

Finalize Section Cuts and Details & Sedimentation Tank Updates

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Spring 2014

Part I

Finalize Section Cuts

Problem Definition

Introduction

Section cut helps our customers and operators better understand how is AguaClara plant look like. Also, they provide a detail information for each part of the plant. The main task for finalizing section cuts is to check if the code is working properly. After running through all the codes built up last term, the resulting graphs give mirror images which are not as predicted. Figure 1 shows current section cut view for Entrance tank, which has the view of positive y direction. But actually it gives the mirror image of the y axis if looking from the top. Figure 2 gives the right image for the Entrance Tank cut. Also another goal for this semester is to create two more section cuts, which have the view of “Above entrance tank upper wall looking downward inwards into the plant” and “To the left of the filter’s outside wall, looking to the right and inwards into the plant”.

Design Details

The function that I am going to create in Mathcad is based on those existing ones. I used the code that has been created in a previous semester to generate the plant layouts, and different section cuts are created in AutoCAD based on the code written by the previous team. The critical part of our code is the “SectionCut” function, and we modified it in order to avoid an unexpected layer which would be generated after running “SPTB” command. Moreover, I decided creating a command of “Enter” and used it instead of “SP” command in order to avoid an unexpected error that happened while running the “SectionCut” function. I inserted a line called “Flip” into SectionCut function in order to

Figure 1: 2D Section Cut for Entrance Tank 1

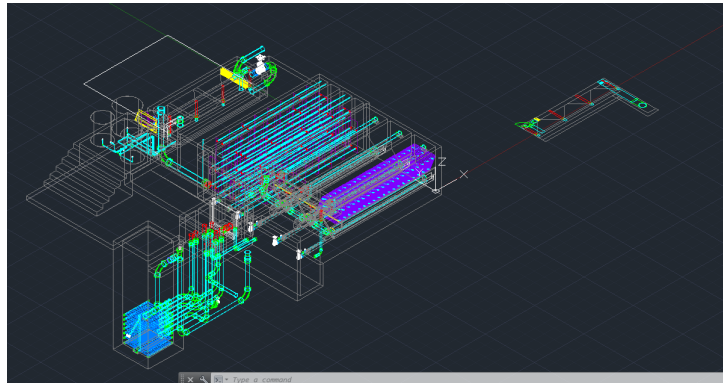
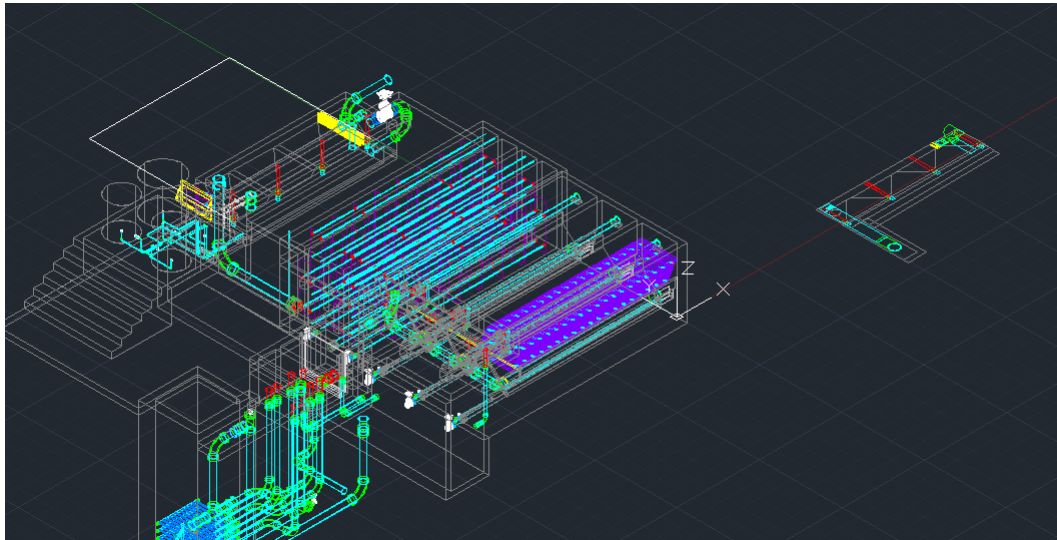


Figure 2: 2D Section Cut for Entrance Tank 2



give the right image of different cuts. Finally, I created another two cuts as I mentioned in introduction to finally have all the required graphs.

