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Pre-Fabrication 1L/s

To discuss the progress of Fall 2016 team and the changes we are making to the process of fabricating the 1L/s plant

Purpose

- AguaClara has recently taken on the idea of extending research into smaller volume flow plants. The 1L/s plant marks the potential to make clean water more accessible to people in remote locations/those unable to front the costs of a large traditional plant.
- The purpose of our team was to construct a second 1L/s plant and work to streamline the fabrication processes involved.

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Sedimentation Tank Fabrication

- In order to cut the pipe, a wooden jig consisting of a board with an ellipse cut in its center was fit over the pipe.
- The jig was fixed using 80/20 bars and joints, screwed directly to the pipe

Pipe before it was cut

Pipe from other side

Cradle Jig

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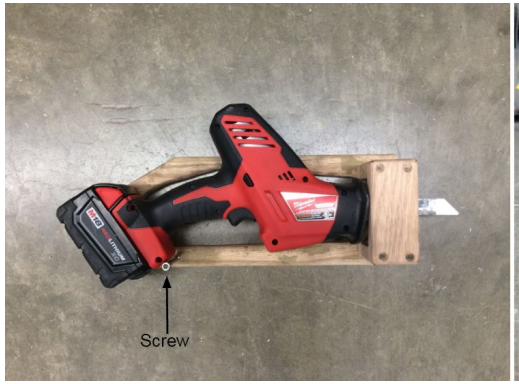
- To properly get the blade parallel to the angle set by the plywood board jig a "cradle jig" had to be created.



Saw in cradle.

Empty cradle

Sedimentation Tank cont.

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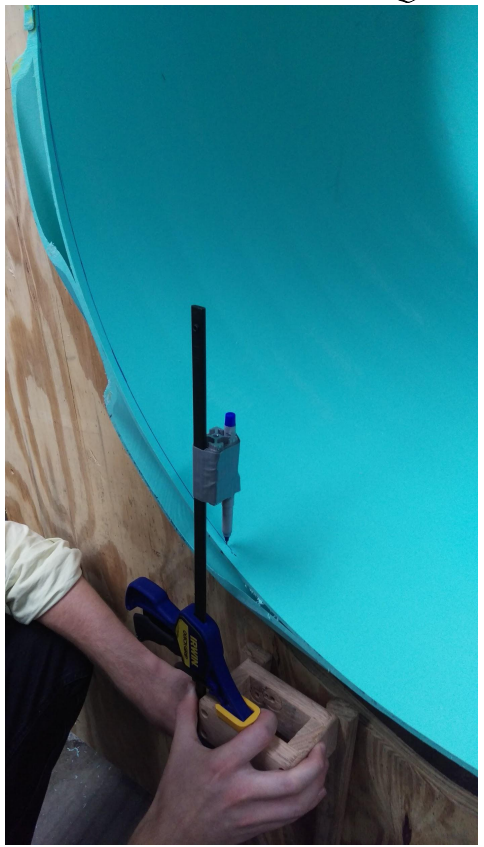
- In order to actually make the cut, a reciprocating saw was fit into a cradle and brought around the circumference of the pipe.

Sean cutting the pipe

Recutting the Sed Tank

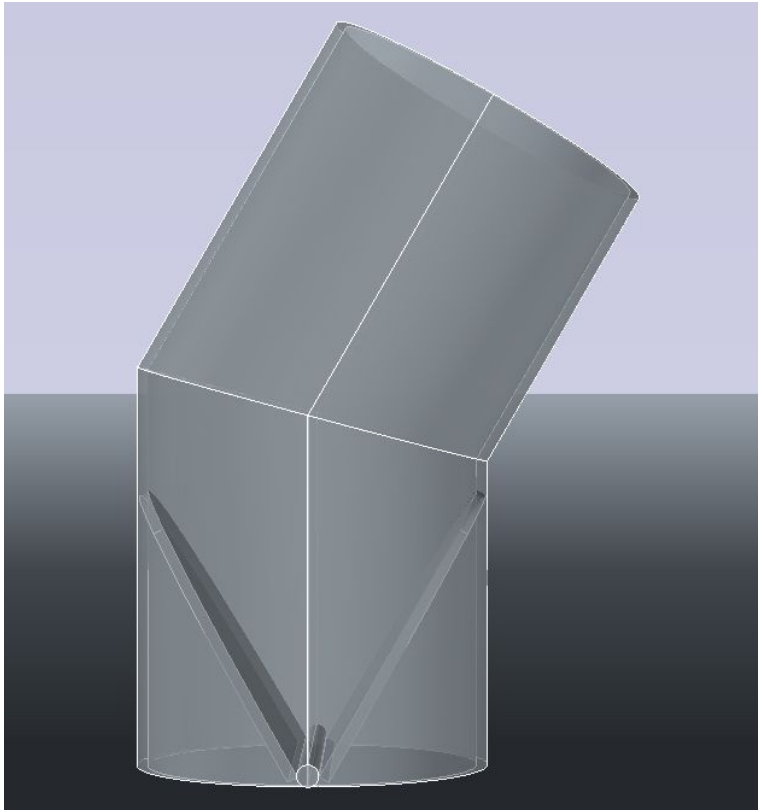
- Initial cut was not satisfactory. Had to cut again.
- Jig was constructed to make it more accurate.
- This new system accomplished its goal.
- Even more accurate methods of cutting should be explored.



Using the jig

Base Plates

- The geometry of the base plates consist of two half ellipses connected by a 3 inch diameter half pipe, called the jet reverser.
- The jet reverser serves as the joint for the two ellipses and the piece to redirect the flow of water from the inlet manifold upwards into the tank.
- The ellipse halves sit at 60 degrees to each other and the ground in line with standard sedimentation practice.



This schematic of the sed tank shows the base plates and jet reverser

Creating the Base Plates

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- To create the base plates, we first had to establish the proper geometry, and used standard ellipse geometry to do so.
- Using the Sed Tank Diameter as the minor axis and using trigonometry we determined the major axis to be 71 inches
- In order to trace out the ellipse, we measured where the foci points should be on our pvc sheets and affixed two small weld rods to those points. We used a loop of string with a length of 132.488 inches wrapped around the weld rods and traced a marker around the circumference .

