Reverse Engineering And Design Optimization of Radiator Fan Ford Ikon

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Abstract- *Computer aided design programming bundle and FEM is in effect logically used in demonstrating of different building item and breaking down their auxiliary conduct. It ends up basic for an item to be tried all through its creating strategy underneath indistinguishable physical conditions (Loads, Vibrations and Thermal varieties) it experiences all through its genuine working to sidestep the possibility of disappointment. FEM and its partner CAE programming bundle foresee the aftereffects of the effect of working conditions on a designing item. In our blessing study, figuring out of a vehicle radiator fan is done. The auxiliary 3D model of the radiator fan is prepared in CAD programming bundle Pro-E with the privilege real measurements and parameters. The model was then remote into FEM instrument ANSYS then the basic investigation were performed by task indistinguishable material the radiator fan is framed of. The limit conditions all through the investigation were solid concurring the specific condition the theme goes all through its sensible ethicalness.*

The consequences of the examination zone unit given amid this paper for the point of correlation all through the enhancement of the arranging. When the figuring out strategy, an undertaking to streamline the arranging of the radiator fan is done. The generally Mass and consequently the effect of connected inconveniences at the model all through the investigation were taken into the worries of the enhancement. The technique for development all through our work comprised of the adjustment inside the parameters of the model like center distance across and ribs severally and in the meantime with the change inside the materials. The basic examination was performed for each material severally. The different outcomes for each material and parameter change from the basic investigation were then contrasted and each other. All through the similar investigation of the yield, the examination result that demonstrated the lesser effect of the connected outer inconveniences was pondered on the grounds that the last upgraded style of the radiator fan.

Keywords- Reverse engineering, Finite Element Methods, Structural Analysis, and Design Optimization.

I. INTRODUCTION

Encompassing conditions assume a powerful job in the support of productivity of a working framework. The encompassing or condition states of a framework must be good for a framework to work dynamically. The vehicle motor proficiency is very subject to its cooling framework as it needs moment cooling to maintain a strategic distance from the danger of overheating. The cooling framework which is a go between of motor and air must be much productive with the goal that it can keep up the cooling of vehicle motor. The radiator and radiator fan are two noteworthy parts of the cooling framework. Warmth created by a running motor is disseminated by the radiator and radiator fan which trade warm from the motor. The radiator includes circuit of cylinders and blades which are in open access of air. The coolant travel through these cylinders and blades trade warm from the coolant by means of cylinders with the air. The turning radiator fan pushes or pulls the cool air over the radiator concerning its situation at front or back of the radiator. Radiator fans have four to six sharp edges. These edges might be darted to the center point of the radiator fan or appended to it as one piece. The air constrained in by fan when interacts with the radiator blades trades the warmth and is then drawn out.

II. BACKGROUND

The historical backdrop of fan returns to a large number of years back. The soonest fans were called screen fans and were utilized to avert the creepy crawlies and to deliver breeze by hand. Endeavors began in center of seventeenth century to structure the mechanical fan. In late 1800s, belt driven fans fueled by manufacturing plant waterwheels were presented. A functional fan was worked by A.A. Sablukov in 1932. Amid 1832-1834, outward fans

Were tried inside coal mines and production lines. Individual electrical fan was presented in mid 1900s for open by Thomas Edison and Nikola Tesla. In 1920, modern advances raised the large scale manufacturing of steel in this way cutting the fan costs down and more property holders

could bear the cost of fans. Karl Benz in 1885 imagined and licensed first radiator. Wilhelm Maybach planned the primary honeycomb radiator in 1901 and introduced it to the Mercedes 35 Hp demonstrate. The primary radiator fan was licensed by P. L. Silick.

III. MATERIAL UTILIZED IN RADIATOR FANS

A designing material is the prime factor influencing the life of an item working in extraordinary conditions. The material of a designing item ought to be as much appropriate as per the earth conditions, financial perspective and above all the inconveniences connected to the item. For the radiator fan, various materials are utilized which are compounds and plastics. The plastics and compounds are adaptable and have great elasticity. Other than these materials utilized are lighter in weight which is one sort of favorable position. These materials are Aluminum amalgams, Steel combinations, Plastics like Polypropylene, Nylon 6 cast, Acrylonitrile Butadiene Styrene and so on.