The way to manually create a section plane is as follows:

- Command “Netload”
- Select “Sectioner.dll” module
- Define two points that will create a section plane
- Define one point of the section plane direction
- Select the plane
- Create section cut with “SPTB” command
- Select cut insert point
- Specify X & Y factor, usually use 1 for each
- Specify angle, usually use 0 deg

The longitudinal and transverse section cuts can be produced to illustrate details of plant. This is very useful for our implementation partners to construct the plants. The following list contains the command to create cross section cuts for sedimentation tank and flocculator seperately from appropriate view. Other section cuts created by previous team for the filter, entrance tank and etc. will not be listed here. These functions can be modified for other specific plants or special designs.

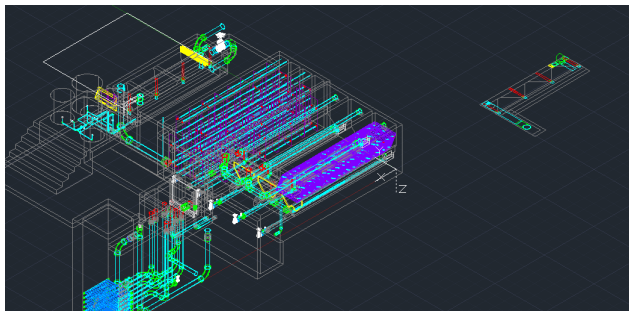
Longitudinal cuts (section plane which is parallel to x-axis):

- Inside of sedimentation tanks with section cut in the middle, looking to front direction (negative y direction)
- Inside of flocculator with section cut in the middle, looking to front direction (negative y direction)

Transverse cuts(section plane which is parallel to y-axis):

- Inside of sedimentation tanks with section cut in the middle, looking to right direction (positive x direction)
- Inside of flocculator with section cut in the middle, looking to right direction (positive x direction)

Figure 3: 2D Section Cut for Entrance Tank 3



Documented Progress

Problems Encountered

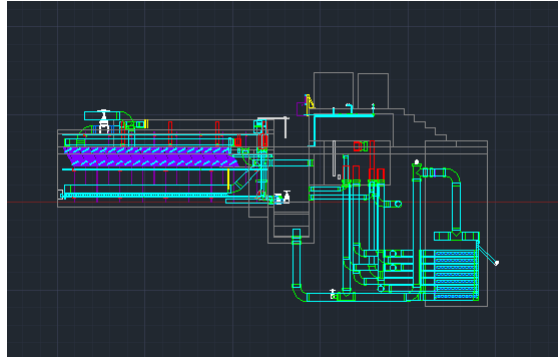
The first problem I faced was automation of “3DRotate” command. The first idea that came to my mind to avoid the mirror image was “3DRotate”. I worked pretty well with manual operation in AutoCAD, but I encountered a problem when trying to select the rotation axis within the command line. AutoCAD didn’t allow me to select x, y, or z axis after I typed in 3DRotate in command line, and I was not able to automate the command with built in Mathcad code.

Another way I tried to avoid the above problem was to use “Rotate” command to rotate the 2D image. Since the “Rotate” command only allowed me to rotate about the z axis, there was no way to have a flipped image of y axis with this command. The solution for this was to take advantage of UCS. The UCS is the coordinate system in AutoCAD, which can be adjusted with “UCS” command. I tried to adjust the UCS system before I ran “SPTB” command, and the code ran separately, but did not work if I ran all the code at once. That means if I adjust the UCS and pause in AutoCAD before I run “SPTB”, it will work. Otherwise it will give a mirror image as well.

The final way I tried to solve it was still using the “Rotate” and “UCS” command. The only way I found to avoid the above problem was to not to adjust UCS back after the graph has been created. Figure 3 shows the automated cut for Entrance Tank. Notice that the UCS system has z axis pointed downward after the graph was created. It can be changed back manually but not with automation, otherwise mirror image comes out again.

