EXPERIMENTAL ANALYSIS OF VIBRATION CHARACTERISTICS OF VARIOUS BRANDED TWO WHEELERS

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ABSTRACT

The main aim of our project is to provide necessary solution to the adversities caused due to vibration and analyze the vibration produced in the vehicle at idle and running condition. The vibration analysis is done using vibrometer (VB8205) monitoring parameters such as vibration frequency, velocity, acceleration and displacement. The analysis is done in three different manufacturer two wheelers such as Yamaha FZ-S, Hero achiever, Bajaj pulsar. The three bikes tested are 150cc engine. The Yamaha FZ-S houses mono shock suspension in the rear and telescopic suspension in the front, The Hero achiever houses swing arm suspension in the rear and telescopic suspension in the front, The Bajaj pulsar houses nitrox shock absorber in the rear and telescopic suspension in the front. The analysis is done in two different condition of two wheeler they are idle condition and running condition. The running condition at about 40-60km/hr the readings are noted only for chassis and handlebar positions. The parameters are recorded in idle condition at positions of before suspension, after suspension, chassis, and handlebar. The readings are noted for the different parameters and the corresponding graph is plotted. The graphs are used to record the maximum, minimum and mean values of the corresponding measuring parameters. The graph for the various parameters at running condition are compare and analyzed. Finally the root cause for vibration is detected and necessary solution is provided.

Keyword – *Vibrometer, suspension, acceleration, velocity, displacement, frequency.*

1. INTRODUCTION

1.1 VIBRATION IN TWO WHEELERS

The two wheeler riders are subjected to extreme vibrations due to the vibrations of its engine, improper structural design of the two wheeler and bad road conditions. These vibrations are most hazardous to the health, if it exceeds the permissible limit and may cause the illness of the spine, musculoskeletal symptom in the lower back as well as the neck and upper limbs. Analytical studies on the transmission of vertical vibrations which are beyond the permissible limit according to the literatures confirm that, vibrations certainly affect the health of the two wheeler rider. Therefore it is necessary to evaluate the influence of vibration to the human body and to make up appropriate guidelines for the two wheeler design and selection parts. The intensity of these harmful vibrations is reduced by providing a standard type of seat, front and rear suspension. In this work, the coupled human body and two wheeler is modelled as a lumped parameter system. The mathematical model is Analyzed by analytical method for vertical vibrations responses of the rear seat to vertical vibrations inputs (sinusoidal) applied to wheels.

It is evident that there is a constantly growing interest in providing acceptable system performances of vehicle suspension systems, especially in the past two decades as vehicle suspension systems have many vital functions: for instance, to support the vehicle weight, to provide effective isolation of the chassis from road excitations, to keep tire contact with the ground, and to maintain the wheels in appropriate position on the road surface. Vehicle suspension systems play an important role in guaranteeing the stability and improving suspension performances of vehicles. In this Research a Suspension System is Analyzed by considering load. Vibration Analysis is done to validate the strength of suspension system. The Deformation of suspension system is checked under various loading conditions. Acceleration and Velocity of Suspension system is checked under various Road Conditions.

1.2 TYPES OF VIBRATION

Vibrations can be categorized into three types, depending on the nature of the vibrations:

- **Torsional Vibration.**
- **Axial or Longitudinal Vibration.**
- **Transverse Vibration.**

1.2.1 Torsional Vibration

Torsional vibration is angular vibration of an object-commonly a shaft along its axis of rotation. Torsional vibration is often a concern in power transmission systems using rotating shafts or couplings where it can cause failures if not controlled. A second effect of torsional vibrations applies to passenger cars. Torsional vibrations can lead to seat vibrations or noise at certain speeds. Both reduce the comfort.

1.2.2 Axial or Longitudinal Vibration

A continuing periodic change in the displacement of elements of a rod shaped object in the direction of the long axis of the rod.