The pvc plates after having the ellipse circumference drawn

Base Plate Redesign

- Upon cutting these ellipse halves, we discovered a major flaw in our initial geometry
- The plates were measured to meet in the middle of the sed tank, but in actuality needed a different shape due to being offset from the center of the pipe from sitting on the jet reverser
- Returning to our geometric model, we determined that 3 inches needed to be taken off of the minor axis side of each ellipse to account for the 3 inch gap created by sitting on the jet reverser

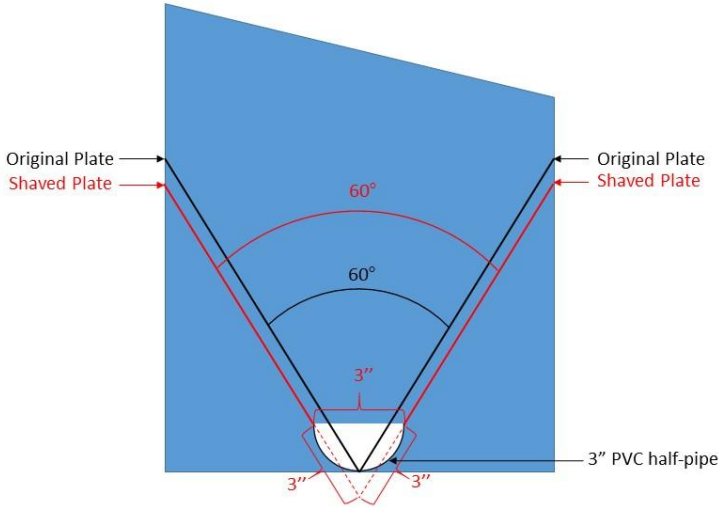
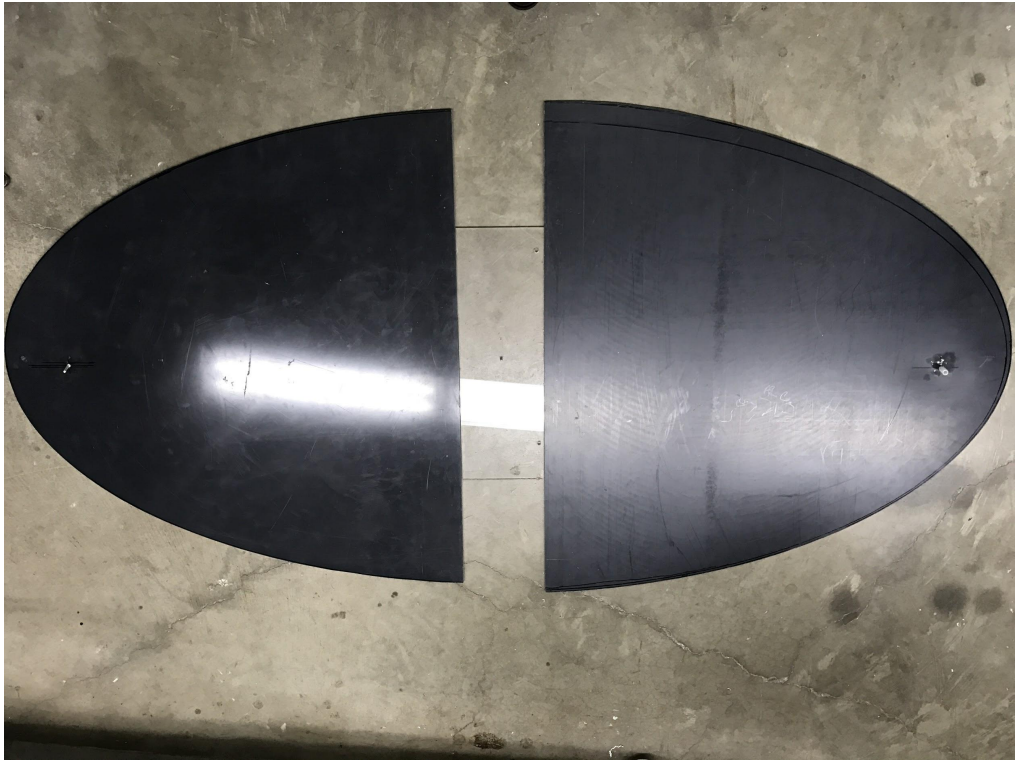


Diagram Showing the Geometry of the original base plates and the geometry accounting for the jet reverser

Base Plates cont.

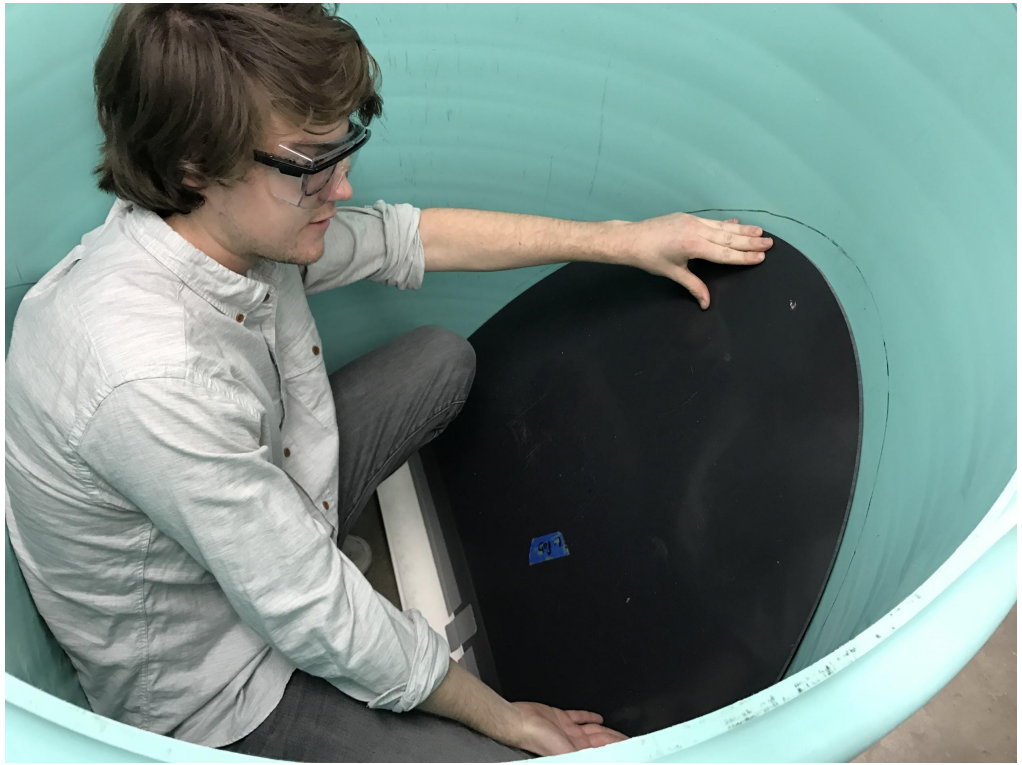
- To accomplish this, we used a 6 inch spacer during the tracing process to create a natural separation in the ellipse halves.



Ellipse halves with 6 inch spacer in the middle

Base Plates cont.

- After tracing and cutting the new ellipse halves, they achieved the geometry we desired.
- Going through a time intensive process like this, we decided to keep one of the correct ellipse halves as a pattern to trace all subsequent halves off of.
- This can save a lot of time and confusion of future builds.



