International Journal of Advance Research in Science and Engineering
Vol. No.4, Issue 07, July 2015
www.ijarse.com
IJARSE
ISSN 2319 - 8354

DESIGN AND ANALYSIS OF FEEDERSHAFT/OPENER SHAFT FOR GINNING MACHINE

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ABSTRACT

This paper deals with the design and analysis of feeder shaft using ANSYS. Substitution of composite material over the conventional materialsfor feeder shaft has increases the advantages of design due to its high specific stiffness and strength. Feeder shaft is the main component of feeding mechanism for ginning machine. Use of conventional materials for manufacturing of feeder shaft has many disadvantages such as low specific stiffness and strength. Feeder shaft increases the weight of drive shaft which is not desirable in today's market. Many methods are available at present for the design analysis of structural systems and these methods based on mathematical programming techniques involving gradient search and direct search. These methods assume that the design variables are continuous. But in practical structural engineering, almost all the design variables are discrete. This is due to the availability of components in standard sizes and constraints due to construction and manufacturing practices. This paper present the work done on feeder shafts using ANSYS.

Keywords: ANSYS, Composite Material, Feeder Shaft.

I. INTRODUCTION.

Rapid technological advances in engineering design field result in finding the alternate solution for the conventional materials. The design engineers brought to a point to finding the materials which are more reliable than conventional materials. Researchers and designers are constantly looking for the solutions to provide stronger and durable materials which will answer the needs of fellow engineers. There is a heavy requirement for lightweight materials. Composite materials are favored by most of the scientist in the design of machines due to its higher specific strength and stiffness. The advanced composite materials such as graphite, carbon, Kevlar and glass with suitable resins are widely used because of their high specific strength (strength / density) and high specific modulus (modulus / density). In metallic shaft design, knowing the torque and the allowable service shear stress for the material allows the size of the shaft's cross-section to be determined.

Conventional feeder shafts are manufacture to increase its fundamental natural bending frequency. The composite drive shaft has advantages like considerable weight reduction, symmetric composite assured the

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ISSN 2319 - 8354

dynamic balance of increasing operating speed, electrically nonconductive, custom end fitting considerations, vibrations and harshness (NVH), long fatigue life and also it reduce the bearing & journal wear. The materials usually have a lower modulus of elasticity which results in when torque peaks are occurred the drive shaft may works as a shock absorber.

II. COTTON FEEDER

The primary function of the feeder is to feed seed cotton uniformly to the gin stand at controllable rates. Seed cotton cleaning is a secondary function. Feed rollers, located at the top of the feeder and directly under the distributor hopper, control the feed rate of seed cotton to the gin stand.

2.1 Types of Feeding

1. Manual feeding
2. Automatic feeding

III. COMPOSITE MATERIAL

Composite consist of two or more material phase that are combine to produce a material that has superior properties to these of its individual constituent. Technologically the most important composite are those in which the dispersed phase is in the form of fibre. The composite materials can be classified on the basis of micro structures, multi phases, reinforcements, manner of packing of fibers layered compositions, method of compositions, matrix system, processing methods, etc. Composite materials can be classified as: 1) Polymer Matrix Composites. 2) Metal Matrix Composites. 3) Ceramic Composites

3.1 Conventional Material VS Epoxy

Table 1: Comparision of Conventional Material with Epoxy

Material properties	HS carbon/glass epoxy	Conventional material
Young's Modulus	210	110
Shear Modulus	70000	4296
Poisson's ratio	0.3	0.28
Density	1600	7200
Shear Strength	420	240

3.2 Advantages of Composite Materials Over Conventional Materials

1. High strength to weight ratio.
2. High stiffness to weight ratio.
3. High impact resistance.
4. Better fatigue resistance.
5. Improved corrosion resistance.
6. Good thermal conductivity.

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7. High damping capacity.

8. Low coefficient of thermal expansion.

IV. DESIGN GUIDELINES

1. The minimum number of teeth in a sprocket should be 17 unless the drive is operating at a very low speed, under 100 rpm.
2. The maximum speed ratio should be 7.0, although higher ratios are feasible. Two or more stages of reduction can be used to achieve higher ratios.
3. The center distance between the sprocket axes should be approximately 30 to 50pitches (30 to 50 times the pitch of the chain).

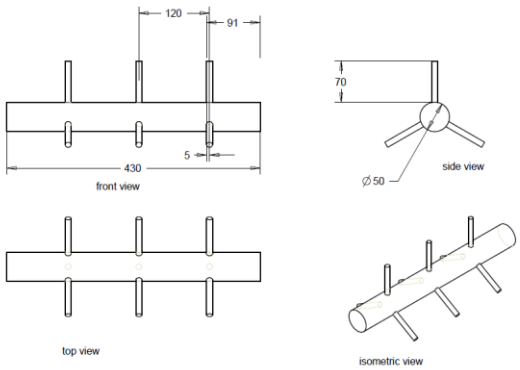

Fig. 1: Design Details of Feeder Shaft

V. ANALYSIS BY USING ANSYS 13.0 SOFTWARE

ANSYS is a general-purpose finite-element modelling package for numericallysolving a wide variety of mechanical problems. These problems include static/dynamic, structural analysis (both linear and nonlinear) problems. The ANSYS program has many finite-element analysis capabilities, ranging from a simple linear static analysis to a complex nonlinear transient dynamic analysis.

