Journal of Engineering Sciences
Vol 10, Issue 11, NOV/2019
ISSN NO:0377-9254

DESING AND ANALYSIS OF POLE FOR HYBRID ENERGY SYSTEM WITH LED STREET LIGHT

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ABSTRACT

Solar hybrid power systems are hybrid power systems that combine solar power from a photovoltaic system with another power generating energy source. A common type is a wind

In this project, it focuses on design of analysis of pole for hybrid energy system with Led Street Light for India, the southern Ghats of Andhra Pradesh State, which is one of the potential sources of wind energy. It begins with understanding of the physics involved, in their function. Static analysis Pole ,Bulking Analysis pole , Static Analysis of Analysis of street light pole, Bulking Analysis of Assembly of street light pole,

In this thesis the street light pole with different shapes (I-section, C-section and Circular) designing in CATIA software and analysis in ANSYS software with different materials (cast iron, fiber reinforced polymer (FRP), s2 glass and ASTM a572 grade 50).

Static analysis to determine the deformation, stress and strain sat different materials.

Buckling analysis to determine the deformation with respect to load multiplier.

Finding which is the better cross section of the pole, and the pole is assembling with wind and solar panel.

Keywords: Wind turbine, Pole, Buckling Analysis, static Analysis, Modal Analysis of pole

INTRODUCTION

Due to geo-climatic conditions, Sri Lanka is blessed with several forms of renewable energy resources. Some of them are widely used and developed to supply the energy requirement of the country. Others have the potential for development when the technologies become mature and economically feasible for use. Following are the main renewable resources.

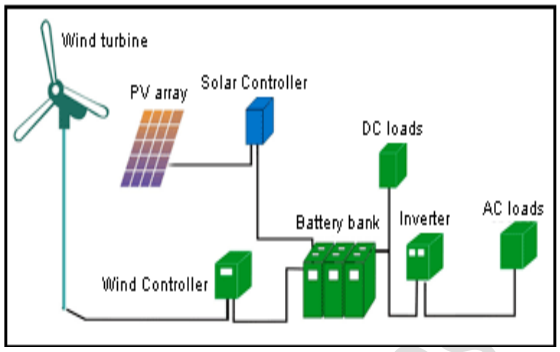
- Biomass
- Hydro
- Solar
- Wind

In addition to the above indigenous renewable resources, the availability of petroleum within the country territory is being investigated. Petroleum, Coal, Natural Gas, Nuclear Energy are the most common energy sources globally available for electricity supply purposes. However, in Sri Lanka petroleum and coal are imported in large scale into the country as a source of energy while coal is imported very recently for electricity generation. The use of other energy sources is still being studied. Biomass Large quantities of firewood and other biomass resources are used for cooking in rural

households. Even though the majority of energy needs of the rural population are fulfilled by the use of firewood, there are possibilities of further increasing the use of biomass for energy purposes in the country, especially for electricity generation. Hydro Power Hydro Power is a key energy source used for electricity generation in Sri Lanka. Better part of the major hydro potential has been already developed and they are delivering valuable low cost electricity. Currently, hydro power stations are operated to supply both peaking and base electricity generation requirement. Apart from the grid connected large hydro power stations, many small scale hydro power plants are in operation serving off-grid loads and grid connected loads. A substantial number of small scale hydro power stations have been already connected to the national grid and many more is expected to join in. 12 Wind According to the wind energy resource atlas of Sri Lanka developed by the National Renewable Energy Laboratory (NREL), there are 5,000km2 of windy areas with good to excellent wind resource potential in Sri Lanka. The windy area represents about 6% of total land area of Sri Lanka and this windy area could support 24,000MW . Solar Being located close to the equator, Sri Lanka does not experience a marked seasonal variation in solar radiation over the island, though significant spatial differentiation could be observed in between the low lands and mountain regions.

The combination of renewable energy sources, wind & solar are used for generating power called as wind solar hybrid system. This system is designed using the solar panels and small wind turbines generators for generating electricity.