Sean Testing the new Base Plate geometry for accuracy

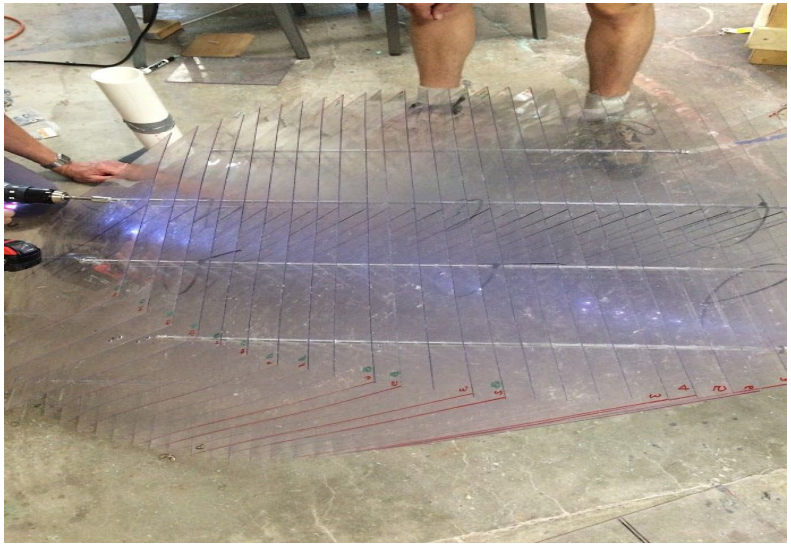
Welding together

- Once we had the ellipse halves cut, we needed to assemble the ellipse/jet reverser combination.
- We did this using a jig consisting basically of two equilateral triangles made of wood and 80/20 pieces. Mounting the jet reverser on the top and hanging the ellipses over the sides gave the 60 degree angle we needed and gave a nice exposed surface for welding.
- The inside surface weld was trickier, but accomplished using an angled head piece on the welder.

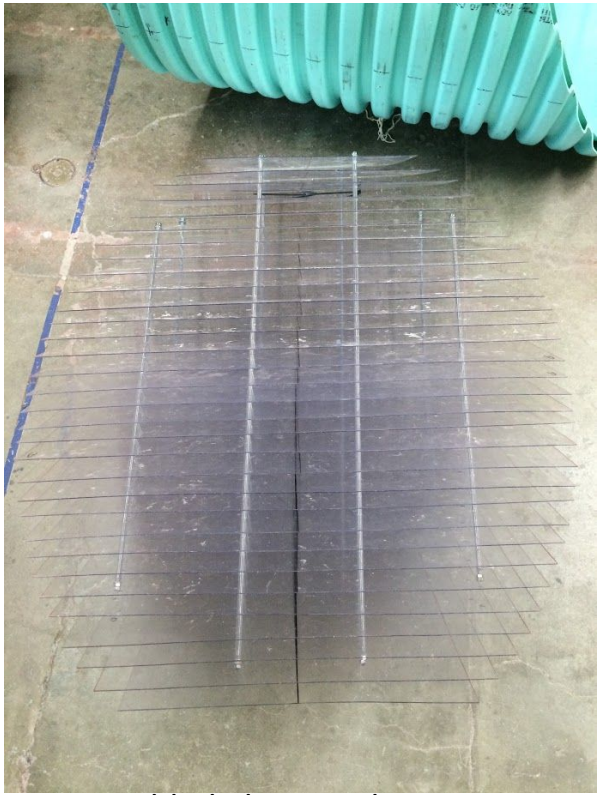
The jig used to hold the half ellipses to the jet reverser at the correct angle

Plate Settlers

- Plate settlers spacers were cut longer than they needed to be
- Resulted in the loss of 3 plates.
- Though the plant still worked, it was not ideal.

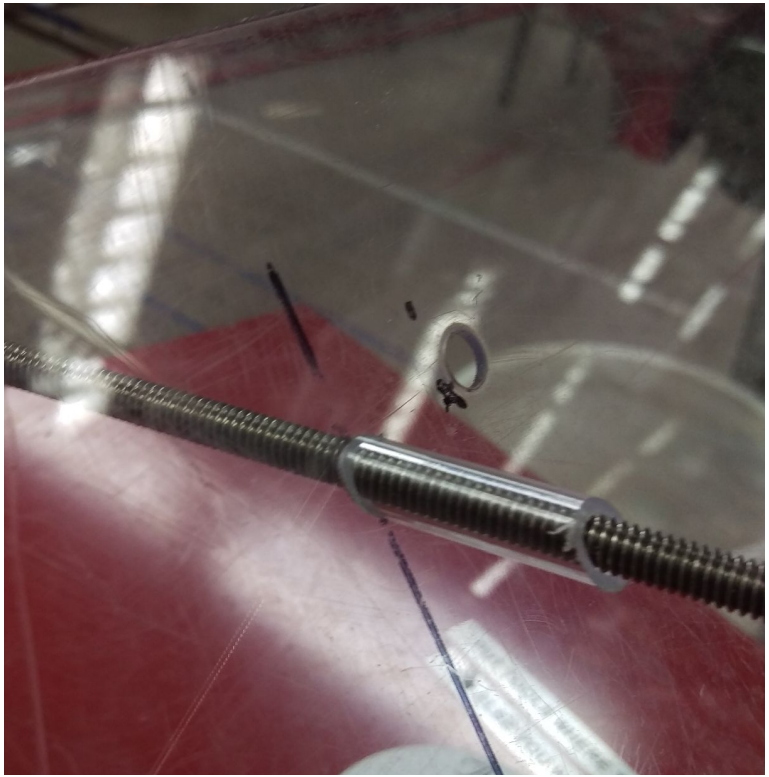


Assembled Plate Settlers Side View

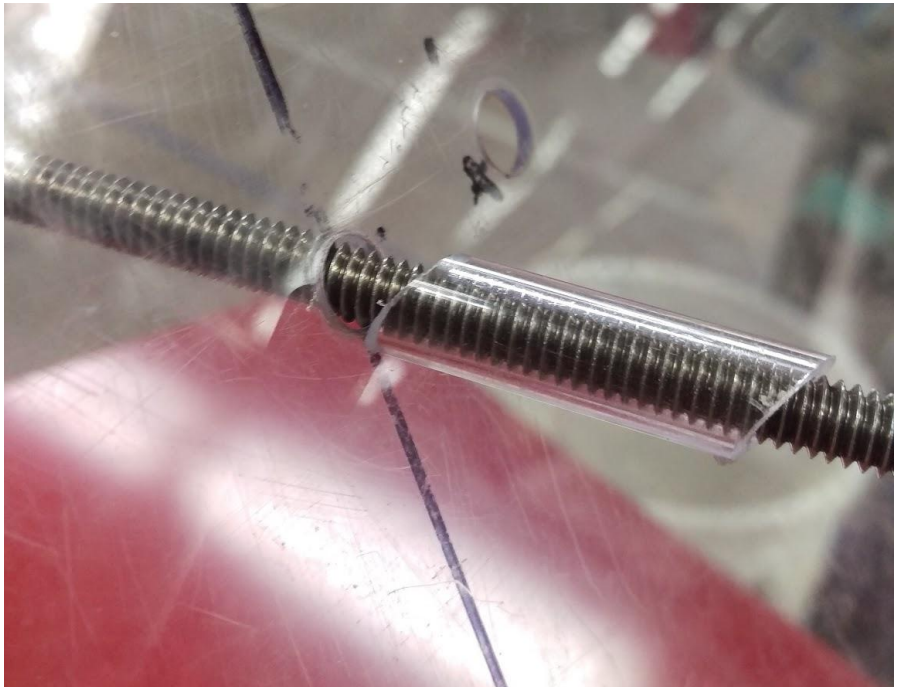


Assembled Plate Settlers Top View

Plate Settlers cont.



