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Finite Element Analysis (FEA) of Helical Tidal Turbine

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Abstract:- The spiral turbine assembly can provide unidirectional rotation at ultra-high speed, lower than the multi-directional ultra low head fluid provided. The assembly consists of a series of spiral turbine units or modules arranged vertically or horizontally to harness the power of water or wind, for example. Each turbine unit or module has multiple spiral blades and an airfoil. The wind energy modules can be connected to a rotating shaft supported by a light weight on the ground of the men. Spiral turbines can also use the power of ocean waves to provide thrust for ships. In other embodiments, a cylindrical distributor is provided in the helical turbine to direct the fluid flow to the turbine blades, thus increasing efficiency and power output. In this paper, simulation analysis is performed using finite element analysis techniques with the help of Ansys to evaluate the overall performance of helical and straight blade crossflow hydroelectric turbines with linear horizontal/vertical mode and the like. The duration, diameter and hydrofoil type of each generator are assumed to be equal.

Keywords:- *Helical Tidal Turbine, Finite Element Analysis, Ansys, Turbine blades, 3-D Design, Benefits.*

I. INTRODUCTION

The extraction of energy using modern marine generat ors seems to be an effective method of generating renewabl e energy without using green gases in some stages of the no rmal operation process. Technological developments in this area are still ongoing. The system uses the kinetic energy o f the flow in the tidal front channels and currents and hydro electric power to generate electricity. Modern marine powe r source converters can be divided into three types, such as horizontal axis, vertical axis and crossflow generators. The fact that the ocean speed is 832 times greater than that of ai r has encouraged many scientists to take advantage of wind changes in the ocean. China's earliest tidal turbines were b uilt and tested in the 1970s. The model uses a hydraulic pre ss turbine for power conversion and produces 5.8 kW at a s peed of 3 m/s per day. Vertical shaft designs are attractive because they can accommodate all types of buoyancy and a llow machines to be built off the water with vertical shaft d rives. The Darrieus turbine is a good example of a verticala xis tidal turbine with 3 or 4 extended hydrofoil section blad es mounted vertically on a radial palm tip. Takamatsu and Takenouchi have already tested some independent models i n the laboratory. Gorlov came up with his own patent, wher e the blade is designed to be twisted in a spiral shape relativ e to the axis of rotation. The vibration value of the spiral bl ade turbine is small and its starting characteristics are better than other straight blade vertical axis generators. The powe r of the turbines will be very important in generating electri city from the ocean current. The energy of the ocean is con verted into mechanical energy by the blades, which in turn causes the turbine shaft to rotate. The shape of the teeth and the correct use of these elements can lead to good work wit h the teeth.

II. ADVANTAGES OF HELICAL TIDAL TURBINE

➢ *Spiral Tidal Generators have Many Advantages Over O ther Types of Mills, Such As:*

- *Self-Starting*

Spiral mills are easier to start than blade mills and can reach the highest rotation speed.

- *Reduce Torque Ripple*

At certain power consumption points of the spiral generator, the torque ripple is small, which means the rotating axis is stable.

- *Smoother Torque Curve*

Spiral mills have a smoother torque curve, which mea ns they vibrate and make less noise than other types of gene rators.

- *Uniformly Distributed Paper Cross Section*

The blade of the spiral turbine is curved along the axis , which means there is always a foil level at each angle of a ttack. This helps reduce the stress on the turbine structure a nd equipment.

- *Hydroelectric*

The hydrodynamic force is slowly distributed in the spiral turbine, which reduces vibration and provides stable electric power.