1.2.3 Transverse Vibration

Transverse vibration is a vibration in which the element moves to and fro in a direction perpendicular to the direction of the advance of the wave

2. EQUIPMENTS AND BIKES

2.1 Vibrometer used

Features:

- Measure accelerator/ velocity/ displacement with RPM and Frequency
- metric/ imperial measurement
- AC output socket for headphones and recording
- Optional headphones for use as electronic stethoscope
- Optional RS-232 communication

(advanced software program for all windows)

2.2 BIKES USED:

Bikes used are:

- Yamaha FZ-S
- Bajaj Pulsar
- Hero Achiever

Fig 2.1 Yamaha FZ-S

Fig 2.2 Bajaj Pulsar

Fig 1.3 Hero Achiever

3.READINGS AND GRAPHS

3.1 ACCELERATION COMPARISION FOR THREE BIKES

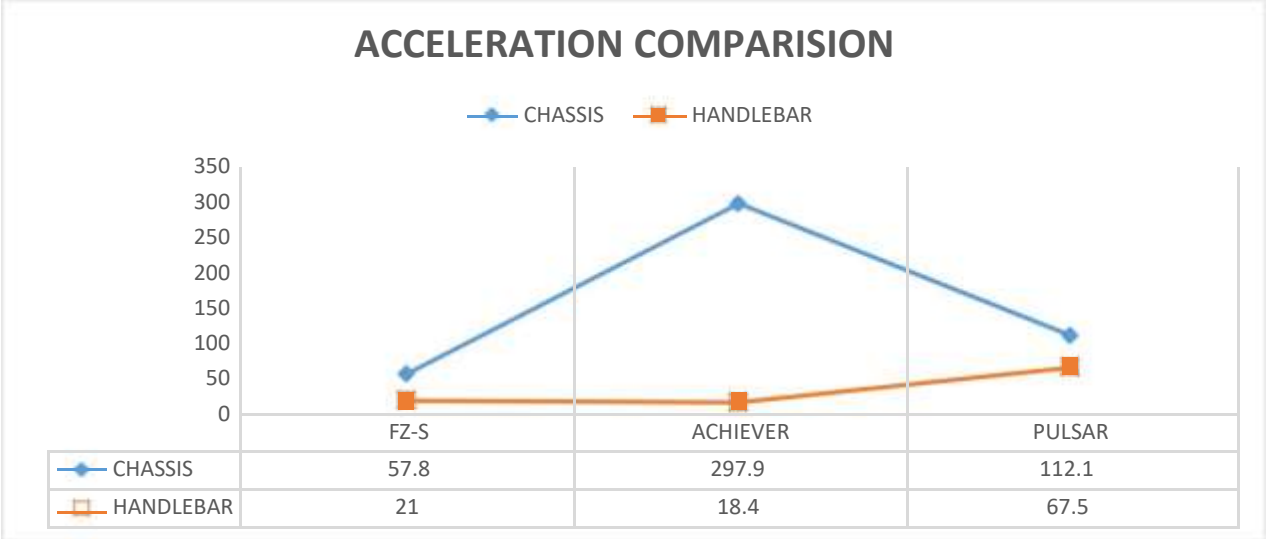

Fig 3.1 Acceleration comparison for three bikes

The above graph shows the comparison of acceleration of the three bikes in the chassis and handlebar positions for running condition. The acceleration was initially recorded in the chassis position which produced maximum acceleration of 297.9m/s^2 in hero achiever and minimum was seen in Yamaha FZ-S of 57.8m/s^2. The other bike Bajaj pulsar showed acceleration of 112.1m/s^2.The acceleration was recorded in the handlebar position which produced maximum acceleration of 67.5m/s^2 in Bajaj pulsar and minimum was seen in hero achiever of 18.4m/s^2. The other bike Yamaha FZ-S showed acceleration of 21m/s^2.