Correct spacer orientation

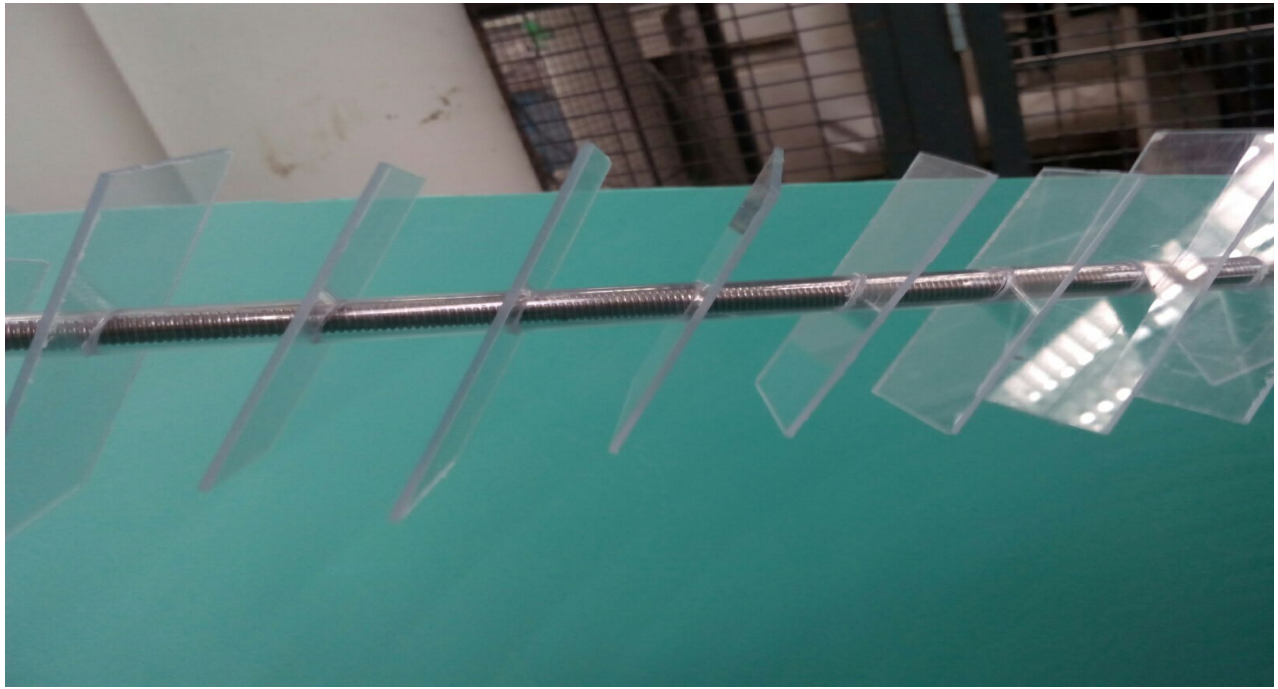


Incorrect spacer orientation

Plate Settlers Spacing

34 plate settlers can now correctly fit

Plate Settlers Spacing



34 plate settlers can now correctly fit

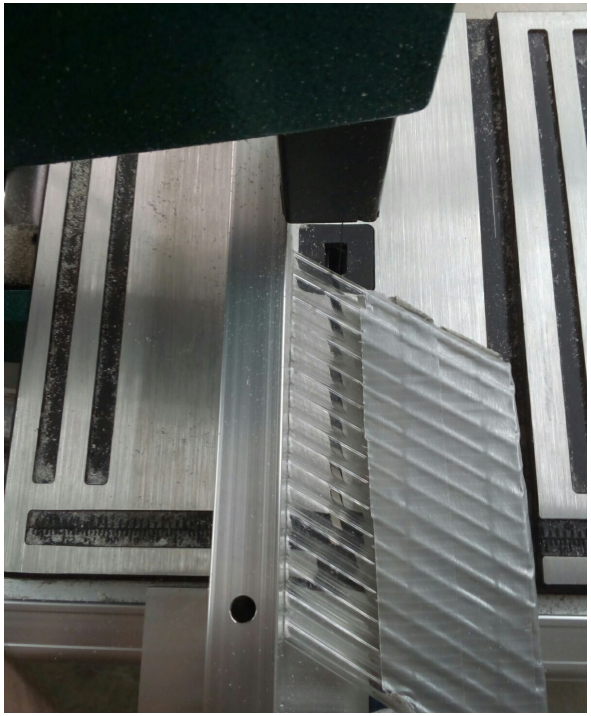
Closeup on how the sheets and spacers fit together on the small scale simulation

Plate Settlers Spacer Fabrication

- Provided spacers were cut again: 2.5 cm -> 2.3 cm.
- As they were insufficient new spacers had to be cut.:
  - Cut PVC pipes in 4 pieces.
  - Align pieces in 60º angle (to optimize material), and put together with duct tape.
  - Then use the bandsaw (with fixed spacing at 60º of 23mm) to cut 16 spacers each time.
  - Finally clean every spacer and quick measure to check the dimension.

Device to align PVC pipes at 60º angle

Plate Settlers Spacer Fabrication



Pipes being cut in the band[saw

Before - After of cleaning spacers

Plate Settler Shear-Jig

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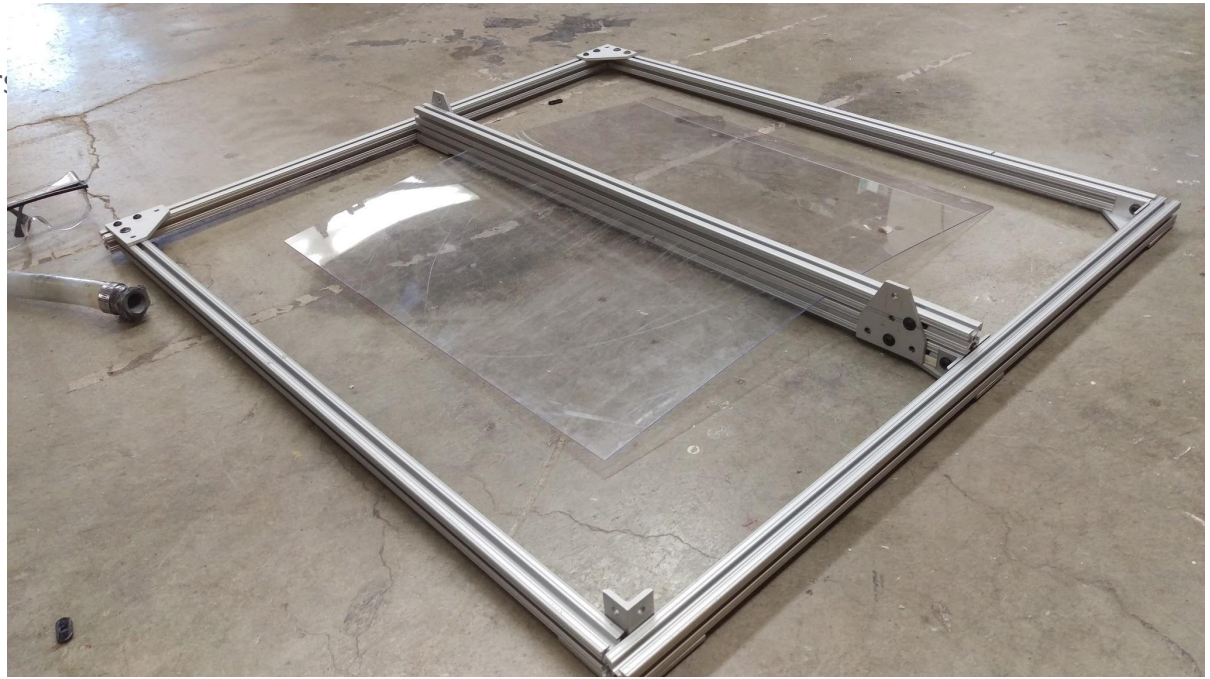
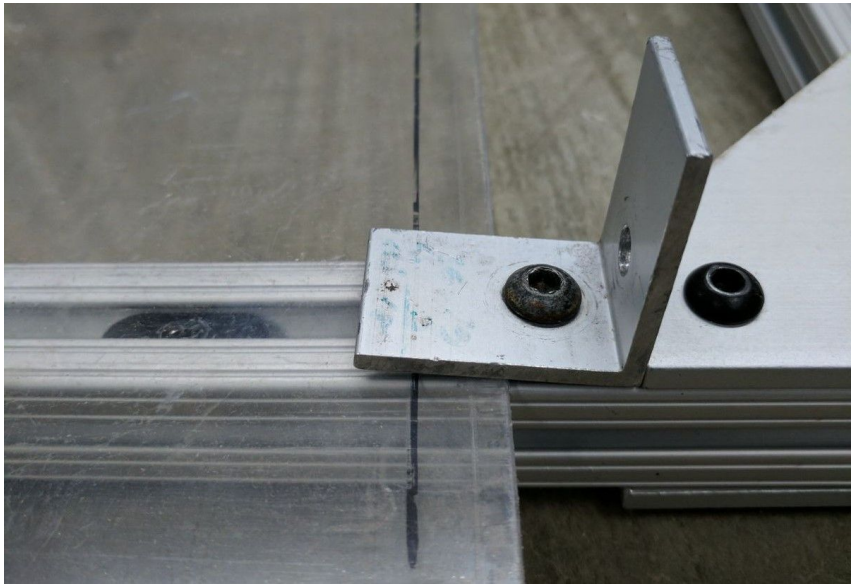
- Allows for the shear to cut plate settlers more accurately.
- Does this by having a surface to lay against.
- Is easily reproduced and only requires 80/20
- Actually additional bracing to prevent plate from rotating.



