SMART TECHNOLOGY IN WEED REMOVAL FROM LAKES

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ABSTRACT :*Aquatic weeds are parasitic plants that grow under or on the surface of water bodies. They have a rapid growth rate and are highly adaptable. They grow in lakes, ponds, backwaters and bays. There are many methods available for the removal of weeds from lakes and other such water bodies. The main drawbacks of these methods are their short range and efforts required to remove the weeds. Of all the methods available, the physical or mechanical means of weed removal are the most effective so far. In this project we have implemented one such mechanism which is inspired by a conventional grass cutter. The cutter is designed in such a manner that it enables the efficient removal of weeds of various concentrations under water. The cutting action of the cutter is linear in nature and is driven by a motor.*

KEYWORDS –*Cutter, mechanical methods, weed concentration.*

I. INTRODUCTION

Weeds are a growing crisis among the masses. Their rapid growth rate along with their adaptability enables them to grow almost anywhere. Weeds growing in water bodies are the primary source of concern because they inhibit farming, fishing, irrigation, and other means of livelihood for the local population.

The major types of aquatic weeds are :

- Hyacinth
- Hydrilla
- Duckweed
- Algae (Limited to certain kinds)

Hyacinth grows on the surface of the water body whereas Hydrilla grow at a certain depth from the surface of the water body. Duckweed and Algae mostly grow at the bottom of the water body. Aquatic weeds grow in various water bodies such as lakes , ponds, backwaters and so on.

The interesting and the most important thing about weeds is to understand their delicate role as supporters of the ecosystem. Weeds may seem diabolical for the most parts but they are uniquely helpful in their own ways. Thus removing them may not always be in the best interests of the environment for instance, Weeds absorb the heavy metals present in the water bodies along with certain unwanted and toxic chemicals released by chemical effluents dumped in the water bodies such as mercury , phosphorous and so on.

II. MOTIVATION

Aquatic weeds pose a major threat to the environment and local ecosystem in which they grow. They have adverse effects on the biodiversity of the surrounding region. They cause a lot of problems ranging from obstruction of work to pestilence. So as to ensure unobstructed functioning of day to day activities and to ensure a well balanced ecosystem we have undertaken this project.

III. OBJECTIVES

The main objective of this project is to "*Study and analyze the* – STRESS, DRAG, BENDING MOMENT, BUOYANCY FORCE, TORSION *and* IMPACT FORCES *acting on the cutter*."

IV. DESIGN AND ANALYSIS

The cutter was designed in CATIA V5 and the analysis was done in ANSYS 15.

4.1. Design

The dimensions of the cutter are:

Length – 60cm
Width – 4cm
Gauge – 2mm
Blade length – 8cm
Blade angle – 45°

The cutter material is aluminum 6061 and the weeds are depicted by pure aluminum which is a soft metal. The properties of the same are mentioned below:

Aluminum 6061 –
Yield stress – 290 MPa
Maximum stress – 680 MPa
Strain modulus – 27600 MPa
Pure Aluminum (AL 1100) –
Yield stress – 40 MPa

4.2. Motor

The motor used is a high torque wiper motor. This motor is essentially used in automobiles and is connected to the wiper to clear the windshield off rain droplets. The motor is attached to a rheostat to control its speed. The motor had to be made to vary speeds as the concentration of weeds changes from place to place, and to cut them, the optimal speed was required.

4.3. Connecting Links

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4.4. Analysis

The analysis rendered the following values of deformation of the cutter:

	Time [s]	Minimum [m]	Maximum [m]
1	1.1755e-038	0.	0.
2	5.0003e-006	0.	1.7001e-003
3	1.0002e-005	0.	3.3938e-003
4	1.5001e-005	0.	5.0288e-003
5	2.0003e-005	0.	6.5904e-003
6	2.5002e-005	0.	8.2722e-003
7	3.0005e-005	0.	9.9559e-003
8	3.5005e-005	0.	1.1639e-002
9	4.0001e-005	0.	1.332e-002
10	4.5003e-005	0.	1.5003e-002
11	5.0002e-005	0.	1.6686e-002
12	5.5001e-005	0.	1.8368e-002
13	6.0001e-005	0.	2.0051e-002
14	6.5e-005	0.	2.1734e-002
15	7.0005e-005	0.	2.3418e-002
16	7.5003e-005	0.	2.5101e-002
17	8.0003e-005	0.	2.6783e-002
18	8.5e-005	0.	2.8466e-002
19	9.0001e-005	0.	3.0149e-002
20	9.5003e-005	0.	3.1832e-002
21	1.e-004	0.	3.3515e-002