➢ *3-D Design of Helical Tidal Turbine*

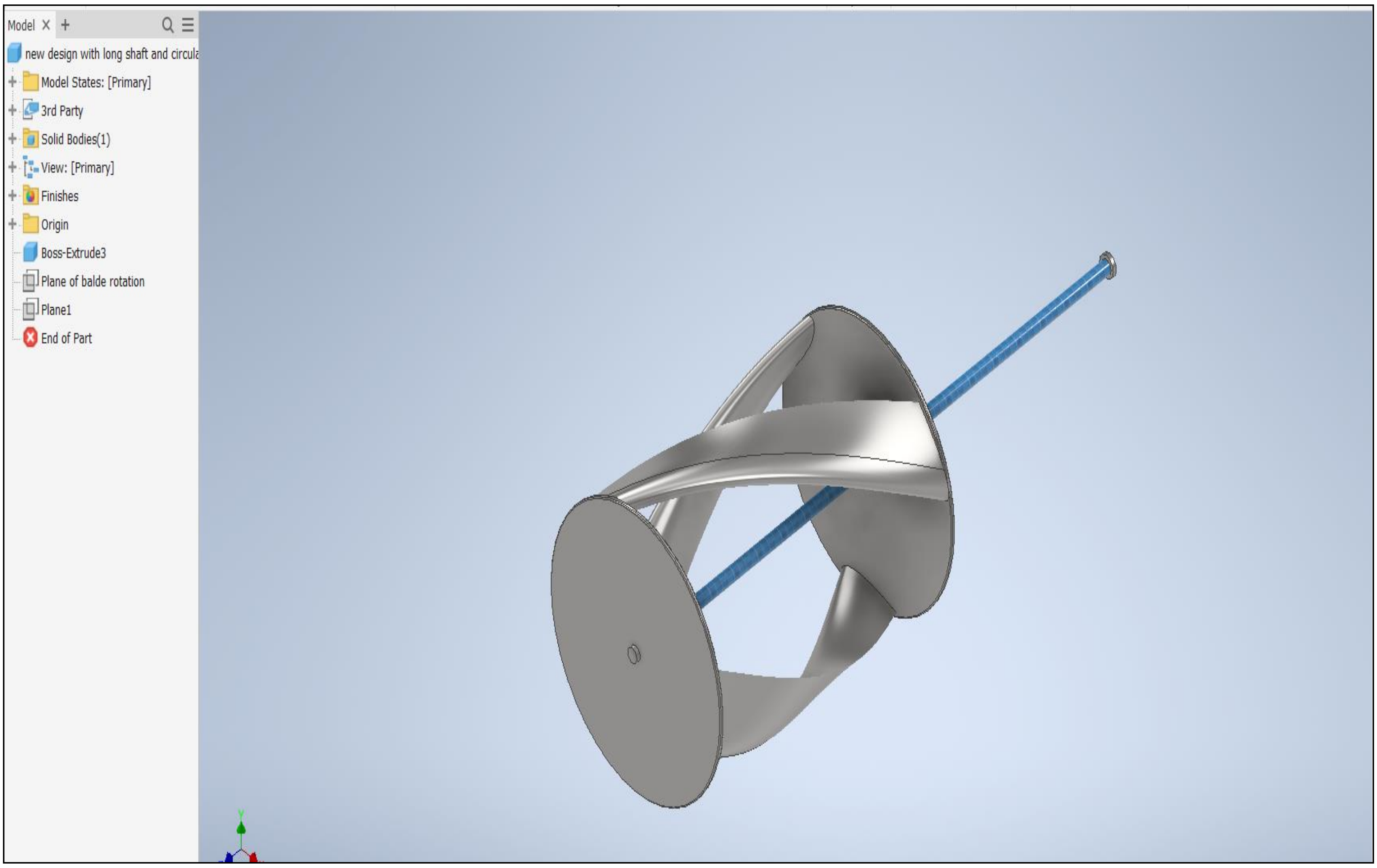

Fig 1: 3-D Model of Helical Tidal Turbine

III. SIMULATION OF HELICAL TIDAL TURBINE

