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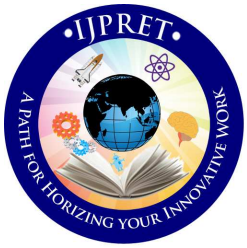

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A PATH FOR HORIZING YOUR INNOVATIVE WORK

SEAT DESIGN OF TRUCK FOR IMPROVED ERGONOMICS AND COMFORT FOR DRIVER

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Abstract

Drivers spend maximum time in travelling and need comfort. The present investigation addresses to driver's seat comfort. Comfort is vital attribute those today's drivers are demanding the most. It is the prime issue because customer's satisfaction and evaluation is directly based on their seating comfort. If comfort is not provided it will results in various problems of driver's health. Driver's comfort is not being studied seriously in Indian trucks. Driving a truck in Indian condition cannot be compared with developing countries because of the external factors like road condition etc. Driving throughout the day in such conditions leads to various health problems for the drivers. This may even lead to accidents. So it is important to design the comfortable seat for truck drivers keeping in view the ergonomic factors such as anthropometry, physiological workload, psychological stress etc. Present research is divided in two parts. First, to conduct survey amongst the truck drivers, examine the travel time factor, and seat discomfort. Second is to design and recommend best possible alternatives of driver's seat with the aid of ergonomics and advanced design tools like CAD CAE.

INTRODUCTION

Most of the research findings concerning industrial and office chair design can be applied to automobile seat design. However, there are several important considerations unique to the mobile environment that should influence design recommendations. In particular, the control locations and sight line requirements serve to constrain postures to a greater extent than in most other seated environments. Safety concerns dictate that the driver be alert and continually responding to changing road conditions, and be positioned in such a way that the occupant restraint systems offer maximal protection in a crash.

Automotive seats, which are in contact with vehicle occupants, play an important role in improving the comfort and work environment of a driver and passengers. The improvement of automotive seating systems, particularly for the driver, has been the subject of intense interest for many years since a driver feels more fatigue than passengers. Seat is one of the important features of vehicle and there is the place where the truck driver spends most of their time. According to the 'European Union Legislation for Drivers and Promote', the weekly driving time for truck drivers shall not exceed 56 hours [2]. In America, the driving limit for truck drivers, as defined by the Federal Highway Administration Hours of Service (HOS) regulations, is 10 hours. Almost 20% of drivers, however, reported that they "always or often" exceed that limit. Commercial trucks are unique in that they are specifically designed to transport loads over long distances, in contrast to aircraft passenger seat that are designed for individual comfort. The truck driver's seat, which is in contact with the drivers, plays an important role to position the driver to perform the task of driving, meet the safety requirements, and be acceptable to the driver's comfort needs.

The seat comfort is typically used to define short term effect of seat to the human body. Comfort is generic and subjective feeling that is difficult to measure, interpret and related to individual.

Defining Work Zones

The purpose of modelling is as follow.

• To get clear idea to locate the seat and exact position of seat.

• To define the work zones according to the usage of features.

• To make use of anthropometric dimensions while designing the seat.

• To modify the dimensions if it is not correct.

Figure 1.1 Rigid and non adjustable seats in 6 wheelers trucks in India.

Need of Project

Most people are probably aware that driving is detrimental to the general health of the spine, and many authorities believe it is an aetiological factor in many conditions. The most obvious reasons are the loss of the lumbar curve during prolonged driving and the vibration and jolting to which the spine is subjected. Whilst these factors are of great importance there are other less obvious ones at work all of which are due to the design of the modern motor car, heavy duty vehicles like truck. The object of this project is to design a comfortable seat for truck drivers on Indian road conditions. Hence some points are essential while designing a seat & they are

- Improve the driver's overall experience
- Increased comfort
- Reduces fidgeting by maintaining proper posture
- Reduce risk of musculoskeletal injury
- Both achieved by design for proper ergonomics
- Adjustable Seat which provides a sense of customization
- Accommodates maximum of the population
- Advanced features can increase marketability of product
- Improved benefit of long-term physical health of drivers.

Figure 1.2 Position of back during seating

LITERATURE REVIEW

The automotive industry strongly encourages research in the field of objective comfort assessment, especially dedicated to the seat and the related postures .Driver posture is one of the most important issues to be considered in the vehicle design process regarding not only the car and the user but also the experimental conditions. A simulation is the execution of a model, represented by a computer program that gives information about the system being investigated. The simulation approach of analysing a model is opposed to the analytical approach, where the method of analysing the system is purely theoretical. A simulation approach may be more reliable, depending on the quality of the model.

- Alem and Strawn [1] designed and evaluated an energy absorbing truck seat for a 5 ton military truck for increased protection from landmine blasts.
- Chang et al. [2] developed a practical method for measuring seat pan and seatback contours and a graphical presentation for visual evaluation. Seat designers can use this method for evaluating seat comfort such as support, fitness and accommodation.
- Cho and Yoon [3] developed a biomechanical model of humans on a seat with a backrest for evaluating the vehicular ride quality.
- Rakheja et al. [4] developed a model to study the seated occupant interactions with seat backrest and pan, and biodynamic response under vertical vibration.
- Wang et al. [5] studied the role of seat geometry and posture on the mechanical energy absorption characteristics of seated occupants under vertical vibration. The results show that the absorbed power quantity increases approximately quadratic ally with the exposure level by the person. The results also reveal that the absorbed power is strongly dependent upon the individual anthropometry variables such as body mass, fat, and mass index. But there is no real proof of the variables given.