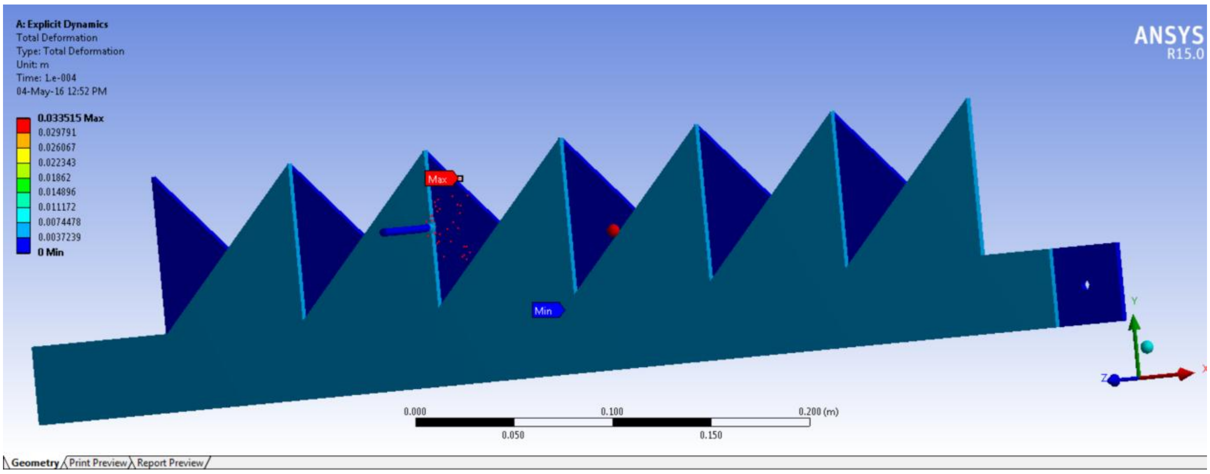

FIG-4.1 Deformation in the cutter

The values of stress in the cutter are as follows:

Tabular Data

	Time [s]	Minimum [Pa]	Maximum [Pa]
1	1.1755e-038	0.	0.
2	5.0003e-006	0.	4.2424e+008
3	1.0002e-005	0.	4.0875e+008
4	1.5001e-005	0.	4.246e+008
5	2.0003e-005	0.	4.284e+008
6	2.5002e-005	0.	4.2045e+008
7	3.0005e-005	0.	4.1408e+008
8	3.5005e-005	0.	4.0365e+008
9	4.0001e-005	0.	3.9786e+008
10	4.5003e-005	0.	4.0467e+008
11	5.0002e-005	0.	4.1064e+008
12	5.5001e-005	0.	4.1022e+008
13	6.0001e-005	0.	4.217e+008
14	6.5e-005	0.	4.1985e+008
15	7.0005e-005	0.	4.2179e+008
16	7.5003e-005	0.	4.2446e+008
17	8.0003e-005	0.	4.0231e+008
18	8.5e-005	0.	4.136e+008
19	9.0001e-005	0.	4.0439e+008
20	9.5003e-005	0.	4.141e+008
21	1.e-004	0.	4.2253e+008

The stress in the cutter is mostly concentrated at the sharp edges of the blades of the cutter, that is the cutting portion of the cutter. If the stress concentration increases beyond a point, the metal begins to deform and fail. This results in creep formation, the damage caused by creep can be destructive and finally the part shears off and fracture occurs.

