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DESIGN AND ANALYSIS OF ROPELESS FISHING DEVICE

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Abstract

The fisheries sector is rarely a strategic sector for national economic development. Although it plays a prominent role in only a few countries such as Iceland, Namibia, Maldives and other small island developing states rich in fishery resources relative to their populations, it is nonetheless an important economic activity, and very often a strategic one, in many coastal regions of the world. Indeed, in many countries, fish export is a major contributor to foreign exchange earnings, often ranking far higher than other agricultural commodities. The major trade flow -- from south to north -- underlines the significance of this sector for the trade balance of many developing countries. Licensing fees of foreign fishing fleets are another source of foreign exchange revenue from marine fishery resources, especially in West African and South Pacific countries.

The fishing industry is based on traditional techniques from many years. It has certain disadvantages. It harms the marine life as well as causes the water pollution due to lost fishing gears, ropes, etc. Many times the large fishes risks their life due to entanglement of very large fishes in fishing instruments and machineries. Also, traditional fishing causes death of workers due to risky techniques and also effects on costal. In order to avoid this there is need to apply solution of rope-less fishing technique. Many times death of fishermen occurs due to fire hazard, sinking etc. Automated fishing techniques can save the life of fishermen by providing human less fishing.

This paper contains designing and analysis of fishing device which will eliminate the use of fishing ropes as well as it will reduce human work and injury rates as well.

***Keywords**:* fish, fisheries, marine pollution, endangered marine species, fishing industry

1. Introduction

1.1 Background

Critically endangered marine species are in threat of getting extinct day by day because of entanglement of large fishes such as whales, in vertical lines used in trap/pot fishing. Sometimes, an entangled fish or whale frees itself but struggle leaves tell-tale scars on sea species.

Existing methods of fishing have made commercial fishing industry as most of the highest injury and morality rates of all occupational area. This is due to small crafts are manned by very few individuals who works with heavy duty equipment in dangerous environment at all hours. Fatigue is also a problem that fishermen as they have to face long working periods and short resting periods.

Fishing gears are made up of materials like plastic which are generally non bio- degradable and may sink to sea floor or drift around in currents. It remains un-noticed and shows up in coral reefs, beaches and other habitats. It damages the soft tissues and fragile skeleton of coral reefs.

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1.2 Objectives

1. Provide rope-less fish catching device which is economical.
2. To reduce human effort and human fatigue
3. To reduce marine pollution which is caused by plastic and non-degradable fishing gears?
4. To provide a fishing technique which will avoid causing entanglement of large fishes?
5. To reduce number of working fishermen for a certain lot.
6. To provide long resting hours and short working hours to fishermen.
7. To protect coral reefs this is caused by conventional fish catching techniques.

1.3 Scope

Even in today‘s world most of the world‘s fishermen use conventional fishing technique which has many disadvantages. Those techniques are giving rise to whale’s entanglement, pollution of coral reefs etc. Also the work on single fishermen is also more as well as fishing is considered as having high death rates as compared to other occupations. In order to avoid these problems we are building a prototype of a fishing device which will provide rope less fishing technique using principle of negative pressure. It will not use any non-degradable plastic fishing gears, so it will not cause marine pollution. It will reduce efforts of fishermen and lesser their work. It will also increase productivity as compared to conventional techniques.

1.4 Methodology

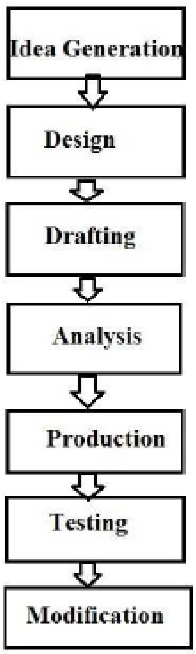

Figure 1: Methodology Flow Chart

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2. Design of Container

2.1 Dimensions Consideration

For prototype, following dimensions are fixed by assumption to make a compact but effective model of container in setup-

