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ASSESSMENT OF THE VIBRATION ON THE FOAM LEGGED AND SHEET METAL-LEGGED PASSENGER SEAT

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In this study, it was aimed to decrease the vibration reaching to passenger from the legs of vehicle seats. In order to determine the levels of vibrations reaching at passengers, a test pad placed under the passenger seat was used, and HVM100 device was used for digitizing the information obtained. By transferring the vibration data to system by using HVM100 device, the acceleration graphics were prepared with Blaze software. As a result, it was determined that the acceleration values of seat legs made of foam material were lower than that of seat legs made of 2 mm thick sheet metal, so they damped the vibration better.

Key words: Foam material, vibration, damping, acceleration

INTRODUCTION

Acceleration is an important parameter in vibration. Acceleration, in vehicles, leads passengers to get tired. Tiredness curves were prepared according to the acceleration value of World Health Organization. Tiredness durations varydepending on the acceleration value. As the acceleration increases, the duration of tiredness decreases. In other words, as the acceleration gets higher, the patient reaches at the tiredness threshold sooner.

Nowadays, metallic foams are produced from many metals. Dimensions of pores affect to the mechanic properties [1]. In fact, many car seats are made of molded poly-urethane foam blocks. Foam is a highly nonlinear and complex material [2]. In general; the dynamic response of the seats is examined in tests, where the acceleration is measured at the ground and seat-bottom while there is a passenger on the seat [3]. It has been emphasized that the roughness and the velocity on road is a factor increasing the vibration value [4]. The standards of seat test require the use ofhuman objects for measuring vibration isolation of the seats [5].

In a field study on whole-body vibration, which tractor drivers are exposed to, it has been found that 45 % of the seats have increased the level of vibration that the drivers are exposed to [6]. Estimating the response of structure of human body and seat contacting each other is still a difficult task. The mean reason of that is the dynamic behavior thathuman body sitting on the seat exhibits in response to the vibration [7]. In order to minimize the response to the vibration, a mathematical model of tractor-passenger involving a new seat suspension was investigated [8]. By using 2 alternative models of human body (single degree of freedom and double degrees of freedom), the seat and foam conductivities were estimated at 1,25 and 25 Hz frequency ranges [9]. In porous material, the damping coefficient depends on the pours. As the number of pours increases, then the damping also increases [10]. Medical and biological effects of the vibration significantly depend on its magnitude and its exposure duration. The frequency of vibration having significant effect on human body is between 1 Hz and 100 Hz [11]. In vehicles, the effect of vibration firstly emerges as tiredness. Tiredness gradually increases the muscle tension of driver, and leads to increase in hormonal secretion by affecting nervous, blood circulation and digestive systems [12]. The reason of spinal failures has been,in many studies,found to be the vibrations transmitted from the vehicle to driver. In a clinic study carried on a person spending more than half of his working hours on driving a motor vehicle,it has been determined that he was more compliant about the back ache than other people do [13-15].

In experimental study carried out, it has been investigated, by assessing the information obtained from acceleration measurement that damping was affected from, how much the contribution of material, which was used in manufacturing the seat leg, on vibration damping was. Acceleration measurements were taken by imitating the smoothness of a standard road. All these information were translated into graphic data by collecting in computer environment.

MATERIALS AND METHODS

Because it is much more resistant in proportion to other metal materials despite it is much more lightweight than them, and it has abilities such as adsorbing shocks and pulses, and providing thermal isolation, foam metals have found many areas of use in various industrial branches.

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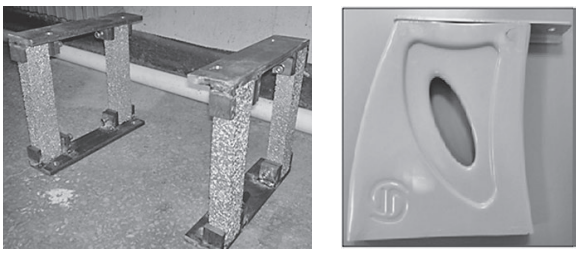

Figure 1 The Original legs and foam legs

In order to cast the open-porous aluminum foam material that will be used in seat legs, the mold made of SAE1040 material with dimensions of 50 x 30 x 500 mm to be used in leg manufacture was prepared.

