Summer 2013 Stock Tank Mixer and Stacked Rapid Sand Filter Drawings Final Report

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8/1/13

Problem Definition

Introduction

Every semester the design team compiles a list of design challenges that have yet to be met. From the Spring 2012 list of design challenges, I chose two drawings to complete this summer. The first challenge was to to incorporate a stock tank mixer design into existing drawings. The stock tank mixer uses a centrifugal pump system to ensure that the coagulant and chlorine stock solutions are uniformly mixed. My task was to take the new design, including relative dimensions, and create Mathcad code that would draw the tank mixer in AutoCAD. The second challenge was to implement a method for properly spacing the stacked rapid sand filter (SRSF) based on the Spring 2012 SRSF team's spacer design. The team designed two different spacers: the branch manifold receiver spacer and the trunk line spacer. My task was to create code in Mathcad that will draw these spacers into the existing AutoCAD drawing of the SRSF.

Design Details

Stock Tank Mixer

All pieces of the new stock tank mixer design were created by using functions already written in the existing code. The AutoCAD script will draw the cylindrical tank first and then the inside pipes and cylinders. The dimensions for the tank were based on the stock tank report from Spring 2012 (Figure1). Because some parts, such as the bottom two inflow holes, did not have dimensions marked, I had to set my own numbers for those (Figure2). The user can, however, easily change these variable values in the code and make a more accurate drawing. Currently, the code draws a tank with the internal mixer, but the tank might need to be removed when the part is implemented into the current full plant drawings because a tank already exists there.

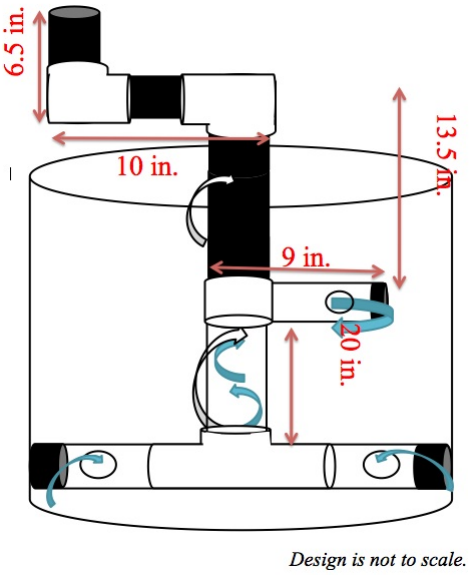

Figure 1: Updated Stock Tank Design from Spring 2012

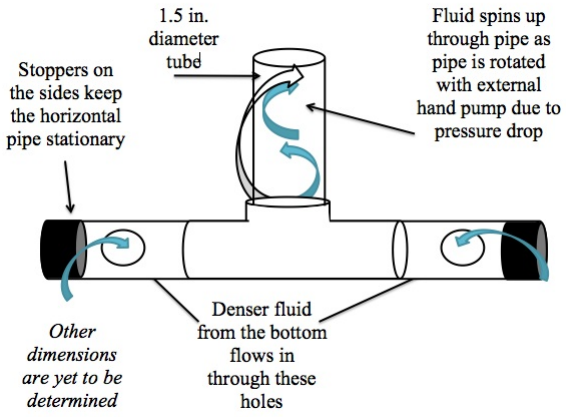

Figure 2: The bottom segment of the Centrifugal Pump from the Spring 2012 report

Stacked Rapid Sand Filter Spacers

The branch manifold receiver spacer required no new functions. The spacer uses tees and pipes; both of these drawing functions already exist in the design tool (Figure3). The team included a piece called a hose clamp that connected the

spacer to the branch receiver that I had to create a drawing for in AutoCAD, but that was done by using the cylinder function in the design tool (Figure4).

The trunk line spacer did require a new function. The Spring 2012 team designed the spacer with two PVC pipes, two threaded rods, and eight jam nuts (Figure5). The pipes already exist in the design tool and the threaded rods were drawn with the cylinder function, but the jam nuts were new parts and needed a new function.

The Spring 2012 team also specified where in the filter they wanted to place the spacers, so I had to integrate existing origin points and height variables into my new pieces of code to ensure that the spcers were drawn in the correct location (Figure6).

Figure 3: Branch Manifold Receiver Spacer from the Spring 2012 Report

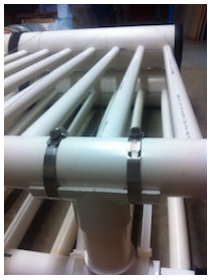

Figure 4: Spacer with Hose Clamps

Figure 5: Trunk line spacer from the Spring 2012 report

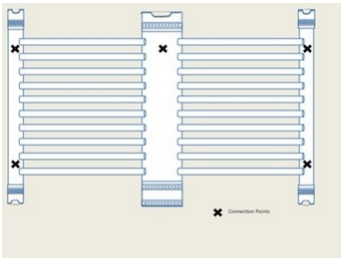

Figure 6: Placing of Spacers

Documentation

Problems Encountered

Stock Tank Mixer

The main issue was the unmarked dimensions in the sketches from the report. When writing the code, it became difficult to ascertain how pieces measured relative to one another making scalability a tough task. The current dimensions were determined through trial and error, so more accurate dimensions might need to be calculated in the future.

