

# Vibration Analysis of Three Wheeler Vehicle

Rakesh R Poojari<sup>1</sup>, Santhosh R Whankade<sup>2</sup>

M. E Student, Machine Design, YTIET, Bhivpuri, India<sup>1</sup>

Professor, Department of Mechanical Engineering, YTIET, Bhivpuri, India<sup>2</sup>

**ABSTRACT:** This Research Paper describes about the practical measurement of vibration produced in three wheeler vehicle and its effect on driver health is studied according to International standard Organization(ISO 2631).This standard recommends the measurement of four axes of vibration on the seat (fore-aft, lateral and vertical vibration on the seat surface and fore-aft vibration at the backrest) and combining these in an evaluation procedure before assessing the vibration severity. Here driver seat is modified and experimental work is carried to measure the magnitude of vibration produced on driver through FFT analyser and acceleration level is analysed and compared with original seat and modified seat at different road profiles at different speed condition (10Kmph,20Kmph,30Kmph).As per ISO (2631) vibration evaluated with respect to WBV considering frequency 0.5-80Hz.

**KEYWORDS:** FFT Analyser, ISO(2631),Whole body Vibration.

## I. INTRODUCTION

In whole-body vibration research the interest has been to link the discomfort feeling to the vibration characteristics, such as frequency, amplitude, direction and duration, and to human characteristics, such as height, weight, age and gender. Human reaction to vibration is dependent on three factors:

1) Characteristics of the vibration, 2) Characteristics of the human and 3) Characteristics of the environment.

A seated person on a typical seat will usually perceive vibration from three locations (seat surface, backrest and floor). In a normal situation the vibration to a human is multi-directional, meaning that it is a combination of three translational axes (vertical, lateral and fore-and-aft) and three rotational axes (pitch, roll and yaw). Back and floor vibrations can be analyzed using translational axes, because in a rigid-seat environment the rotational axes can be assumed to be the same for floor and backrest as for the seat surface.



**Fig-1:Axes and locations of vibration for a seated person**

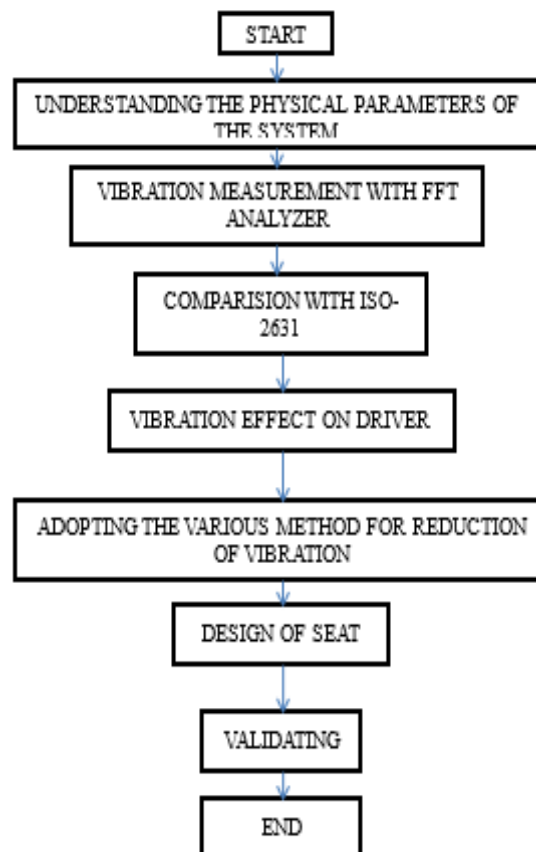
# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, September 2017

Discomfort can be related to fatigue, lowered concentration and work performance, and indirectly to work motivation and happiness, which can increase workload and reduce performance. Vibration can also cause drowsiness and irritation. These factors are becoming more and more important in work environments. A worker-friendly workplace can also show benefits in productivity. Although there is not necessarily a link between discomfort and health, it is generally assumed that improved comfort is associated with reduced health risk. Even though vibration is rarely the only contributor, it is possible to improve overall comfort by reducing it. Because of the harmful effects of vibration, research has been conducted to quantify methods for evaluating the effects. Currently there are several methods available for evaluating the effects of vibration and an internationally standardized procedure to measure and calculate values (ISO 2631-1 1997), which has been updated with an amendment in 2009. Also legislation has been produced to minimize the negative effects of vibration to work health by forcing all employers within the European Union to assess the risks arising from vibration exposure.

