MODELING AND STRESS ANALYSIS OF COMPOSITE MATERIAL FOR SPUR GEAR UNDER STATIC LOADING CONDITION

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Abstract - Spur equipment is the only & widely used in electricity transmission gadget. A spur Gear is typically subjected to bending pressure which causes tooth failure. However it's miles found that overall performance of the spur equipment isn't nice in positive packages and therefore it's miles required to discover some exchange materials to enhance the performance of the spur gears. Composite materials offer good enough electricity with weight reduction and they're rising as a higher alternative for replacing metal gears. The undertaking is directed closer to the modeling of Spur equipment in a 3d cad tool referred to as solid works. The spur tools is analysed using 6 substances together with Stainless steel, malleable cast iron, 6061 alloy, S-glass epoxy fabric, CFRP & E-glass epoxy material. The Solid works simulation device is used for analysis. From the consequences the von misses pressure triggered for S-Glass Epoxy cloth as compared to all the cloth with the cost of three.105Mpa.The resultant displacement is likewise low for malleable cast iron material in comparison to all materials with fee of zero.000675mm.The S-glass Epoxy cloth stress caused is much less in comparison to all materials. So it's far the best material for the Spur equipment.

Key Words: solid works simulation, composites metrical, CFRP Spur gear.

INTRODUCTION TO POWER TRANSMISSION

Mechanical power can be transmitted across large distances in a variety of ways. Shafts transfer motion from point to point along their axis of motion. Shafts can be connected to each other by the following ways

- Gear Drive
- Chain Drive
- Belt Drive

Gear Drive

Gear drive is a mechanism consisting of toothed wheels that engage and transmit rotary motion, usually transforming angular velocity and torques. Gear drives are the most practical and wide spread type of mechanical transmission. They are used to transmit power— from negligibly small values to tens of thousands of kilowatts-and to transmit circumferential forces of fractions of a gram to 10 meganewtons (1,000 tonsforce). The main advantages of gear drives are their significantly smaller dimensions, high efficiency (losses in precision-made, well-lubricated drives are 1-2 percent, and, under especially favorable conditions, 0.5 percent), longer life and greater dependability, lack of slippage, and small shaft loads. The disadvantages of gear drives include noisy operation and the need for precision manufacture.

LITERATURE REVIEW

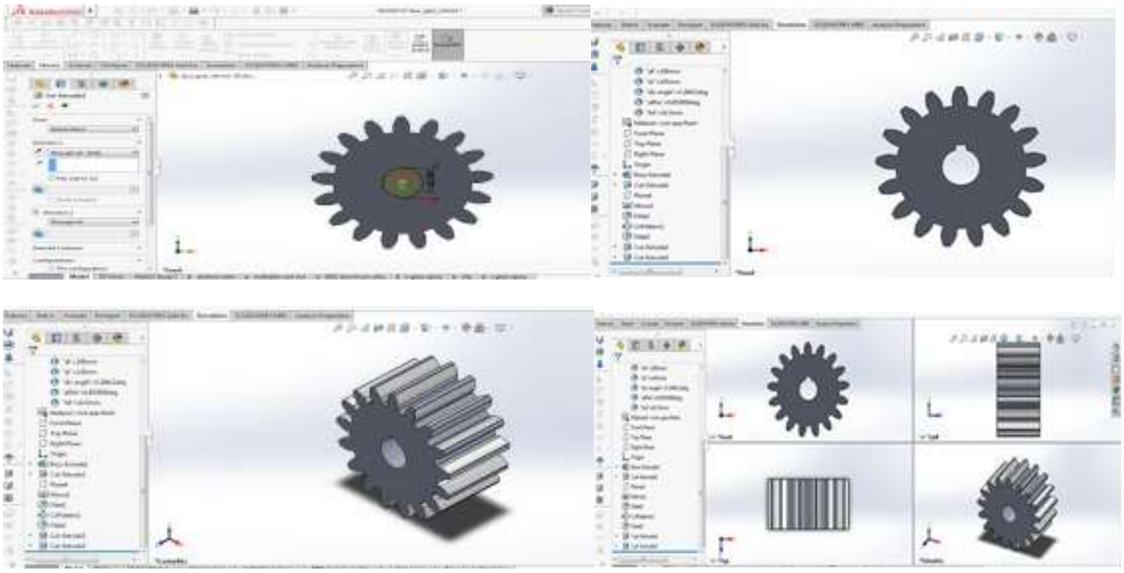
Gear evaluation is one of the most vast troubles within the device elements idea mainly in the discipline of gear layout and tools production. Many of the researchers have proposed several ideas for tools layout optimization to enhance the overall performance of gear structures. S. Jyothirmai, et.Al., [1] mentioned “A Finite Element Approach to Bending, Contact and Fatigue Stress Distribution in Helical Gear Systems” objective of paper is comparative observe on helical equipment design and its overall performance primarily based on diverse overall performance metrics via the finite detail analysis and Theoretical evaluation by AGMA preferred. Than after FEA & theoretical results as compared to every different. J. Venkatesh, et.Al., [2] mentioned “Design and Structural Analysis of High Speed Helical Gear Using Ansys” additionally commenced the techniques that used to calculating the Bending and Contact stresses of involute helical gear pair.