To better understand the working of solar wind hybrid system, we must know the working of solar energy system and wind energy system. Solar power system can be defined as the system that uses solar energy for power generation with solar panels. The block diagram of solar wind hybrid system is shown in the figure in which the solar panels and wind turbine are used for power generation.



Wind energy is also one of the renewable energy resources that can be used for generating electrical energy with wind turbines coupled with generators.

LITERATURE REVIEW

Solar and Wind Hybrid Energy System for Street Lighting[1] This paper represents the hybrid energy system using solar and wind energy sources for the control of street lighting. Solar-Wind Street light is an intelligent, small scale, and off grid LED lighting system. It's components are solar panel, wind generator system (PVC blowers), Dynamo, LDRs, battery, LED light, charge controller. The energy stored in battery during day time due to solar panel, get extracted by LEDs during the night time (because LDRs get activated due to absence of sun light). Wind also charges the batteries due to wind which is used for glowing street light. The advantage of this idea is to avoid daily running cost and make the system purely off-grid. In this prototype, we have used 12V DC system to supply energy to the lights.

Design of a Wind-Solar Hybrid Power Generation System in Sri Lanka[2] Wind and solar energy are becoming popular owing to abundance, availability and ease of harnessing for electrical power generation. This thesis focuses on an integrated hybrid renewable energy system consisting of wind and solar energy. Sri Lanka, a small island located south of the Indian subcontinent, has been blessed with renewable energy sources. According to the national energy policy a 10% share is targeted from NCRE (Non-Conventional Renewable Energy) sources by 2015 and 20% by 2020 out of total electricity generation in Sri Lanka. This thesis provides an insight into the energy scenario and present situation of renewable energy development in Sri Lanka. According to wind and solar potential

maps of Sri Lanka which were developed by NREL in 2003, many parts of the country have potential to developed economic power generation. Through these maps locations were identified where both wind and solar potential is high. A detailed study was carried out in these locations with real time field data.

INTRODUCTION TO CAD

CAD (Computer Aided Design) is the use of computer software to design and document a product's design process.

Engineering drawing entails the use of graphical symbols such as points, lines, curves, planes and shapes. Essentially, it gives detailed description about any component in a graphical form.

4.1.1 Background

Engineering drawings have been in use for more than 2000 years. However, the use of orthographic projections was formally introduced by the French mathematician Gaspard Monge in the eighteenth century.

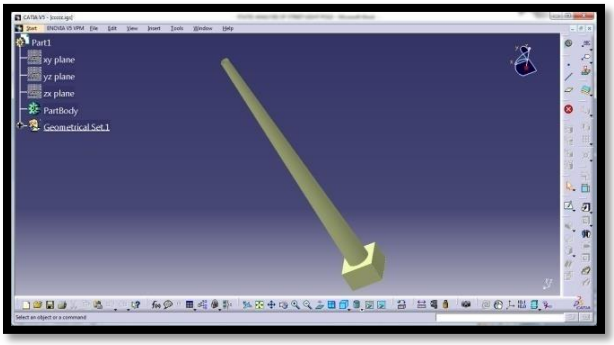
Since visual objects transcend languages, engineering drawings have evolved and become popular over the years. While earlier engineering drawings were handmade, studies have shown that engineering designs are quite complicated. A solution to many engineering problems requires a combination of organization, analysis, problem solving principles and a graphical representation of the problem. Objects in engineering are represented by a technical drawing (also called as drafting) that represents designs and specifications of the physical object and data relationships. Since a technical drawing is precise and communicates all information of the object clearly, it has to be precise. This is where CAD comes to the fore.

INTRODUCTION TO CATIA

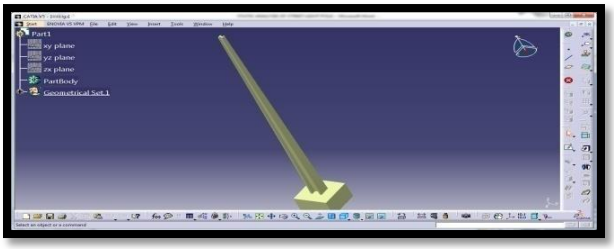
CATIA is an acronym for Computer **A**ided **T**hree-dimensional **I**nteractive **A**pplication. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.