The module “SPTB” has a problem with angle rotation. No matter what degree I tried to rotate, it always gave a graph with about 1 degree rotation. This problem happened because “SPTB” is using radius as rotation angle. And I asked Kean who built “SPTB” to fix the problem for me.

Figure 4: Just above the entrance tank upper wall (outside of the plant) - looking downward (negative y direction) inwards into the plant



Accomplishments

I modified the code created by previous team and made them run correctly, and the mirror image problem has been fixed. Also, the SPTB module is working correctly now with giving a right rotation angle. All required section graphs have been created automatically with current code, and two more additional graphs have been created for reference. The “Appendix” section below shows all graphs for section cuts. I did not add dimensions to the section cuts because there would be too complicated to do the coding. For future work, the section cuts will need to be placed in some sort of layout view, so that they can be easily presented to the user.

Appendix

Part II

Sedimentation Tank Updates

Problem Definition

Introduction

Plate settlers are currently suffering sagging in the sedimentation tank due to gravity. In order to avoid the sagging, a group of longitudinal and transverse pipes will be placed under those plates. I am looking for a way to draw those pipes automatically in AutoCad with Mathcad code. Figure 20 shows current sedimentation tank without support pipes, and Figure 21 shows the sedimentation tank with support pipes added in.

Figure 5: Entrance tank (through the center of the drainage pipes) - looking upward (positive y direction)

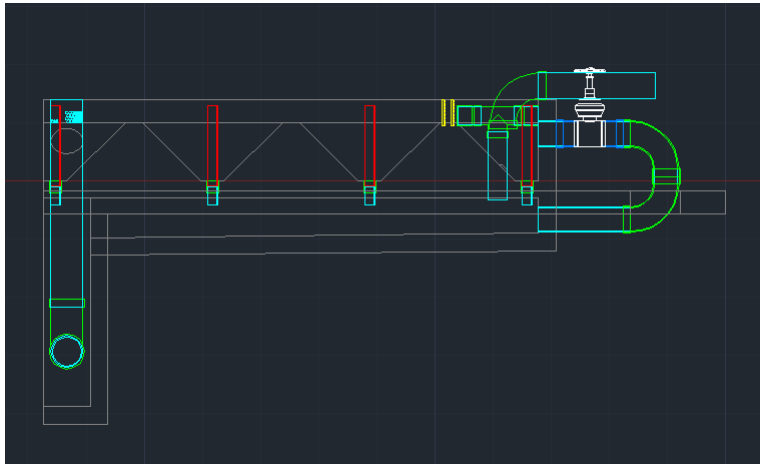


Figure 6: Walkway between entrance tank and flocculator (center)

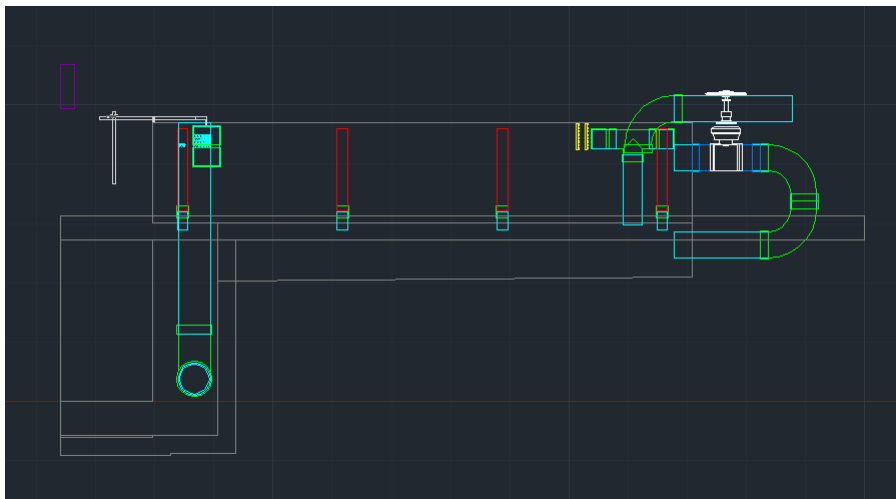


Figure 7: Flocculator (center of a channel, avoiding cutting chem barrels and plumbing off-center if possible)