And model is generated a then helical tools pair to find out their ANSYS and AGMA calculation and consequences are examine to every different. A. Sathyanarayana Achari, et.Al., [3] “A Comparison of Bending Stress and Contact Stress of a Helical Gear as Calculated by AGMA Standards and FEA” To estimate the bending strain on the enamel root Lewis beam energy technique turned into used. NX CAD 8.5 modeling software bundle is used to create the 3-D solid [4]version of helical equipment pairs. NX Nastran 8.5 software program package is used to analyze the tools teeth root bending stress. Contact stresses are calculated by way of AGMA requirements. NX Nastran eight. Five software program package is used to analyze the surface contact pressure. Ultimately, these two methods, [5]enamel root bending stress and speak to stress consequences are compared with each other. Juha hedlund, et.Al.

3. MODELING OF SPUR GEAR

Spur gear technical data

Description	Symbol	Values
Number of teeth	Z	17
Pressure angle	α	20 deg.
Module	m	10mm
Pitch circlediameter	d	170mm
Face width	b	100mm
Addendum circle dia.	da	190mm
Dedendum circle dia.	df	145mm



PERFORMING STATIC ANALYSIS ON GEAR USING STAINLESS STEEL

The structural stress analysis of the gear tooth model is carry out using the FEA in

Solid works simulation .The load applied at the tooth of the gear by applying the analysis over the tooth which is facing the load we get the stress distribution in the numeric as well as in the form of the color scheme.

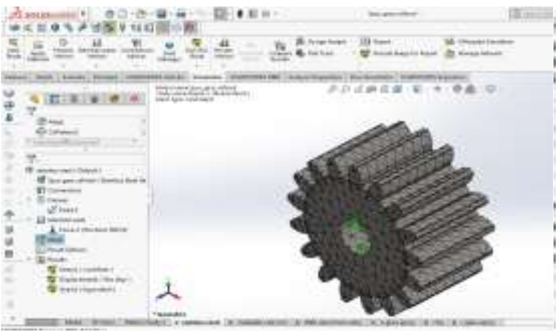


Fig.4 Figure: Meshing of Gear

Fig: 5 Running the simulation

RESULTS:

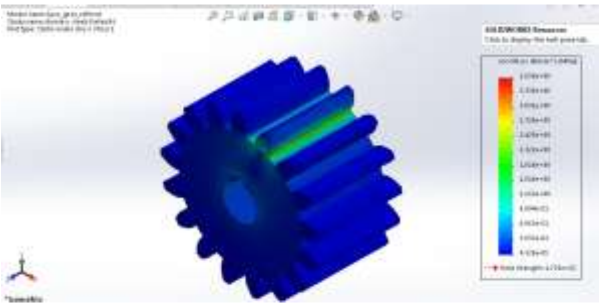


Figure: 6 Stresses induced in the gear

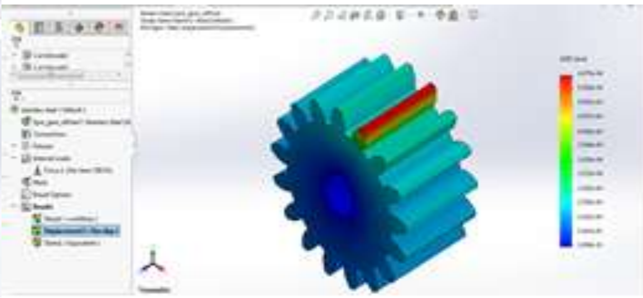


Figure: 7 Resultant displacement

PERFORMING STATIC ANALYSIS ON GEAR USING MALLEABLE CAST IRON

By performing same initial and boundary conditions just by changing the material to Malleable cast iron.

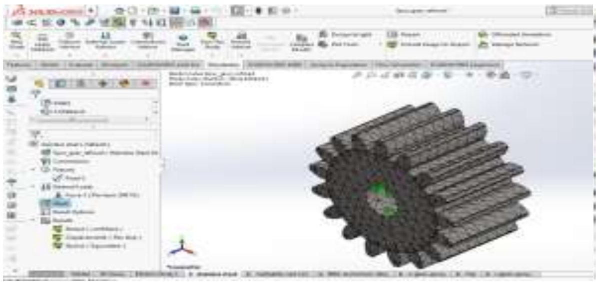


Figure: 11 Meshing of Gear

Fig: 12 running the simulation

RESULTS

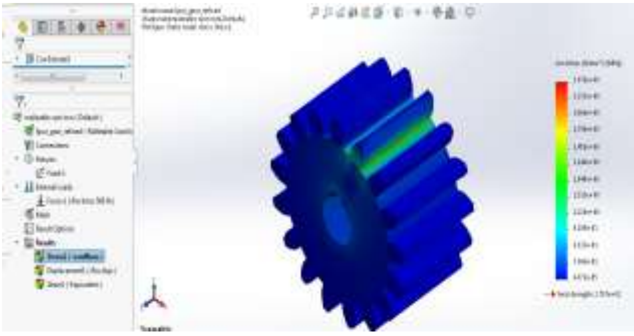


Figure: 13 Stresses induced in the gear

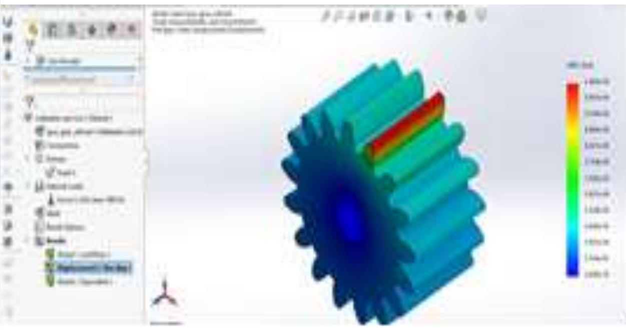


Figure: 14 Resultant displacement

PERFORMING STATIC ANALYSIS ON GEAR USING 6061 ALLOY

By performing same initial and boundary conditions just by changing the material to 6061 Aluminum alloy

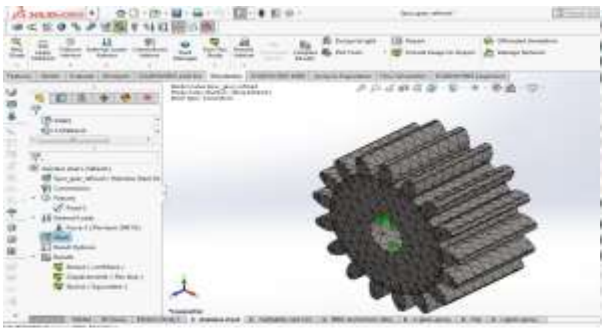
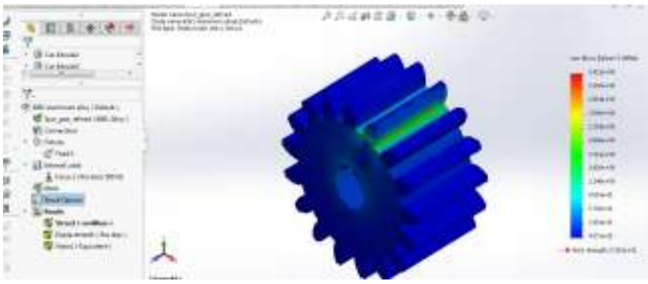