CATIA is a multi platform 3D software suite developed by Dassault Systèmes, encompassing CAD, CAM as well as CAE. Dassault is a French engineering giant active in the field of aviation, 3D design, 3D digital mock-ups, and product lifecycle management (PLM) software. CATIA is a solid modelling tool that unites the 3D parametric features with 2D tools and also addresses every design-to-manufacturing process.

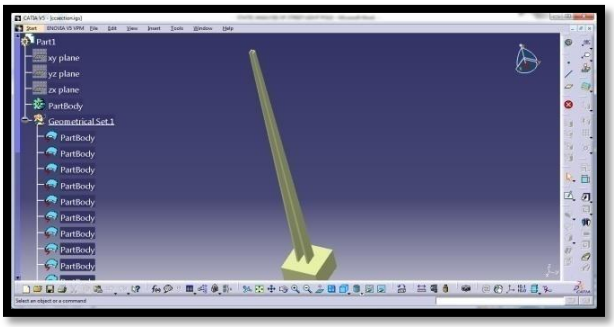
CIRCULAR TYPE POLE



I-SECTION TYPE POLE



C-SECTION TYPE POLE



INTRODUCTION TO FEA

Finite detail assessment is a way of solving, normally approximately, fine issues in engineering and technology. It is used specially for troubles for which no real solution, expressible in a few mathematical shape, is to be had. As such, it's miles a numerical instead of an analytical method. Methods of this type are wanted due to the fact analytical techniques can't

deal with the real, complex issues which might be met with in engineering. For instance, engineering strength of substances or the mathematical idea of elasticity can be used to calculate analytically the stresses and traces in a dishonest beam, however neither can be very a success in locating out what's taking area in part of a car suspension gadget inside the course of cornering.