Table 1: Dimensions of Container

Parameters	Dimensions
Length x Width x Height	(230 x 210 x 150)mm
Diameter for inlet pipe	76.2 mm (3 inch)
Diameter of outlet pipe	76.2 mm (3 inch)
Diameter of hole at the top for actuator	25.4 mm (1 inch)
Diameter of hole for coupling of motor	25.4 mm (1 inch)

2.2 Drafting of Container

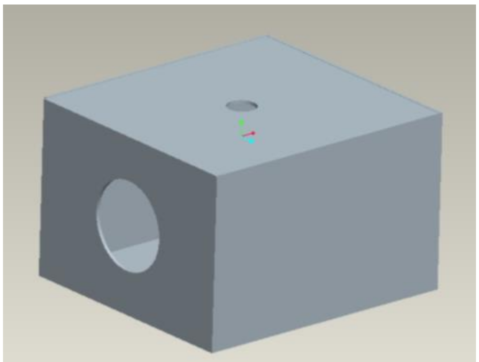

Figure 2: Drafting of Container

2.3 Material Selection

For material selection, analysis of aluminium and sheet metal is carried out on Ansys for above dimensions,

Ansys Results for Aluminium-

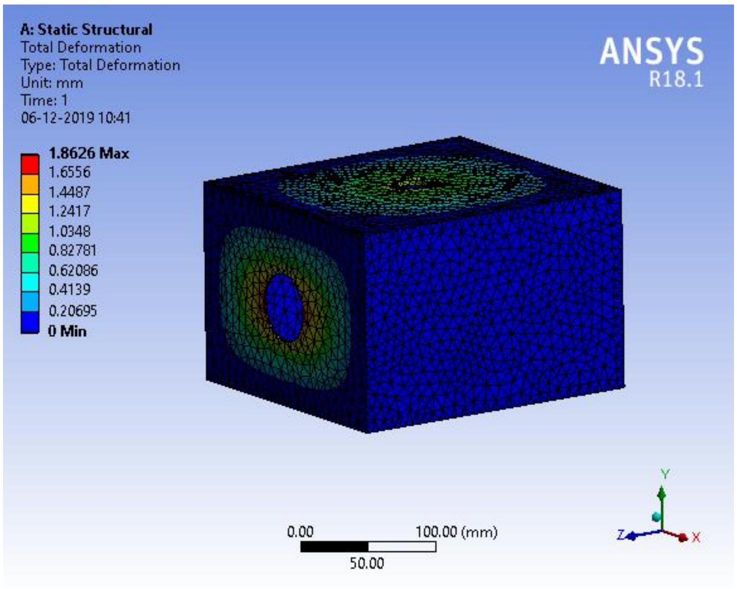

Figure 3: Ansys Results for Aluminium

Ansys Results for MS Sheet Metal-

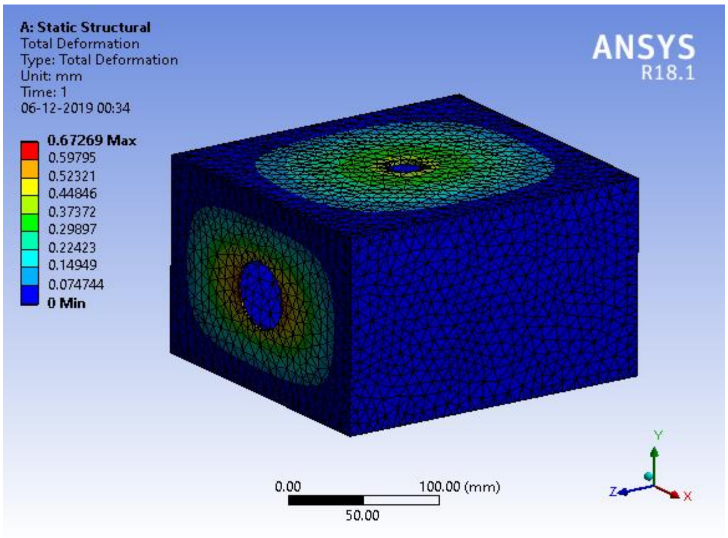

Figure 4: Ansys Results for M.S. Sheet Metal

Above results shows that both materials satisfies the loading conditions and deformation criteria but MS is better because-
1. MS is cheaper than aluminium
2. Steel is strong and less likely to warp, deform or bend underweight, force or heat.
3. Nevertheless the strength of steel's trade-off is that steel is much heavier /much denser than aluminium.
4. Steel is typically 2.5 times denser than aluminium.

