Numerical Modeling of the Flow Pattern in MWRD Calumet Pumping Station

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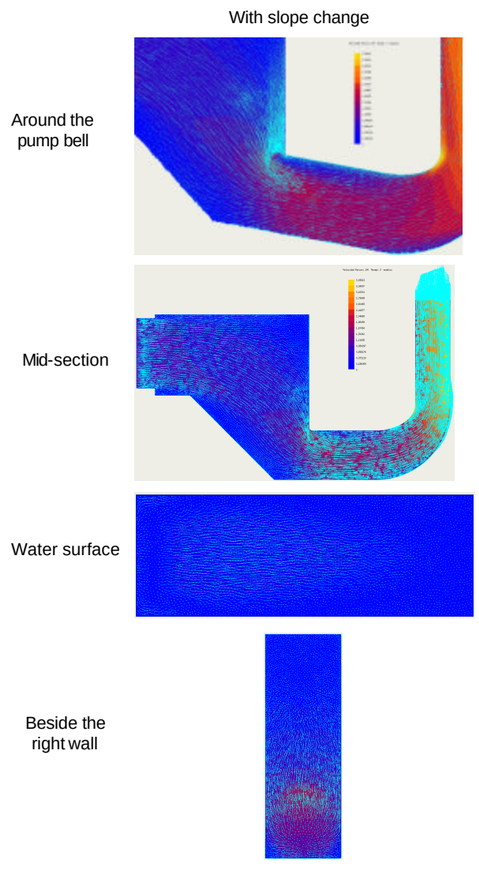
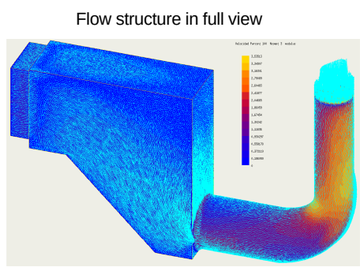
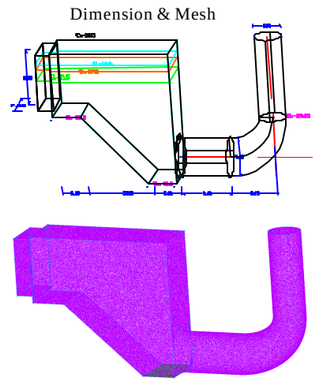
To improve the flow structure in the wet well and in the suction pipe, the bottom slope upstream of the pump bell was decreased so that its upstream starting point is shifted to 5 ft (originally, 11 ft) away from the left wall of the wet well. The flow patterns under this change are reexamined.

Again, four cases are modeled corresponding to different wet well elevations at -21.5 or -18.5 for lower pump speeds and -19.5 or -16.5 for higher pump speeds respectively. The input discharge to the wet well is taken as 120 mgd.

The following shows the comparison of flow patterns between before and after the slope change for the El. -16.5 case.







Two improvements could be observed clearly:

1. The flow structure around the pump bell (the area of most concern due to its notoriously bad flow structure) is much improved, as expected. Compared to the results without the slope change, the circulation along the tilted bed is much reduced; the streamlines of the incoming flow to the bell are changing much less dramatically; the turbulent intensity around the upper part of the bell is much reduced too. All of these could reduce the possibility of the occurrence of cavitation along the upper part of the horizontal pipe.

2. Comparing the flow patterns at the water surface and beside the right wall in the wet well , it can be seen, especially in the case of El. -16.5, the flow velocity close to the water surface is reduced, so is the turbulent intensity. And the stagnation point height beside the wall is lowered a little. These could lessen the risk of air suction at the water surface.

So, this geometry modification does improve the flow behaviour. But the region around the bell remains not very satisfactory and further improvement could be required.