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Low Flow Stacked Rapid Sand Filter

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LFSRSF: Major Semester Objectives

- LFSRSFs in India
- Fabrication and documentation
- Test filter performance
  - Backwash ability
  - Turbidity
  - Flow distribution

The Filter

- What are the filter parts?
- Two modes:
  - Filtration
  - Backwash
- What is the path of water/dirt?

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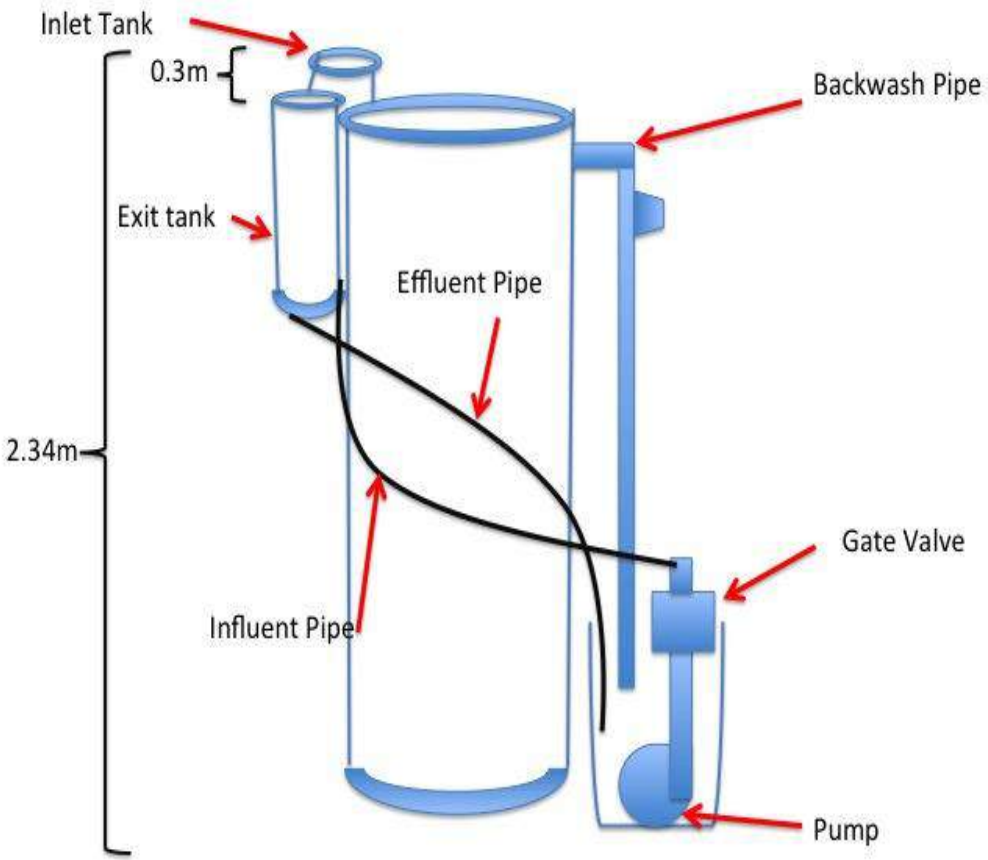
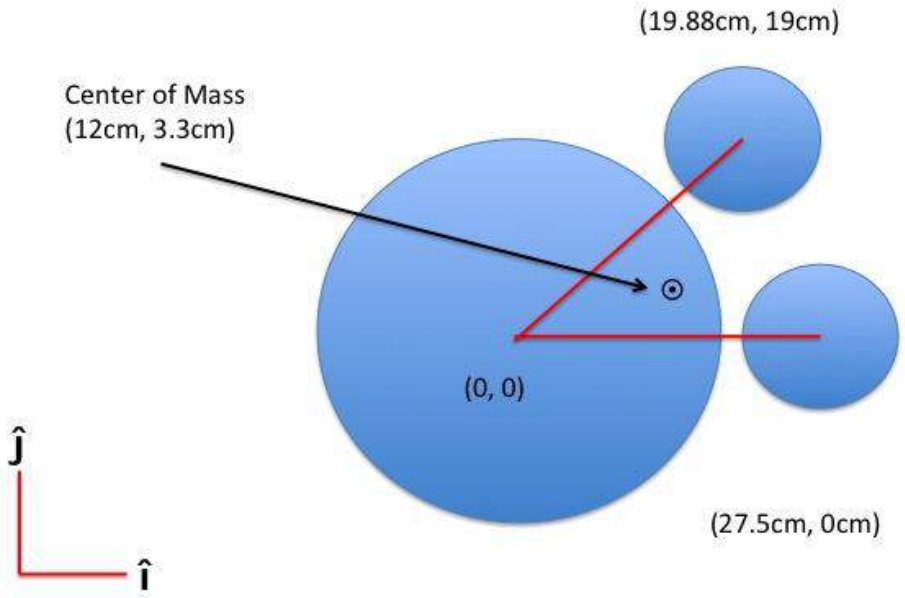