➢ *Boundary Conditions (Force and Support)*

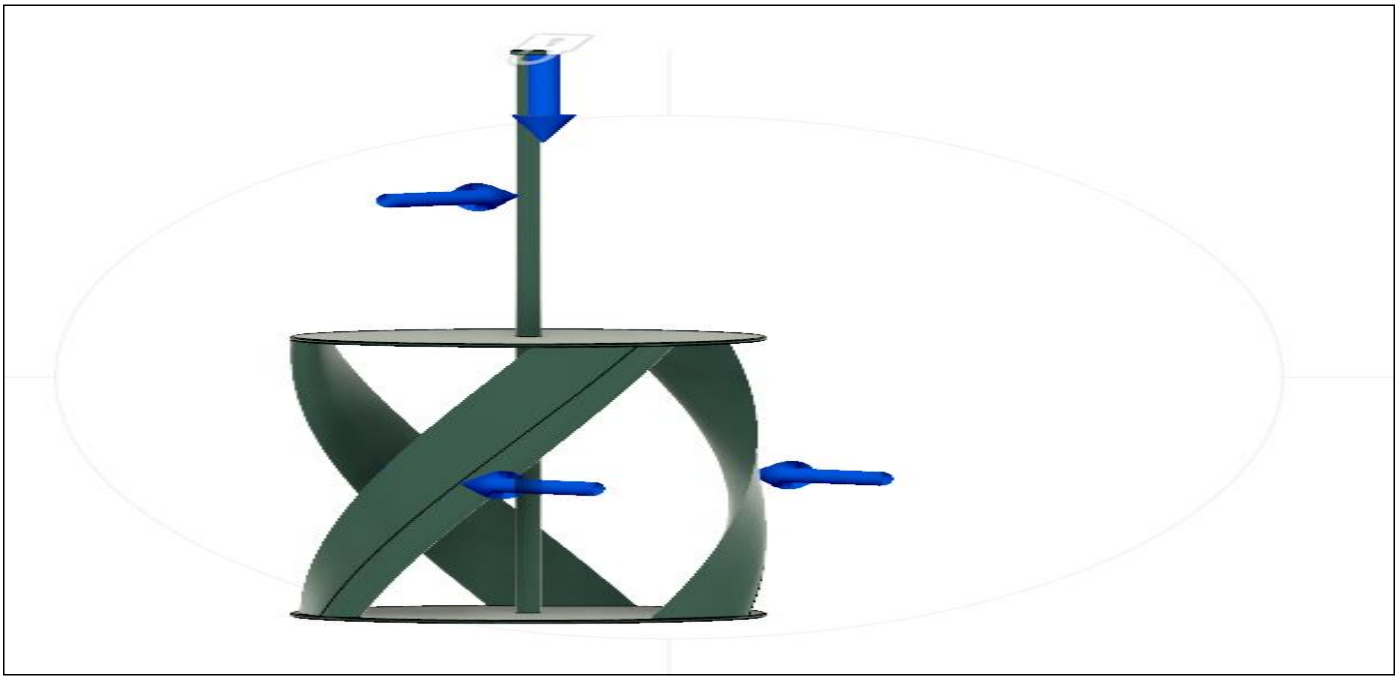

Fig 2: Boundary Conditions (Force and Support)

