Research Paper Engineering

A Review on Hand Arm Vibrations With Special Reference to Motorcycle Handlebar

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ABSTRACT

Two wheeler rider have to work with handlebar. During the travelling, handlebar transfer vibration energy to a rider's body. The motorcycle riders are subjected to extreme vibrations due to the vibrations of its engine, improper structural design of the motorcycle and the bad road conditions. The exposure to vibration, depending on various parameters of vibration, may affect major part of rider's body or only a particular organ. This exposure to part body of operator is called as 'Segmental vibration'. The most common consequences of such exposure are 'hand-arm vibration syndromes' (HAVS), which affects the hands and arms. Segmental vibration not only influences the health but also efficiency and social life of riders. Paper is a review of various literatures available on hand arm vibration and its effects. The literature review reveals that the vibrations are most hazardous to thehealth if it exceeds the limit

KEYWORDS two wheeler, vibration, handlebar, HAVS, health, segmental vibration, rider

INTRODUCTION

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. Experimental studies on the transmission and tolerance of vertical vibrations which are beyond the permissible limit according to the literatures confirms 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.

Hand arm vibration & its effects

Hand arm vibration (HAV) is vibration transmitted from hand-held equipment such as jack hammers and steering wheel and handle bar into the hands and arms of operators. It leads to vibration induced white finger (VWF). If detected early, this dis-ease is curable. If not, it can cause permanent disability in the use of the hands. Steering wheel vibration levels as high as 1 m/s^2 have been reported in one study. HAV at this level may present a slight risk of injury considering the long exposure durations of driving. It was also observed that the rates of finger numbness, finger stiffness, and shoulder pain and shoulder stiffness were significantly higher among traffic motorcyclists as compared with the control group.

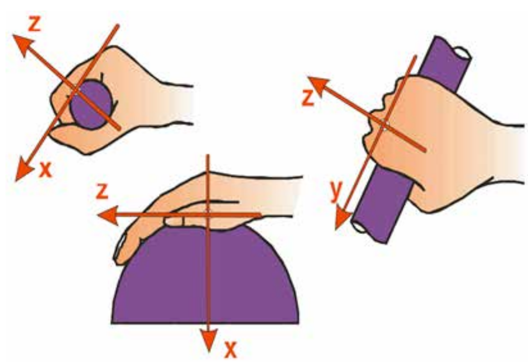

Figure 1: Hand-arm Vibration[2]

Whole body vibration and its effects

Whole body vibration (WBV) occurs when workers sit or stand on vibrating seats or foot pedals. Prolonged exposure to high lev-els of WBV causes motion sickness, fatigue and headaches. WBV is one of the strongest risk factors for low back disorders. Vibrations with less than 0.315m/s2 are found to be comfortable between 0.315m/s2 and 2.5m/s2 are found to be uncomfortable greater than 2.5m/s2 are found to be extremely uncomfortable. Typical whole-body vibration exposure levels of heavy vehicle drivers are in the range 0.4 to 2.0 m/s2. Vibration is highest in the frequency range 2 to 4 Hz. For a seated person vibration in the range of 4 to 8 Hz cause the entire upper torso to resonate and should be reduced and avoided. Health effects that associated with WBV and especially the driving environment are piles, high blood pressure, kidney disorders and impotence.

Figure 2: Two wheeler handlebar

LITERATURE REVIEW

S. Agostoni et al. [1] developed the research with the aim of investigating motor vehicle ride comfort. Particular attention was paid to the handlebar owing to the fact that this component is directly related to the driver. A well-grounded, repeatable methodology is proposed with a view to designing a Tuned Mass Damper (TMD) capable of absorbing vibrations, i.e. one that is capable of reducing the vibrations transmitted to the driver via the handlebar. The starting point of this methodology is related to the steering balances placed at the extremities of the handlebar of practically all motorcycles. This paper also proposes a mean of reducing structural vibrations. Thus, not only is driver exposure to engine unbalance vibration reduced, but ride comfort is also improved.