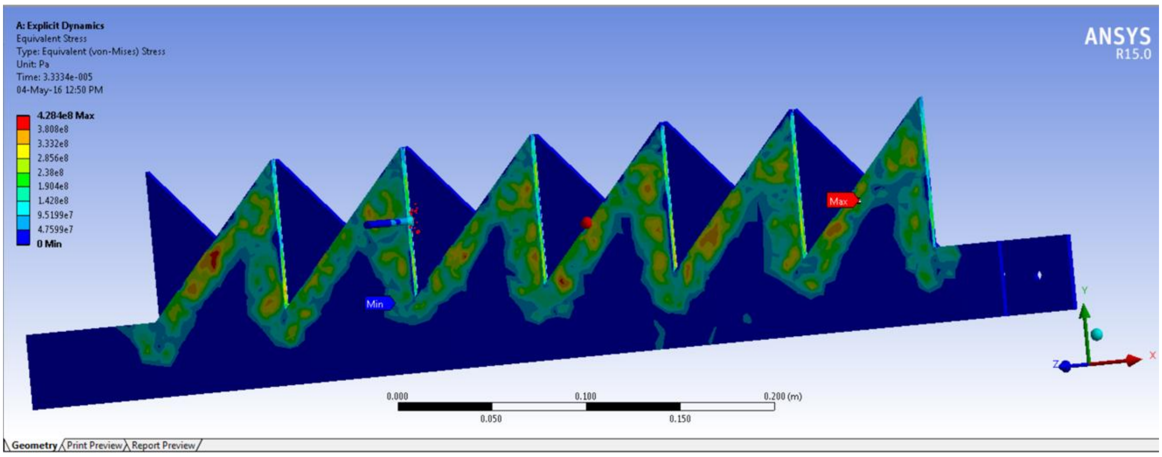

FIG-4.2 Stress concentration in the cutter

4.5. Stress-Strain curve

The stress-strain curve of the cutter is shown in the figure below. The elastic and plastic regions are shown as the material obeys Hooke’s law. The Modulus of elasticity of aluminum is 70 MPa.

