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Study of Vibration of Three Wheeler Vehicle and Its Effects on the Health of a Driver

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***Abstract*— The majority population in India is depends on three wheeler vehicle for their transportation due to economic reasons. The vibration is common in most of the vehicle and it is more in the three wheeler vehicle because of its dynamic nature. Waves of energy of vibration transferred into the body of the driver are transmitted 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 vehicle vibration produces physiological effect on humans. The present work is carried out experimentally to measure the magnitude of vibration acting on driver on different Road profiles at different speed (10mkph,20kmph, 30kmph) using FFT analyser. As per ISO(2631) vibration evaluated with respect to whole body vibration considering frequency 0.5-80Hz.**

Keywords: *FFT analyser,ISO-2631, body vibration*

I INTRODUCTION

The vibration is common in most of the vehicle and it is more in the three wheeler vehicle because of its dynamic nature. 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 The health problems are also increasing, it is essential to identify whether there is any relation between the health problems of the driver. Vibration within the frequency range up to 12 Hz affects the whole human organs, while the vibrations above 12 Hz will have a local effect. Low frequencies (4-6 Hz) cyclic motions like those caused by tires rolling over an uneven road can put the body into resonance. Just one hour of seated vibration exposure can cause muscle fatigue and make a user more susceptible to back injury. Currently, there are two main standards for evaluating vibration with respect to the human responses to whole body vibration; British Standard BS 6841 (1987) and International Standard ISO 2631 (1997). BS 6841 considers a frequency range of 0.5-80Hz.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. Therefore it is necessary to evaluate the influence of vibration to the human body and to make up appropriate guidelines for the three wheeler design and selection parts.

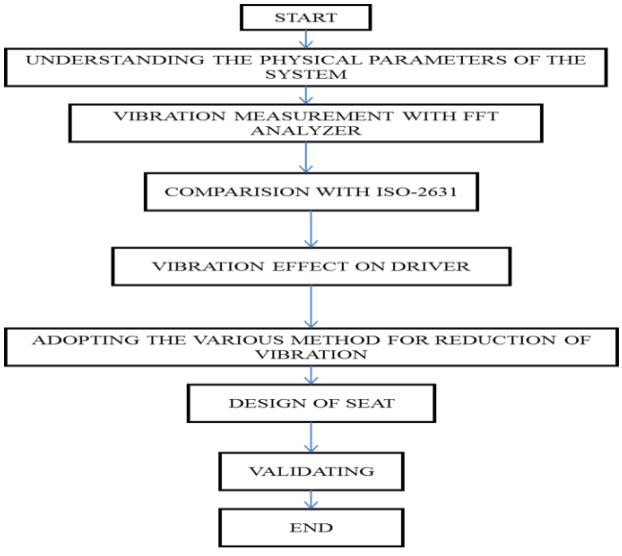
II PROBLEM IDENTIFICATION

India has a population of more than one billion people, many of whom do not have the means to own a car for their own. A common vehicle of transportation for these people is three wheeler vehicles. Therefore it becomes essential to study the phenomenon of vehicle vibration and its effects on human body. Exposure to whole-body vibration causes motions and forces within the human body that may:

1)Cause discomfort 2)Adversely affect performance 3)Aggravate pre-existing back injuries 4)Present a health and safety risk.

In three wheeler vehicles the magnitude of the vibration is depends on the type of the vehicle, engine, body weight, age of the vehicle, type of seating, type of suspension and road surface factors etc. Hence it is necessary to evaluate the influence of vibration to the human body and to make up appropriate guidelines for the three wheeler design and selection parts. The intensity of these harmful vibrations is reduced by providing a standard type of seat, front and rear suspension.

III METHODOLOGY



IV EXPERMENTATION

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 8. 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.

Figure 1 Experiment Setup

The below figure 2 shows rough road condition, different readings taken as mentioned above in experiment methodology.

Figure 2 Rough road condition

The below figure 3 shows urban road condition, different readings taken as mentioned above in experiment methodology.

Figure 3 Urban road conditions

V RESULT

Effect of speed condition on acceleration level is analysed, speed of vehicle plotted on x-axis and acceleration level on Y-axis. By observing figure 4 the speed v/s acceleration level for three wheeler vehicle for high way road condition is increased from 10kmph to 20kmph and reduced from 20kmph to 30kmph, this states as speed increased acceleration level decreased.