Inlet Tank
0.3m
Backwash Pipe
Exit tank
Effluent Pipe
2.34m
Gate Valve
Influent Pipe
Pump

Column Stability

- Worst Case Scenario
- Additional Factor of Safety
- Center of Mass within Column

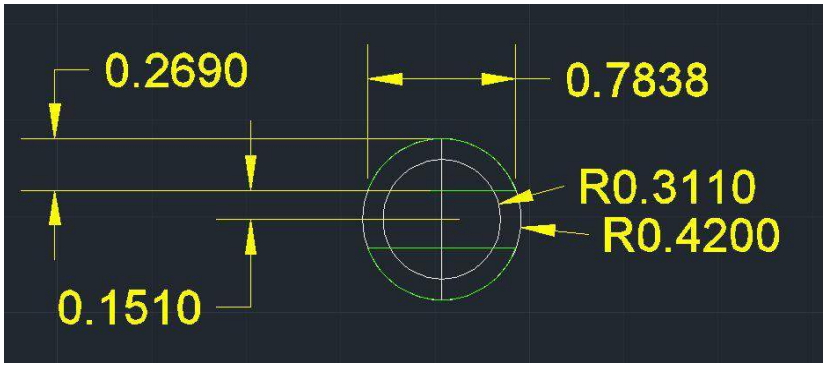


Design Constraints

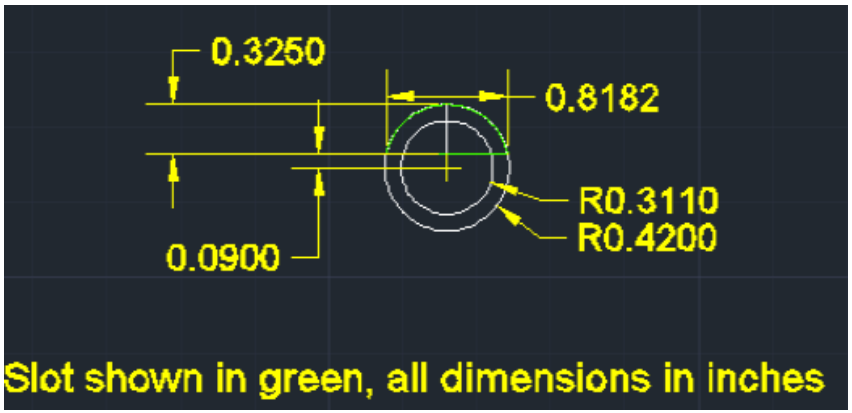
- Circular Body
- Backwash head loss
- 0.5 inch manifolds
  - Area available on short (er) trunks
- Forward filtration head loss

Manifold Slots

- 0.2 mm width, 3.175 mm (⅛ inch) spacing
- Manifolds on 1 inch trunks:



- Manifolds on 2 inch (backwash) trunks:



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Assembly

- Precise drilling
- Manifold specifications critical for performance

Sand Specs

Design Specs:

d10: 0.5mm

UC: 1.6

Delivered Specs:

d10: 0.45 mm

UC: 1.4

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Sand Drain

- Extends above water level to stop flow
- Acts as manometer

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Flexible Tubing

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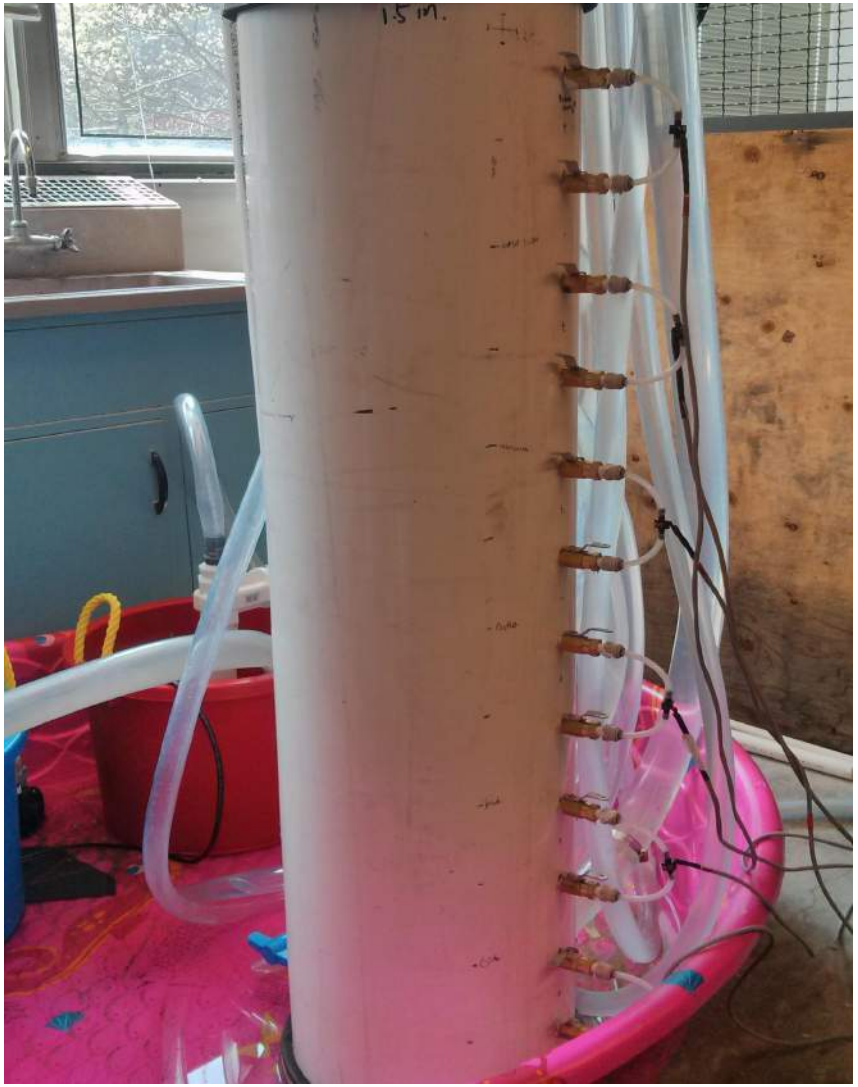
Pressure Sensors



Wet Testing

- Recycling system
  - 2.34 m head, 0.8 L/s

- Secondary containment

Fixed Leaks

- Inlet/outlet flexible tubing connections
- Glued tank coupling connections
- Middle gasket leak