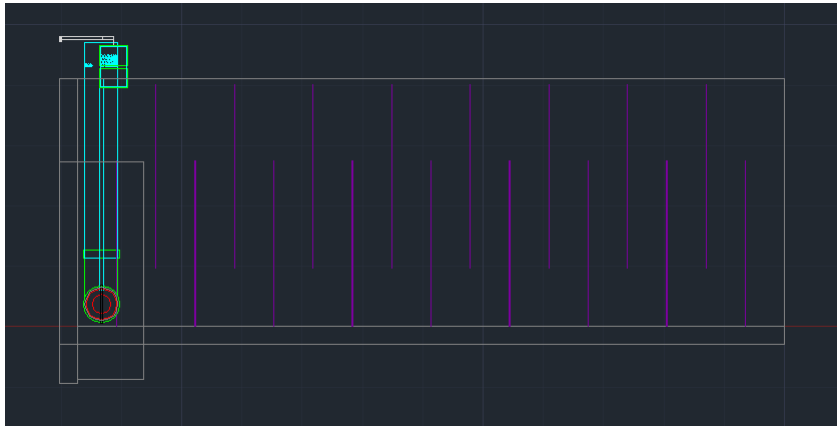


Figure 8: Sedimentation tank (down the center of a bay - try to choose one that cuts the filter in an informative way)

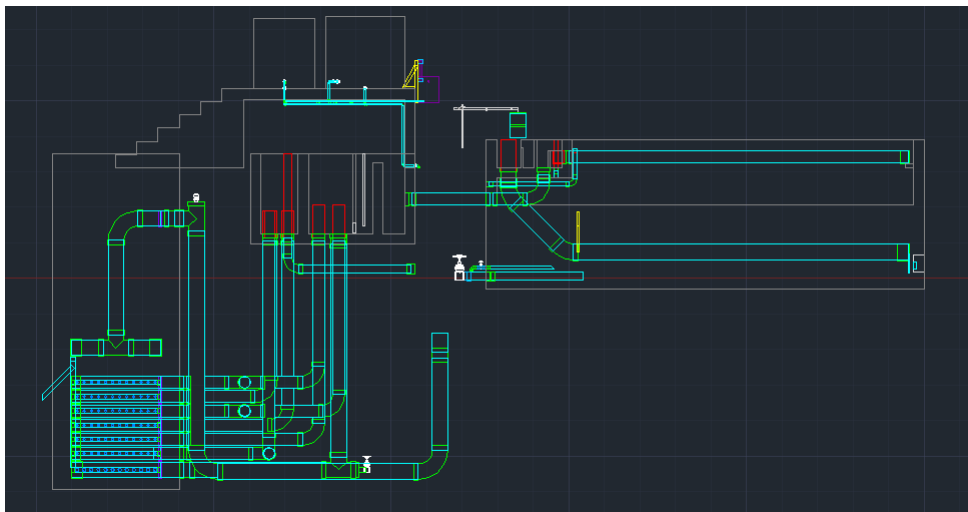


Figure 9: Filter (through the center of the overflow box if there are two filters)

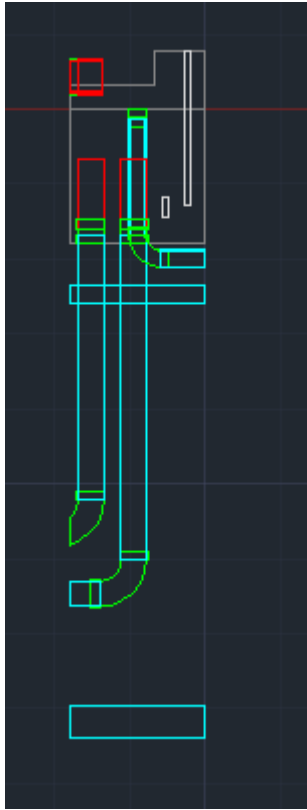


Figure 10: Walkway between entrance tank and flocculator (center)

