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Effect of Vibration on the Health of Driver of Three Wheeler Using ISO 2631

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ABSTRACT

The majority population in India depends on vehicle- 3 wheeler for transportation due to their poor economic condition. These vehicles are exposed to vibrations due to irregular surface of road or soil profile, engine vibration and condition of vehicle which affects the health as well as discomfort of the driver and passengers. These oscillations are transferred into the body of driver and passenger through the body tissues, organs and systems of the individual causing various effects on the structures within the body before it is dampened and dissipated. The literature review reveals that the vibrations are most hazardous to the health if it exceeds the limit. The experimental analysis is carried out to measure the magnitude of the vibrations acting on driver as well as passenger for the different road profile at different speed. The methodology adopted is as per the International Organization for Standardization (ISO) guidelines for whole body vibration (WBV) exposure having frequency ranges from 0 to 100 Hz. The study emphasis on vibration tests for different road and speed conditions by referring, ISO 2631 and human comfort charts.

***Keywords*— FFT analyzer, ISO-2631,acceleration level**

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I. INTRODUCTION

All vehicles are exposed to vibrations because of unevenness of the road or soil Profile, moving elements within the machine. Increased vehicle speed and engine capacity produce a lot of vibration problems which affects the vehicle life span. This has also resulted in increased number of people getting affected by whole-body vibrations during transportation. These vibrations are known to have effects such as sensory responses like discomfort, injuries and health issues. Human response to whole body vibration is very complex and nonlinear in nature. There are a number of standards which provide guidelines for measurement and evaluation of whole-body vibration such as ISO 2631 or BS 6841

The vibrations generated in three wheeler 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. The present paper highlights the effect of vehicle vibration on human body. This data is also useful in vehicle design & dynamic analysis of vehicle.

The vehicle vibration produces physiological effect on humans. The evidence suggest that short time exposure to vibration causes small physiological effects such as increase in heart rate, increase in muscle tension long term exposure to vibration causes effects such as disk to spine &

effects on digestive system peripheral veins & the female reproductive organ.

When spring supported mass such as that of a motor vehicle chassis is given an impulse, it is set in to vibratory motion & it keeps on vibrating until the energy of the impulse completely dies out in overcoming damping forces. There are different sources of vibration of vehicle i.e. road roughness, the unbalance of the engine, whirling of shafts the cam forces & tensional fluctuations etc.

Depending upon the cause the vibration may be free or forced. The free vibration may occur when the vehicle passes over an isolated irregularity in the road surface, which may die off as a result of dissipation of energy in damping. Then the forced vibration may result when disturbances occur persistently such as passing over obstacles on a proving road. In this case even if there may be damping, the vibration may persist & build up an undesirable level.

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II. LITERATURE SURVEY

Stephan Milosavljevic et al. [1] examined the whole body vibration was measured in 12 farmers during their daily use of all-terrain vehicles (ATVs). The vibrations were measured in accordance with the ISO 2631-1 guidelines for whole body vibration. All those who participated in the experiment were asked to ride their ATV for around 20 min on a typical daily work route of their choice with helmet mounted on their head. The farmers asked to ride when each farmer was sitting on the seat pad containing a tri-axial accelerometer. The exposure vibration data were digitally stored in a 6 channel data logger. Filtering of vibration data and weighted accelerations, VDV calculations were done with the help of Lab View software. The questionnaire survey method was used, whether the participants had suffered with low back pain, neck back or neck pain within the past 7 days or within past 12 months and concluded Low back pain was the most usual sicknesses for both 7-day (50%) and 12-month (67%), followed by the neck (17% and 42%) and the upper back (17% and 25%), respectively.

Rebecca Wolfgang , et al. [2]studied the haul truck drivers at surface mines are exposed to whole-body vibration for extended periods. Thirty-two whole-body vibration measurements were gathered from haul trucks under a range of normal operating conditions. Measurements taken from 30 of the 32 trucks fell within the health guidance caution zone defined by ISO2631-1 for an 8 h daily

Ornwipa Thamsuwan , et al. [3] examined whether differences exist in WBV exposures between two buses commonly used in long urban commuter routes: a high-floor coach and a low-floor city bus. Each bus was driven over a standardized test route which included four road types. On average, the seats only attenuated 10% of the floor transmitted vibration and amplified the vibration exposures on the speed humps. Due to the low vibration attenuation performance of the bus driver's seat, evaluating different types of seats and seat suspensions may be merited

Jaimon Dennis Quadros, et al. [4] analyzed and obtain the idealized operating conditions of the human body. The analysis has shown that for the given vehicle and human body, the idealized operating speed for HERO HONDA SPLENDOR vehicle on the terrain of specified amplitude at given input is found to be 49.66 km/hr.

