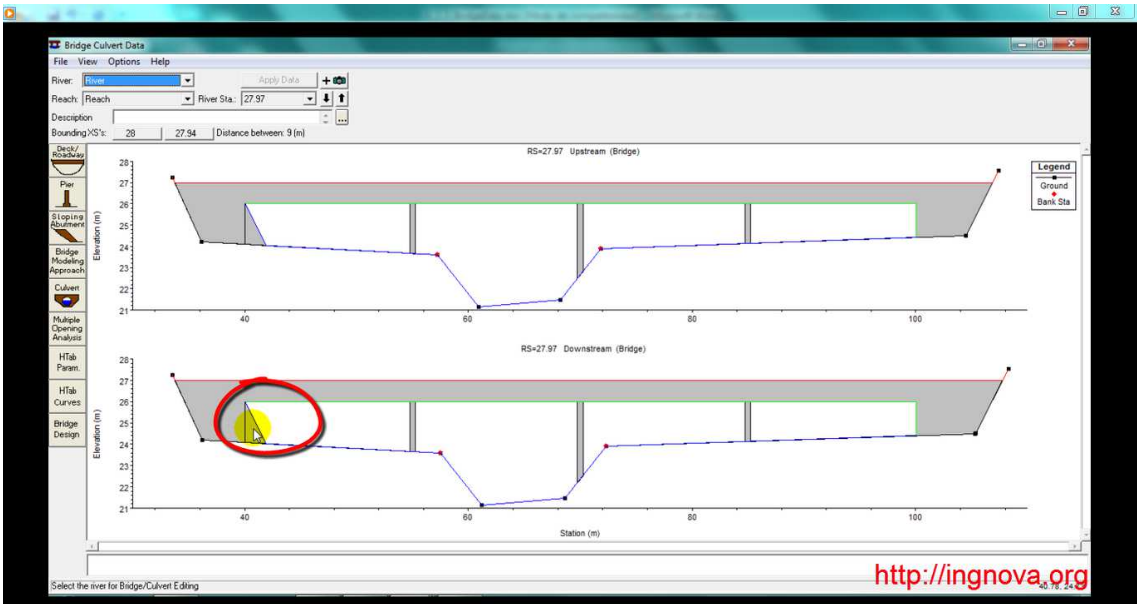

Figure 31. Left downstream abutment

And now, **enter the right abutment data**:

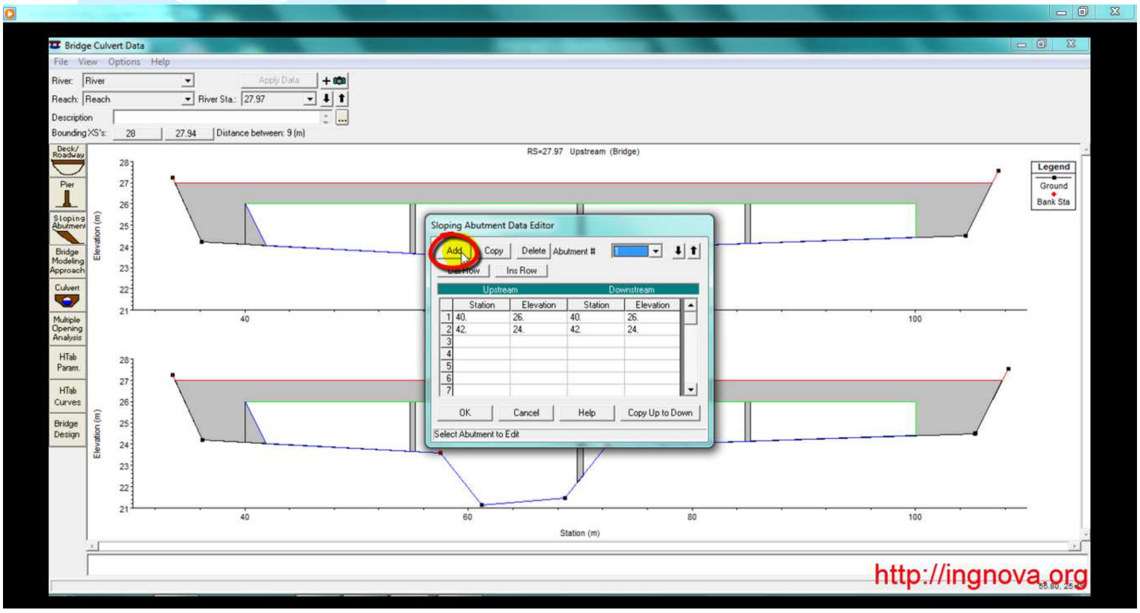

Figure 32. Add a new abutment

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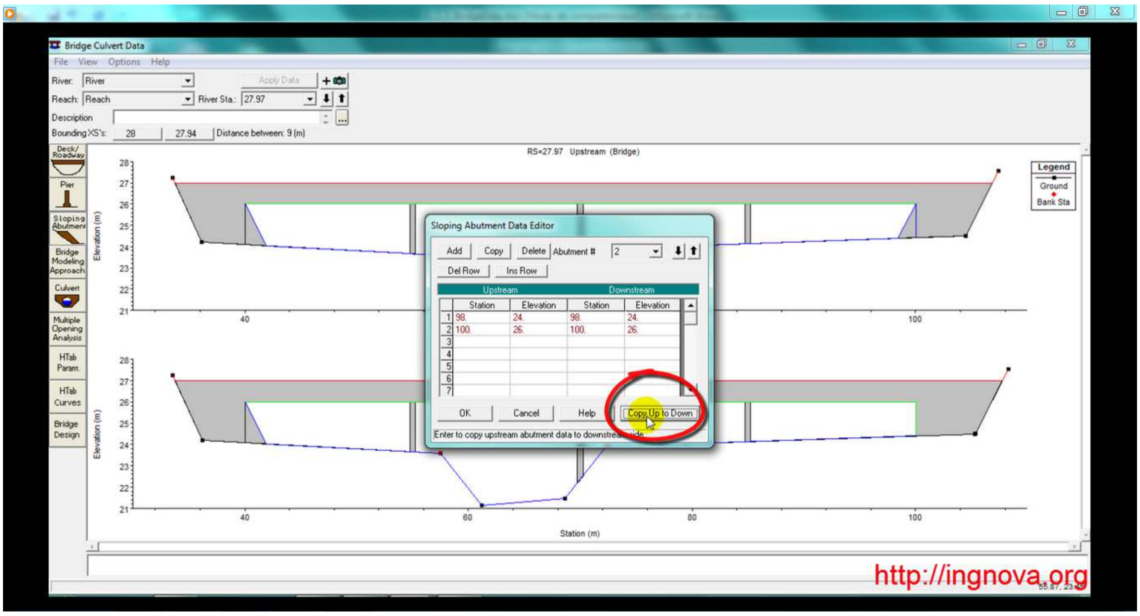