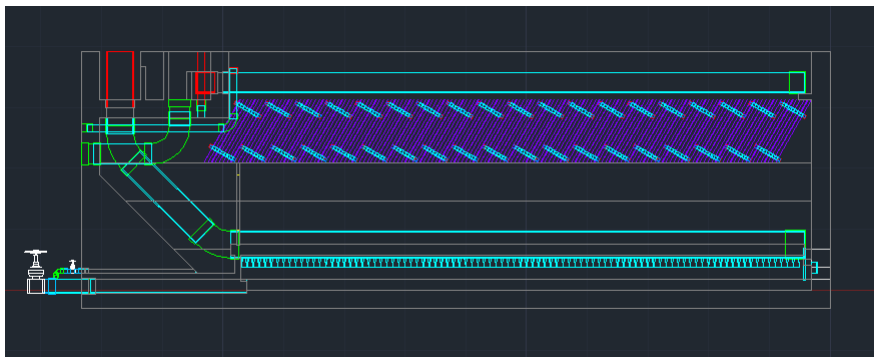
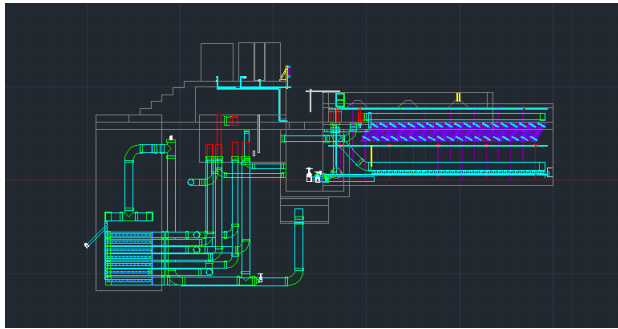


Figure 11: Just below the last sed tank wall (outside of the plant)



(a) To the left of the filter's outside wall (outside of the plant)

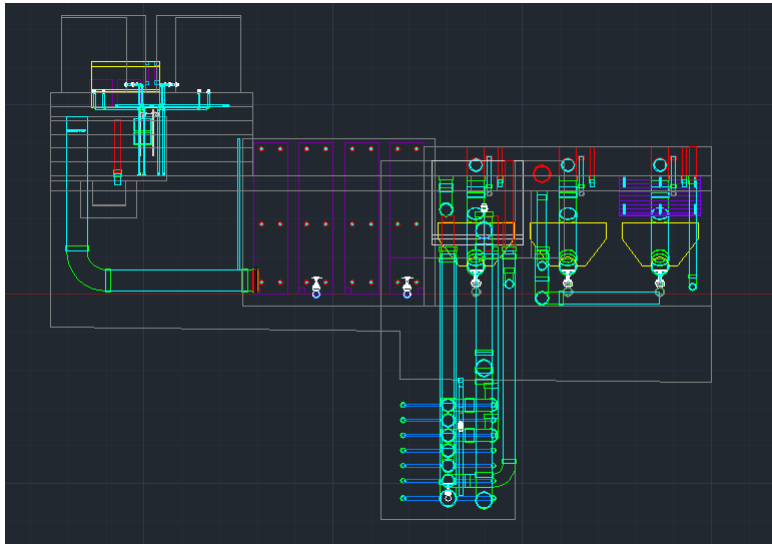


Figure 12: Inside the filter box (through the center of a branch)

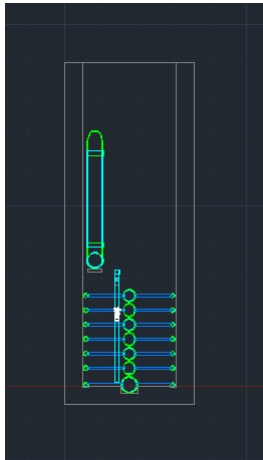


Figure 13: Between the filter box and the filter's exit box (avoid cutting the vertical siphon pipe or cut it down the center, if possible avoid cutting chemical tanks and plumbing off center)

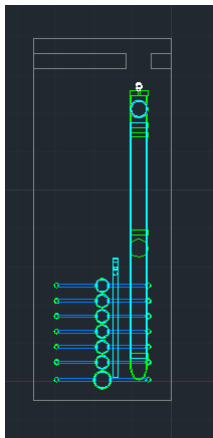


Figure 14: Inside the filter's entrance box (through the center of the most distance entrance pipes or to the right of them)