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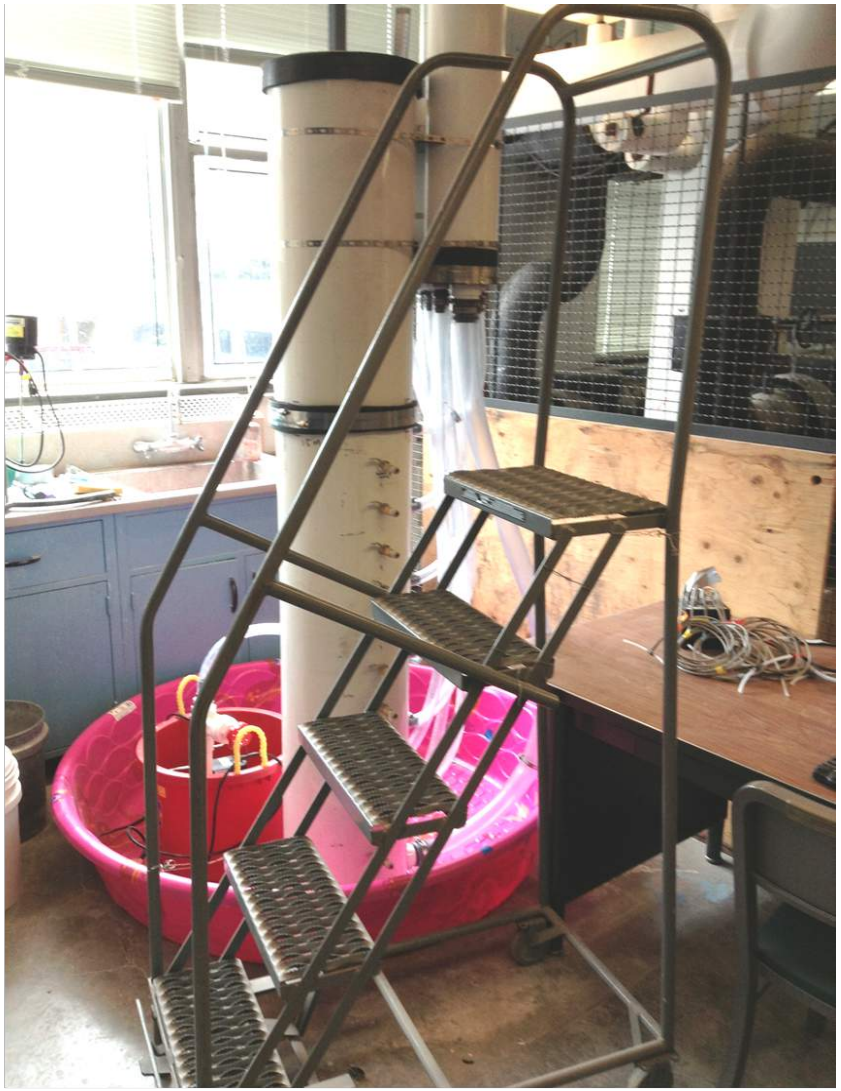
Setup



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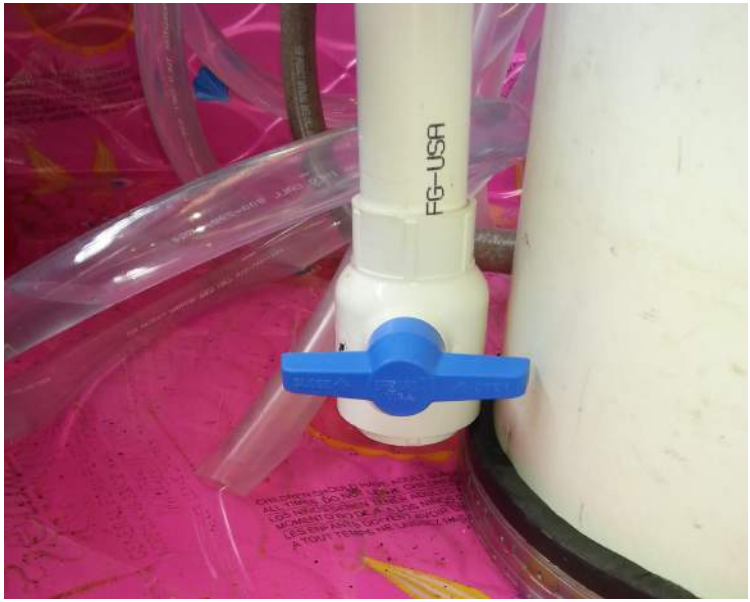
Operating the Filter