Stacked Rapid Sand Filter

I experienced some difficulty with the array function when trying to place the spacers (Figure7). After some manipulation of existing stacks, both spacers fit

into the drawing (8). Another difficulty occurred when I attempted to write a function to draw the jam nut. The jam nut is a hexagon, so I was attempting to draw a flat polygon figure and extrude it. I then tried to subtract a cylinder from the center of it. Unfortunately, this did not work. The code would not run past the subtract command. We believe this is because AutoCAD can not subtract a 3D figure from an extruded 2D figure. This issue prevented us from writing the new function. Instead, I used cylinders to represent where the jam nuts would be in the drawing (Figure9).

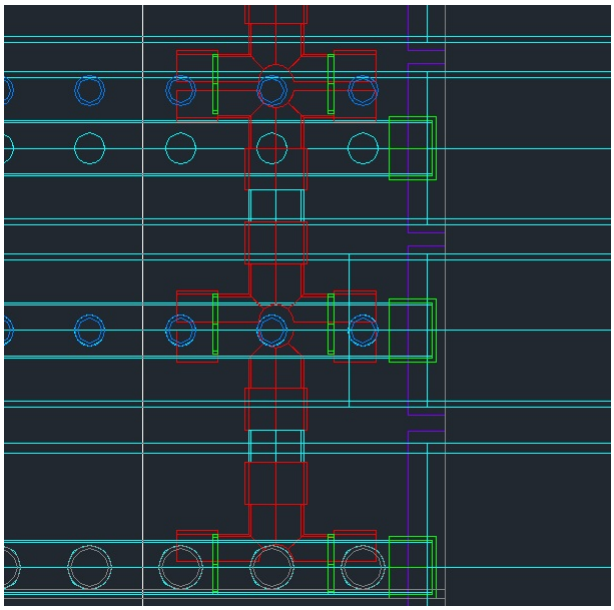

Figure 7: AutoCAD drawing of the branch receiver spacer and manifold layers with the incorrect array function

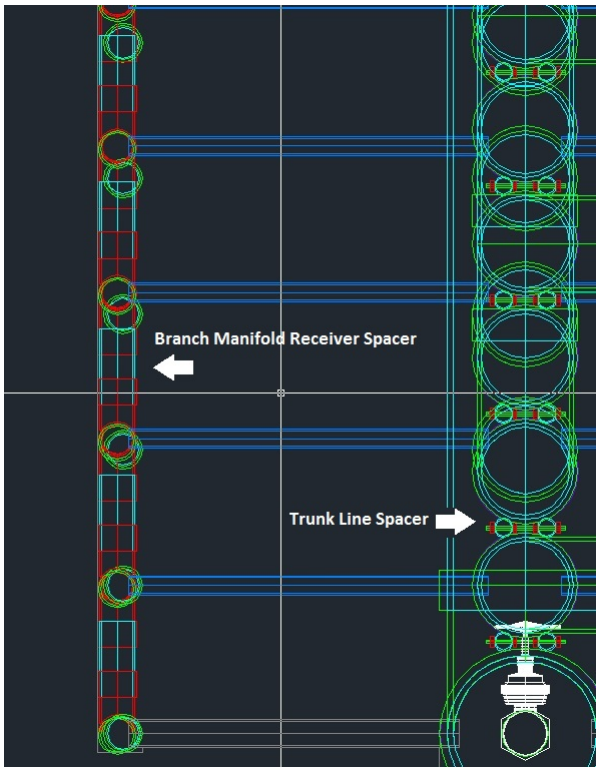

Figure 8: Current AutoCAD of the trunk line spacer

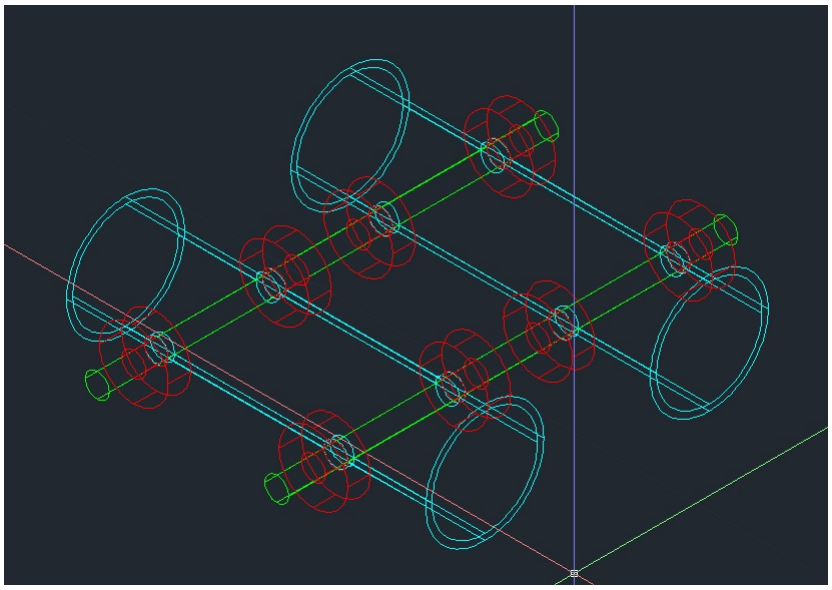

Figure 9: Current Placement of Jam Nuts

Accomplishments

AutoCAD scripts have been created to draw the new stock tank mixer design and the two spacers for the stacked rapid sand filter bed manifolds.

Future Work

Future design team members should focus on making the stock tank mixer drawing scalable and integrate it into the full plant drawing. They should also work on writing the function to draw a jam nut and use it in the trunk line spacer code instead of the cylinders.