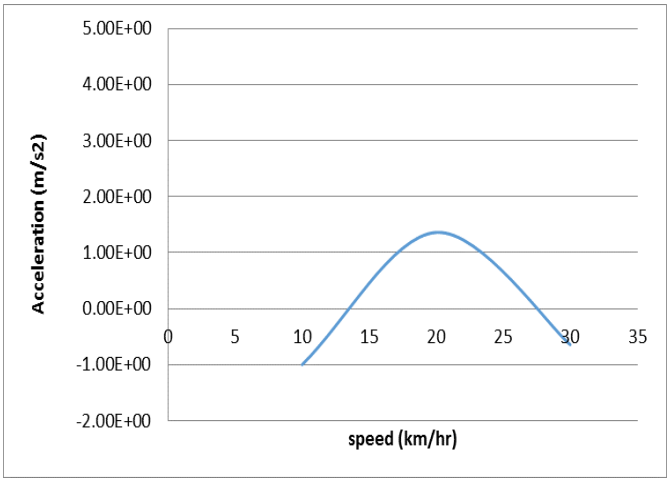


Figure 4 Speed vs acceleration for highway road

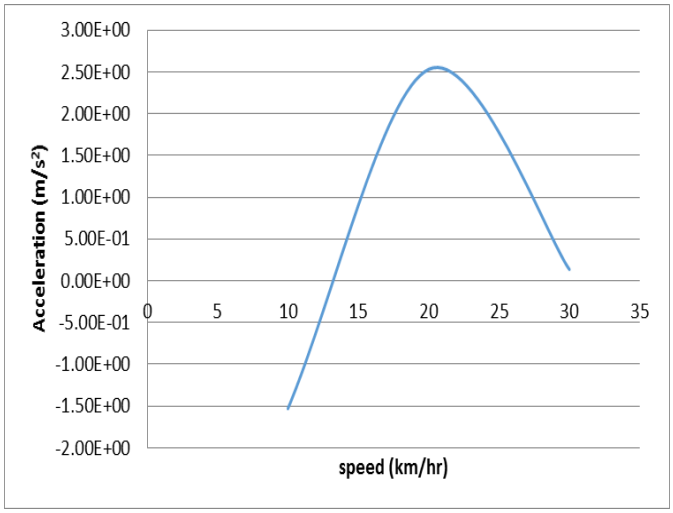


Figure 5 Speed vs Acceleration for rough road condition

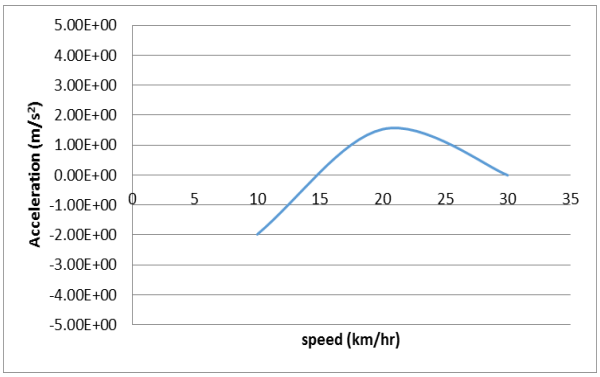


Figure 6 Speed vs acceleration for urban road condition

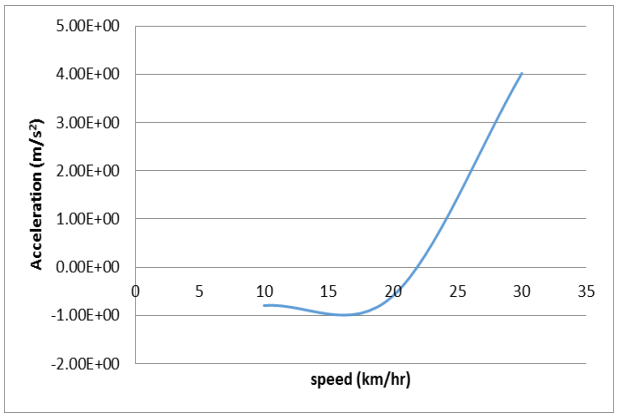


Figure 7 Speed vs acceleration for bumpy road condition

Table 1 Vibration measurement for different road condition

Sr.no.	Types of road conditions	Seat vibration
1	Rough	1.62
2	urban	1.4
3	Bumpy	1.9
4	highway	1.25

After analysing the effects of vibration level on driver as shown in above charts, the acceleration level for urban road condition are from 0.06 to 0.4, so driver sitting in three wheeler vehicle feels fairly comfortable.

Table 2 Range of comfort ISO-2631

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

VI CONCLUSION

After practical investigating, the vibration on driver analysed for different road condition and came to following conclusion that as road condition changed rough to smooth acceleration level decreased. For rough road condition driver feels uncomfortable and acceleration level increased.

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