Figure 33. Copy right abutment coordinates from US to DS

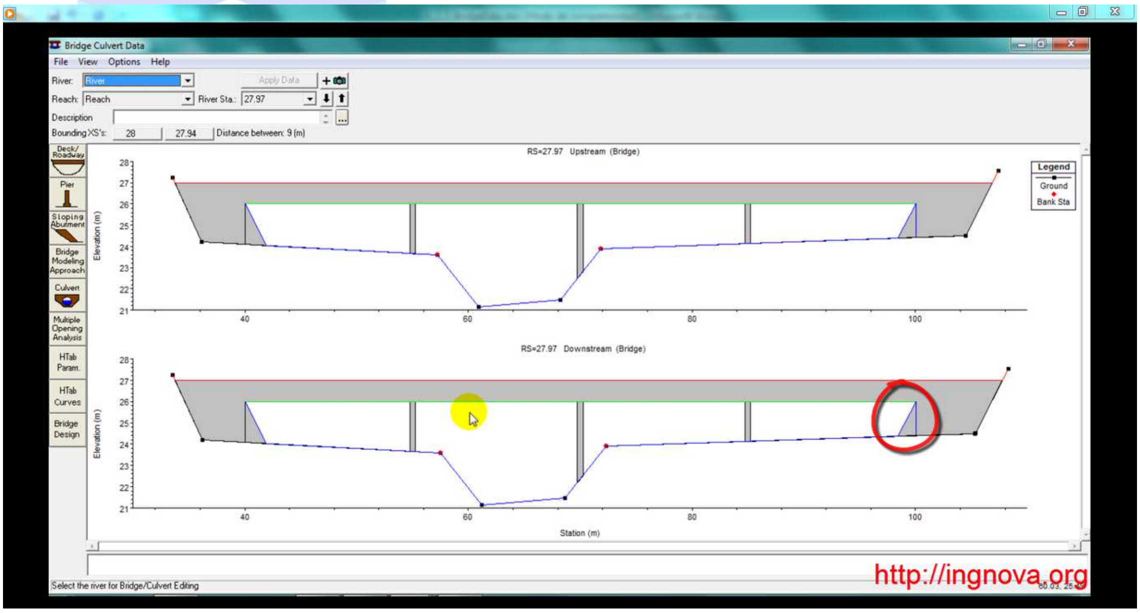

Figure 34. Right downstream abutment

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Now if we go to the geometry window, the bridge is drawn with a grey rectangle.

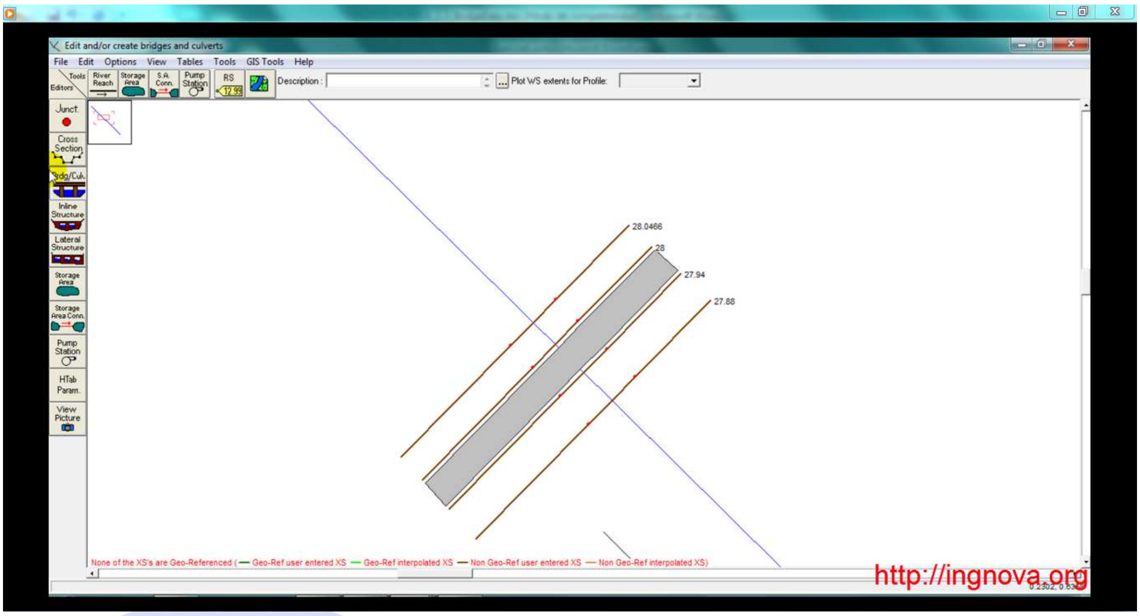

Figure 35. Geometry (cross sections and bridge)