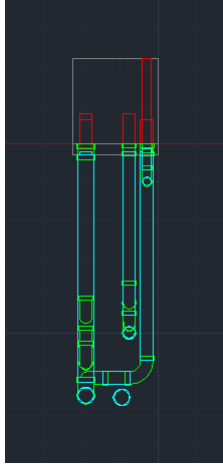


Figure 15: Drain channel (through the center of the siphon pipe exits or to the right of them, avoid cutting into the sed tank drain valves if possible)

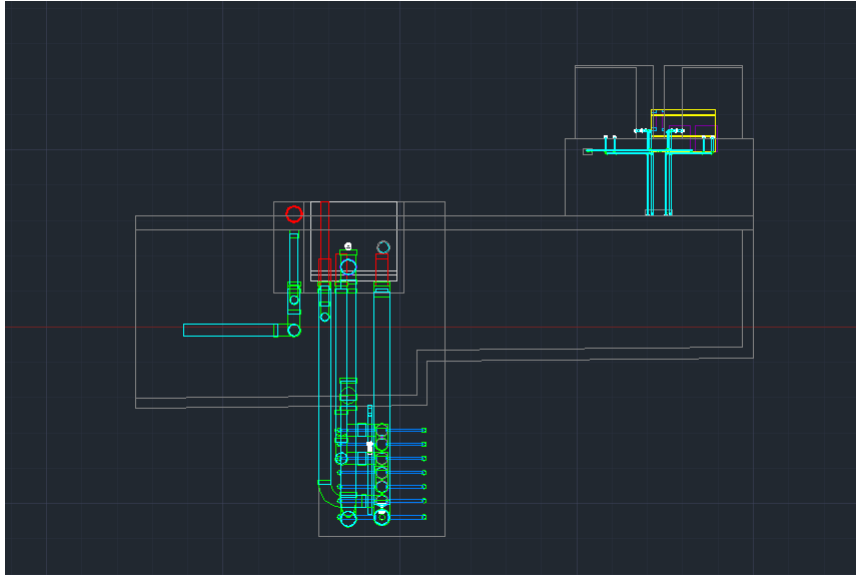


Figure 16: Center of the first hopper of the entrance tank (should take care of flocculator and sed tank transversal cuts)

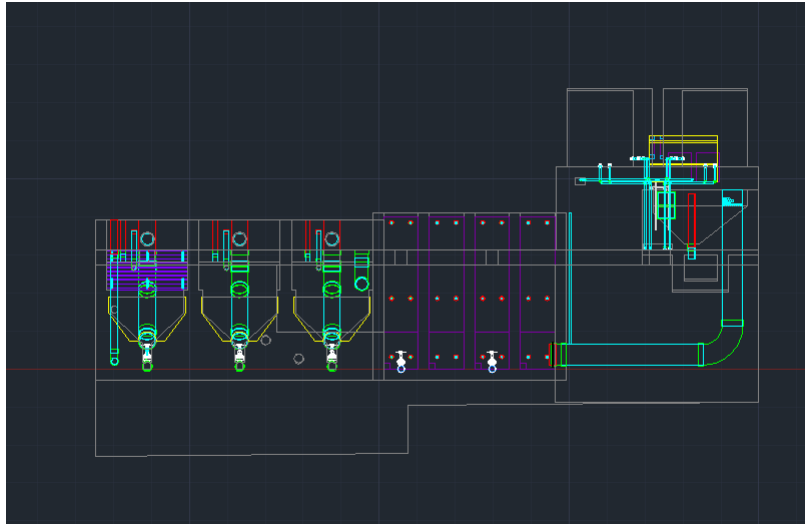


Figure 17: To the right of the furthest wall of the sed/floc tanks (outside the plant)