CASE: 1 CIRCULAR TYPE POLE

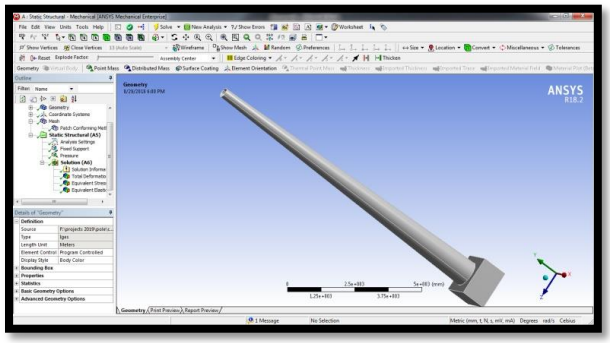


Fig: 5.1.1 Imported model

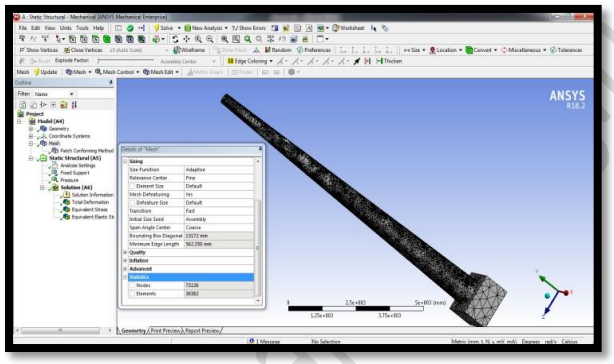


Fig: 5.1.2 Meshed model

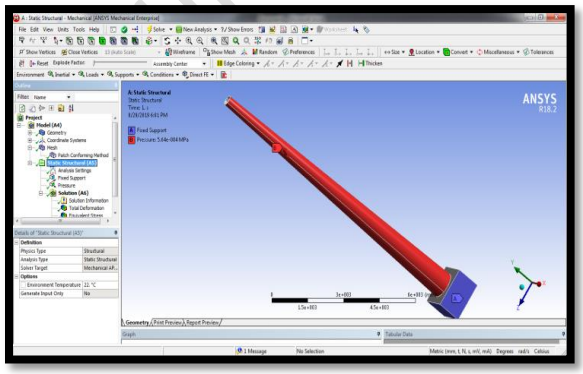


Fig: 5.1.3 Load conditions

MATERIAL- ASTM A572 GRADE 50

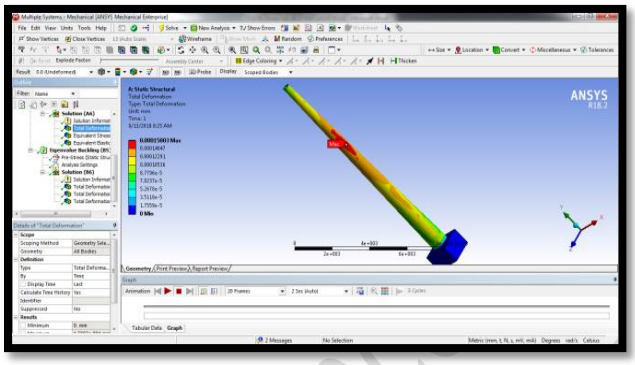


Fig: 5.1.4 Deformation

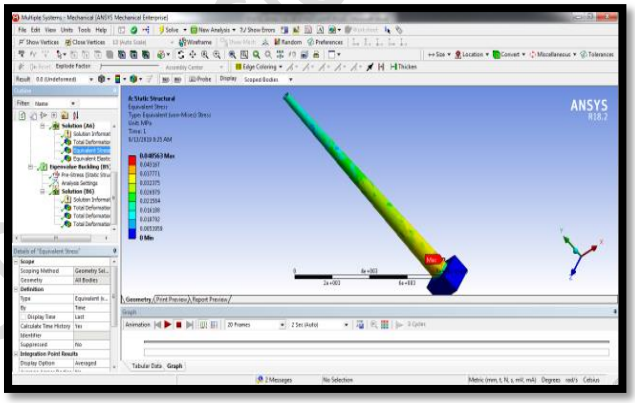


Fig: 5.1.5 Stress

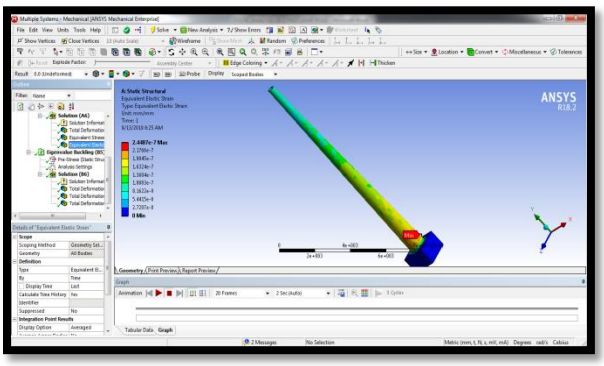


Fig: 5.1.6 Strain

MATERIAL- FIBER REINFORCED POLYMER (FRP)