2.4 Conclusion

We carried out aluminium and M.S. sheet metal analysis on Ansys. Based on Ansys result, cost, availability and other factors sheet metal is selected for container material.

3. Design of Elbow

We assumed a punch hole of 3 inches at inlet so, elbow should be designed with reference to nominal diameter of 3 inches. Also, water is required to turn at angle of 90 degree,
According to standard dimensions of 90 degree elbow, For nominal diameter of 76.2mm i.e. 3 inch,
Outside diameter= 88.9 mm i.e. 3.5 inches Long radius centre to end=A=88.9 mm Wall thickness = 3 mm
No. of elbows=1

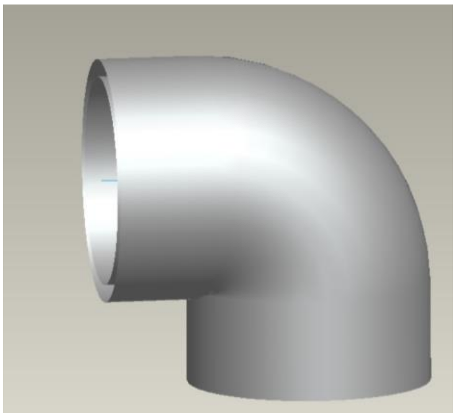

Figure 5: Drafting of Elbow

4. Design of Length of Pipe and Pump Capacity

4.1 Calculation for Assumption 1

Calculation based on 1.5 feet head Head= 40cm i.e. 1.5 feet
Friction loss can be neglecting,

1. Pressure range calculation-

Pressure range= Discharge Pressure – Suction Pressure

Calculations for suction pressure-

Suction pressure = Barometric pressure + Static suction pressure

Static suction pressure= Head (feet) x Specific gravity/ 2.31
= (1.5 x 1.2)/ 2.31
= 0.779220 Psi = 0.0537253 bar

So,
Suction pressure= Barometric pressure (Psi) + Static suction pressure
= 14.7+0.779220
= 15.4792 Psi

Discharge pressure= Static discharge pressure+ Length of pipe

Static discharge pressure= Head x specific gravity / 2.31
= 60 x 1.2/ 2.31
=2.30 Psi

Discharge Pressure= Static discharge pressure+ Length of pipe

Static discharge pressure= Head x specific gravity / 2.31
= 60 x 1.2/ 2.31
=2.30 Psi

Discharge Pressure= Static discharge pressure+ Length of pipe
= 2.30+514 = 516.3 Psi

So,
Pressure Range = Discharge Pressure – Suction Pressure
= 15.4792-14.6959
= 531.7792 Psi= 35.42 bar

2. Flow rate calculation-
Pipe size- 3 inch

Area=3.14 x diameter x diameter
=3.14 x 3 x 3
=7.06 inches

Pressure depends on height

For 2.31 feet height, pressure required is 1 Psi
Our overall height is 889 mm or 2.91667 feet or 35 inches Now,

Volume= 3.14 sq. inches x 7.06 sq. inches x 35 inches
=775.894 cubic inches of volume

Conversion of volume into cubic feet-
1 cubic feet= 1728 cubic inches
So,
Volume = 775.894/1728= 0.44901 cubic feet

Conversion of cubic feet into gallons-
1 cubic feet = 7.48 gallons
So,
0.449012 x 7.48 = 3.3586 gallons

Assume,
Flow of water is one foot/ sec, So,
1foot/sec x 60 sec/min= 60 feet/min
3.3586 x 6= 20.1516~= 25 GPM

From calculation,
We have,
For 400 mm head,
GPM= 20.1526
Pressure= 35.4238 bar
According to HP calculator,
9 HP pump is required which is non-convenient

