Review of Vibrations Occuring in Handlebar of Two-Wheeler Vehicle and its Effect on Human Body

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***Abstract*— In order to compete in a competitive market, two-wheelers are becoming increasingly intricate in terms of utility and style. Most of the two-wheeler vehicles causes discomfort at high speeds due to vibrations from the engine. At the same time, weight limits to increase performance are a crucial influence in the design and development life cycle. Predicting potential difficulties as early as possible is the most difficult component of the design phase. The handlebar assembly is more prone to failure due to a variety of loads like as bumps, braking, and road excitations. Modal frequency response analysis can be used to measure the strength of structural mountings within the vehicle's excitation frequency range. These vibrations are also tend to cause discomfort to the rider. In order to reduce the vibrations various alternative methods such as changing geometry, material can be implemented.**

Keywords*— *Handle Assembly, Vibration, two-wheeler vehicle

I. INTRODUCTION

The measurement of a periodic series of oscillations with regard to an equilibrium point is known as mechanical vibration. The topics of vibrational analysis, uncertainty modelling, and vibration control should all be covered in this book. It should also provide a solid foundation for computational findings, mathematical modelling, and performance evaluation of various systems and system components. The two-wheeler handle-bar assembly is the user's first point of contact with the vehicle; it is also quite sophisticated in manufacture and crucial in terms of performance and safety. As the handle-bar assembly consists of a headlight, mirrors, clutch and brake levers, and a speedometer with plastic covers for aesthetic purposes. Because it is subjected to multiple forces such as bumps, braking, engine vibrations, rider force, and road excitations, the entire handle bar assembly is more prone to failure. The practical measurement of vibration occurring on two-wheeler vehicles, which are extremely dangerous when communicated to the human body through the thigh, footrest, seat, and handle, was investigated. As a result, determining the vibration level in the two-wheeler vehicle and taking actions to lower it should be beneficial[1] . The handle bar assembly is prone to vibration with acceleration obtained from road load data throughout a frequency range of 0 to 200 Hz, which is an operational frequency for evaluating the robustness of handle-bar mountings in vibration[2]. The type of vibration present in a vehicle is determined by the two-dynamic wheeler's properties as well as the characteristics of the road surface. The frequency, magnitude, direction of vibration, area of contact, and duration of exposure all have an impact on the human body. When vibratory energy is exposed to the human body, it is transmitted throughout the body, resulting in a localized effect. It has an impact on comfort, body function, and health. Vibrations of certain frequencies may have an influence on specific parts of the body[4].

II. LITERATURE REVIEW

Gaurav P. Sinha, P. S. Bajaj[1] Examined the practical measurement of vibration occurring on two wheeler vehicles, which are extremely dangerous when communicated to the human body through the thigh, footrest, seat, and handle, was investigated. As a result, determining the vibration level in the car and taking actions to lower it should be beneficial.

Harale Shivraj. N Gyanendra Roy[2] Describes the handle bar assembly is aroused with acceleration obtained from road load data throughout a frequency range of 0 to 200 Hz, which is an operational frequency for evaluating the robustness of handle-bar mountings in vibration. Using the Altair solver Data in bulk on the handle bar assembly, a frequency response analysis is performed. The handle bar assembly is excited with dynamic loads, i.e., acceleration calculated from road load data, for an operational frequency range in order to test the strength of handle-bar mountings in vibration.

ISO Standard 2631-1 [3] The purpose of this standard is to determine the impact of whole-body vibration on the human body. Suggests boundaries to standardize the subjective level of exposition that a given vibration state can be tolerated. The mentioned boundary values are approximate indicators of possible reactions to various magnitudes of total vibration, rather than true limits. Vibration exposure, on the other hand, is determined not only by the amount of the vibration, but also by the duration of the exposure.

ISO Standard 5349-1-2001[4] Explains vibration from vibrating power equipment held in the hands of the operator in the industrial industry, construction, and agriculture, as well as handed vibrating controls like motorcycle handlebars or vehicle steering wheels, can cause hand-arm-transmitted vibration. It causes white finger as a result of vibration (VWF). It also lays out the broad guidelines for

measuring and evaluating human exposure to vibration conveyed by the hand and arm.

Mr. Barister Giri, Prof. Shah B. R[5], The technical papers referenced to cover the design and analysis of the model, as well as the circumstances required for applying various constraints and how the loads will be imposed. The qualities of several alternative materials such as carbon fiber, aluminum alloy, and titanium have been examined and compared to standard mild steel using the results of these literature reviews.

III. SOURCES OF VIBRATION ON HANDLEBAR

A. Irregular Road Surfaces

Vibration is classed as free or forced depending on the reason. For example, when a two-wheeler vehicle goes over an uneven road surface, free vibration may occur; but, when the vehicle passes over barriers repeatedly, forced vibration may develop. Because of the road irregularities, the vehicle accelerates vertically, causing pain to the driver and passengers[9].

B. Engine Unbalance

Because of their periodic movement, engine parts are also a source of vibration [9].

IV. VIBRATION EFFECT ON HUMAN BEING

Vibration has three basic effects on the human body.

A. Physical Damage

Damages occur when acceleration exceeds the tolerance threshold, such as when exposed over an extended period of time, chronic injuries might occur. When subjected to repeated blows or shaking, erratic motion will result. Injuries to the spinal cord, such as vertebral fractures, are frequently discovered in the rider's spinal cord.

B. Physiological Damage

The human body is extremely sensitive to vibrations in the vertical direction (between 5 and 16 Hz) as well as lateral vibrations (between 1 and 2 Hz). The passenger's response to vibration is that the lower abdomen responds at 2 Hz, then moves up to the body at a frequency between 4 and 8 Hz, and finally the head responds at 16 Hz.

C. Visual effect

- Vibration in the frequency range of 10 to 25 Hz causes vision impairment in the driver and passengers.
- The key influencing component is the vibration amplitude; at frequencies below 3 Hz, the picture movement on the retina causes the image to blur. In order to stabilize, the driver might make compensating movements with his head and eyes.

D. Measurement of Vibrations

- Accelerometer Basics

The acceleration created by vibrations, according to Newton's second law, causes a force that is caught by the force detecting system. The accelerometer senses force and transforms it to acceleration by applying a force to one of the axes. An accelerometer is a type of electromechanical device that has holes, cavities, springs, and channels in it.

- Mechanism of Sensing

Using various sensors, the vibrations can be identified easily. FFT Analyzers, Velometers, Vibrometers can be used to detect vibrations in the vehicle.

V. MEASURES TO REDUCE THE VIBRATIONS

The vibrations in two- wheeler vehicle can cause damage to vehicle as well as to the rider. These vibrations through handlebar can cause pain to various body parts such as shoulder, palm etc. Thus, these vibrations need to be reduced so that rider riding that two-wheeler should feel comfort. Vibrations can be reduced by using various methods such as by changing the geometry of the handlebar, by changing material of the handlebar or by inserting vibration absorbents in handlebar pipe. These techniques can reduce the vibrations and ultimately feeling comfort to the rider.

VI. CONCLUSION

Acceleration of 3g is harmful to human beings. Higher acceleration will exert more vibrations on the handlebar of vehicle. These vibrations can be measured using various methods. High frequency vibrations effect on handlebar of the vehicle. Vibrations from the handlebar are transmitted to the spine and other regions of the body, resulting in physical pain and other negative consequences. These vibrations affect directly or indirectly on human body. These vibrations can be reduced by changing geometry, material or by using vibration absorbers in handlebar.

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