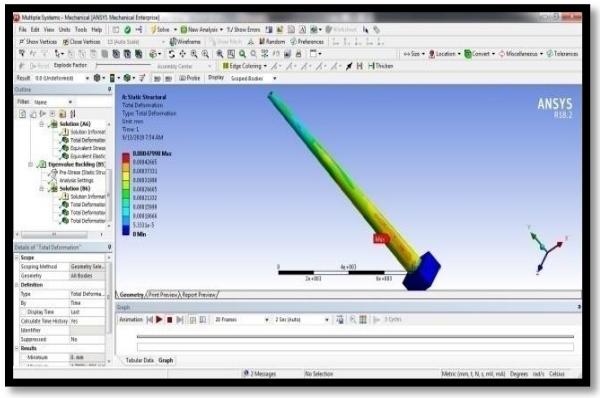


Fig: 5.1.13 Deformation

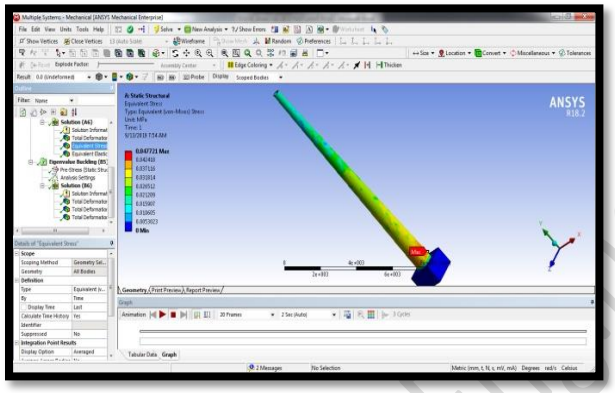


Fig: 5.1.14 Stress

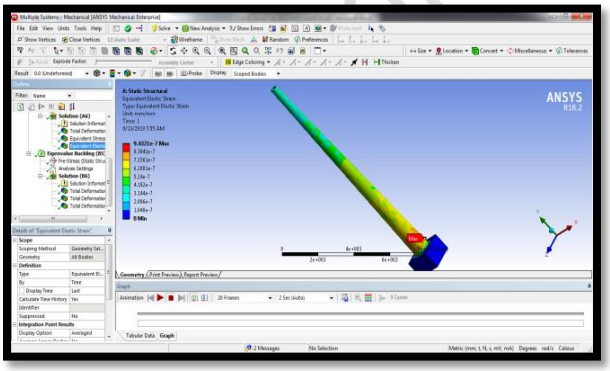
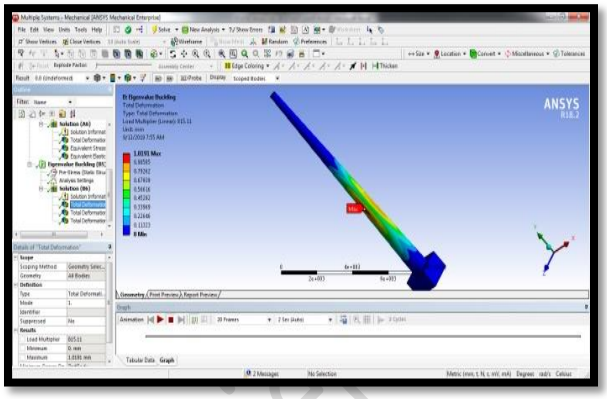


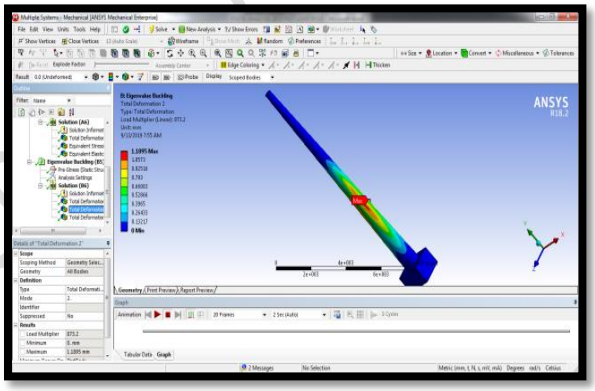
Fig: 5.1.15 Strain

Buckling analysis of street light pole

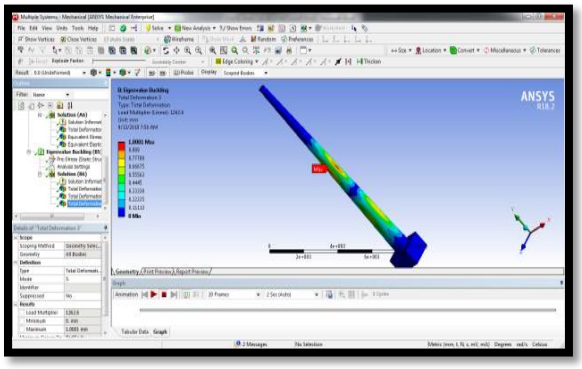
MATERIAL- FIBER REINFORCED POLYMER (FRP)