Figure: 18 Meshing of Gear

Fig: 19 running the simulation

RESULTS:



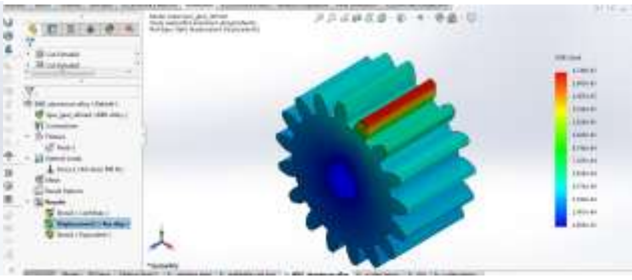


Figure: 20 stresses induced in the gear Figure: 21 Resultant displacement

PERFORMING STATIC ANALYSIS ON GEAR USING E-GLASS EPOXY COMPOSITE MATERIAL

By performing same initial and boundary conditions just by changing the material to E-glass Epoxy material

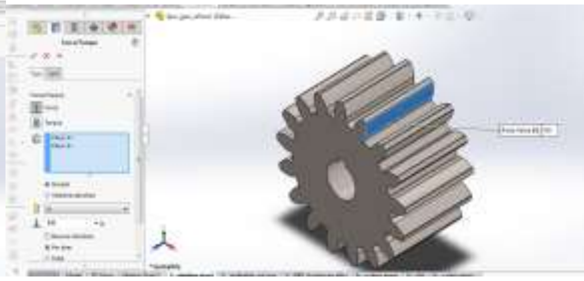


Fig: 23 Fixing the Geometry Fig: 24 applying boundary condition load as 500N

PERFORMING STATIC ANALYSIS ON GEAR USING CFRP COMPOSITE MATERIAL

By performing same initial and boundary conditions just by changing the material to CFRP material

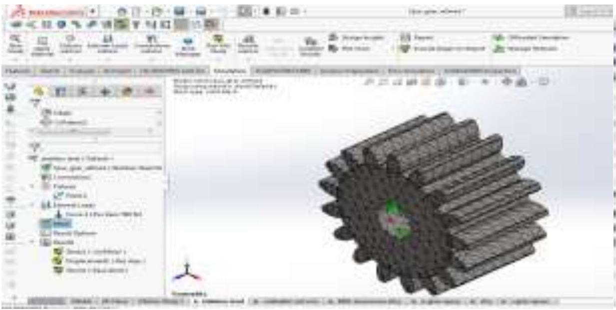


Figure: .29 Meshing of Gear Fig: 5.30 running the simulation

ERFORMING STATIC ANALYSIS ON GEAR USING S-GLASS EPOXY COMPOSITE MATERIAL

By performing same initial and boundary conditions just by changing the material to S-glass epoxy material