Gourav.p.sinha, p.s.bajaj [5] examined about the practical measurement of vibration occurring on two wheeler vehicle which is very dangerous when it is transmitted to human body through thigh, footrest, seat & handle. So finding the level of vibration occurring in vehicle will be helpful and they can take some steps to reduce it. In this paper they will come to know that every aspect of riding vehicle in smooth road and uneven road from vibration point of view.

Vikas Kumara, et al. [6] studied the vibration dose Value (VDV) has been recorded for the driver as well as the pillion of two wheeler vehicle for the different road profile having speed breakers, at different speed. The methodology adopted from the International Organization for Standardization (ISO) guidelines for whole body vibration (WBV) exposure having frequency ranges from 0 to 100 Hz. VDV of six healthy male subjects was recorded through the Human Vibration meter via seat-pad tri-axial accelerometers for two minutes drive and psychophysical response were measured with the help of Borg CR10 scale. The Time to reach 15 VDV and comfort decreases with the increase in vehicle speed and speed breaker's height, for both driver and pillion. Pillion feels more discomfort with the increase in vehicle speed and speed breaker's height when compared with driver.

III. EXPERIMENTAL METHODOLOGY

The whole experiment was conducted with a three wheeler on different road profiles having different road conditions in Pune, India. Out of three road conditions firstly rough road is selected on each road; three speed conditions are selected (10 kmph, 20 kmph, 30Kmph). Then on rough road three wheeler is run for constant speed of 10 Kmph and then readings are taken. After this the readings are taken for 20 kmph & 30 Kmph. Then same procedure is follow 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 analyzer while operating the vehicle as shown in fig 1. The data for particular time span is selected and graphs are plotted with the help of MS – excel Software. Finally these graphs are used for analysis work.


Fig.1 Experimental Setup


Fig.2 Rough road Condition


Fig.3 Bumpy road condition


Fig.4 Urban road condition

IV. RESULT

A. Effect of Speed Condition on Acceleration Level of Vibration

For analyzing effect of speed condition on acceleration level, speed condition of vehicle is taken on x-axis & acceleration level corresponding to that speed is taken on Y-axis & then graphs are plotted with MS – excel Software. By observing fig. 5, it is clear that the acceleration level for of all cars increases from 10 to 20 kmph & then decreases as speed increases for state highway. Change in acceleration level is slowly decreased as speed increases.

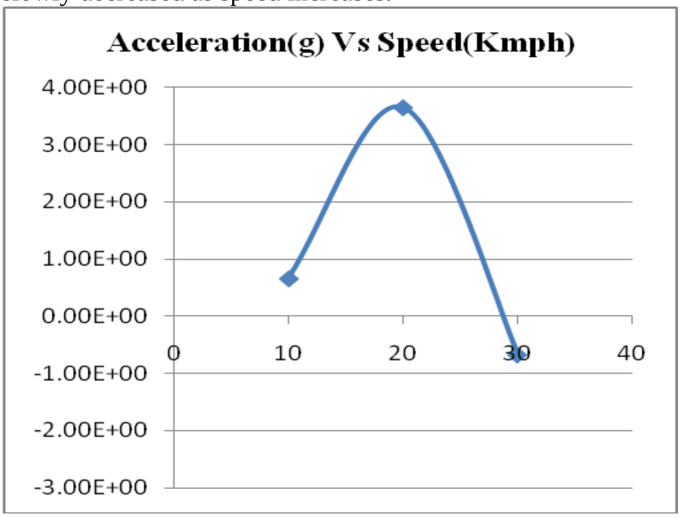

Fig.5 Acceleration(g) Vs Speed(Kmph)

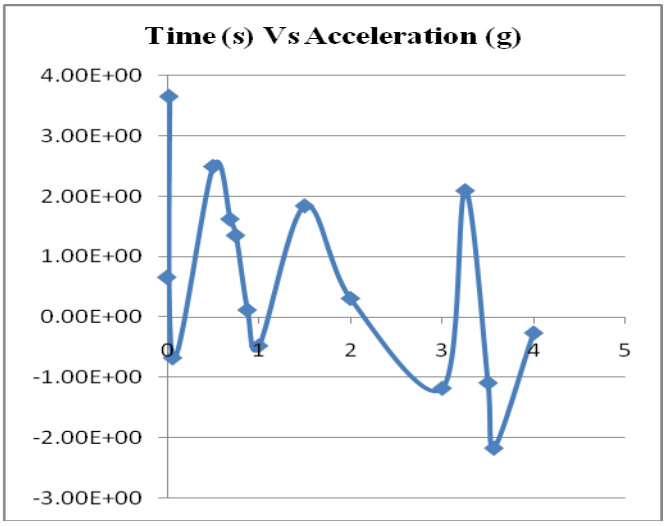

Fig.6 Time (s) Vs Acceleration (g)