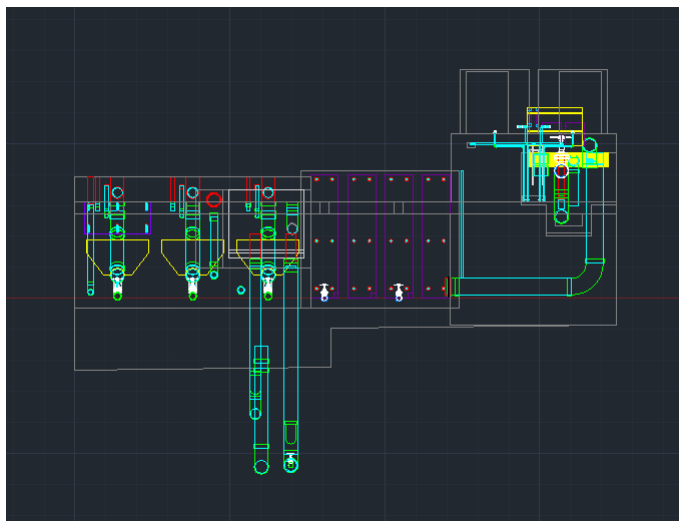


Figure 18: To the right of the sedimentation tanks with section cut in the middle

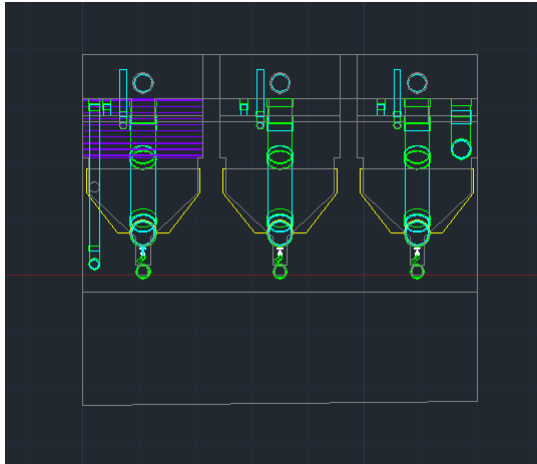


Figure 19: Sedimentation tanks with section cut in the middle

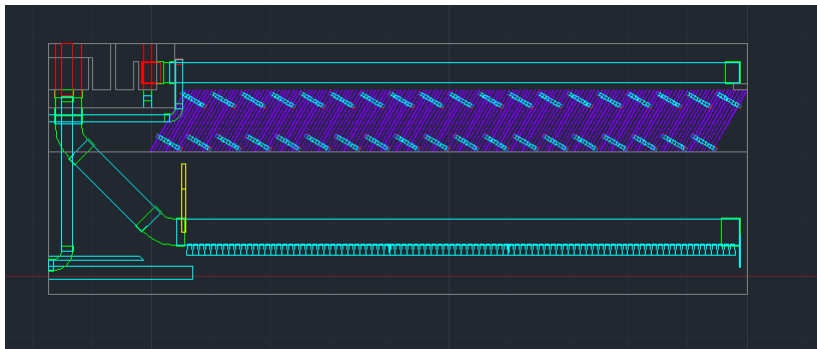
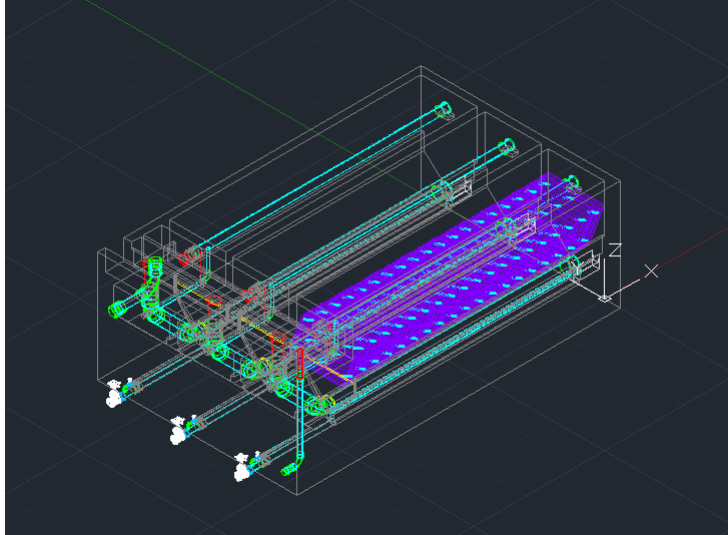


Figure 20: Original Sedimentation Tank



Design Details

The function I created is based on two input parameters, the maximum space between two transverse pipes and support pipe diameter. Once the maximum space has been chosen, the function will automatically calculate out the real space between transverse pipes according to the length of the sedimentation tank. And then, the function will also create longitudinal supporting pipes at proper location in the sedimentation tank. Note that, I have three functions for creating transverse pipes (Front, Middle, End) because the first group transverse pipe is never moving, and the last group of transverse pipes' location is dependant on how many longitudinal pipes there are in the sedimentation tank.