Air Leaks and Solutions

- Switching from normal filtration to backwash
- Why must there be no air in the filter column?
  - Set up and maintain backwash siphon
- Where can air enter from?
  - Entrance tank
  - Exit tank
  - Backwash pipe
  - Filter body

Switching from Forward Filtration to Backwash

- Present Solutions
  - (Temporary) valves
- Long Term Solutions
  - Redesign valve placement on backwash-to-waste pipe
  - Raise effluent weir in exit tanks (and thus exit and entry tank heights)

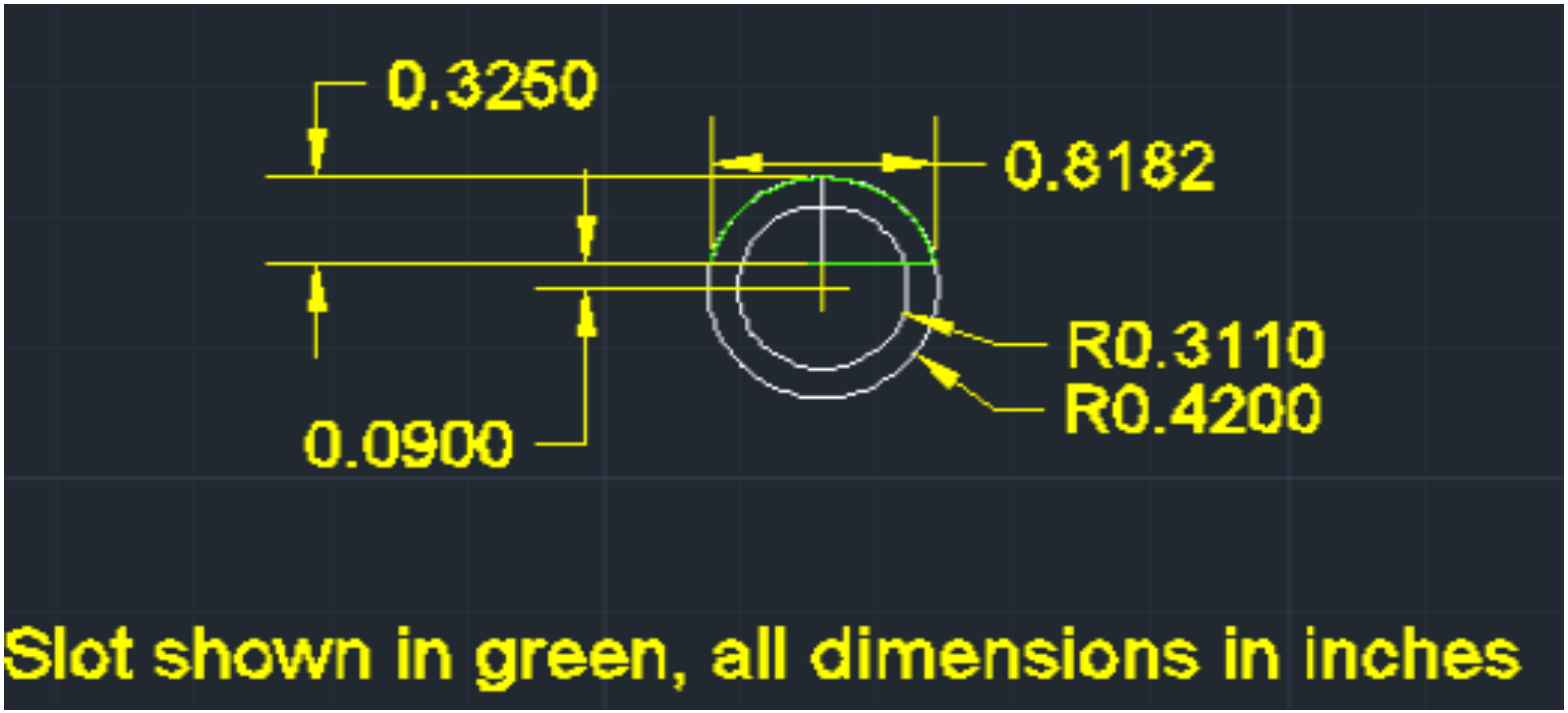


Accounting for Head Loss

- Entrance tank backing up at target flow rate during backwash
- Excessive head loss
- Four suspects
  - Sand in manifold
  - Bed fluidization
  - Slot area
  - Cross section