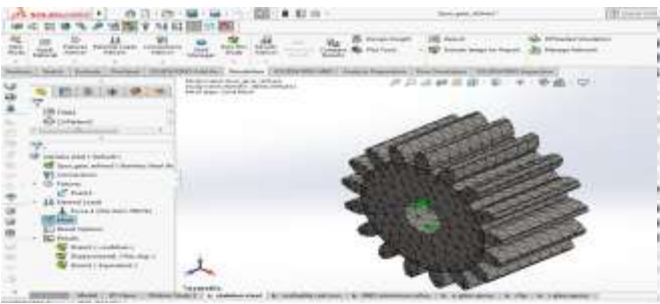


Figure: 33 Meshing of Gear Fig: 34 running the simulation

RESULTS AND DISCUSSIONS

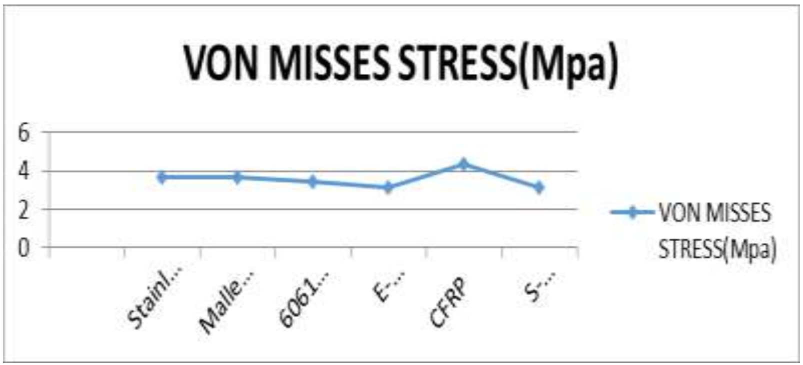
The structural stress analysis of the helical gear tooth model is carry out using the FEA in Solid works simulation. The load applied at the tooth of the helical gear .by applying the analysis over the tooth which is facing the load we get the stress distribution in the numeric as well as in the form of the color scheme.

S.No.	Material Name	VON MISSES STRESS(Mpa)	RESULTANT DISPLACEMENT(mm)
1	Stainless steel	3.638	0.000675
2	Malleable cast iron	3.679	0.000641
3	6061 Aluminum alloy	3.421	0.00179
4	E-glass Epoxy	3.146	0.00148
5	CFRP	4.344	0.00172
6	S-glass Epoxy	3.105	0.00133

Table: 5.1 Comparison of the Results

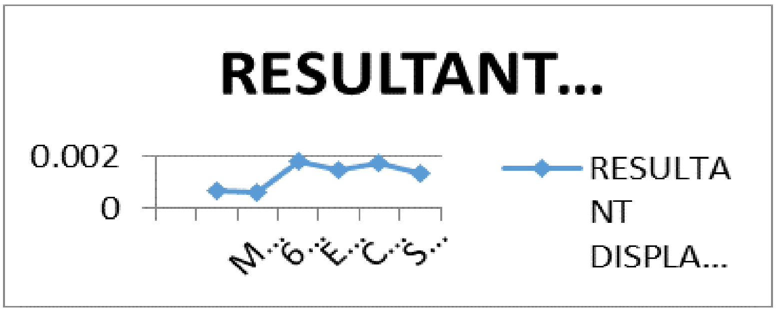
From the above results the von misses stress induced for S-Glass Epoxy material compared to all the material with the value of 3.105Mpa.

The resultant displacement is also low for malleable cast iron material compared to all materials with value of 0.000675mm.The S-glass Epoxy material stress induced is less compared to all materials.so it is the best material for the Spur gear.



Graph: 5.1 von misses stress induced in gear comparison

From the above results the von misses stress induced for S-Glass Epoxy material compared to all the material with the value of 3.105Mpa.



Graph: 5.2 Resultant displacement of gear comparison

The resultant displacement is also low for Malleable cast iron material compared to all materials with value of 0.000675mm.

CONCLUSION

Spur equipment is the best & broadly utilized in strength transmission machine. A spur Gear is usually subjected to bending stress which reasons teeth failure. However it's miles located that performance of the spur gear isn't great in positive applications and therefore it is required to explore some trade materials to enhance the performance of the spur gears. Composite materials provide adequate electricity with weight reduction and they're emerging as a higher alternative for changing metallic gears. In theory of Gear, we're thinking about that the weight is acting at one point and the strain is calculated. The calculation of most stresses in a tools at tooth root is three dimensional troubles. The correct evaluation of stress country is complex project. The contribution of this thesis work may be summarized as follows: The energy of tools teeth is a crucial parameter to prevent failure. In this work, it is shown that the effective method to estimate the foundation bending stress using 3 dimensional model of a equipment and to verify the accuracy of this technique the results with specific substances. From the effects the von misses strain brought on for S-Glass Epoxy material in comparison to all of the fabric with the price of three.105Mpa. The resultant displacement is also low for malleable forged iron material as compared to all substances with price of 0.000675mm. The S-glass Epoxy cloth strain caused is much less in comparison to all substances. So it is the exceptional fabric for the Spur gear.

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