It is important to remember that ANSYS does not assume a system of units for intended analysis. Except in magnetic field analyses, any system of units can be used so long as it is ensured that units are consistent for all input data.Structural analysis is probably the most common application of the finite element method.Structural Analysis is a multi-discipline Computer Aided Engineering (CAE) tool thatanalyzes the physical behavior of a model to better understand and improve the mechanicalperformance of a design. It is used to directly calculate stresses, deflections, thus topredict the behavior of the design in the real world. Structural Analysis is available in theintegrated mode of Pro/E and analysis can be performed within the Pro/E environment.Pro/E Structural Analysis and Pro/E Thermal Analysis share a very similar approach.

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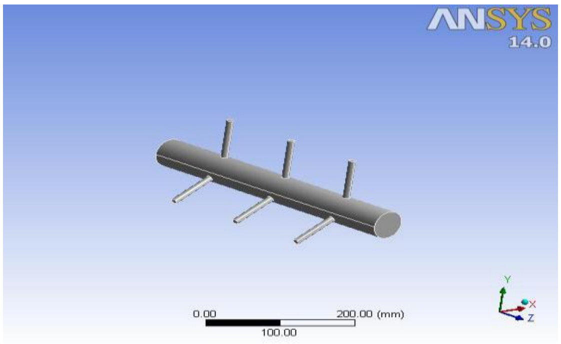
5.1 Analysis of Feeder Drive

5.1.1 Static Structural Analysis



Object Name	Fixed Support	Moment
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	2 Faces
Definition		
Type	Fixed Support	Moment
Suppressed	No	
Define By		Vector
Magnitude		1.5591e+006 N·mm (ramped)
Direction		Defined
Behavior		Deformable
Advanced		
Pinball Region		All

Fig. 2: Loading Conditions

Object Name	Total Deformation	Equivalent Elastic Strain	Equivalent Stress	Shear Stress
State	Solved			
Scope				
Scoping Method	Geometry Selection			
Geometry	All Bodies			
Definition				
Type	Total Deformation	Equivalent Elastic Strain	Equivalent (von-Mises) Stress	Shear Stress
By	Time			
Display Time	Last			
Calculate Time History	Yes			
Identifier				
Suppressed	No			
Orientation				XY Plane
Coordinate System				Global Coordinate System
Results				
Minimum	0. mm	1.8771e-011 mm/mm	1.6415e-006 MPa	-15.649 MPa
Maximum	1.1367 mm	1.0984e-003 mm/mm	120.39 MPa	12.059 MPa
Information				
Time	1. s			
Load Step	1			
Substep	1			
Iteration Number	1			
Integration Point Results				
Display Option		Averaged		

Fig.3: Results

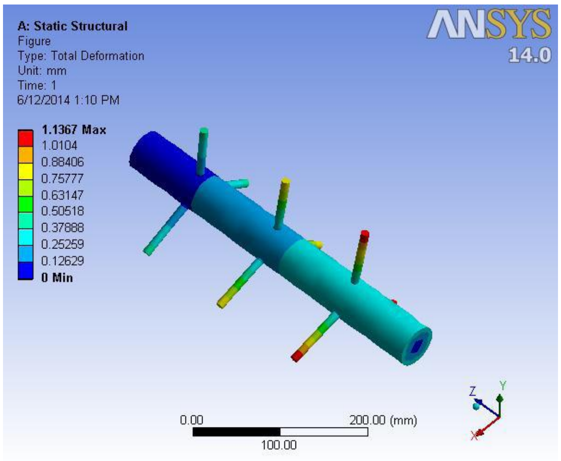


Fig. 4: Deformation

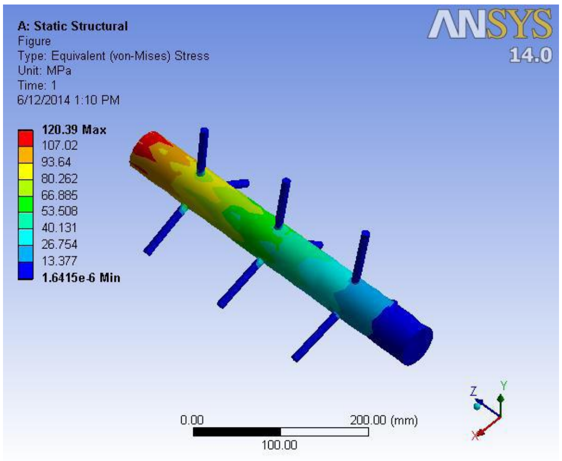


Fig. 5: Stresses

VI. CONCLUSION

Many methods are used for the design analysis that assumes all the design variables are continuous. But in actual structural analysis almost all the variables are discrete. At each generation, a new set of approximations is created by the process of selecting individuals according to their level of fitness in the problem domain.

The replacement of conventional drive shaft results in reduction in weight. The finite element analysis is used in this work to predict the deformation of shaft. The deflection of steel, HS Carbon / Epoxy and HM Carbon / Epoxy shafts was 0.00016618, 0.00032761 and 0.0003261 mm respectively.

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