

MOTOR VEHICLE SEATS AND THEIR DEFECT CLASSIFICATION

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Abstract. A seat is the most important component of a vehicle where the driver spends most of his time. Various seat constructions, driver's back support, seat depth, seat upholstery can have a complex impact on the driver's working capacity and professional health. The driver is subjected to a number of health problems because of vibrations. Because of long hours of sitting in dynamic action environment, discomfort and tiredness may appear which can lead to decreased attention, perceptivity, decision-making, watchfulness, reaction time. The aim of the paper is to analyze the classification of seats and their defects for further research to analyse a driver's tiredness and vibration impact.

Key words: motor vehicle seats classification, defects of seats, all body vibration.

Introduction

Vehicles of different age and quality are exploited in Latvia and various seat constructions are used in them. Over time, the seat material is damaged hence the repair of a seat is required. A defective seat cannot provide a proper seated position of a vehicle driver or a passenger and as a result might cause different occupational diseases. Human vibration refers to the effects of mechanical vibration on the human body. Excessive exposure to mechanical vibrations can negatively affect the human body. For example, exposure to whole-body vibration from operating machinery can lead to physical problems such as spinal disorders. Measuring and analyzing human vibration signals can help control the negative effects of mechanical vibration on the human body. There are three types of human vibration signals which are possible to measure and analyze: hand-arm vibration signals; whole-body vibration signals; low-frequency whole-body vibration signals. The following illustration shows the coordinate system used to measure whole-body human vibration, as defined by ISO 2631-1:1997 [1].

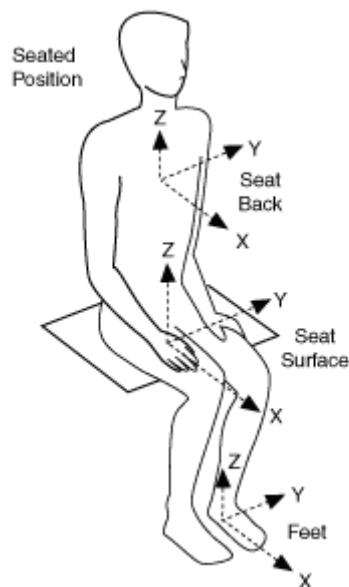


Fig. 1. Coordinate system for measuring whole-body vibration according to ISO 2631-1:1997

In order to carry out further research of seats and material selection for repair and selection of an appropriate repair type as well, it is required to make the classification of seats and wear and tear classification of seats.

Materials and methods

A number of studies have proved that there is a great correlation between comfort (short-term sense) and tiredness (long-term physical impact). At the beginning, the initial comfort might be

acceptable, but not always it will be comfortably for a long-time [2]. Human tiredness is influenced by many physical factors: pressure on a seat, posture, dynamics and vibrations of a body, a number of environment factors in a vehicle's cab. Studies have shown that a single seat cushion construction cannot perfectly comply with a driver's multiform group of adjustable features: width of a seat, side supports, lumbar support, elbow-rests [3]. Some studies have shown that correlation between tiredness and low-frequency vibrations is possible and which is usually experienced by truck drivers. Vibrations can cause discomfort and tiredness. Human's exposure to mechanical vibrations can cause tiredness and discomfort. The magnitude of that impact depends on duration of intensity and direction of excitation. The requirement of the base of a seat cushion design is to provide a frequency range of the strength (2 – 8 Hz) for persons sitting within resonance motion [4]. Porolone helps to prevent resonance. Since porolone grows weary in the course of time, a seat which was comfortable at the beginning can become uncomfortable over time. It makes a driver to move himself in order to find a new more favourable position. Two major theories are brought forward in designing of seat comfort in regard to distribution of pressure contact:

1. to even the applied pressure.
2. to focus pressure on the hardest parts of a body.