After the mold production, the casting process of the foam material to be used in seat construction was started. 4 seat legs at dimensions of 25 x 40 x 250 mm were produced from porous aluminum material by using vacuum casting method. The Original legs and foam Legs as seen in Figure 1.

The legs were changed on car. For experimental study, the speed bump was placed on the road in order to make seat acceleration significant. Fiat Ducato minibus was utilized in this study. The vehicle had pass over the speed bump at speeds of 25 km/h, 50 km/h and 75 km/h. The accelerations occurring as a result of vibrations reaching to passenger from original leg and foam leg were compared through these graphics.

In order to determine the levels of vibrations reaching at passenger seat, as seen in Figure 2, the passenger was sit on 3 directional acceleration receiver – test pad placed on the seat.In order to prevent any weight change throughout the study, the person sitting on the seat during the study was the same person in all the measurements. The acceleration in 3 directions was recorded HVM 100 device during 2 minutes of vehicle travel.

The information in HVM100 device was translated into graphics in computer by utilizing Blaze package software, and acceleration graphics were obtained by measuring the vibrations reaching at human body through driver seat.

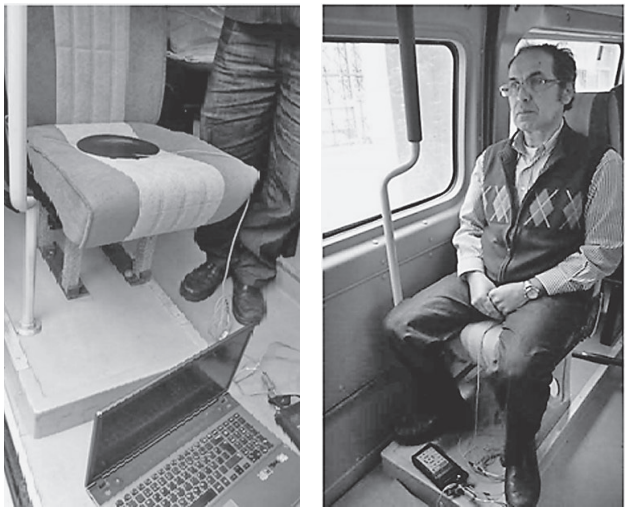

Figure 2 Acceleration measurement test work

RESULTS AND DISCUSSION

Acceleration is an important parameter in vibration. Decreasing the acceleration magnitude in vehicles is an important area of research. As the level of acceleration increases, the duration of tiredness decreases. In other words, as the acceleration gets higher, the patient reaches at the tiredness threshold sooner.

The accelerations of both of seat legs were measured at 3 speed levels.While the vehicle passes over the speed bump, the acceleration in vehicle is higher than it is on a normal road.

As seen in Figure 3, the acceleration value of original leg was higher than that of foam leg. Moreover, as the speed increased, then the acceleration also increased. The acceleration levels of the seat with original leg increased before the seat with foam leg did.

As seen in Figure 4, the acceleration value of original leg was higher than that of foam leg. Moreover, as the speed increased, then the acceleration also increased. The acceleration levels of the seat with original leg increased before the seat with foam leg did.

As seen in Figure 5, acceleration level of the original leg is higher than that of foam leg. Moreover, as the speed increased, then the acceleration increased more.