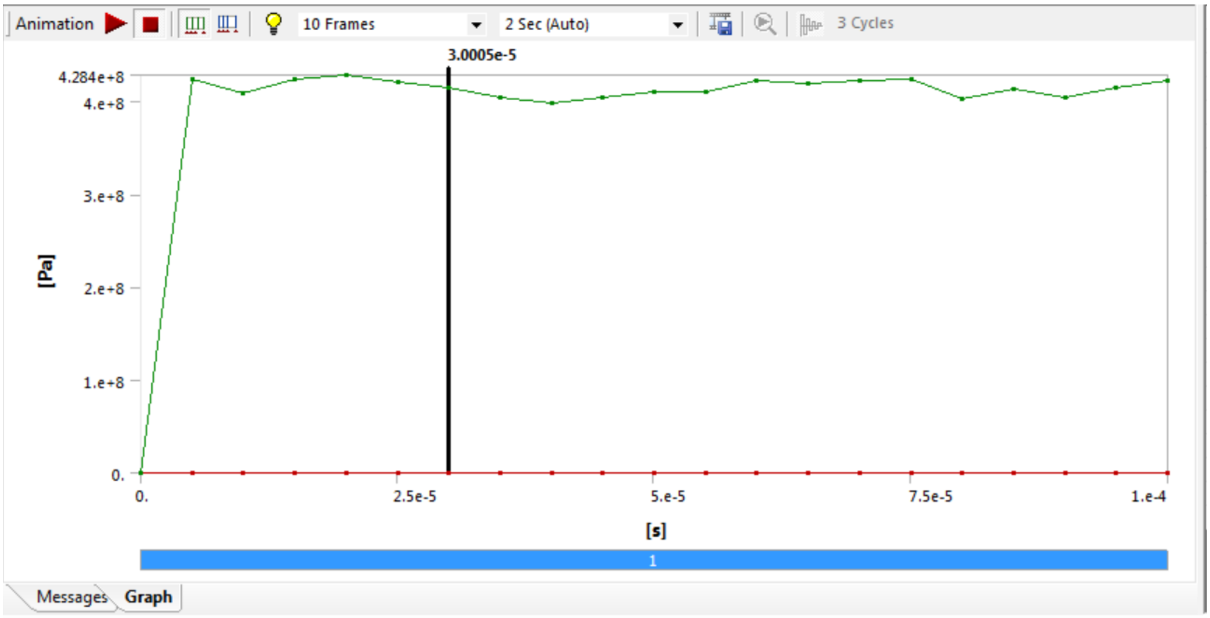

FIG-4.3 Stress vs. Strain graph of the cutter

V. METHODOLOGY

There are various methods of weed removal, the most common being mechanical methods in which a blade attached to a long rod or cable cuts the weed. The other method used is the chemical method in which a chemical is sprayed on the weed infested area. This method is no longer used as it has adverse effects on the ecosystem. The main objective of the project was to design a simple cutter for the removal of weeds from water bodies. Initially, a tiller based design was being considered, but the design had a lot of drawbacks, the main drawback being the excessive drag force. The alternative to this was inspired by a simple grass cutter. The design was simple and easy, nothing ostentatious. The method of weed removal proposed in this project is by optimizing a grass cutter to suit the cutting of weeds under water. The construction and operation are simple in nature and is efficient in cutting the various forms of weeds. The mechanism used in this project to convert rotary motion to linear motion is by means of links, arranged in a similar manner to that of the quick return mechanism, the difference being the forward and backward strokes have the same speed. The motor used here is a high torque, 12V, DC motor. The primary requirement for the cutting motion of the blades under water is more torque than speed as the required force has to be applied to cut the weeds. Hence, a high torque variable motor is used. The figure below shows the final assembly of the blades.

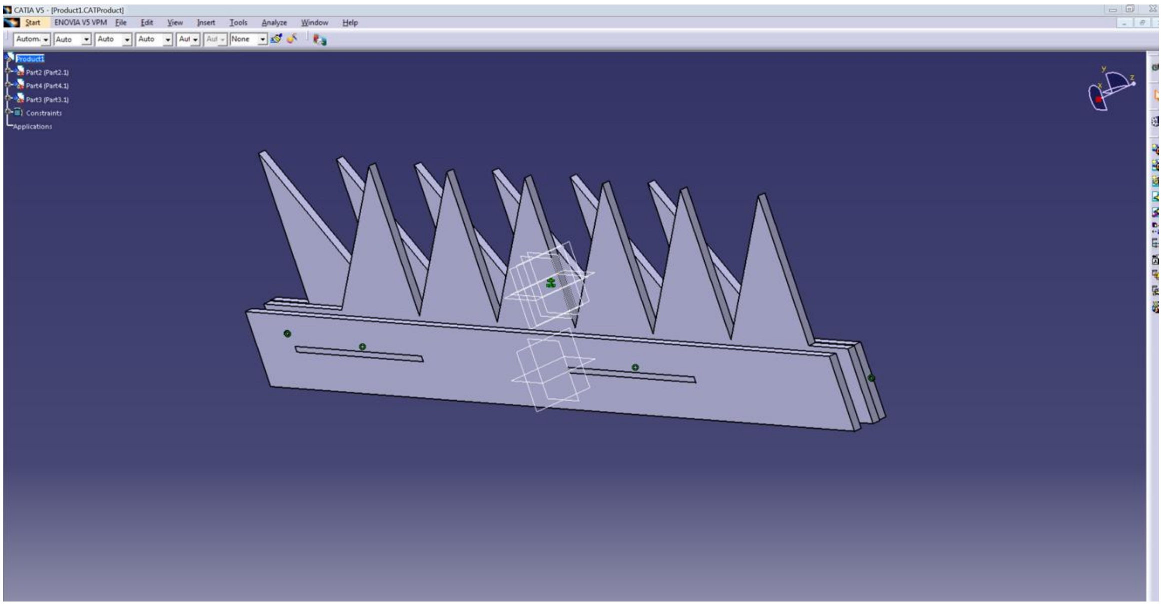

FIG-5.1 Final assembly of the cutter

VI. Conclusion

The main focus of this project is on the design and optimization of the cutter. The scope of this project is vast, with the right funds and sufficient time, the CFD analysis along with the design and fabrication of a prototype with a suitable body and the cutter, would be possible and be the future of this project. The cutter in this project is made of two stationary parts and one moving part. The material used for fabrication of the cutter is aluminum with a gauge of 2mm. The Project has zero emissions and is ecofriendly. In the future, solar panels can be accommodated on the prototype making it self sufficient. The blades can also be attached to the tractors on fields to level out the fields, thus the cutter can be used for multiple purposes.

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