Mode shape-1



Mode shape-2



Mode shape-3

Static analysis results table

Model	Material	Deformation(mm)	Stress (MPa)	Strain
Circular	ASTM A573 GRADE 50	0.00015803	0.048563	2.4487e-7
	Cast iron	0.0003314	0.048827	4.4775e-7
	S2-glass	0.00052846	0.049477	5.3707e-7
	FRP	0.00047998	0.047721	9.4321e-7
I-section	ASTM A573 GRADE 50	0.17174	2.1728	1.0947e-5
	Cast iron	0.31246	2.1627	1.9805e-5
	S2-glass	0.37008	2.1388	2.3141e-5
	FRP	0.67162	2.2023	4.3531e-5
C-section	ASTM A573 GRADE 50	0.11177	1.4479	7.2615e-6
	Cast iron	0.20346	1.4453	1.3175e-5
	S2-glass	0.24121	1.4496	1.5719e-5
	FRP	0.43626	1.4554	2.8655e-5

BULKING ANALYSIS RESULTS

Circular type street light pole

Model	Material	Mode shapes	Deformation(mm)	Bulking load multiplier
Circular	ASTM A573 GRADE 50	1	1.0223	2993.8
		2	1.175	3169.7
		3	1.0005	4710.6
	Cast iron	1	1.0234	1625.1
		2	1.1713	1715.7
		3	1.0007	2564.7
	S2-glass	1	1.026	1345.7
		2	1.1626	1412.8
		3	1.0015	2133.3
	FRP	1	1.0191	815.11
		2	1.1895	873.2
		3	1.0001	1262.6

I-section type street light pole

Model	Material	Mode shapes	Deformation(mm)	Bulking load multiplier
I-section	ASTM A573 GRADE 50	1	1.017	24890
		2	1.1348	19593
		3	1.1205	19871
	Cast iron	1	1.0168	13788
		2	1.1336	10858
		3	1.1194	11007
	S2-glass	1	1.0163	11876
		2	1.131	9360.3
		3	1.1167	9482.2
	FRP	1	1.0176	6219
		2	1.1378	4890.3
		3	1.1239	4968.3

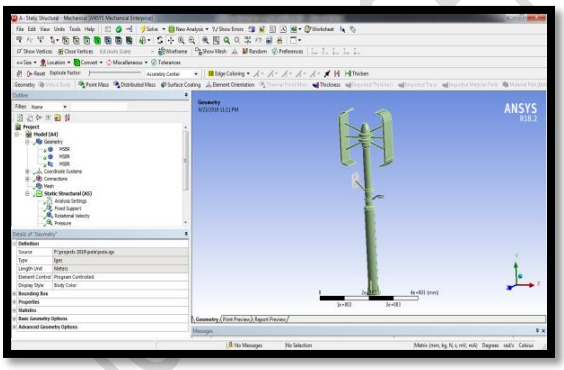
C-section type street light pole

Model	Material	Mode shapes	Deformation(mm)	Bulking load multiplier
C-section	ASTM A573 GRADE 50	1	1.0624	8956.6
		2	1.0496	8041.9
		3	1.0707	8639.9
	Cast iron	1	1.0622	4968.7
		2	1.0493	4463.6
		3	1.0708	4784.1
	S2-glass	1	1.0619	4299.5
		2	1.0488	3867.3
		3	1.0708	4120.2
	FRP	1	1.0628	2232.3
		2	1.0502	2001
		3	1.07	2165.3