Plant Settler Shear- Jig Top View

Plate Settler Cont

- Sheets used the clamps as a pivotal point and shifted the sheets, causing a curved edge along the cut
- Because of squaring issues (manufacturer did not have every plate square), some of the plates were not straight
- Problem had to be alleviated by recutting the sheets.
- Used bandsaw, tablesaw and big shear.



Closeup of the clamp. The 80/20 corner bracket piece was used to clamp down onto the sheet to prevent the sheet from moving while cutting.

Plate Settler Cont

Using the shear to cut the plate settlers

Using the tablesaw to cut the plate settlers

Flocculator

- Flocculators now are designed for spacial efficiency.
- Works the same as traditional flocculators.
- First time produced at such a scale
- Pipe needs contractions to get target headloss.

Current Flocculator
16.8m

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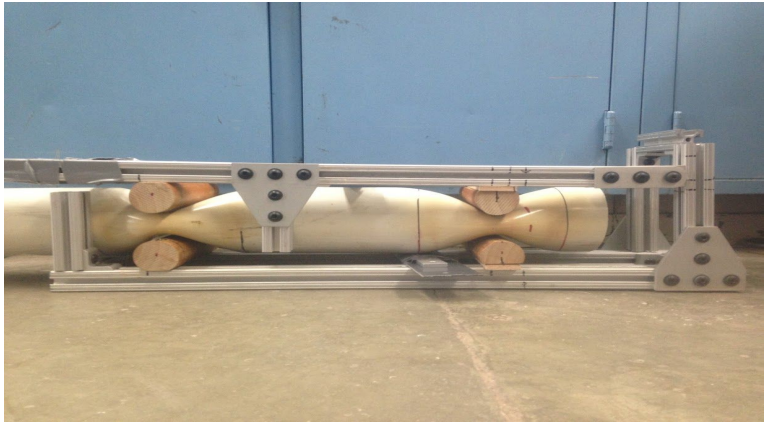
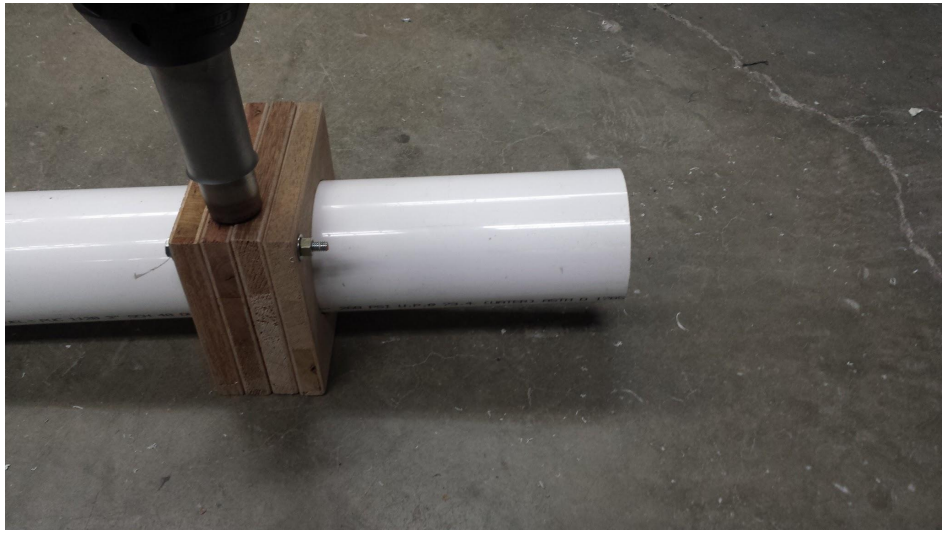
Flocculator Cont.

- Summer 2016 crimping method worked on paper
- However calculations were done for circles and not ellipsoids
- Shapes had same area but results were not ideal



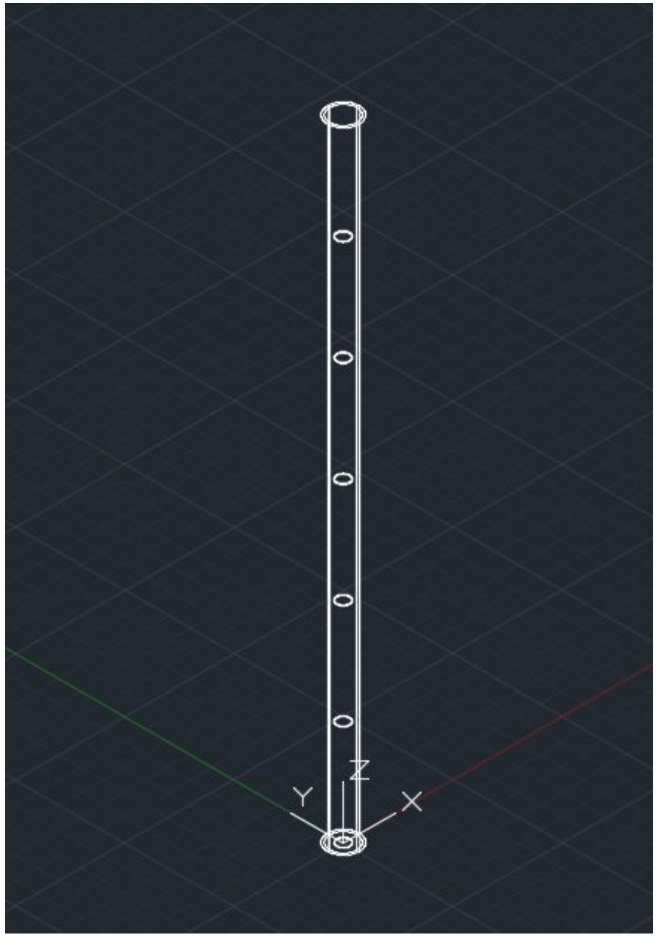
After heating an 80/20 jig was used to “crimp”



“The oven” was created to heat desired section

Flocculator Cont.