IV. WRITING REVIEW

Dwivedi et al. [1] manages hub stream fans that are essentially utilized for cooling towers for cooling Skewed sharp edge profile did utilizing CFD programming FLUENT 6.3 and the outcomes are contrasted and the test results from writing. The CFD examination is finished by demonstrating the hub fan in GAMBIT 2.2 and utilizing Standard k-є show with the Standard divider work for displaying choppiness. The investigation is done with edge stun edge of 25o, Skewed point of 8.3o and at 1440 rpm and 1800 rpm. Jain et al. [2] utilized a hub stream fan expands the exchange of warmth from the motor mounted on the APT T4. CFD examination was performed for a region weighted normal static weight contrast at the bay and outlet of the fan. Ambdekar et al. [4] saw that motor cooling fans are a basic segment of the motor cooling framework which is utilized to disperse the overabundance warm produced by the ignition of energizes inside the motor. Bala Subramanian et al. [5] displayed the static examination of the radiator fan and at the result we dissect the disappointment of the whole sharp edge taking into plan thought. The investigation of the radiator fan is executed to various sorts of materials to check and assess the material and process conditions which withstand the dynamic and basic burdens. In the paper structure of the edge is done through figuring out. Udawant et al. [9] built up an approach for structure and advancement of radiator cooling fan with a target to enhance under hood warm administration. For this reason an Axial Fan Design Software has been created which depends on Arbitrary Vortex Flow hypothesis. A Rapid Prototype test of the upgraded fan configuration is produced and tried in a fan test fix made according to AMCA 210-99 standard to assess the fan execution bend and the power utilization.

V. PROBLEM FORMULATION

Amid the figuring out procedure of an item, the earth conditions and different variables which in real influence the item are again considered and the logical investigation of these components is run in order to limit the effect of these elements. The figuring out process primarily expects to locate the better outcomes and answers for evacuate the downsides of a building item.

In this paper, we will do the figuring out of the radiator fan. For this, the model will be made in CAD programming PRO-E and the auxiliary examination will be performed on it in CAE device ANSYS with the help of FEM procedure. The investigation will be performed under the contemplated limit and load conditions in which the fan really works. At that point the materials and geometric parameters will be modified with the end goal to get the mass decrease with least effect of the heaps on radiator fan. The basic examination results will be contrasted with get the last advanced structure.

VI. GOAL OF THE INVESTIGATION

The primary destinations of the examination are:

i. Reverse designing of the radiator fan in CAD programming PRO-E and basic examination at proposed stack in ANSYS programming

ii. To distinguish the touchy parameters of the radiator fan and concentrate the consequences for stress and distortion with their dimensional varieties.

iii. To break down the outcomes by changing parameters and contrasting the base pressure, distortion and most extreme mass decrease for separate materials.

iv. To optimize the design of radiator fan with minimum mass.

VII. CAD MODELING

In our present work, for the figuring out of the radiator fan, we arranged the radiator fan display in Pro-E. The means of demonstrating are given underneath:

i. The portray of the center point with width 90 mm was first attracted front plane with suitable

measurements which is appeared in the figure beneath and after that it was changed over into a round strong with the Revolve Command.

ii. The crude strong center was then emptied with the shell direction giving the thickness of 3.5 mm to the dividers of center point.

iii. An expelled divider inside the center point with the round at the internal end as was available in the physical model was then presented with explicit measurement and thickness.

iv. To give the quality and internal help to oppose twisting in the center of the fan, there were 12 ribs in the center point of the model, consequently we previously made portray of the rib and after that with the example direction, made ribs.

v. The sharp edge profile bends were then outlined embeddings datum planes and gave the surface with Boundary Blend order. The external range of the fan was 153 mm.

vi. With the help of Thicken order, the mixed surface was given the thickness of 2mm. The thickness was uniform about the surface i.e. the bended lie in mid of the strong sharp edge profile.

vii. After giving the round around the edges of the cutting edge profile, another edge was replicated at 75 degrees of the previous sharp edge with the example order. With the presence of second cutting edge, the two sharp edges are then replicated at the contrary agree with the example of 2 with the edge of 360 degrees.

viii. The last model is appeared beneath in the figure in its standard introduction.

