DEPARTMENT OF MECHANICAL ENGINEERING

TEAM 37

RACK CITY

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Problem Definition

Problem:

- Current sonar mounts for Autonomous Surface Vehicles (ASVs) are not remotely adjustable

Our Goal:

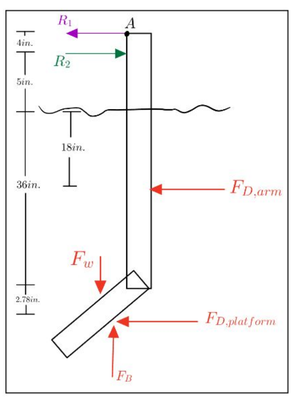
- Develop a mount system to improve floor imaging efficiency in Chesapeake Bay oyster deposit surveys

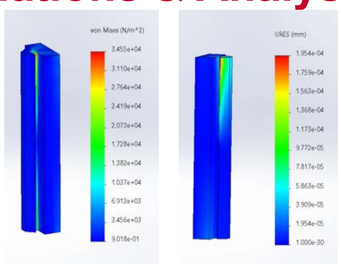
Desired Specifications:

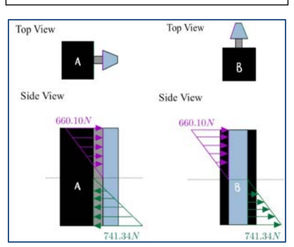
- Vertical translation from 0-3 feet underwater with 1 inch accuracy
- Angle adjustable from 16-45 degrees with 5 degree accuracy
- Remain stable at a maximum speed of 2m/s

Design Calculations & Analysis

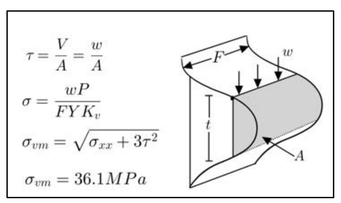
Slider Calculations







Pinion Tooth Calculations:

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% Stresses on pinion gear teeth - 20 deg p angle
z = 28; % # teeth
p = (pi*g_d)/z; % (in) circular pitch
P = pi/p; % (in) diametrical pitch
F = 6*0.0393701; % (in) face width
Y = 0.352; % Lewis form factor 20deg p angle

b_s = (W*P)/(F*Y); % (psi) bending stress in tooth
b_s metric = b_s * 6894.76; % (Pa)
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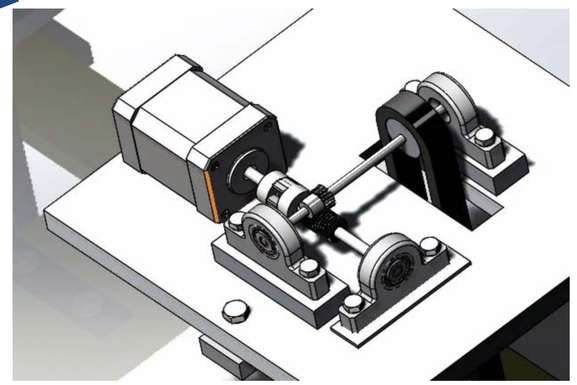
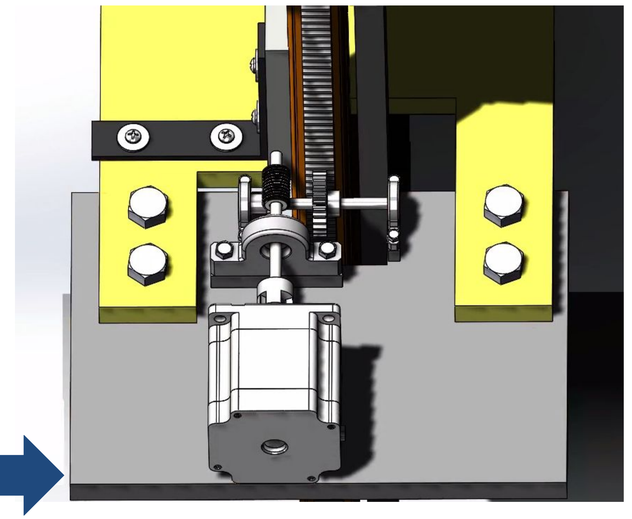
Stress Concentrations on Sliders Induced by Drag, Weight, and Buoyancy Forces:

$\sigma_{head,top} = 56.419kPa$
$\sigma_{head,bottom} = 63.370kPa$
$\sigma_{flange,top} = 39.527kPa$
$\sigma_{flange,bottom} = 44.392kPa$
$\sigma_{face,top} = 90.178kPa$
$\sigma_{face,bottom} = 101.276kPa$

Final Design



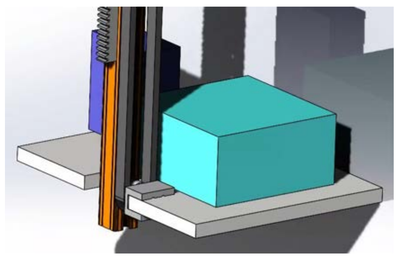
Pulley Motor Subsystem



Pinion Motor Subsystem

Bottom Pulley

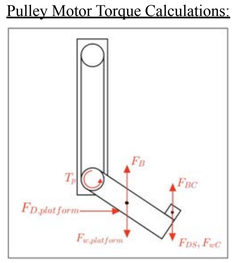
Bottom Pulley Flange



Bottom Platform Containing Sonar and Go-Pro

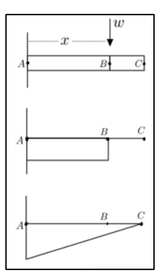
Custom T-slot Brackets

Pulley Motor Torque Calculations:



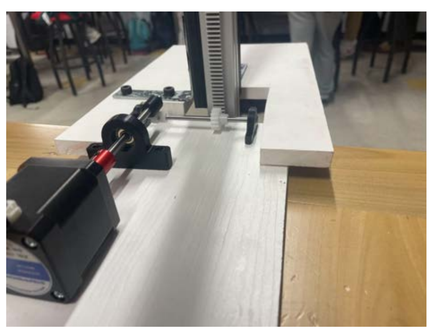
$T_p = 4.42N \cdot m$

Bottom Bolt Calculations:

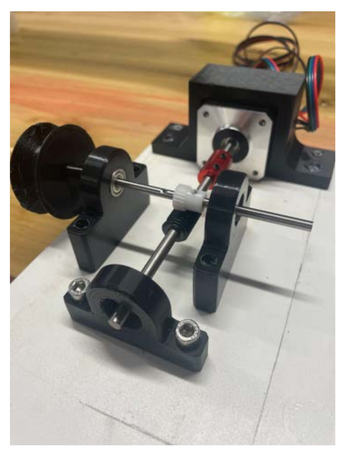


$\sigma_{\max} = 13.62MPa$
$\tau = 136.5kPa$

Prototype & Test Results



Prototype Pinion Motor Subsystem



Prototype Pulley Motor Subsystem

Slider Force Testing

Hanging scale test to determine if sliders can withstand calculated drag forces of ~36lbf