3.2 DISPLACEMENT COMPARISON FOR THREE BIKES

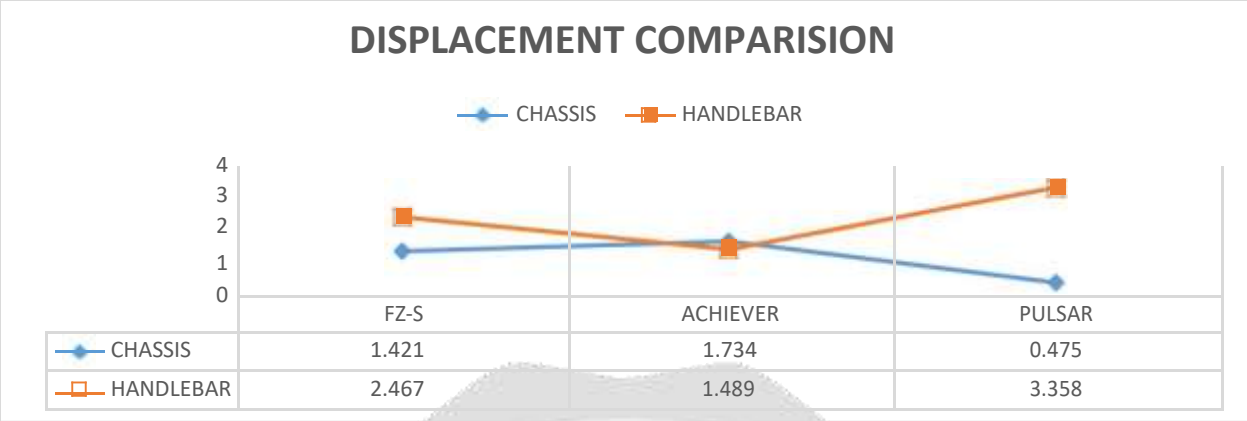

Fig 3.2 Displacement comparison for three bikes

The above graph shows the comparison of displacement of the three bikes in the chassis and handlebar positions for running condition. The displacement was initially recorded in the chassis position which produced maximum displacement of 1.734mm in hero achiever and minimum was seen in Bajaj pulsar of 0.475mm. The other bikeYamaha FZ-S showed displacementof1.421mm.The displacement was recorded in the handlebar position which produced maximum displacement of 3.358mm in Bajaj pulsar and minimum was seen in hero achiever of 1.489mm. The other bikeYamaha FZ-S showed displacement of 2.461mm.

3.3 VELOCITY COMPARISON FOR THREE BIKES

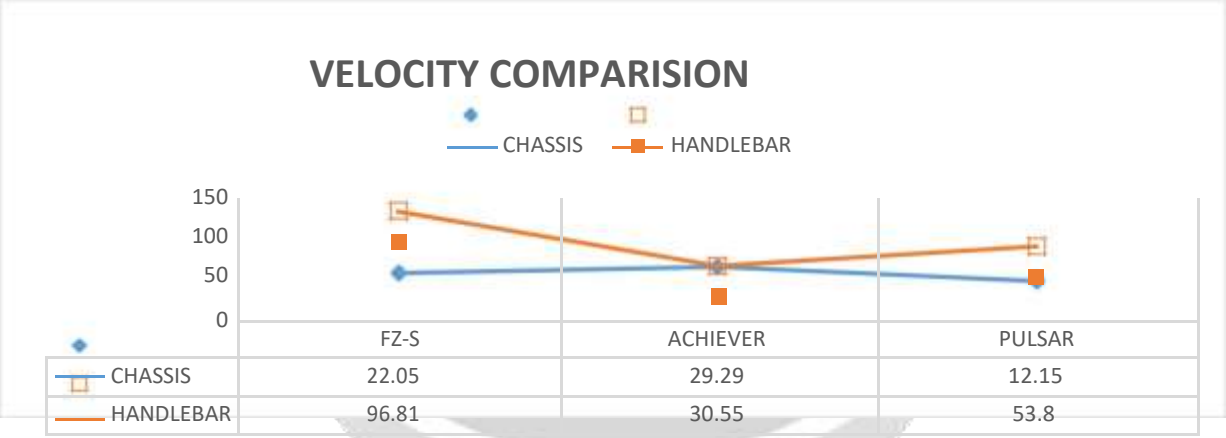

Fig 3.3 Velocity comparison for three bikes

The above graph shows the comparison of velocity of the three bikes in the chassis and handlebar positions for running condition. The velocity was initially recorded in the chassis position which produced maximum velocity of 29.29mm/s in hero achiever and minimum was seen in Bajaj pulsar of 12.15mm/s. The other bike Yamaha FZ-S showed velocity of 22.05mm/s.The velocity was recorded in the handlebar position which produced maximum velocity of 96.81mm/s in Yamaha FZ-S and minimum was seen in hero achiever of 30.55mm/s. The other bike Bajaj pulsar showed velocity of 53.8mm/s.