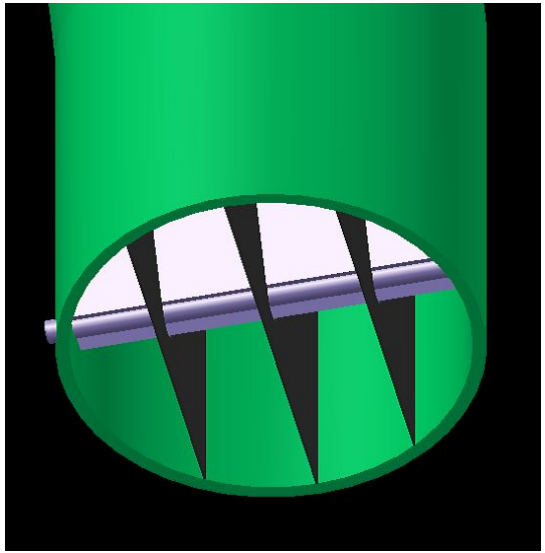
- New design will have orifices that have the same area as the old design.
- Just requires rodding to keep them in place.
- Target: 51 cm of headloss



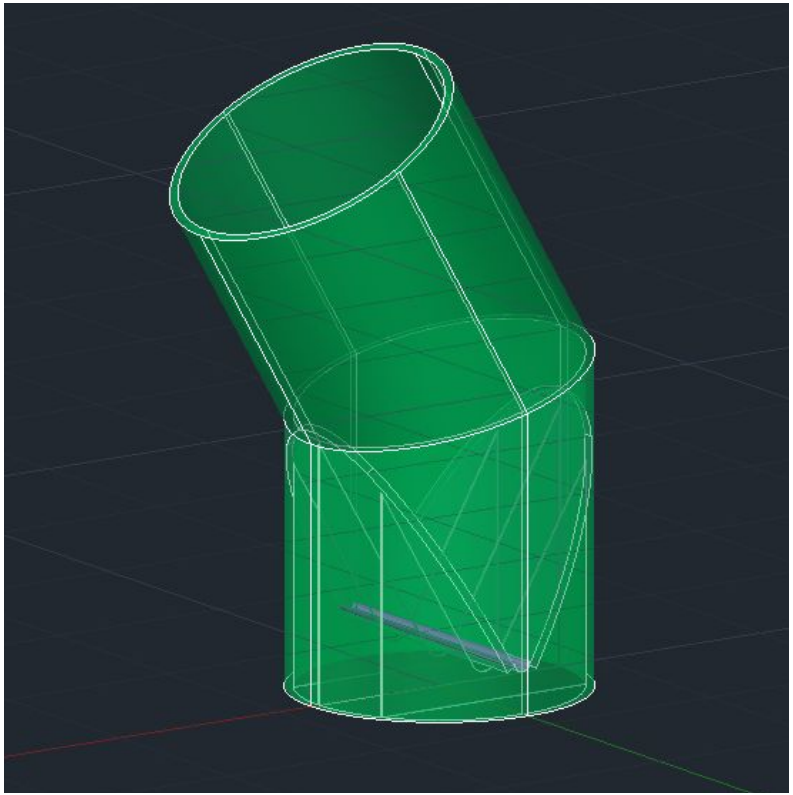
5 orifices per 6 feet pipe

Structural Analysis

- Taken into consideration:
  - Relative price
  - Conservative
  - Shipping issues



Bottom of sedimentation tank



Sedimentation tank without plate settlers

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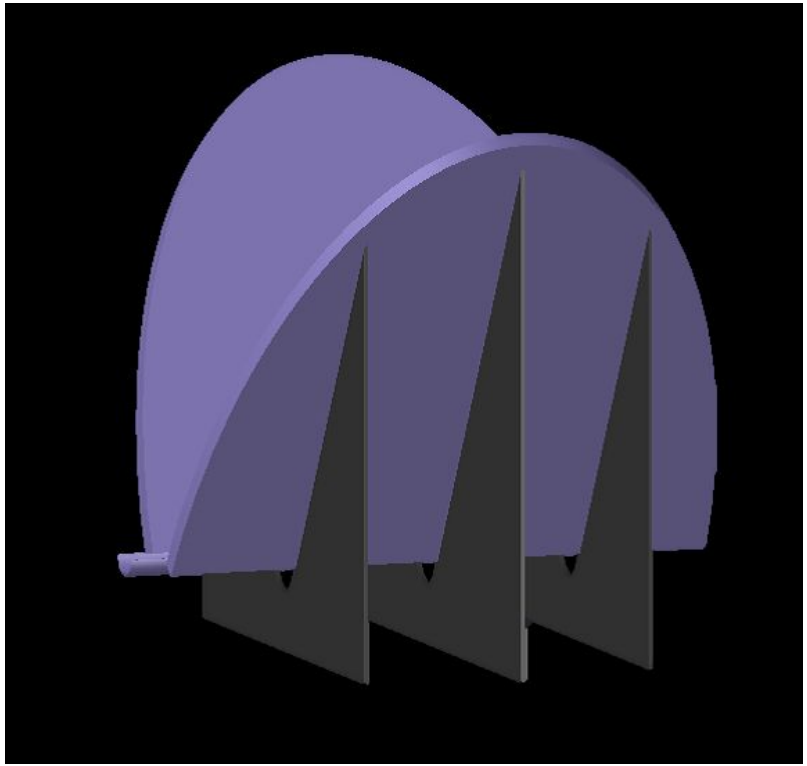
- Taken into consideration:
  - Relative price
  - Safety
  - Shipping issues