A. *Effect of Amplitude on Frequency of Vibration*

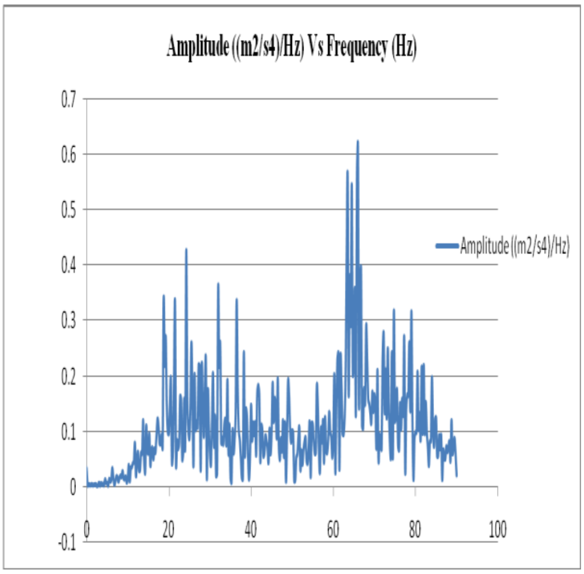

Fig.7 Amplitude ((m2/s4)/Hz) Vs Frequency (Hz)

fig. 7, is shows that the power spectral density of vibration and It is observed form ISO 2631 (table 1) the critical range-affecting humans. For analyzing the effects of acceleration levels of vibrations on humans, Fig. 5 gives the acceleration level for rough road at speed 30 kmph. For urban roads the acceleration levels are from 0.06 to 0.4 therefore the driver sitting in Three wheeler feels fairly uncomfortable

Table 1
Range for Comfort

1) Vibration	*2) Reaction*
3) Less than 0.315m/s^2	*4) Not uncomfortable*
5) 0.315 to 0.63 m/s^2	*6) A little uncomfortable*
7) 0.5 to 1 m/s^2	*8) Fairly uncomfortable*
9) 0.8 to 1.6 m/s^2	*10) uncomfortable*
11) 1.25 to 2.5 m/s^2	*12) Very uncomfortable*
13) Greater than 2 m/s^2	*14) Extremely uncomfortable*

V. CONCLUSION

The experimentation is carried out to study effects of vehicle vibration on humans through vibration analysis and feasibility of it, practically investigated. The vibration Spectrum obtained for different speed are presented in figure 6 and based on acceleration level following conclusion are drawn

1. As road condition varies rough to smooth the acceleration level decreases,
2. For rough road condition the acceleration levels are higher therefore the man seating in vehicle feels very uncomfortable
3. For rough roads if the driver is exposed more than 90 to 120 minutes he will feel uncomfortable.

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REFERENCES

[1] 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
[2] Rebecca Wolfgang, Robin Burgess-Limerick "Whole-body vibration exposure of haul truck drivers at a surface coal Mine" Elsevier Applied Ergonomics, 2014
[3] Ornwipa Thamsuwan Ryan P. Blood , Randal P. Ching , Linda Boyle , Peter W. Johnson "Whole body vibration exposures in bus drivers: A comparison between a high-floor coach and a low-floor city bus" International Journal of Industrial Ergonomics, 2013, 9-17
[4] Jaimon Dennis Quadros, Suhas, Vaishak N.L, Shilpa. B "Study of vibration and its effects on health of a two wheeler rider" IJRET,Volume-2,Issue 08 | Aug-2013
[5] Gourav.P.Sinha, P.S.Bajaj "Vibration analysis of hero honda vehicle" IJMPE, Volume-2,Issue 2 Feb-2014
[6] Vikas Kumara, V.H. Saranb and Veeresalingam Guruguntla " Study of Vibration Dose Value and Discomfort due to Whole Body Vibration Exposure for a Two Wheeler Drive" Proc. of the 1st International and 16th National Conference on Machines and Mechanisms (iNaCoMM2013), IIT Roorkee, India, Dec 18-20 2013

[7] Hsieh-Ching Chen , Wei-Chyuan Chen , Yung-Ping Liu , Chih-Yong Chen , Yi-Tsong Pan **“**Whole-body vibration exposure experienced by motorcycle riders – An evaluation according to ISO 2631-1 and ISO 2631-5 standards**”** International Journal of Industrial Ergonomics, 2009, 708-178

[8] M K Naidu, S Srinivasa Rao 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

[9] Min-Soo PARK, Takabumi FUKUDA, Tae-gu KIM and Setsuo MAEDA, “Health Risk Evaluation of Whole-body Vibration by ISO 2631-5 and ISO 2631-1 for Operators of Agricultural Tractors and Recreational Vehicles” J-STAGE April 5, 2013

[10] Shivakumara BS, Sridhar V, “Study of vibration and its effect on health of the motorcycle rider” Online Journal of Health and Applied Science, Volume 9,Issue 2,Apr-Jun 2010

a) Stephan Milosavljevic , Ramakrishnan Mani , Daniel Cury Ribeiro , Radivoj Vasiljev , Borje Rehn “Exploring how anthropometric, vehicle and workplace factors influence whole-body vibration exposures during on-farm use of a quad bike” International Journal.