S. Agostoni et al. [2] reviewed that motor vehicle riding comfort is mainly affected by volumetric engine inertial unbalances. Those propagate till the rider passing via engine mounts, main frame and auxiliary sub systems physically in contact with driver. On-road traction vehicle's engines are mainly characterized by transient exercise. Several structural resonances are forced by unbalances spectra exposing driver to amplified vibrations. Aim of the research is to reduce driver vibration exposure acting on modal response of structures physically in contact with river, as handlebar, footpad and saddle. An experimental methodology able to identify local vibration modes has been developed.

Jaimon Dennis Quadros et al. [3] has made an attempt to analyze and obtain the idealized operating conditions of the human body. Majority of Indian population depends on a two wheeler 1 vibration. The most common consequences of such exposure are 'hand-arm vibration syndromes' (HAVS), which affects the hands and arms. The major effects of segmental vibration can be classified as vascular and neurological. Segmental vibration not only influences the health but also efficiency and social life of workers. . Paper is a review of various literatures available on segmental vibration and its effects.

Xueyan S et al. [6] stated that the objective of this study is to evaluate an adapter method for measuring the vibration on the human arms. Four instrumented adapters with different weights were used to measure the vibration transmitted to the wrist, forearm, and upper arm of each subject. Each adapter was attached at each location on the subjects using an elastic cloth wrap. Two laser vibrometers were also used to measure the transmitted vibration at each location to evaluate the validity of the adapter method. This study found that the adapter and laser-measured transmissibility spectra were comparable with some systematic differences.

Table 2-
Probable Subjective Reactions of Persons to Whole-Body Vibration Expressed in Terms of the Overall Vibration Value [4]

Vibration	Reaction
Less than 0.315 m/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

Xueyan S et al. [7] states that to help optimize the adapter approach, the specific aims of this study are to identify and understand the major sources and mechanisms of measurement errors and uncertainties associated with using these adapters, and to explore their improvements. Five representative adapter models were selected and used in the experiment. Five human subjects served as operators in the experiment on a hand-arm vibration test system. The results of this study confirm that many of the handheld adapters can produce substantial overestimations of vibration exposure, and measurement errors can significantly vary with tool, adapter model, mounting position, mounting orientation, and subject.

Ren G. Dong et al. [9] states that the hand coordinate systems for measuring vibration exposures and biodynamic responses have been standardized, but they are not actually used in many studies. This contradicts the purpose of the standardization. The objectives of this study were to identify the major sources of this problem, and to help define or identify better coordinate systems for the standardization. This study systematically reviewed the principles and definition methods, and evaluated typical hand coordinate systems. This study confirms that, as accelerometers remain the major technology for vibration measurement, it is reasonable to standardize two types of coordinate systems: a tool-based basicentric (BC) system and an anatomically based biodynamic (BD) system.

Stefano Mattioli et al. [10] stated that prolonged exposure to hand-transmitted vibration is associated with an increased occur-rence of symptoms and signs of disorders in the vascular, neuro-logical and osteoarticular systems of the upper limbs. However, the available epidemiological evidence is derived from studies on high vibration levels caused by vibratory tools, whereas little is known about possible upper limb disorders caused by chronic exposure to low vibration levels emitted by fixed sources.

CONCLUSIONS

Vibration is a physical disturbance that occurs in machines and automobiles. The nature of vibration that is present in a vehicle depends upon the dynamic characteristics of the automobile and road surface characters. Its effect on the human body depends mainly on the frequency, magnitude, direction, area of contact and duration of exposure. Exposure to HAV and WBV will result in transmission of vibratory energy to the entire body and leads to localized effects. It affects comfort, normal functioning of the body and health. Exposure to certain frequencies of vibration may have profound effects on specific systems of the body de-pending upon the natural frequencies of it and acceleration of the vibration at that frequency. The acceleration depending upon its magnitude and duration of exposure leads to unhealthiness of the human being. The HAV accelerations measured on different roads on different motorcycles shows it is dangerous even considering short duration of riding. The review concludes that HAV affects very seriously on human health. Uptil now the research has been covered for HAV reduction in the areas like mining industries, power tools, heavy machinery but there is extreme need to reduce the vibration in two wheeler handlebar. The research focuses on the HAV reduction related to two wheeler handlebar by using particle damping.

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