- Worst case scenario:
  - Pressure
  - Material
  - Shape of PVC sheets



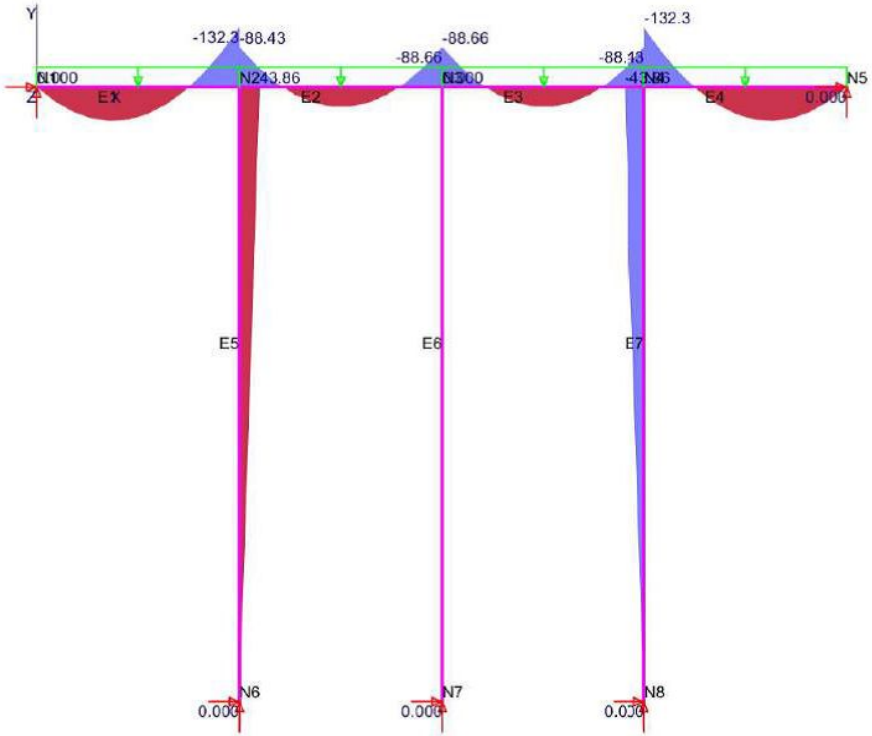
Base plates with supports

Structural Analysis

•Analysis performed using open software Mastan®.

• Considers a elastic regime as strains are much smaller than 0.001.

• All necessary parameters have been obtained to lay on the safety side (dimensions, inertia, load)



Bending moment diagram

Structural Analysis

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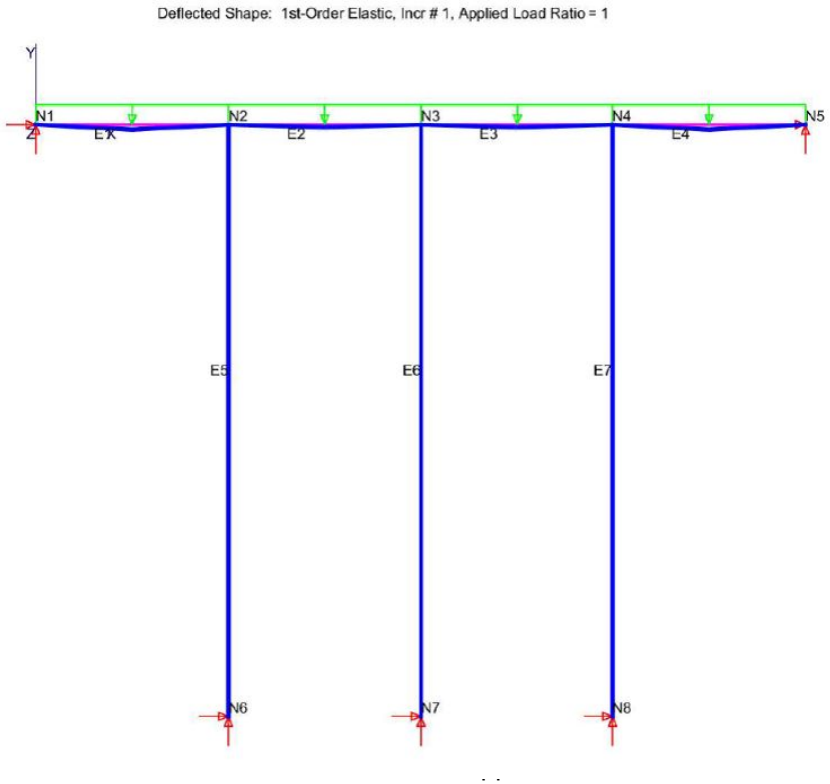

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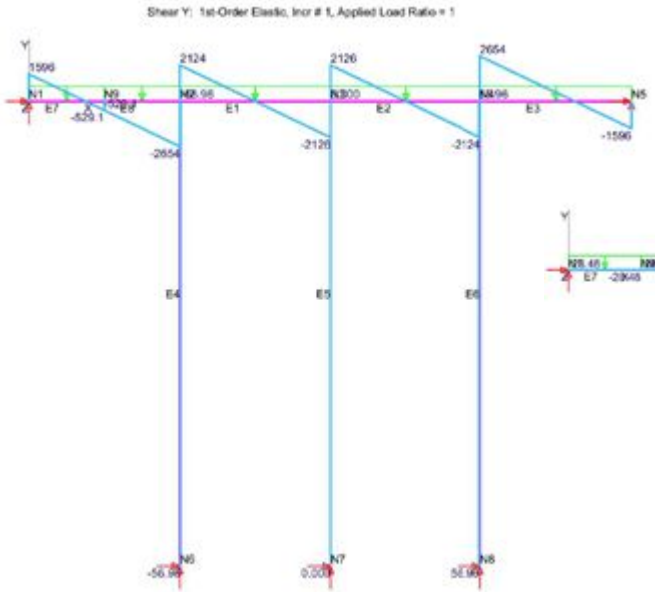
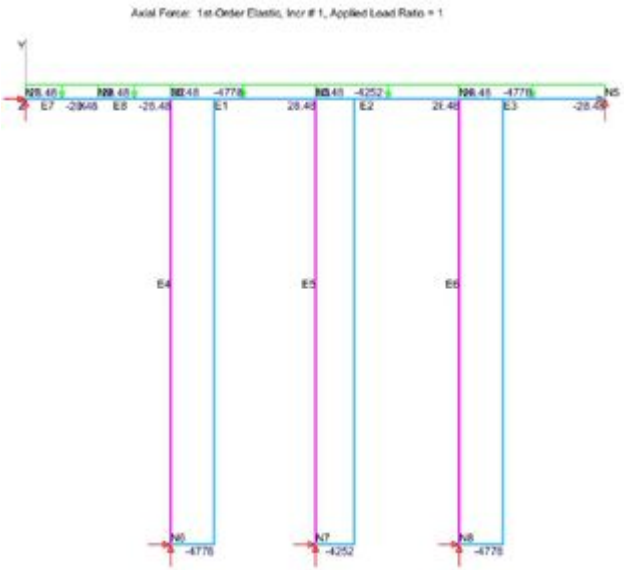


Shear force diagram



Axial force diagram

Structural Analysis

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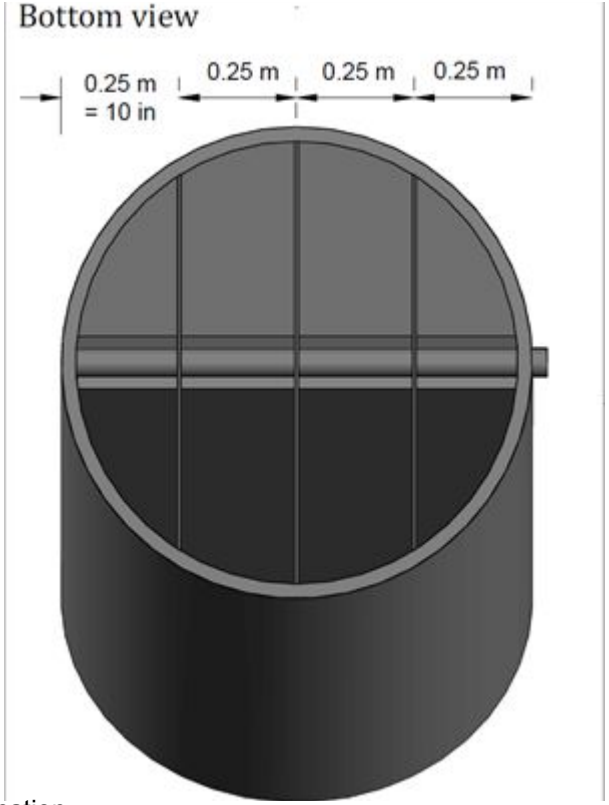
	Three supports	Two supports	One support
Maximum deflection (mm)	**6.5 (¼ in)**	50 (2 in)	100 (4 in)
Maximum positive bending moment (Nm)	75	180	270
Maximum negative bending moment (Nm)	130	350	530
Maximum shear force (N)	2100	4300	5300
Maximum axial force (N)	4800	7000	10000