➢ *Meshing*

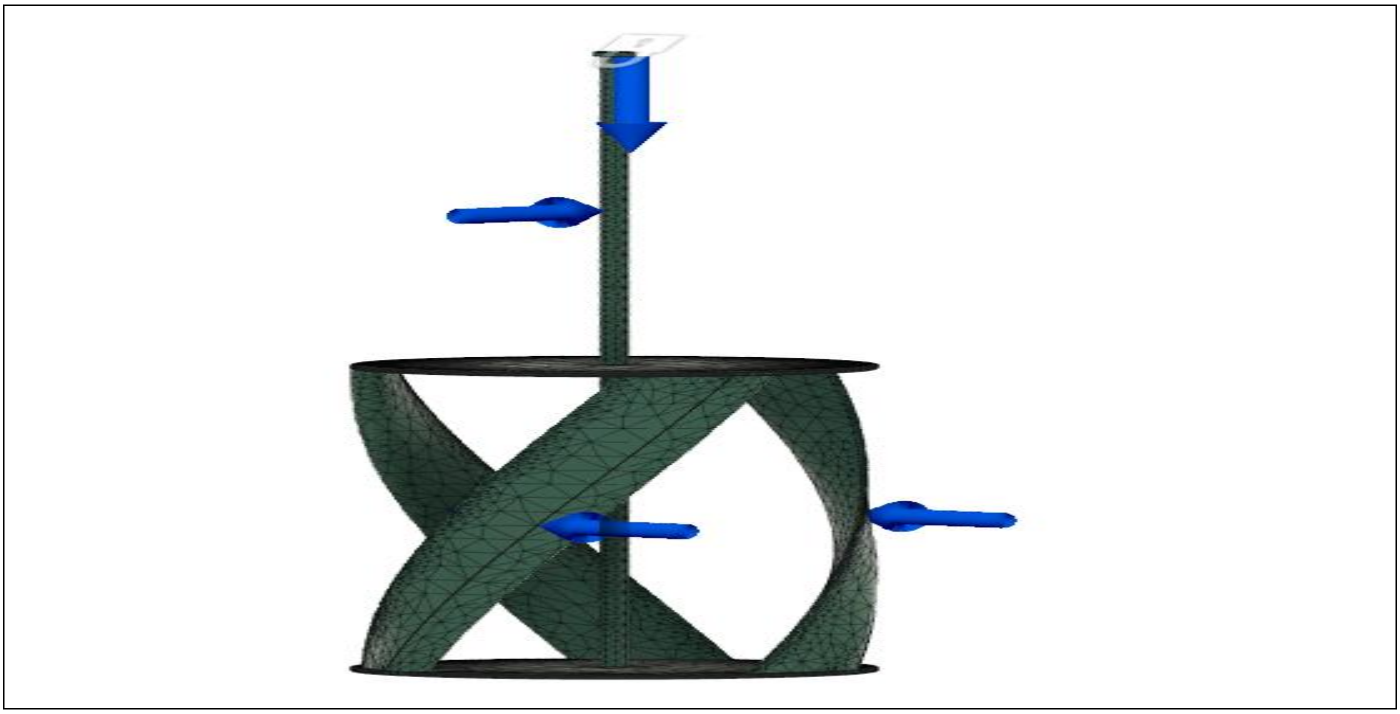

Fig 3: Meshng

➢ *Von-Mises Stress*

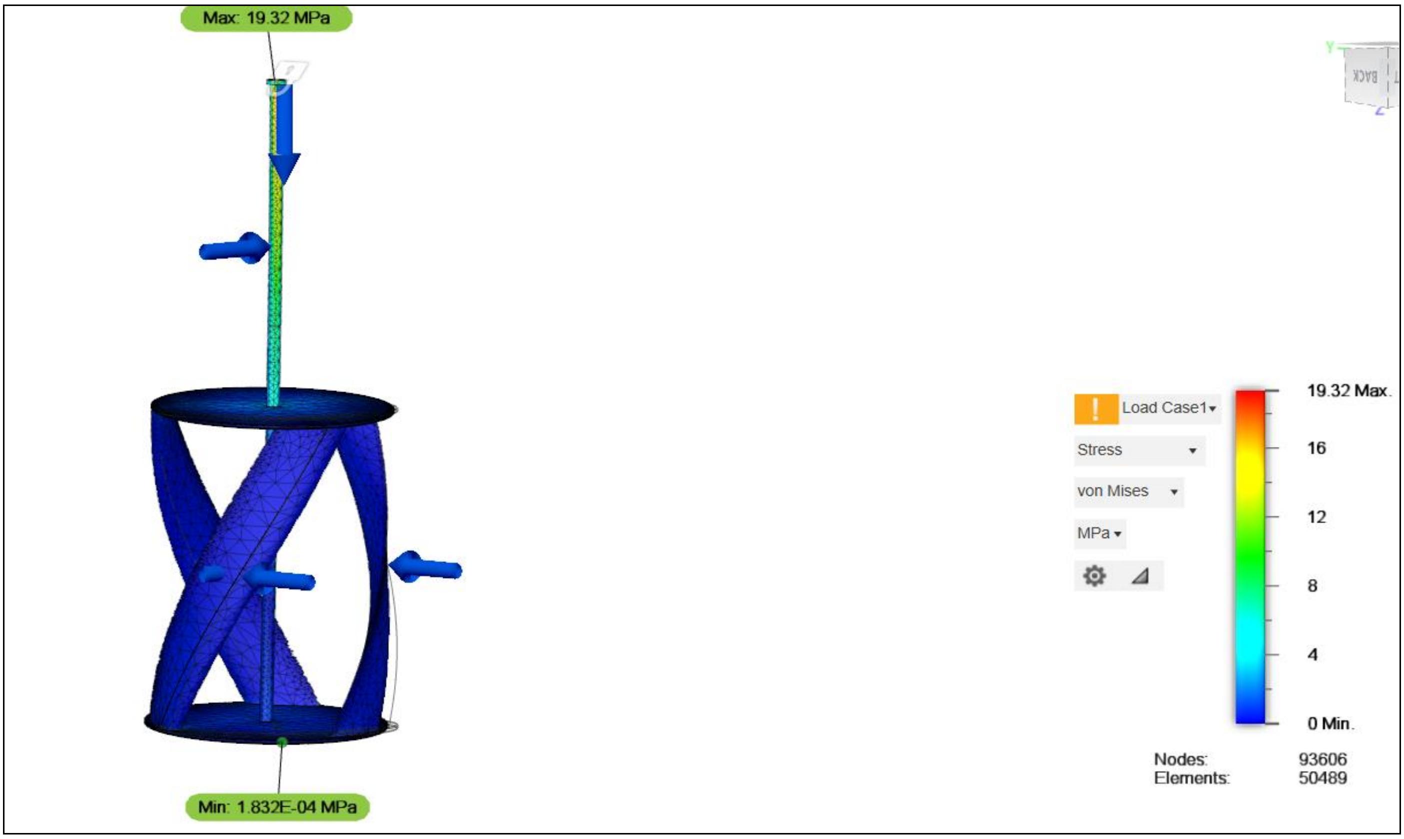

Fig 4: Von-Mises Stress

➢ *Displacement*

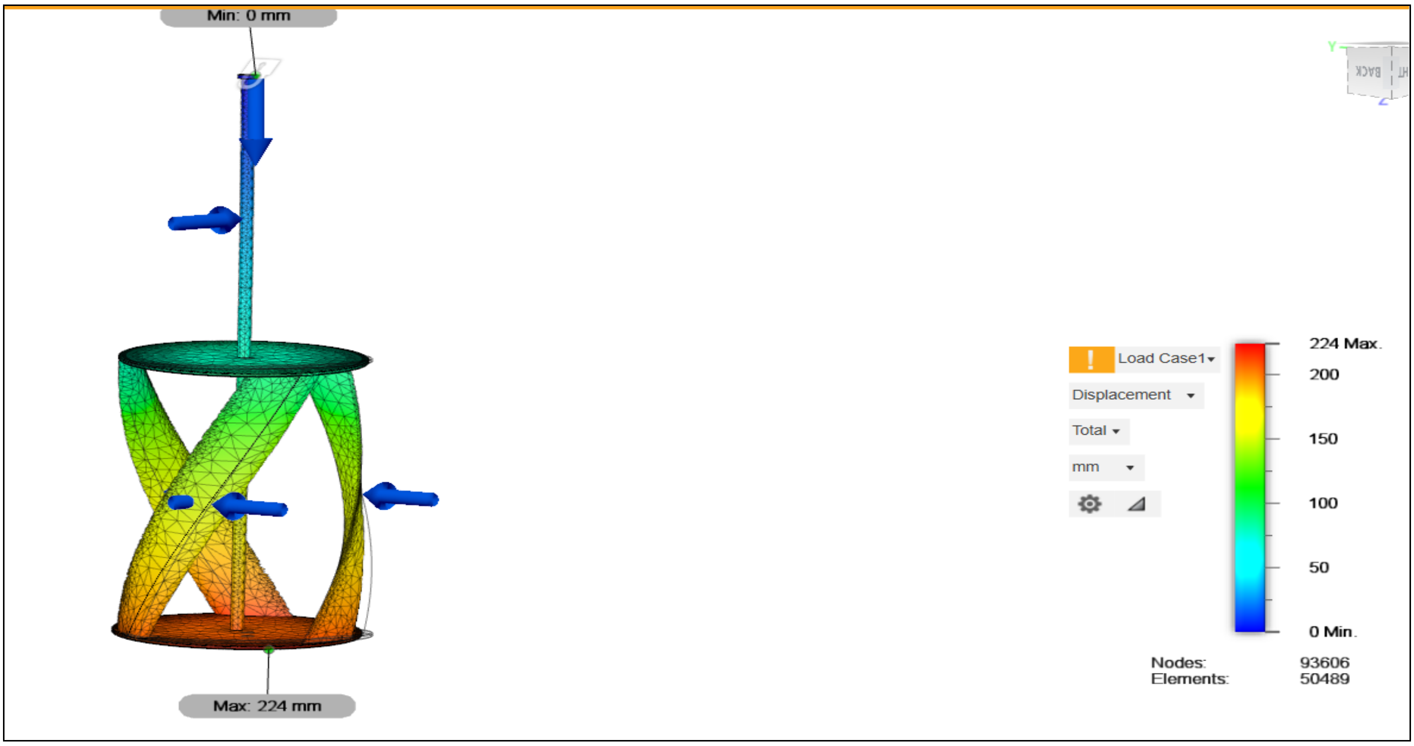

Fig 5: Displacement

➢ *Safety Factor*

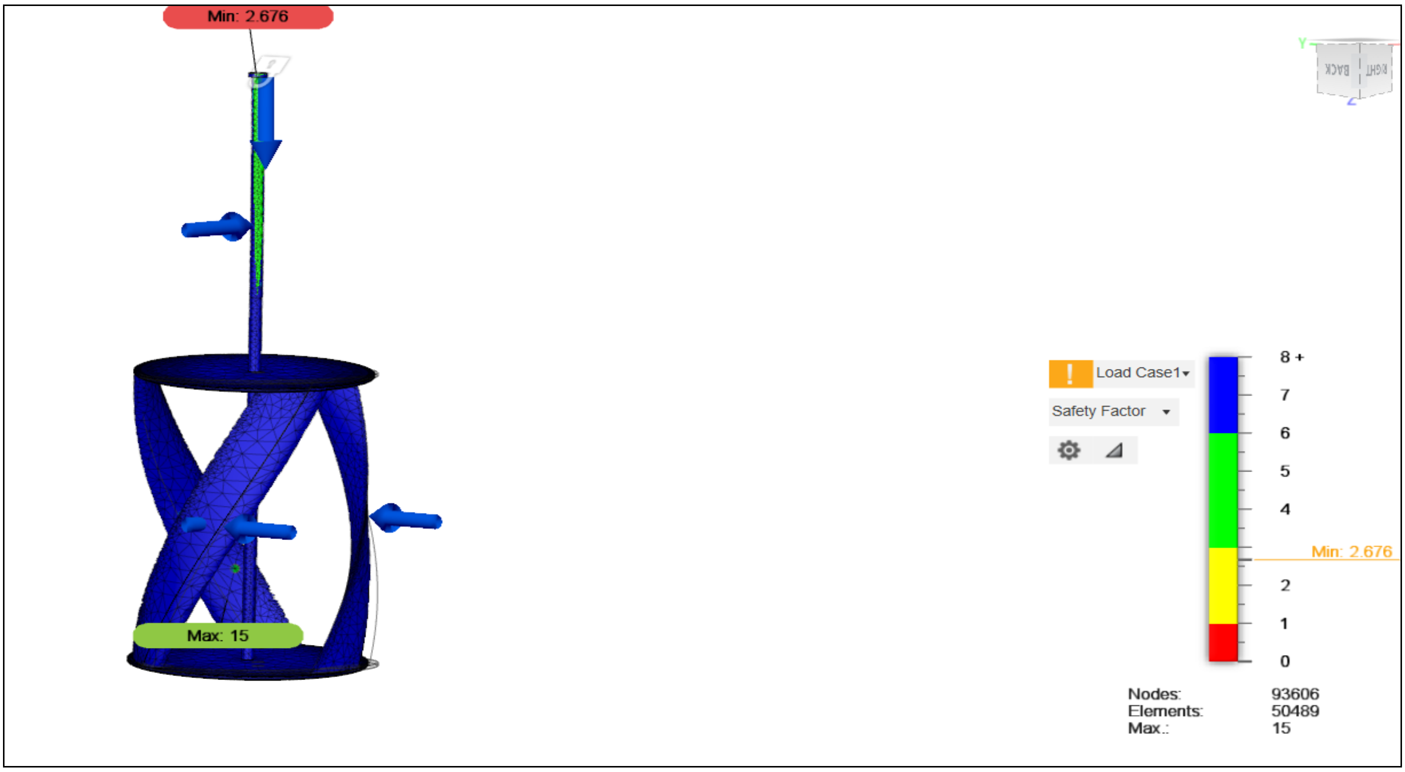

Fig 6: Safety Factor

➢ *Equivalent Strain*

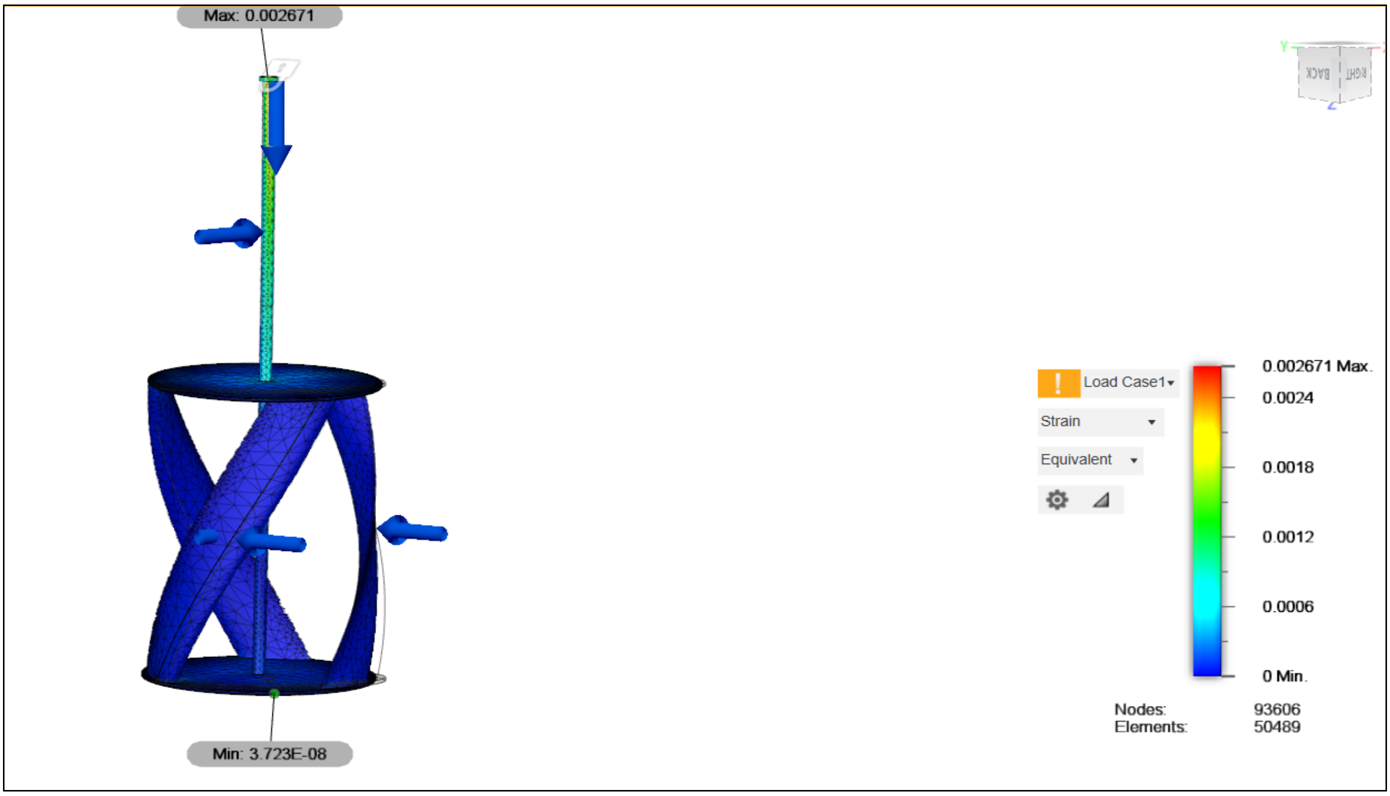

Fig 7: Equivalent Strain

➢ *X Displacement*

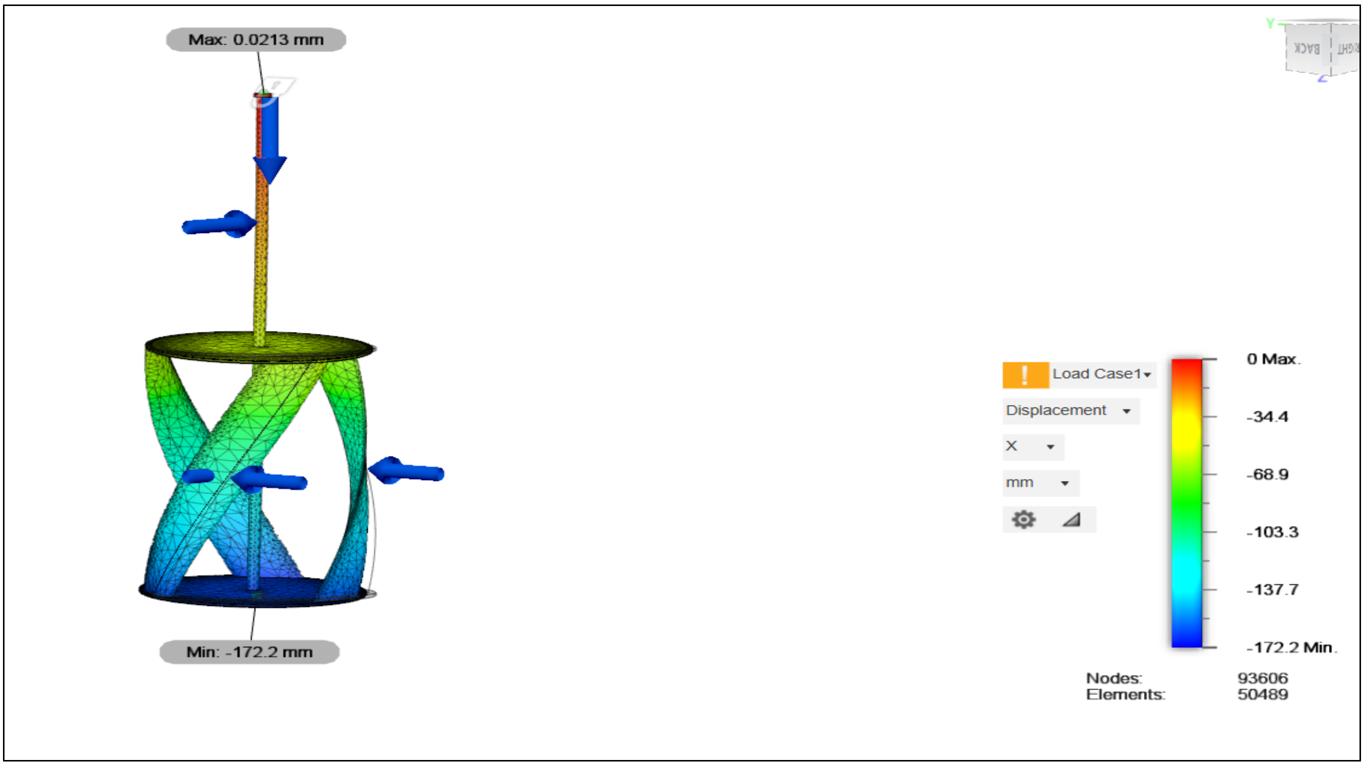