Computer-aided engineering (CAE) methods such as finite element analysis and

simulation techniques have also been used to study and to develop vehicle seats.

- For modelling purposes and for evaluation of driver's seat performance in the vertical direction various computer-aided design models of the seated human body have been developed and standardized by the ISO such as ISO 2631.

Some research used the seated man model, anthropometrics and low back pain problems to study the driver's ergonomics. In this project, we will be designing and suggesting new improved design of driver's seat on Indian roads.

IMPORTANT FACTORS FOR SEAT DESIGN

- Comfort Level during seating
- Backrest Width, Height
- Cushion Width, Length
- Seat Height
- Lumbar Support
- Neck height
- Thigh height
- Backbone height

Data Collection & Evaluation

- 68 trucks of different make (TATA and ASHOK LEAYLAND) were considered.
- 68 truck drivers from Nagpur and Madhya Pradesh were interviewed personally and the detailed questionnaire was filled by them which include details regarding seating posture, driving habits, body parts dimensions, problems due to driving etc.
- Feedback results were used to decide the average dimension for seat design as per ergonomic standard and working situations.

The data of different drivers are collected by using the photographs, survey and detailed questionnaire which includes the data related to the truck type, truck maintenance schedule, driver's habits, drivers body dimensions, drivers pain history etc. The 14 different parameters are found out which are essential for designing a seat for drivers. The averages of all the parameters are taken individually to set the exact dimensions of the seat. The data is collected from the Musale Mines Pvt Ltd, Ambakhapa, Madhya Pradesh.

TABLE 3.1THE AVERAGE DIMENSION OF DRIVERS FROM MUSALE FIRM

Notation	Parameters	ABC FIRM (AVG)
A	Normal sitting	770
B	eye length	687
C	lower lumber	99
D	mid shoulder	577
E	elbow rest	227
F	knee	536
G	vertical upward reach from mid shoulder	750
H	popliteal	377
I	Buttock to pop.	389
J	ventricle upward reach from seat surface	1361
K	arm reach from floor	1573
L	buttock to leg length	776
M	comfortable length	965
N	bi deltoid	480
O	waist	245
ALL ABOVE DIMENSIONS ARE IN MM		

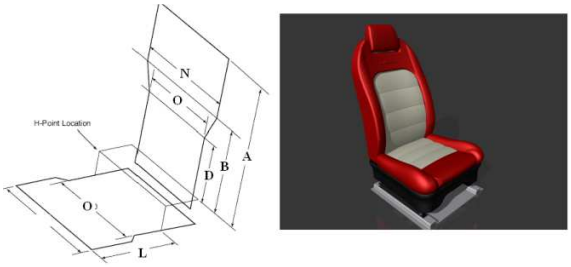

Figure 3.1 Proposed conceptual seat having the notations for dimensions

Figure 3.2 Human models testing on conceptual seat in CAD software

Importance of H Point:

In vehicle design and especially automotive design, the H-point (or hip-point) is the theoretical, relative location of an occupant's hip, specifically the pivot point between the torso and upper leg portions of the body, either relative to the floor of the vehicle or relative to the height above pavement level and pertinent to seating comfort, visibility from the vehicle into traffic and other design factors. Technically, the measurement uses the hip joint of a 50th percentile male occupant, viewed laterally.

The position of H point must be as close as possible to centre of gravity.

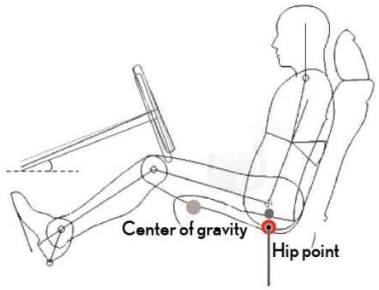

Figure 3.3 Position of H point while driving

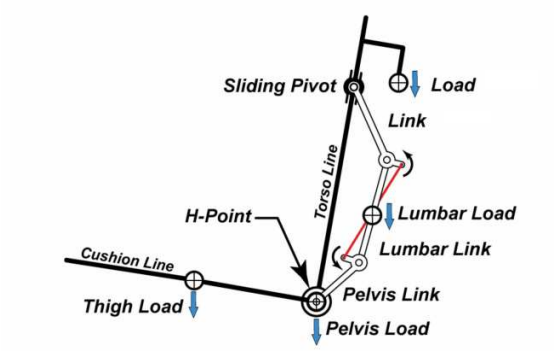

Figure 3.4 Load distribution and attachments in new seat for comfort

CONCLUSIONS

Critical review of literature has been done in context with the problem defined. The Ergonomic investigation is carried out to estimate the seat dimension which can

accommodate the majority of the driver's population. The comfort is the key feature in this context and safety of driver is other. Few of the dimensions are calculated using available data and rest with sample data. The conceptual model is created using CAD packages and comfort level test is carried out.

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