Structural Analysis

- Assembling model:



Bottom view of supporting sheets location

Structural Analysis

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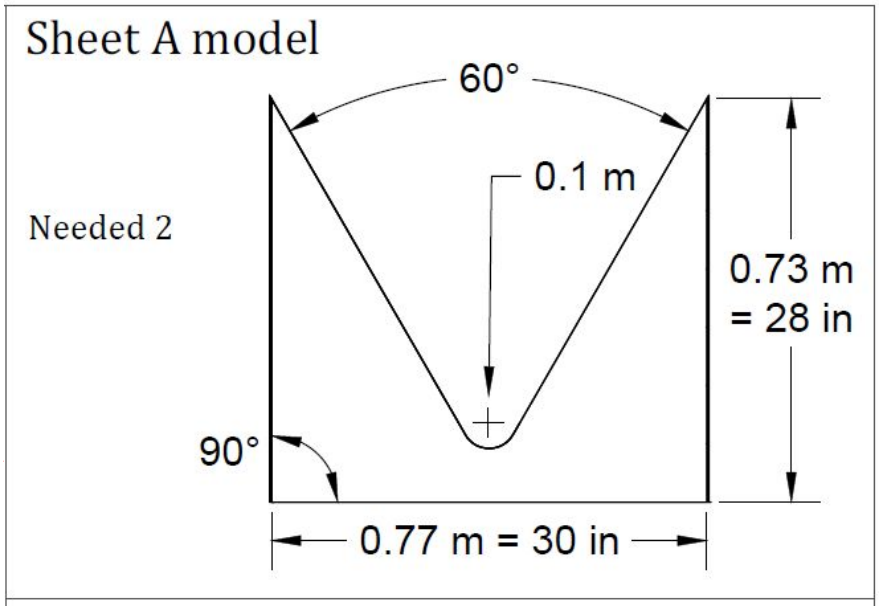
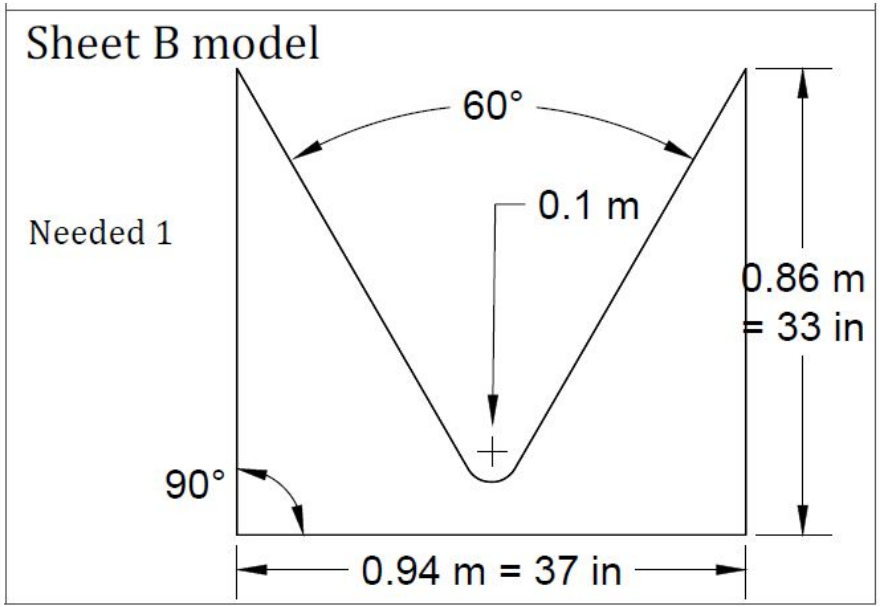
- Cutting models:





Front views of supporting sheets

Future Work

- Welding of sedimentation tank together.
- Welding of base plates to sedimentation tank
- Fully assembling the plate settlers
- Flocculator assembly
- In the winter, there will be a team here working on the completion of the plant.

Future Tasks

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Goals

- Have stricter deadlines
- Have larger blocks of time dedicated to working
- Be more efficient

Questions

- How can we as a team work better together?
- How can the team detail instruction better?

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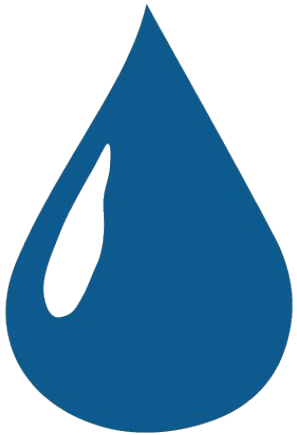
Questions and Recommendations



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Sedimentation Tank Geometry

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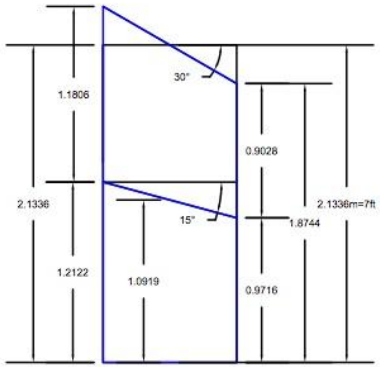
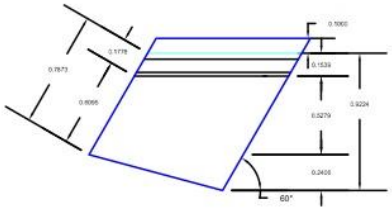
•The angles for the Sed Tank geometry were chosen because the optimal angle for the plate settlers was 30 degrees from horizontal. This angle ensures adequate settling but also ensures there won't be too much buildup in the settlers.

• Thus, the main cut for the Sed tank was chosen to be 15 degrees, so that when the pieces were rotated for the correct shape, the total bend angle would add to 30 degrees.





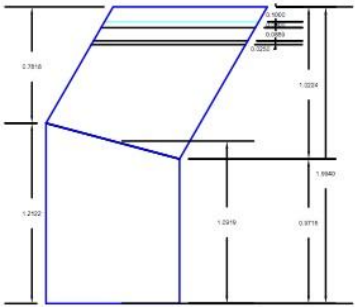


Plate Settlers Geometry

- The plate settlers are angled 60 degrees from the horizontal because it is the critical angle for the plate settlers to be so the flocs do not roll up the plates and settle at the bottom.
- The number of plate settlers (34) were chosen to maximize trapping the flocs.