

Section Cuts

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Problem Definition

Introduction

For our task this semester, we worked to create section cuts through the AguaClara plant that could be incorporated into the Design Tool and produce reference drawings similar to those of an architect. Currently, Agua Para el Pueblo (APP) makes section cuts directly in the AutoCAD model space once it receives a design, but the process for making section cuts is not only tedious, but exceedingly time consuming on APP's computers. The ability to have these cuts diagrammed within the Design Tool is essential for efficiently planning both the construction of an AguaClara plant as well as creating a structural design for each plant.

As a result of our work this semester, there are a few separate tasks that we considered with regard to creating plant layouts in AutoCAD. First, we worked to define a function within the Design Tool that will make section cuts from the command line. When done manually, making a cut requires opening a dialog box that explains the options for making a section cut through the plant, but we are working to redefine the way in which this is implemented so that it can all be done from the command line. An example of the type of section cut that we are using as an example can be seen in Figure 1. This plan was created by an architect in Honduras, and is serving as a goal for our work this semester, which will include adding dimensions and a scale for the drawing sheets.

In addition to creating a function for creating AutoCAD layouts, we will evaluate the process of creating detail layouts for specific processes of the AguaClara plant including: CDC, LFOM, etc. In regard to the detail layout for the SRSF, we began to evaluate the most effective way to communicate the filter plumbing to an engineer or technician looking at plans for the SRSF. As the layout is drawn now, it is very hard to spatially understand the way in which the pipes are constructed, and we will work to create a system that makes this more readily understandable from the detailed layout.

Finally, an incredibly important aspect of our task is to utilize the 'section-plane' feature to be able to effectively communicate to other implementation

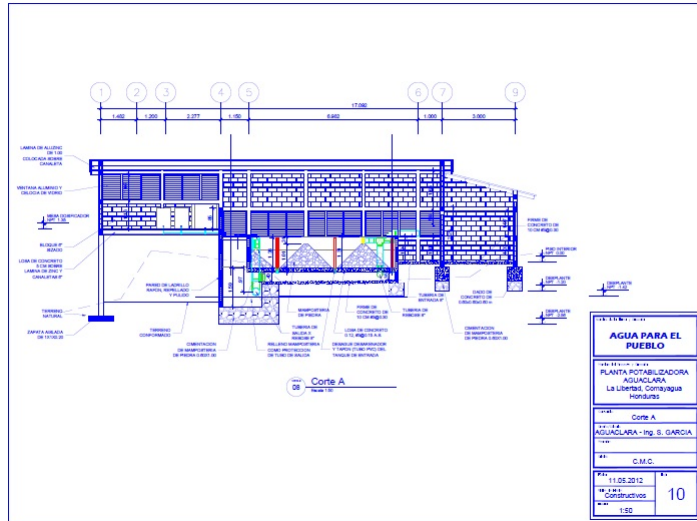


Figure 1: Corte A - Example layout done by Agua Para el Pueblo architect

partners how the AguaClara plants are designed and constructed. APP’s familiarity with AguaClara plant designs allows them to take more of a leadership role in creating the section cuts that they are currently using to construct AguaClara plants. New implementation partners will not be as familiar with the plant design, and the goal of our project is to clearly illustrate the way in which the AguaClara plant is designed and needs to be constructed.

Design Details

The function that we created in Mathcad is independent from much of the other code that already exists. We were looking at code that had been created in a previous semester to generate plant operation layouts, but we are going to create our own code for this specific purpose. The only dependency that this code will have on previously existing code will be in defining a plane within the plant that will provide the section cut once the overall plant rendering has been completed.

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

- Command “sectionplane”
- Define two points that will create a plane
- Select the plane and indicate which direction the cut will be looking in from the direction of the blue arrow

- Once the section plane is selected, command “sectionplanetoblock” which opens a Section Settings Dialog Box
- Select “2D Section/Elevation”
- “Include all objects”
- “Insert as new block”
- All components must have Layer defined as “Layers by Object”
- Under “Background Line”, set Hidden Line to No
- If not already checked, check “Apply settings to all section objects”
- Define the insertion point of the 2D cut block. This can be on the side of the Model Space drawing, but should not interfere with the plant.
- Asks for X scale and Y scale, 1 for each.

Andrew Hart has recommended an initial series of longitudinal and transverse section cuts that can be produced which would depict useful information for implementation partners abroad constructing the plants. The following list contains descriptions of locations where we have defined section cuts in our initial function, and these can be modified in the future for any specific plant or implementation partner.

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Longitudinal cuts (parallel to the x-axis):

1. Above the entrance tank upper wall (outside the plant) looking downward (negative y direction) inwards into the plant.
2. Through the entrance tank (along center of the drainage pipes) looking upward (positive y direction).
3. Through the walkway between the entrance tank and the flocculator (center) looking upward.
4. Through the flocculator (center of channel) without cutting through the chemical storage tanks and avoiding cuts across pipes off-center, looking upward.
5. Through the sedimentation tank along the center of a bay, looking upward. We will determine whether cutting through the SRSF will be informative or will just clutter the layout.
6. Through the SRSF along the center of the overflow box, looking upward.
7. Through the sedimentation tank with settler plates along the center of the bay, looking upward.

