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Modal Analysis of Spur Gear in Lathe Headstock for different Material

T Eswara Rao[1], Swadhin Kumar Patel[2], Abhishek Kumar Jha[3], R Subhendu Pradhan[4]
Assistant Professor[1], Student [2, 3, 4], Department of Mechanical Engineering, GIET, Gunupur, Odisha
*Email: eswar.thumula@gmail.com[1], swadhinsdn.skp@gmail.*com[2]

Abstract- For the power transmission gears are the most important component used in machines. Being very important it is very important these gears are designed properly and right material is used. There is a need for a better material so that it can sustain more forced frequency and so that we can get more fruitful results in shorter time.
In this paper frequency of a spur gear of lathe headstock is studied in order to analyze the dynamic parameter of the gear. We will suggest a better material for the spur gear over the conventionally used materials. We first modeled the spur gear in CATIA V5 and the natural frequency is calculated using Ansys. These are then analyzed and the suggestion for material is given according to that.

Index Terms- Spur Gear, Modal Analysis, frequency, CATIA V5, Ansys

1. INTRODUCTION

Spur gears are the most common and simplest of all the gear available. They have straight teeth and usually mounted on parallel shafts. Together they are used to have a large gear reduction.
Spur gear‘s teeth are designed in such a manner that they will mesh correctly if they get fitted to parallel axis and for making the leading edges parallel to the line of axis of rotation. It is the most efficient gear to provide a constant and positive speed drive. The general materials which are used to make the spur gears are steel, nylon, aluminum, bronze, cast iron Bakelite and now plastics also. The materials used here in the spur gear are one of the main criteria for designing. The material can decide the amount of vibration it can take or whether the input speed will cause resonance or not. These all depend on the natural frequencies it will generate and these are studied by Ansys.
The composite materials are preferred over the conventional materials used now because of their strength even at light weight. These materials are used in various engineering structures including airplanes, spacecraft, automobiles, boats bridges and buildings. It is widely used in the industry due to the good characteristics of its strength to density and hardness to density.

2. BACKGROUND

The conventional materials used for making the spur gear have the following problems

- They have poor weight to strength ratio.
- More prone to corrosion so proper shielding is required.
- More wear in between the gears so proper lubrication is required.
- Metal cost is increasing.
- Have poor weight to strength ratio that result in more power loss.

These things are need to be considered and therefore composite materials are used which provide the scope of solution over the current gear available.

3. MODELING OF THE SPUR GEAR

The modeling of spur gear is done using CATIA V5.The input parameters for the mdelling of the spur gear is as follows which is referred from M.Raju (2014) in which the headstock spur gear is used

Description	Symbol	Values
Number of teeth	N	22
Pressure angle(degree)	α	20
Module	m	3
Pitch circle dia(mm)	D	66
Face width(mm)	W	28
Input Speed(rpm)	Ni	140

Table 1. Geometry of spur gear

4. SOLID MODEL OF SPUR GEAR

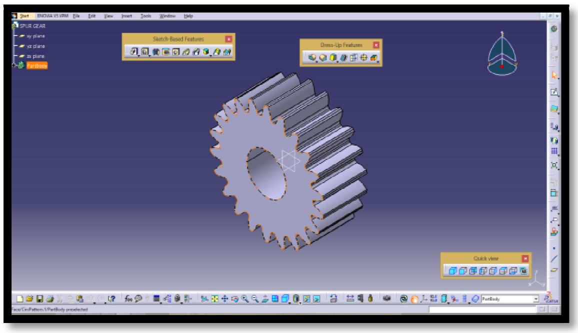

Fig 1. Spur Gear Design

5. FINITE ELEMENT ANALYSIS OF SPUR GEAR

Under the modal analysis the materials natural frequency is analyzed and from that we can compare those natural frequency with the forced frequency that we input to the gear. Here we have done the modal analysis on the spur gear having the three conventional materials and a composite material which are Structural Steel, Aluminium alloy and grey cast iron and San foam (81 kg/m^3) respectively. The resultant natural frequency at each nodes for these materials are follows:

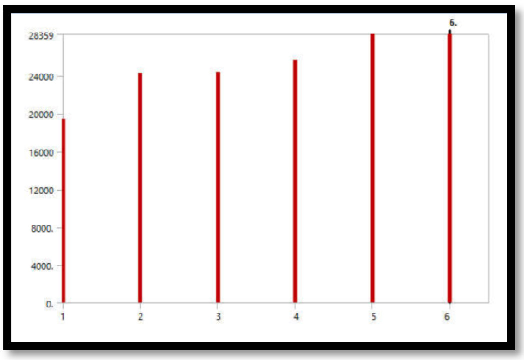

Fig 2. Mode frequency of structural steel

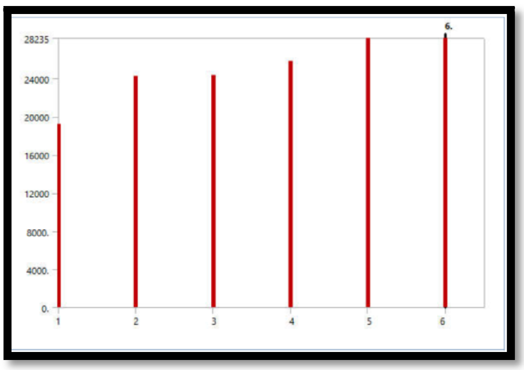

Fig 3. Mode frequency of aluminium alloy

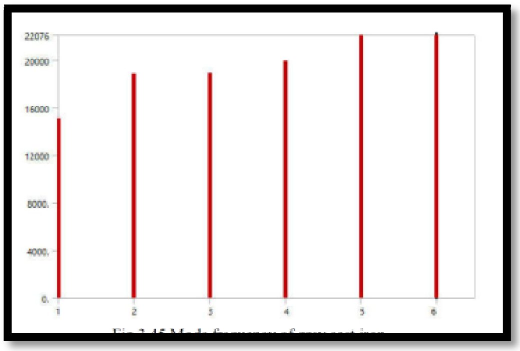

Fig 3. Mode frequency of grey cast iron

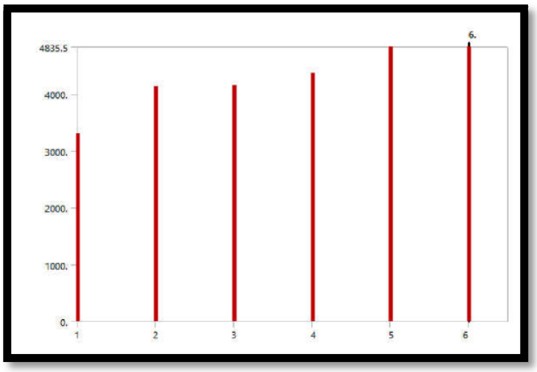

Fig 4. Mode frequency of San foam (81 kg/ m^3)

6. RESULT

From the above four figures the average of the mode natural frequency we got for them are as follows:

Material	Mode frequency(Hz)
Structural Steel	25066.17
Aluminium alloy	25018.33
Grey cast iron	19480.67
San foam	4274.15

Table 2. Mode frequency of the selected materials

Here the input speed is 140 rpm and therefore it is 2.33Hz forced frequency we are giving to the gear.

7. CONCLUSION

Hence the composite material San foam which we used here is much better than that of the conventional materials used as it more mechanically strong.

As the forced frequency is nowhere near to the natural there will be no chance of the resonance as inorder to do so the forced and the natural frequency should be same.

8. REFERENCES

[1] Roy, M. Raja; Kumar, S. Pani, Kiran, D.S. Sai Ravi (2014): Contact pressure analysis of spur gear using FEA. International Journal of Advanced Engineering Application, **7**(3), pp.27-41.

[2] Desai, Utkarsh M.;Patel, Dhawal A. (2015): Modeling and stress analyisis of composite material for spur gear under static loading condition. IJAPME, **1**(2), pp.(print) 2394-6202,pp.(online) 2394-6210.

[3] Snakpal, Abhijit Mahadev; Mirza, M.M. (2014): Contact stress analysis of spur gear by photoelastic technique and finite element analysis. IJTARME, **3**(2), pp. 2319-3189.

[4] Gurumani, Ramalingam; Shanmugam, Subramaniam. (2011): Modeling and contact analysis of crowned spur gear teeth. Engineering Mechanics, **18**(1), pp. 65-78.

[5] Potghan, Deepika; Sharma, Suman. (2015): Stress reduction by introducing stress relieving features of spur gear used in lathe headstock. IJESRT, **4**(8), pp. 2277-9655.

[6] Mahendran, S; Eazhil, K.M; Kumar, L.Senthil (2014): Design and analysis of ccomposite spur gear. IJRSI, **1**(6), pp. 2321-2705.

[7] Hasan, Shaik Gulam Abdul; Kumar, Ganoju Sravan; Fatima ,Syeda Saniya (2015): Finite element analysis and fatique analysis of spur gear under random loading. IJESRT, **4**(7), pp. 2277-9655.

[8] Pathan, Aniskhan; Prajapati, Pritesh; Patel, Vijay D. (2012): Using FEM method stress and strain state analysis of the spur gear pair. International journal of advanced engineering research and studies, **1**(2), pp. 44-47.

[9] Vigithra, R (2015): Design and analysis of nano composite spur gear. ARPN Journal of Enginering and Applied Science, **10**(11), pp. 1819-6608.