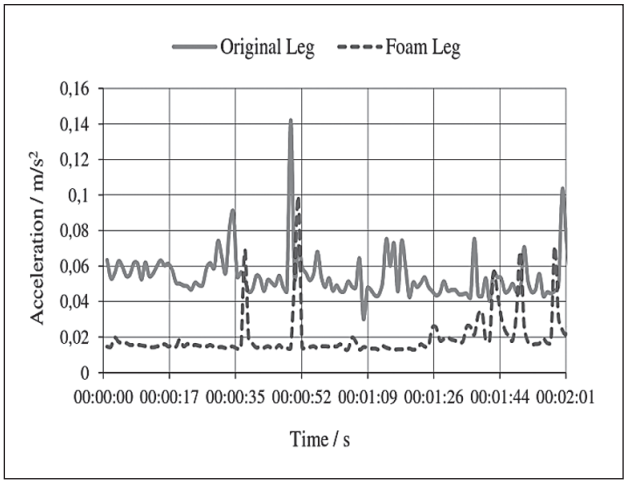

Figure 3 Acceleration-time graphic of original and foam legs at 25 km/h

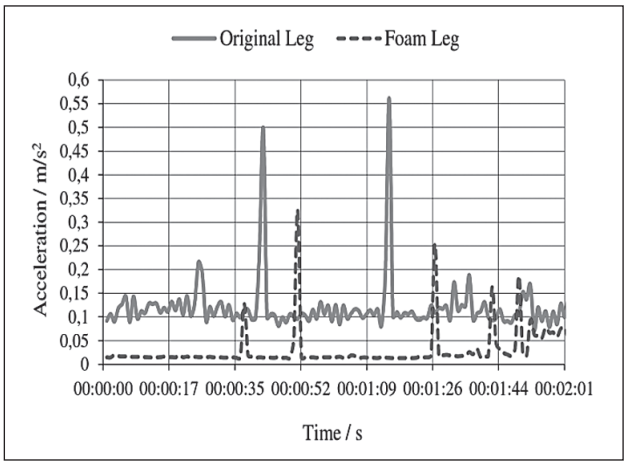

Figure 4 Acceleration-time graphic of original and foam legs at 50 km/h

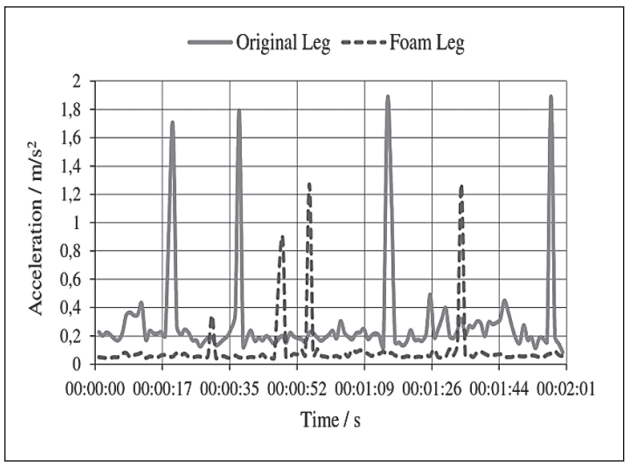

Figure 5 Acceleration-time graphic of original and foam legs at 75 km/h

As seen in graphics, whole of the vehicle passing over the speed bump showed vertical rigidity. On the other hand, both of speed and acceleration of the vehicle reached maximum. The graphics prepared are the graphics of vertical acceleration. It was observed that acceleration values increased as the speed increased.

CONCLUSIONS

Passengers may be damaged permanently in the condition of vibration.

In this study, it was aimed to decrease the vibration reaching to passenger from the legs of vehicle seats. For this purpose, seat legs were manufactured from aluminum foam material by utilizing vacuum casting method. In experimental study, 2 seats having different legs were placed into the same type of vehicles. By examining the values of vibrations reaching at passengers on seat while the vehicle was moving, the effects of the legs on vibration damping were compared. At speeds of 25km/h, 50km/h and 75km/h, the passenger travelled on a bumpy road.

As a result of performed experimental study, it was observed that acceleration has increased in both of legs as the speed increased. Acceleration measured at seat with aluminum foam leg was found to be lower than the acceleration measured at the seat with original leg. Acceleration levels of the seat with original leg increased before the seat with foam leg did. It was observed that the foam material improved the comfort and delayed the tiredness threshold. Accordingly, the seat with foam leg damped the stimuli forces better than original legs did. Faster movement of vehicles decreases the tiredness threshold. Thus, passengers get tired sooner. Travelling at appropriate speeds is more advantageous from the aspect of vibration.

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Note: The responsible translator for English language: Volkan Serin, Izmir, Turkey