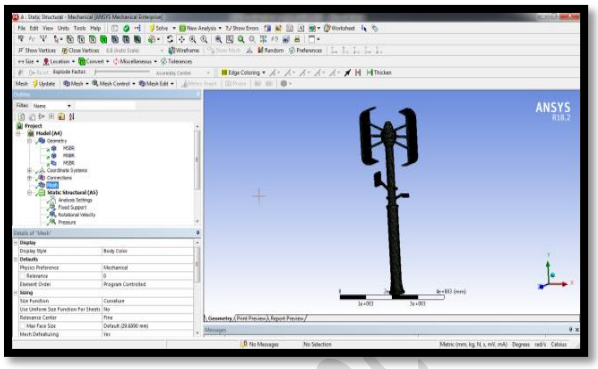
ASSEMBLY OF STREET LIGHT POLE

STATIC ANALYSIS OF ASSEMBLY OF STREET LIGHT POLE

Imported model

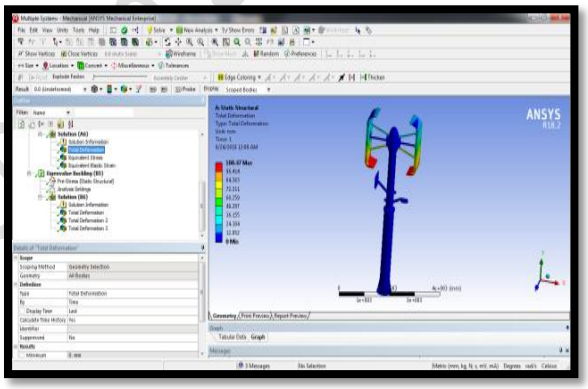


Meshed model

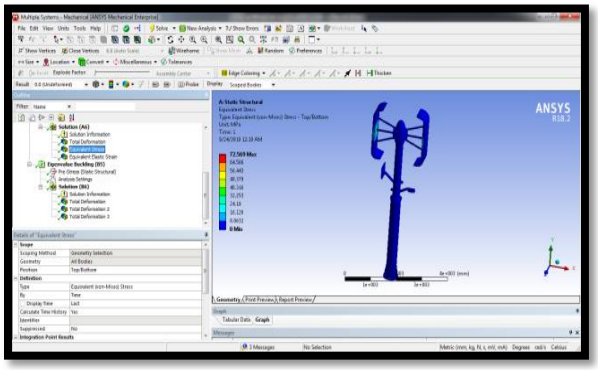


MATERIAL- FIBER REINFORCED POLYMER (FRP)