## II. METHODOLOGY



# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, September 2017

## III. EXPERIMENTAL WORK



Fig-2 Experimental Work

The experiment was conducted with a three wheeler on different road profiles in Mumbai, India. Three speed conditions are selected (10 kmph, 20 kmph, 30 kmph). Then the three wheeler vehicle is run on rough road condition for constant 10 kmph and then for 20 kmph and 30 kmph. Then the same procedure is followed for next road conditions. The driver had driven the three wheeler on the road profile having rough, urban road condition and Bumpy road condition. Two minutes of vibration data were recorded by FFT analyser while operating the vehicle as shown in the below figure. The data for a particular time span is selected and graphs are plotted with the help of MS – excel Software. Finally these graphs are used for analysis work.

### 3.1 Effect of Speed Condition on Acceleration Level of Vibration

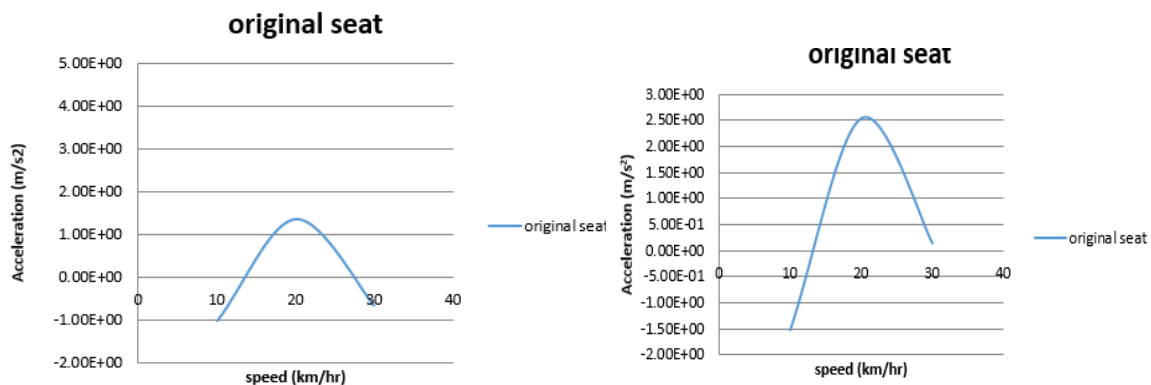


Fig-5 Speed Vs Acceleration for high way road Fig-6 Speed Vs Acceleration for rough road

### 3.2 Design of new Seat

The vibrations generated in vehicle produce Mechanical Damage, Physiological Response, & Subjective Responses to humans. Human Engineering deals with various effects of vibrations on the different parts of human body. For this the solution is design a new seat the design of new seat is given below

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, September 2017

Design of seat with spring  
Calculation of spring

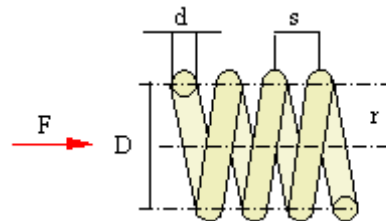


Fig-7 Compression of Spring

Stiffness of spring is defined as the ratio load per unit deflection  
In the mathematical form,

$$\text{load } = w = 70 \text{ kg}$$

$$\text{deflection } = x = \frac{G \cdot d^4}{8 \cdot D^3 \cdot n}$$

Spring stiffness,  $k = w/x$   
 $K = 61.533 \text{ N/mm}$

Where,

G=shear modulus  
D= mean coil diameter  
d=diameter of spring wire  
n=number of active coils

Assembly of seat

Initially base is made with the help of plywood  
Dimension of plywood =65cm X 45cm (thickness= 1.2mm)