4.2 Calculation for Assumption 2

Head= 15cm i.e. 0.492126 feet
Friction loss can be neglecting,

1. Pressure range calculation-

Pressure range= Discharge Pressure – Suction Pressure

Calculations for suction pressure-

Suction pressure = Barometric pressure + Static suction pressure

Static suction pressure= Head (feet) x Specific gravity/ 2.31
= (0.49226 x 1.2)/ 2.31
= 0.25571 Psi

So,
Suction pressure= Barometric pressure (Psi) + Static suction pressure
= 14.7+0.255 = 14.95571 Psi

Discharge pressure= Static discharge pressure+ Length of pipe

Static discharge pressure= Head x specific gravity / 2.31
= 30 x 1.2/ 2.31
=15.58 Psi
Discharge Pressure= Static discharge pressure+ Length of pipe
= 2.30+0.656168
= 16.24058 Psi

So,
Pressure Range = Discharge Pressure – Suction Pressure
= 16.24058-15.58
= 1.28487 Psi

2. Flow rate Calculations- Pipe size- 3 inch

Area=3.14 x diameter x diameter
=3.14 x 3 x 3
=7.06 inches

Pressure depends on height

For 2.31 feet height,
Pressure required is 1 Psi
Our overall height is 889 mm= 0.866142 feet

Now,
Volume= 3.14 sq. inches x 7.06 sq. inches x 0.866142 inches
=19.221 cubic inches of volume

Conversion of volume into cubic feet-
1 cubic feet= 1728 cubic inches
So,
Volume = 19.221/1728= 0.011123 cubic feet

Conversion of cubic feet into gallons-
1 cubic feet = 7.48 gallons
So,
0.011123 x 7.48= 0.08320 gallons

Assume,
Flow of water is one foot/ sec, So,
1foot/sec x 60 sec/min= 60 feet/min
0.08320 x 60= 29.95 GPM

From calculation,
We have for 150 mm head,
GPM= 29.95
Pressure= 1.28487 Psi

According to HP calculator for pump,
0.03 HP or 0.5 HP pump is required which is convenient

4.3 Conclusion

By assuming two different heads, the pressure range and flow rate in gallons per minute is calculated. Based on these calculations, the horsepower required is found out for each assumption and accordingly 0.5 HP pump is selected.

5. Design of Perforated Sheet

As perforated sheet should slide in the container, dimensions of the sheet is maintained slight below dimensions of container
So,
From container dimensions,
Perforated sheet dimensions- (220 x 200) mm

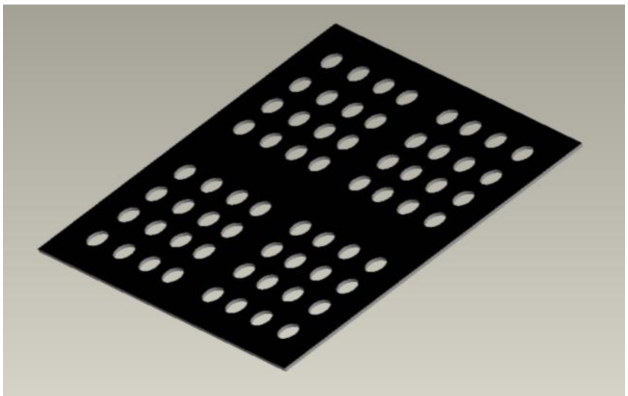

Figure 6: Drafting of Perforated Sheet

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6. Drafting of Ropeless Fishing Device