Fig 8: Displacement in X- Direction

➢ *Total Reaction Force*

Fig 9: Total Reaction Force

IV. RESULT SUMMARY

Table 1: Result

Name	Minimum	Maximum
Safety Factor		
Safety Factor (Per Body)	2.676	15
Stress		
von Mises	1.832E-04 MPa	19.32 MPa
1st Principal	-3.253 MPa	19.64 MPa
3rd Principal	-20.16 MPa	3.302 MPa
Normal XX	-6.464 MPa	6.622 MPa
Normal YY	-6.274 MPa	6.115 MPa
Normal ZZ	-20.04 MPa	19.56 MPa
Shear XY	-2.914 MPa	3.012 MPa
Shear YZ	-5.267 MPa	2.827 MPa
Shear ZX	-5.5 MPa	3.553 MPa
Displacement		
Total	0 mm	224 mm
X	-172.2 mm	0.0213 mm
Y	-137.4 mm	0.02047 mm
Z	-49.91 mm	50.15 mm
Reaction Force		
Total	0 N	1568 N
X	-352.6 N	387.5 N
Y	-330.8 N	385.6 N
Z	-1520 N	1418 N
Strain		
Equivalent	3.723E-08	0.002671
1st Principal	-1.094E-04	0.002962
3rd Principal	-0.003205	7.307E-05
Normal XX	-9.111E-04	9.334E-04
Normal YY	-8.846E-04	8.292E-04
Normal ZZ	-0.0029	0.002831
Shear XY	-8.711E-04	9.006E-04
Shear YZ	-0.001575	8.452E-04
Shear ZX	-0.001645	0.001062
Contact Force		
Total	0 N	0 N
X	0 N	0 N
Y	0 N	0 N
Z	0 N	0 N

V. CONCLUSION

One of the crucial components of the vertical turbine is that it does now not want to be indicated in the direction of the tidal for it to work powerfully. This makes it powerful inside a territory with shifting tidal direction. also, it is ready for operating amid insignificant tidal pace, that is because of its long curved propellers are supposed to be driven with the aid of a bit measure of tidal. similarly testing has also established that it does now not need to introduce at a excessive vicinity. effectively obvious to natural existence, even as turning or very nevertheless. when compared to the opposite generators, horizontal, we notice that execs of the vertical outweigh that of the horizontal.

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