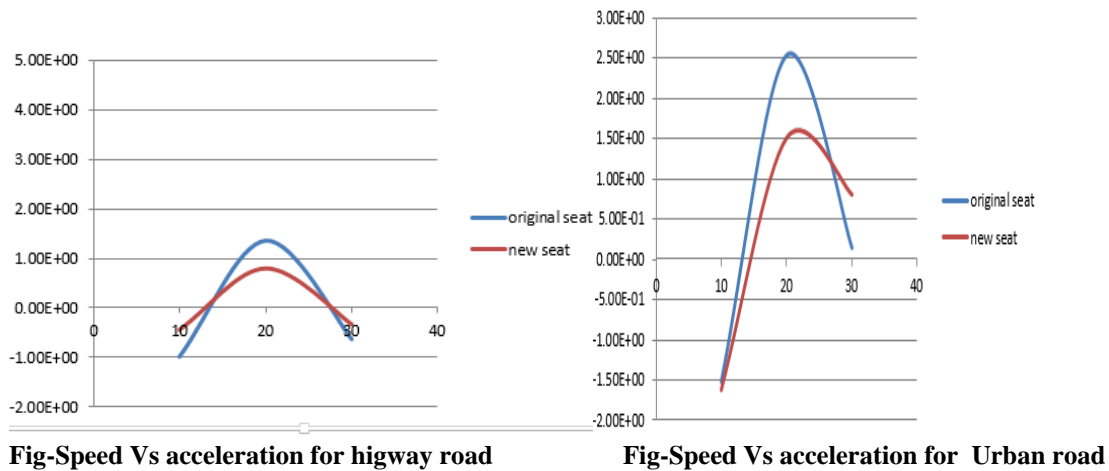
Fig-8 Spring sandwiched between ply

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, September 2017

## IV. RESULT AND DISCUSSION



Above figure shows the comparison of speed vs acceleration for highway and urban road

Sr.n o.	Types of road conditions	original seat vibration	new design seat vibration	% of vibration reduction
1	Rough	1.62	1.12	30.86
2	urban	1.40	1.2	14.28
3	Bumpy	1.90	1.33	30
4	highway	1.25	0.98	21.6

**Table No-1 Comparison of measurement**

From above table it is clearly shows that for rough road vibration is reduced by 30.86% and for highway road reduced by 21.65%.

Vibration	Reaction
Less than $0.315\text{m/s}^2$	Not uncomfortable
$0.315$ to $0.63\text{ m/s}^2$	A little uncomfortable
$0.5$ to $1\text{ m/s}^2$	Fairly uncomfortable
$0.8$ to $1.6\text{ m/s}^2$	uncomfortable
$1.25$ to $2.5\text{ m/s}^2$	Very uncomfortable
Greater than $2\text{ m/s}^2$	Extremely uncomfortable

**Table no.2: Value of acceleration level of vibration according to ISO-2631**

## V. CONCLUSION

The experimentation is carried out to study effects of vehicle vibration on driver through vibration analysis and practically investigated. The vibration values measured for different speed are presented and based on acceleration level following conclusion are drawn

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, September 2017

1. Acceleration level decreases, as road surface varies from rough to smooth
2. Driver feel uncomfortable, as acceleration level is more for rough road
3. The vibration level for different road conditions are 30.86%, 14.28%, 30%, 21.6% by replacing new seat with original

## ACKNOWLEDGEMENT

I would sincerely like to thank Prof. Santosh R Whankade, Head of the Department of Mechanical Engineering and Principal Prof. P. A Ghonge for constant source of guidance and inspiration for me throughout the entire study of work.

## REFERENCES

1. M K Naidu, S Srinivasa Rao<sup>2</sup> and T Tejesh "Ride Analysis of Three Wheeled Vehicle Using MATLAB/ Simulink " AMAE Int. J. on Manufacturing and Material Science, Vol. 02, No. 01, May 2012.
2. B. Sathish Kumar, Vinod K. Banthia, Alok Kumar Ray, Design Of Three Wheeler Vehicle For Physically Challenged People, SAS TECH Journal, Volume 12, Issue 1, April 2013, pp. 80-89.
3. Stephan Milosavljevic , Frida Bergman , Borje Rehn , Allan B. Carman "All-terrain vehicle use in agriculture: Exposure to whole body vibration and mechanical shock " Elsevier Applied Ergonomics, 2009.
4. GhumanKuljit Singh, Effect of Whole-Body Vibration on Vehicle Operators: A Review, International Journal of Science and Research, Volume 3 Issue 7, July 2014, pp.320-323.
5. Rebecca Wolfgang, Robin Burgess-Limerick "Whole-body vibration exposure of haul truck drivers at a surface coal Mine" Elsevier Applied Ergonomics, 2014.
6. Handbook of shock and vibration: Anthony J. Brammer "HUMAN RESPONSE TO SHOCK AND VIBRATION" (Chapter 41)
7. Singiresu S. Rao "Mechanical Vibrations", fifth edition, University of Miami