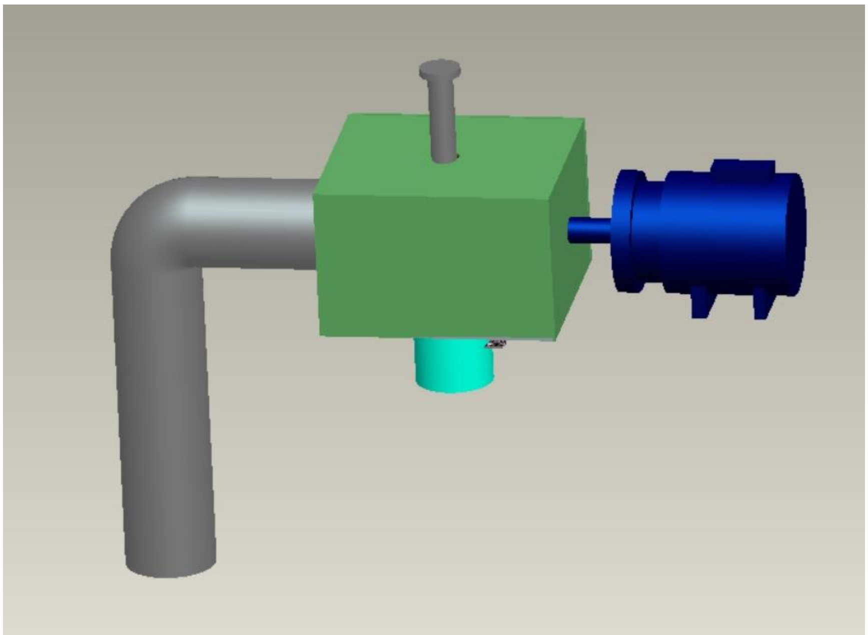

Figure 7: Drafting of Ropeless Fishing Device

Main Components of Ropeless Fishing Device are-
1. Container
2. Double acting pneumatic cylinder
3. Ball Valve
4. Hydraulic Pump
5. Elbow
6. Pipe
7. Perforated Sheet