Documented Progress

Problems Encountered

I faced a problem with finding the correct number of longitudinal and transverse pipes because the number of those pipes are dependant on how big the sedimentation tank is. I solved the problem by creating a function in Mathcad. The way I did this was by calculating an estimated number by giving a nominal distance between pipes, and then I roundup this number to an integer, and recalculated the actual distance between pipes. Figure 23 shows how the function finds the correct number of longitudinal pipes for the sedimentation tank.

Figure 21: Sedimentation Tank with Plate Settler Pipe Supports

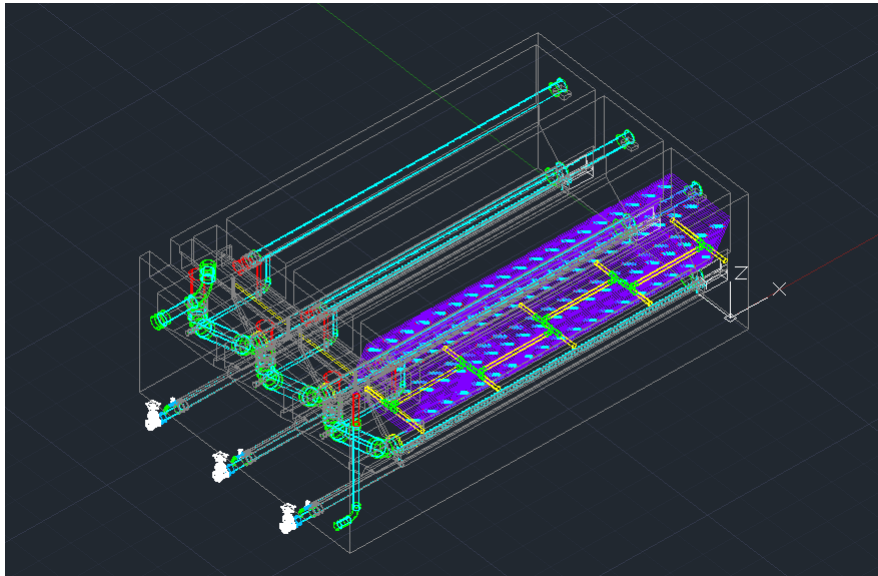
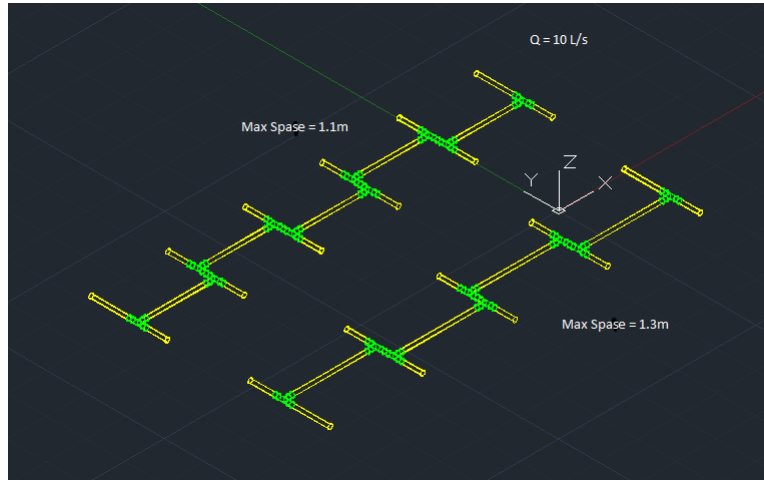


Figure 22: Supporting Pipes In the Sedimentation Tank



Accomplishments

I successfully created a function to draw the plate settler support pipes automatically. The function only requires two input parameters, which are the maximum space between two transverse pipes and the pipe diameter. The function is able to adjust the number of longitudinal and transverse we need, according to the maximum space input. The final drawing can be seen in Figure 21 above.