

ME, ECE, IE Capstone Design Programs



Project 35: Sump Debris Removal

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Objective

Design and build a scalable, automated sump debris removal system.

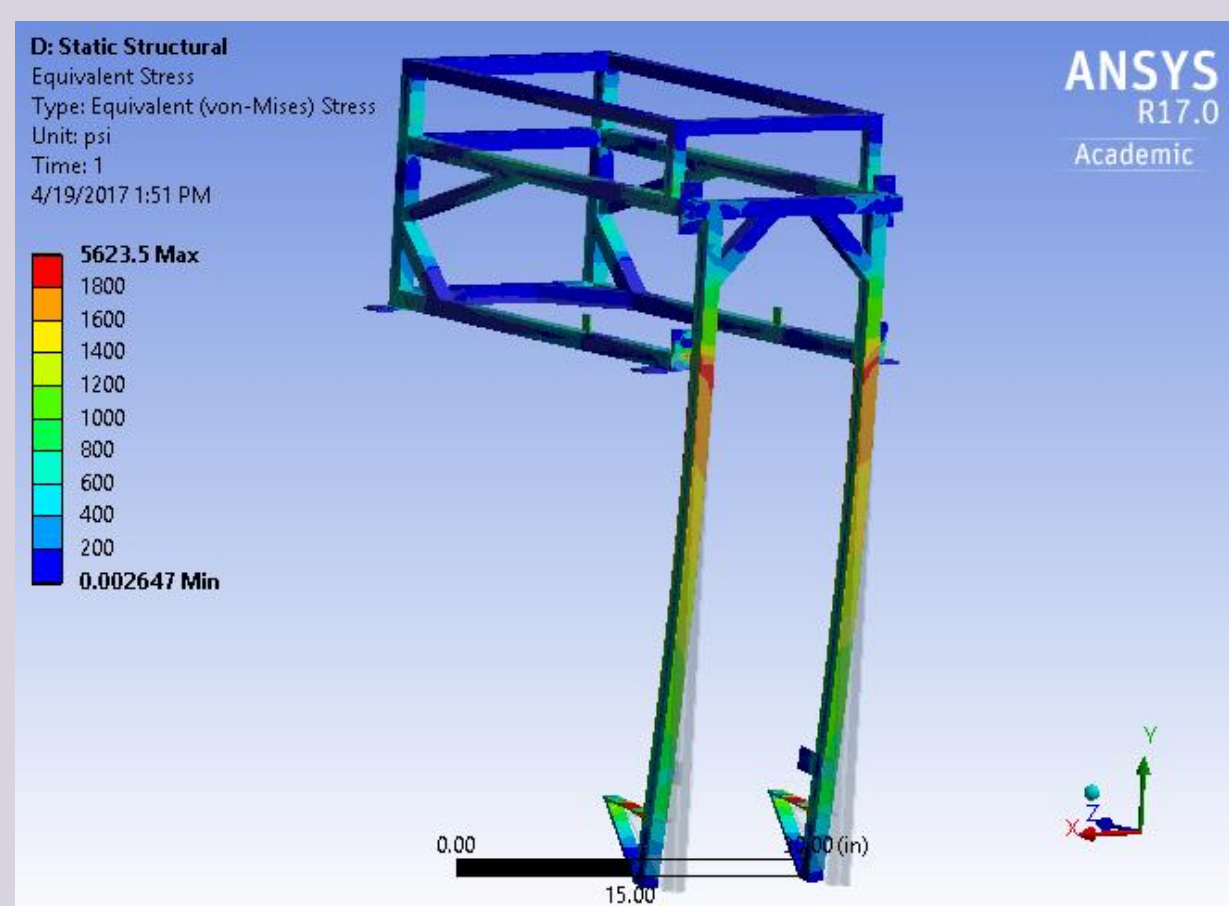
Background

- Debris is currently caught in the sump by a wire mesh screen.
- Sump pump is used to move collected water to a basin in a water treatment plant.
- The current screen cleaning procedure exposes the pump to debris.

Measurable Engineering Specifications

Physical Size	All dimensions of the model are scaled to %35 of the existing sump.
Flow Rate	Maximum flow rate needs to be 105 GPM.
Volume of Debris	Maximum volume of loose debris is to be 4.2 gallons.
Minimum Particle Size	Smallest removable particle will be 1/8" diameter ear plugs. Allowed to miss an average of 2 pieces per cleaning cycle.