7. Analysis of Container-

Forces acting due to pump and actuator on container-

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7.1 Stresses on side 1-

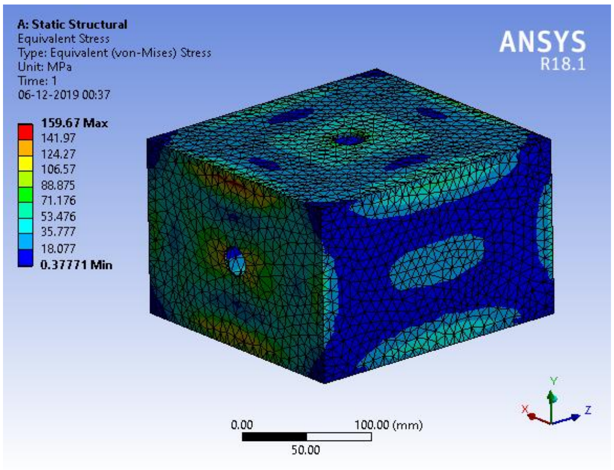

Figure 8: Stresses on side 1

7.2 Stresses on side 2-

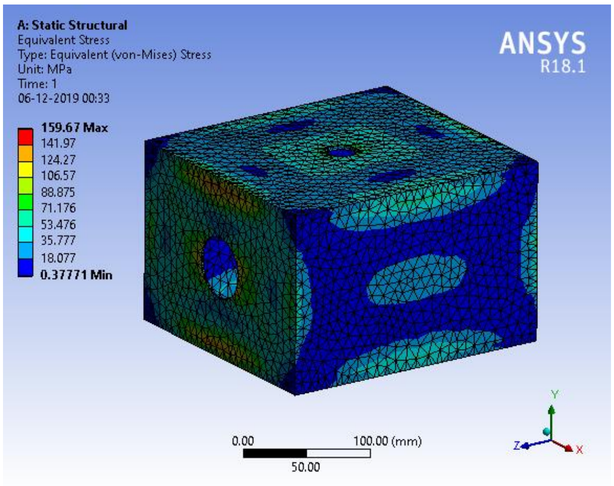

Figure 9: Stresses on side 2

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7.3 Strain on side 1-

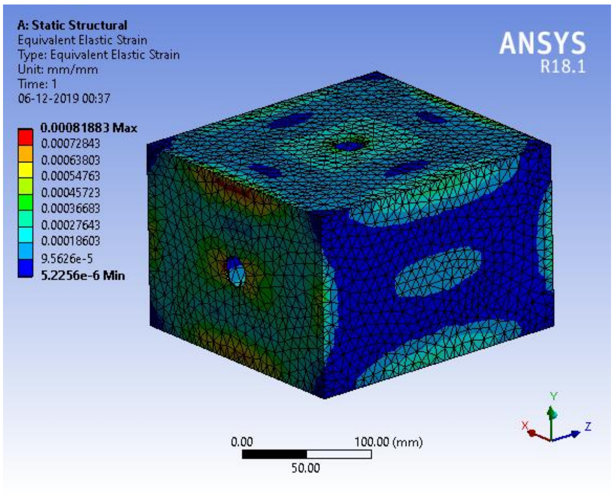

Figure 10: Strain on side 1

7.4 Strain on side 2-

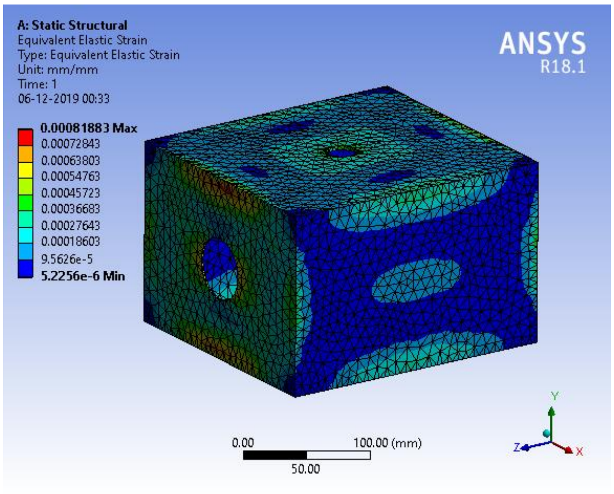

Figure 11: Strain on side 2

7.5 Total deformation on side 1-

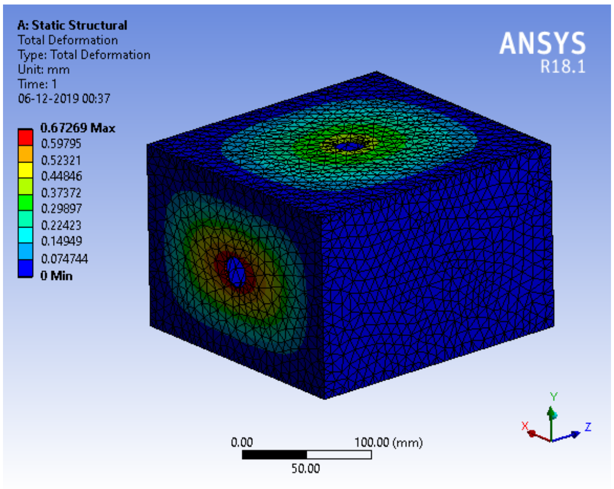

Figure 12: Total deformation on side 1

7.6 Total deformation on side 2-

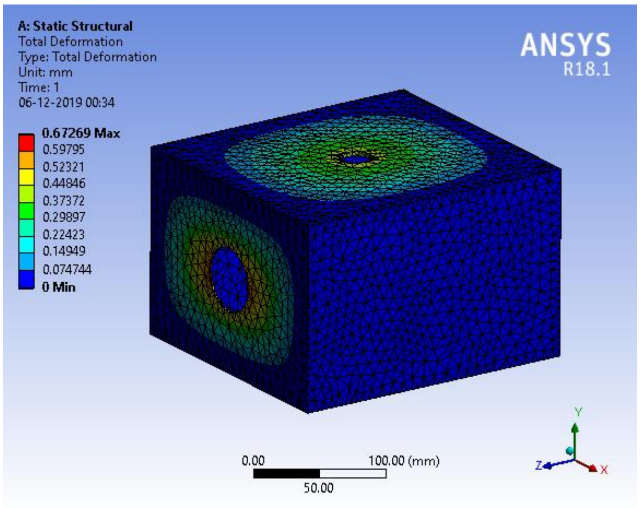

Figure 13: Total deformation on side 2

8. Conclusion

Hence this device is successfully designed to overcome disadvantages of existing fishing techniques and has potential to change the traditional fisheries sector and fishing industry. This device will surely reduce the marine pollution, conserve marine species and reduce the entanglement of unnecessary large whales into fishing ropes. In future this method can be made automated and hence the fatigue of workers can be avoided.

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