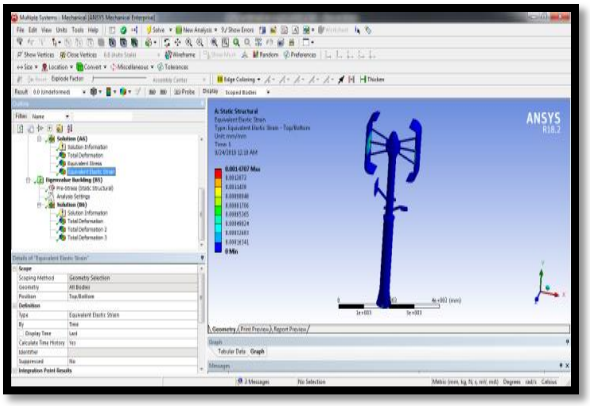
Deformation



Stress



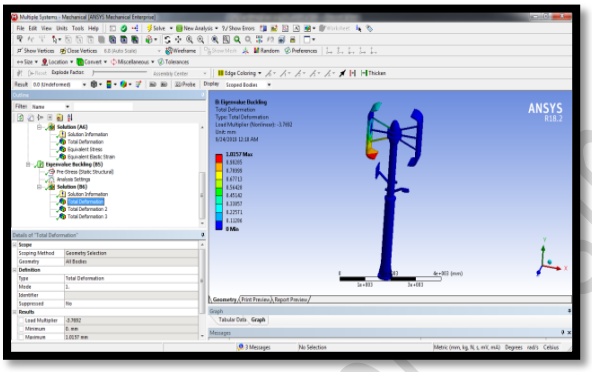
Strain



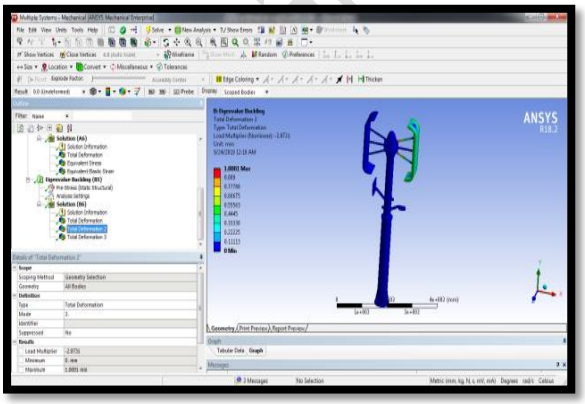
BULKING ANALYSIS OF ASSEMBLY OF STREET LIGHT POLE

MATERIAL- FIBER REINFORCED POLYMER (FRP)

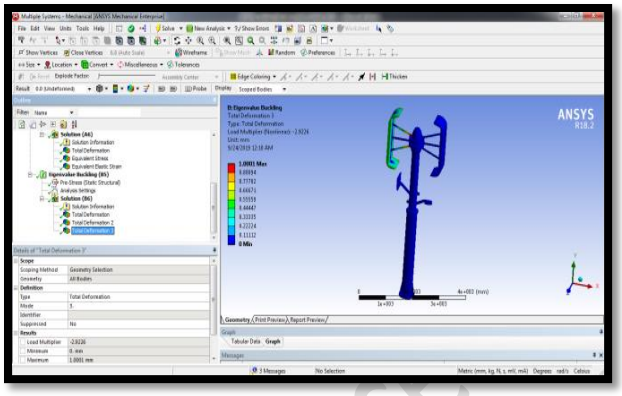
Mode shape-1



Mode shape-2



Mode shape-3



STATIC ANALYSIS

Material	Deformation (mm)	Stress(MPa)	Strain
ASTM A572 GRADE 50	151.01	364.12	0.0018986
CAST IRON	3.947	16.333	0.00015642
S2 GLASS	4.67	16.235	18.569
FIBER REINFORCED POLYMER (FRP)	108.4	72.569	0.0014707

BULKING ANALYSIS

Material	Mode shapes	Deformation(mm)	Bulking load multiplier
ASTM A573 GRADE 50	1	1.0218	3.0843
	2	1.0001	2.1014
	3	1	2.0623
Cast iron	1	1.0113	74.617
	2	1.0028	61.513
	3	1.0043	58.927
S2-glass	1	1.3303	0.0002264

	2	1.1222	0.0000634
	3	0.99151	0.00001448
FRP	1	1.0157	3.7692
	2	1.0001	2.9731
	3	1.0001	2.9226

CONCLUSION

In this project, it focuses on designing a tower for India, the southern Ghats of Andhra Pradesh State, which is one of the potential sources of wind energy. It begins with understanding of the physics involved, in their function. The maximum stress, Deformation Stain Static Analysis of pole, Bulking Analysis of pole, Static Analysis of Assembly of street light pole, Bulking Analysis of Assembly of Street light pole using the Finite Element Analysis (FEA). Processing is done using ANSYS WorkbenchV18.2. Also various checks have been performed to validate the results.

In this thesis the street light pole with different shapes (I-section, C-section and Circular) designed in CATIA software and analyzed in ANSYS software with different materials (cast iron, fiber reinforced polymer (FRP), s2 glass and ASTM a572 grade 50).

Static analysis to determine the deformation, stress and strain sat different materials.

Buckling analysis to determine the deformation with respect to load multiplier.

Finding which is the better cross section of the pole, and the pole is assembling with wind and solar panel.

By observing the static analysis results the circular section pole has less stress and less load multiplier.

So it can be concluded the circular type street light pole is the better model. Taken the circular type pole in street light assembly, in that used wind energy, solar energy.

Finally we concluded the FIBER REINFORCED POLYMER (FRP) materials has less stress compare with other used materials.

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