3.4 FREQUENCY COMPARISON FOR THREE BIKES

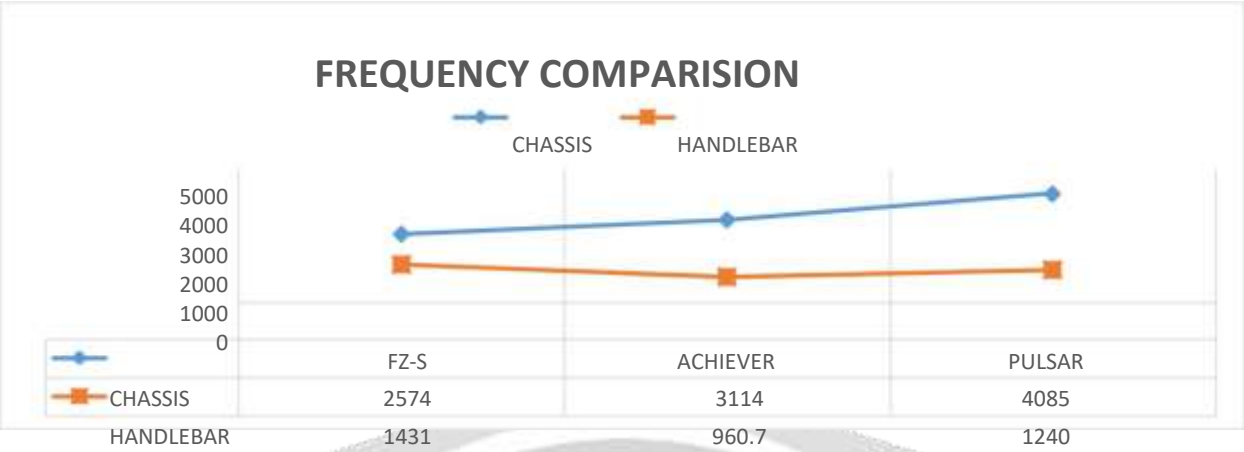

Fig 3.4 Frequency comparison for three bikes

The above graph shows the comparison of frequency of the three bikes in the chassis and handlebar positions for running condition. The frequency was initially recorded in the chassis position which produced maximum frequency of 4085Hz in Bajaj pulsar and minimum was seen in Yamaha FZ-S of 2574Hz. The other bike hero achiever showed frequency of 3114Hz.The frequency was recorded in the handlebar position which produced maximum frequency of 1431Hz in Yamaha FZ-S and minimum was seen in hero achiever of 960.7Hz. The other bike Bajaj pulsar showed frequency of 1240Hz

4.CONCLUSION

The conclusion of our project is that the suspension system of the motor cycle plays a major role in absorbing the vibration. On comparing the various vibration parameters like acceleration, displacement, velocity and frequency of three bikes. It is evident from the fact that the Yamaha FZ-S proved to produce reduced vibration. Due to the mono shock suspension system provided in the chassis this result was proved to be contrary when the hero achiever had a reduced vibration in the handlebar position due to the presence of telescopic suspension thus this raises the suspicion of whether the lack of lubrication might be a major reason for vibration. The Bajaj pulsar recorded the most vibration in the chassis which is recommended to upgrade the suspension system.

- On comparing the acceleration parameter of three bikes at on road condition it is found that hero achiever has recorded maximum acceleration of 297.9m/s^{2}and the minimum acceleration is 57.8m/s^{2}recorded in Yamaha FZ-S, And in handlebar the maximum acceleration measured is 67.5m/s^2 in Bajaj pulsar and minimum acceleration measured is 18.4m/s^2 in hero achiever.

- On comparing the displacement parameter of three bikes at on road condition it is found that hero achiever has recorded maximum displacement of 1.734mmand the minimum displacement is 0.475mmrecorded in Bajaj pulsar, And in handlebar the maximum displacement measured is 3.358mm in Bajaj pulsar and minimum displacement measured is 1.489mm in hero achiever.

- On comparing the velocity parameter of three bikes at on road condition it is found that hero achiever has recorded maximum velocity of 29.29m/sand the minimum velocity is 12.15m/srecorded in Bajaj pulsar,

And in handlebar the maximum velocity measured is 96.81m/s in Yamaha FZ-S and minimum velocity measured is 30.55m/s in hero achiever.

- On comparing the Frequency parameter of three bikes at on road condition it is found that Bajaj pulsar has recorded maximum frequency of 4085Hzand the minimum frequency is 2574Hzrecorded in Yamaha FZ-S, And in handlebar the maximum frequency measured is 1431Hz in Yamaha FZ-S and minimum frequency measured is 960.7Hz in hero achiever.

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