8. Just below the last sedimentation tank wall (outside the plant), looking upward and inwards into the plant.

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Transverse cuts (parallel to the y-axis):

1. To the left of the filter's outside wall (outside the plant), looking to the right and inwards into the plant.
2. Inside the filter box (through the center of a branch), looking left (negative x direction).
3. Between the filter box and the filter's exit box, looking left; we will try not to cut through the vertical siphon pipe as well as cutting through the chemical storage tanks and piping off center.
4. Inside the filter's entrance box (through the center of the most distant entrance pipes or to the right of them), looking left.
5. Through the drain channel (through the center of the siphon pipe exits or to the right of them, avoid cutting into the sedimentation tank drain valves if possible), looking left.
6. Center of the first hopper of the entrance tank, looking left.
7. To the right of the furthest wall of the sedimentation tank/flocculator channel (outside the plant), looking left (inwards into the plant).

Documented Progress

Initially, we consulted Andrew Hart, an AguaClara Engineer and former Design Team member currently working out of Honduras with Agua Para el Pueblo, and he recommended a set of longitudinal and transverse sections through the plant that would convey proper views through specific processes throughout the plant; the descriptions of the sections are shown in the Design Details section of this report. To begin writing a function that would draw these sections, we needed to test different methods of creating two dimensional sections of a 3D object in AutoCAD. After determining that the 'sectionplane' and 'sectionplaneblock' commands were the best option based on what we wanted to portray in these two dimensional section layouts, we began to develop a Mathcad program that would contain algorithms to create these sections. We created Section-Cuts.xmcd which creates section planes at a desired location given two points that create a line, generates the two dimensional sections, and displays them in a linear fashion along the x-axis in the AutoCAD model space. Several of the longitudinal and transverse sections are not section cuts since they actually don't generate a section plane, instead, they are views of the plant from outside of the plant, and are therefore not sections. The remainder of the longitudinal and transverse section cuts are section cuts through the plant along different

components. The SectionCuts.xmcd accepts the plant flow rate as an input parameter. Additionally, the section cut layouts can be modified or altered easily if required in the future by altering the two points utilized to create the section plane. The sections that are generated with this program are inserted into AutoCAD model space are spaced far enough apart such that they don't interfere with each when selecting plants with larger flow rates. We have discussed the possibility of ultimately delivering two separate drawings with every design request so that the section cuts will not confuse the user when looking at the 3D model of the plant. This second drawing would merely be a copy of the original AutoCAD file created by the design tool, but would allow for easier navigation through the section cuts without interfering with the model itself.

Future Work

For next semester, there are still a few aspects of our task that will need to be considered. Per Andrew Hart's suggestion, we did not create specific layout pages that would be given as a set of reference drawings for any implementation partner. In the future, this could be a possible way of specializing our drawings for various implementation partners based on desirable changes to the provided section cuts for any plant. This inclusion of the section cuts on layout pages would require additional code to freeze and unfreeze various layers as you move through different sheets to ensure that creating new layouts does not affect previous ones. This task would also involve modifying the current AguaClara layout and disclaimer so that it fits to the page. Additionally, including section cuts on individual pages would require adding a scale to the drawing. This code is already included in our code for views of the plant taken from outside of the plant itself, and could easily be changed to add scale to various pages.

Given that we were advised not to make specific layout pages, we did not work to include dimensions onto the drawings. This would be a possible task to explore should layouts be put on paper space pages in the future, and these dimensions would be created in an array that could be inserted into the paper space for each layout.

Finally, we created section cuts through the filter as well as all of the separate processes of the plant, but in the future, different ways of communicating the pipe system of the filter should be considered. We discussed the possibility of freezing the inlet pipe layer and showing the outlet pipes and alternatively freezing the outlet pipe layer and showing the inlet pipes to eliminate some of the overlap in the section cut. Other processes in the plant could also be broken down to have more views to more easily communicate the necessary construction elements of the plant for implementation partners that may be less familiar with certain aspects of the AguaClara plant.

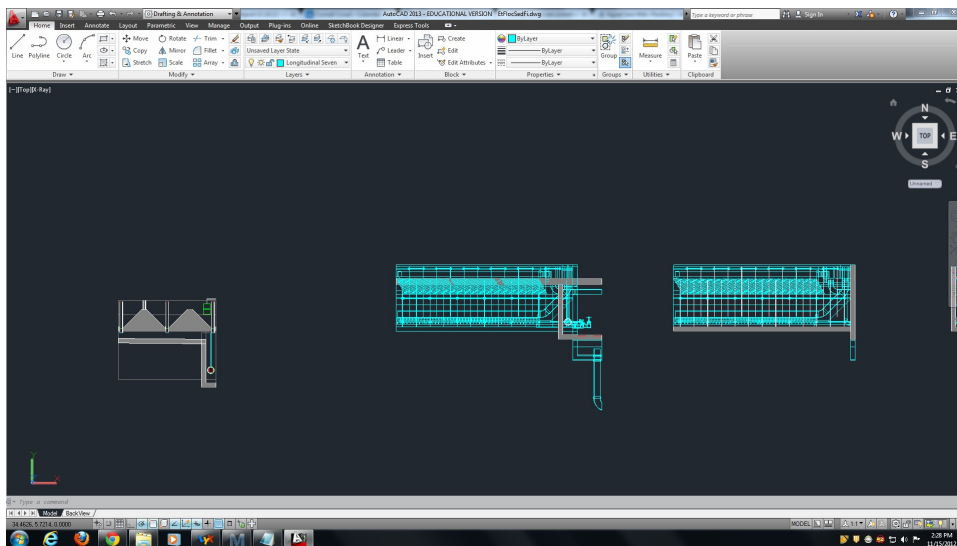


Figure 2: AutoCAD output of our SectionCut function