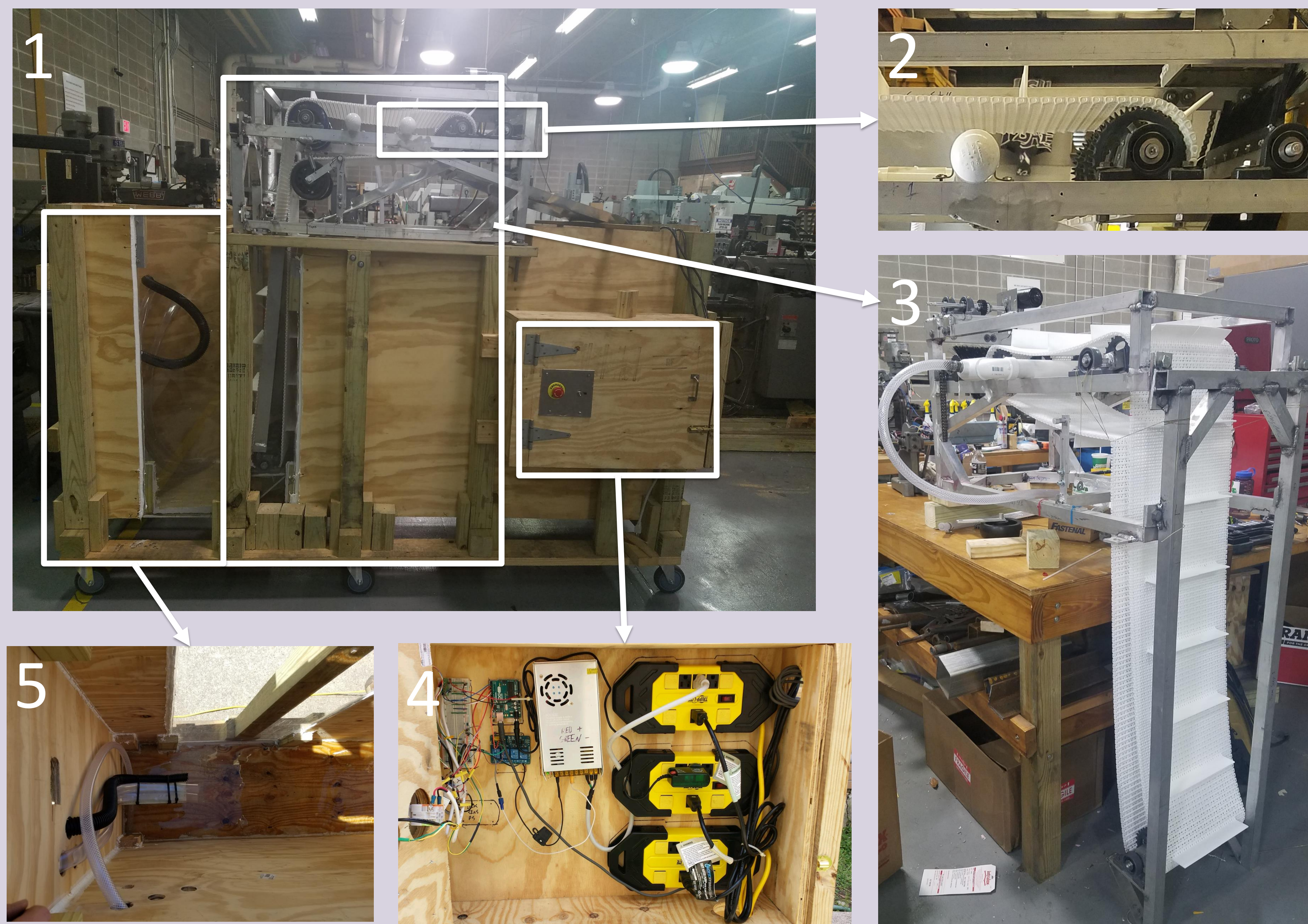
Analysis



Safety

- Machine guards for rotating machinery.
- Safety stickers will direct users to keep hands off during operation.
- Electrical components will be protected by GFCI receptacles.

Prototype



Subsystem Key

- 1 Overall System
- 2 Debris Clearing System: brushes and nozzles
- 3 Debris Removal System: frame, belt, and drivetrain
- 4 Control Panel: sensor relays, circuit boards, electric power source
- 5 Testing Apparatus: top view of channel shown

Part	Manufacturing	Material
Frame	Welded construction with bolted supports	6061-T6 Aluminum
Test Apparatus	Fastened with screws, treated for water resistance and sealed	Plywood, 4x4, 2x4
Belt	Assembled and properly tensioned	Polypropylene
Brush	Brushes glued and secured to shaft	Polypropylene, Aluminum shaft
Nozzle Manifold	Headers assembled, drilled and tapped for nozzles	PVC, Brass nozzles

Model Component	Corresponding Test	Results
Nozzles and Brushes	Test ability of brush and nozzles to remove debris lodged in belt, and to cover full area of the belt.	Lodged Debris: Pass Coverage: Pass
Sensor	Determine accuracy of sensors from 6" up to 4'.	Percent Error = %0.75
Test Apparatus	System's ability to create scaled flow rate similar to the real system.	Max Flow Rate: Pass
Frame	Dye penetrant tests on welds, Deflection test on certain highly loaded members.	Dye Test: Pass Deflection Test: Pass
Overall System	Run entire system and introduce debris.	Average Number of Escaped Pieces = 1.1

Budget