Show Description:

Measurement of center point = 90 mm

Cleared range including center point = 153 mm

Number of cutting edges = 4

Thickness of center point = 3.5

Number of ribs = 12

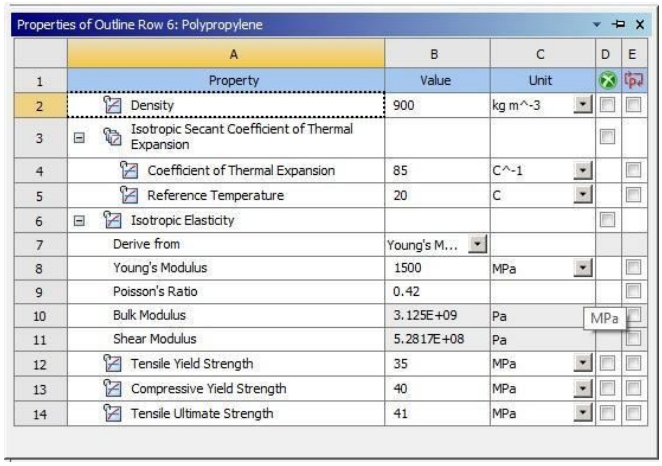
VIII. STRUCTURE ANALYSIS

In the wake of displaying the radiator fan in Pro-E, we imported the model into the CAE programming ANSYS 14.5 and played out the structure examination. The entire procedure is clarified well ordered as underneath:

1. ANSYS workbench was begun and STATIC STRUCTURAL was picked. Above all else, materials were chosen and included by clicking designing information and six materials were chosen and their individual mechanical properties were then included. The genuine material of the model was Polypropylene, however another five materials were likewise decided for the logical way to deal with enhance the plan.
2. After picking materials, we chose the Geometry alternative by which we imported the concerned model in the Design particular.
3. After bringing in the body the work was produced as it is the essential task for examination through Finite Element Methods.
4. After cross section the limit and stacking conditions were connected on the fan. As the fan is kept settled around its pivoting hub and the speed gave was of 250 rad/s.

   The power connected at the back essences of the fan sharp edges was proposed to be higher than the power connected by streaming air. The power here was viewed as 100 N and its heading was kept along the pivot hub of the fan.
5. We characterized the yield parameters for our concerned outcomes; consequently we chose proportional pressure (von-mises), add up to misshapening and shear pressure.
6. We at that point ran the examination and result for every material was determined individually. Particularly, mass was contemplated. The outcomes for Polypropylene are given beneath: Equivalent Stress = 29.143 MPa
7. Total Deformation = 28.332 mm

Shear Stress = 7.6386 MPa
Mass of fan = 0.12178 Kg


Properties of Outline Row 6: Polypropylene

	A	B	C	D	E
1	Property	Value	Unit		
2	Density	900	kg m^-3		
3	Isotropic Secant Coefficient of Thermal Expansion				
4	Coefficient of Thermal Expansion	85	C^-1		
5	Reference Temperature	20	C		
6	Isotropic Elasticity				
7	Derive from	Young's M...			
8	Young's Modulus	1500	MPa		
9	Poisson's Ratio	0.42			
10	Bulk Modulus	3.125E+09	Pa		
11	Shear Modulus	5.2817E+08	Pa		
12	Tensile Yield Strength	35	MPa		
13	Compressive Yield Strength	40	MPa		
14	Tensile Ultimate Strength	41	MPa		

The ultimate tensile strength of Polypropylene as given is 41 MPa. The stress outcome was 29.14 MPa. Thus the radiator fan was safe.

IX. RESULT AND DISCUSSION

In the wake of examining the outcomes at existing edges, the accompanying edges which would add to the heaviness of the radiator fan were changed and the structure investigation was then raced to locate the coveted result:

1. Thickness of the divider; from 3.5 to 2mm
2. Number of ribs; from 12 to 8, as they bolster the center point and furthermore the sharp edge center joint by including quality from inside
3. Diameter of the center: changed inside the scope of 90 mm to 75mm.
4. Inner supporting divider Diameter; from 60mm to 54 for 75 mm of center point width as it were
5. Height of internal divider; lessened esteem = 5mm

The identical pressure, add up to distortion, shear pressure and mass was determined for the accompanying measurements of center point of radiator fan.In the wake of examining the outcomes at existing edges, the accompanying edges which would add to the heaviness of the radiator fan were changed and the structure investigation was then raced to locate the coveted result:

1. Thickness of the divider; from 3.5 to 2mm
2. Number of ribs; from 12 to 8, as they bolster the center point and furthermore the sharp edge center joint by including quality from inside
3. Diameter of the center: changed inside the scope of 90 mm to 75mm.
4. Inner supporting divider Diameter; from 60mm to 54 for 75 mm of center point width as it were
5. Height of internal divider; lessened esteem = 5mm
6. The identical pressure, add up to distortion, shear pressure and mass was determined for the accompanying measurements of center point of radiator fan.