- Two discarded

Slot Area: Faulty Manufacturing?

- Burrs
- Does not satisfy specifications?



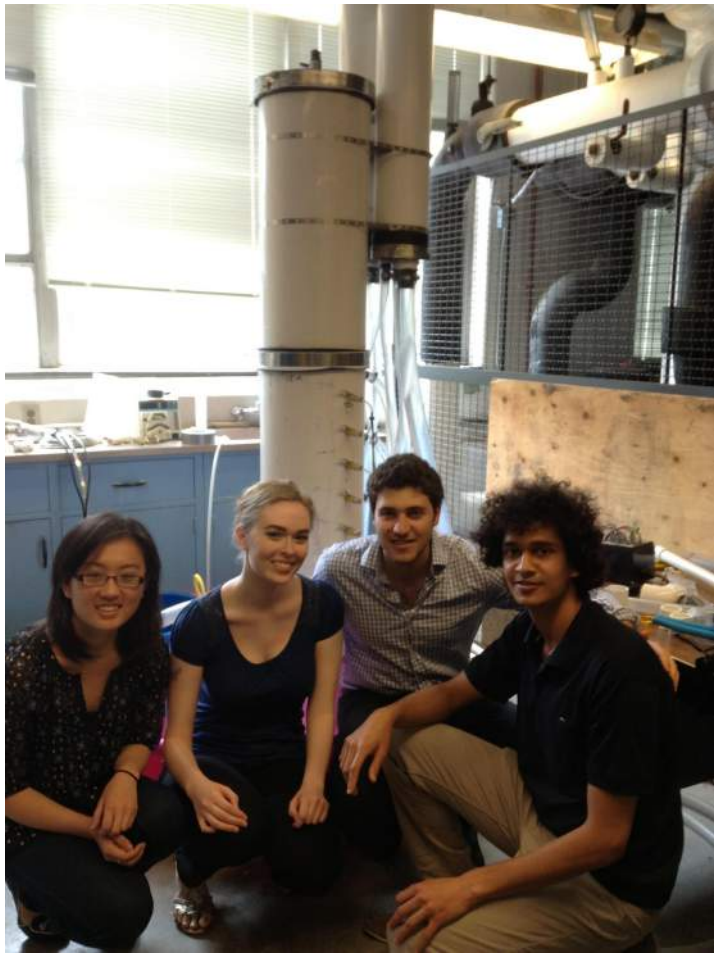
Cross Sectional Layout

- More head loss than expected?
- Complicated head loss calculation

Major Achievements

The LFSRSF Team for Spring 2014:

- Completed an improved design
- Completed all fabrication
- Optimized the filter for easy backwash
- Isolated sources of current issues with hydraulic controls and plumbing head loss
- Took this beautiful picture



Future Work

Future teams need to

- Lift the exit weir/tanks
- Solve problems of large backwash head loss
- Measure and optimize flow distribution during forward filtration
- Run the filter across a range of turbidities
- Implement better designs in India!