TABLE 1. SELECTED PARAMETERS

Diameter of hub	Thickness of Hub	Number of Ribs
90mm	3.5mm	12
85mm	2mm	8
83mm	2mm	8
80mm	2mm	8
75mm	2mm	8

TABLE 2. STRUCTURAL STATUS IN COMPARISON WITH MAX. EQUIVALENT STRESS

S. N.	Material	Ultimate tensile strength (MPa)	Max. Equivalent stress (Mpa)				
			90 mm	85 mm	83 mm	80 mm	75 mm
1	ABS	40	29.884	53.117	55.23	45.442	33.451
2	Aluminum alloy	310	42.737	90.617	96.329	95.051	56.286
3	Nylon 60 cast	75	28.211	55.783	57.42	57.895	34.328
4	Polypropylene	41	29.143	50.784	51.284	52.404	30.556
5	PVC	52	30.142	62.307	64.425	64.928	37.951
6	PVDF	124	33.554	69.331	73.07	61.425	43.285

TABLE 3. STRUCTURAL STATUS IN COMPARISON WITH MASS (IN KG)

S. N.	Material	Mass (Kg.)				
		90 mm	85 mm	83 mm	80 mm	75 mm
1	ABS	0.13801	0.10406	0.10365	0.10394	0.10152
2	Aluminium alloy	0.3748	0.2826	0.28149	0.28226	0.2757
3	Nylon 60 cast	0.15425	0.1163	0.11585	0.11616	0.1137
4	Polypropylene	0.12178	0.0918	0.0091458	0.00917	0.00896
5	PVC	0.19619	0.14793	0.14735	0.14775	0.14432
6	PVDF	0.24084	0.1816	0.18088	0.18138	0.17717

From this study, it can be resulted that maximum weight reduction occurs at the diameter of 75mm where all the models of respective materials are safe too. The total mass reduction was noted approximately 26 percent. , the results for

structural analysis for Polypropylene radiator fan as performed in ANSYS are given below:

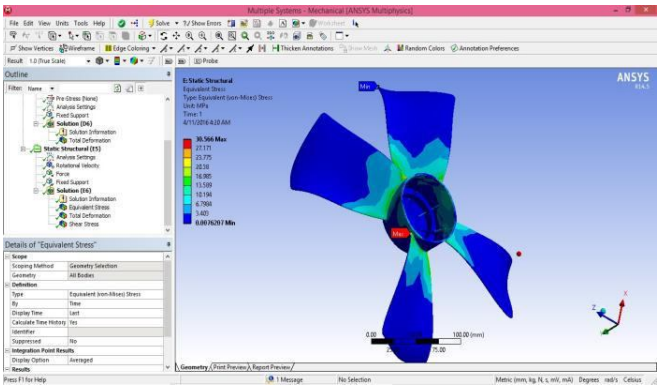


Fig: 1 Polypropylene radiator fan

The maximum equivalent stress in the structure of radiator fan with 75 mm diameter is 30.556 MPa.

The total deformation comes out to be 21.679 mm. The shear stress was found to be 8.2646 MPa.

Since the Ultimate Tensile Strength of Polypropylene is 41MPa, thus the radiator fan is safe from any structural failure at 100 N.

The mass of Polypropylene model reduces from 0.12178 Kg to 0.089579 Kg as calculated during analysis. This is our final optimized design of the radiator fan.

X. CONCLUSION

Amid the structure examination of figured out radiator fan, the conduct of pressure and twisting was assessed for increment and lessening in mass for a similar material or other. It very well may be closed from the above diagrams and unthinkable information gave that the expansion in mass, the worry in the structure likewise increments.

Further it tends to be instructed that expelling concerning material from a territory bearing no effect can be utilized for streamlining of the model as in this paper, if there should be an occurrence of center point measurement, is finished. The decline in measurement and thickness of center brought about the mass decrease of the fan, which is a proficient endeavor in the best approach to enhance a structure

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