In the current research field, the comfort measures have been successfully identified by seat comfort in order to determine the comparative comfort characteristics of different seat cushions. Regarding the seat construction, Mercedes-Benz made improvements on the already existed concept. Now, all seats are equipped with special porolone which is used only by Mercedes-Benz. Under the seat fabric or leather upholstery additional foam filler is put which provides immediate feeling of comfort sitting down in a car. Active multicountur seat package (additional equipment) includes newly built diversified seats with comfortable head restraints and two-stage massage function in the backrest. Depending on a turning angle, acceleration and car speed, high-speed piezoelectric valves change the pressure in the air chambers of the backrest, thus, the volume is changed, ensuring the best side support for a driver and a front passenger. If a seat is too high, the bottom of hips will be compressed. This causes discomfort and troubles circulation of blood. If a seat is too low, the legs will be broadly placed in front, but such position causes the hip discomfort. If a seat is too deep, the front surface or edge of a seat will press the area around knees which troubles circulation of blood both for legs, and feet. Tissue compression leads to discomfort and irritation of a driver. A driver changes the body position to avoid discomfort. The height of a seat depends on a seat type and use. In some cases, it is sufficient just to support the lumbar area slightly up or below as, for example, small tractor vehicles or bus vehicles. The distance for the stated part of buttocks is very important. Each vehicle has its own seat type which is designed exactly for a particular type of vehicle. The vehicle seat has several variants, stationary seats, suspension seats, swivel seats and sport seats (see Fig. 2).

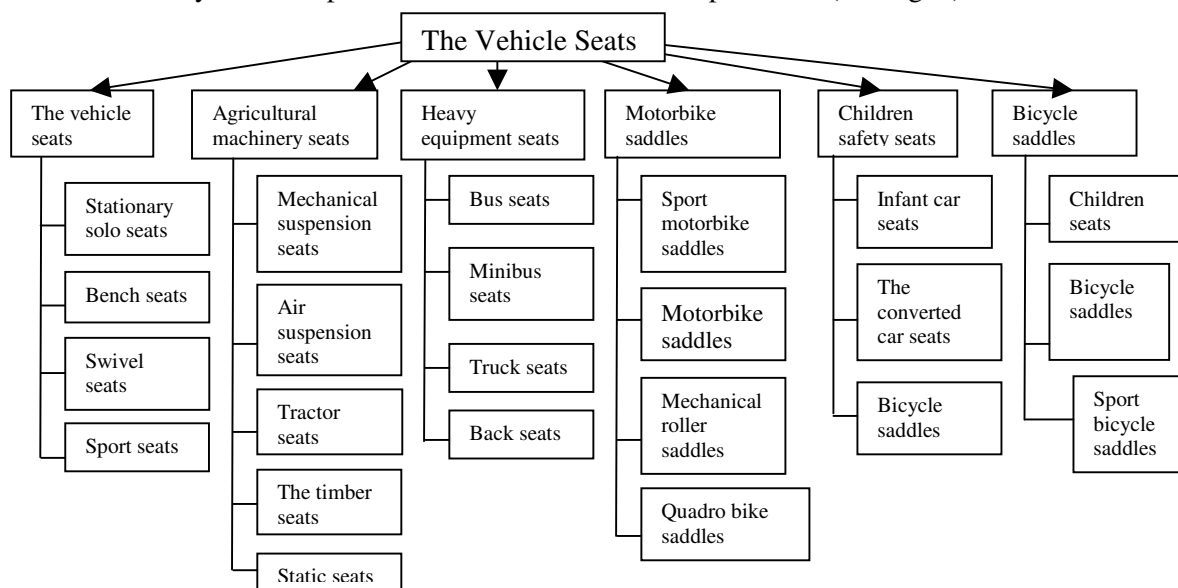


Fig. 2. Classification of motor vehicle seats

Results and discussion

The vehicle seats are shaped with marked streamlines to provide comfort for a driver at the wheel. Sport seats offer opportunity to experience more car driving. The seats are equipped with one of the newest features in order to provide much comfort for a driver. Ergonomic seat position can be adjusted by choosing the most convenient distance to the steering wheel, the seat height, the slope of a backrest, lumbar support and backrest curvature. There are seats equipped with electronic control which provides automatic seat pushing off for driver's easy boarding in a car. The massage function is built in the driver's seat which helps to relax and prevents tiredness during long distance drives. The seats are equipped with the ventilation functions which are useful for cars with leather interior, especially in summers. Depending on the equipment there are seats the edge side supporters of which expand depending on the car manoeuvring speed, securing more support of that side where the driver's body leans. The seat is designed to cope with pressure not exceeding 120 kg. There is an airbag installed into seats in case of accident which jumps out of the material seam place. The seats are covered with genuine leather, leather-substitute, velour, textiles, alcantara (genuine leather product).

Bus seats include small buses, large buses and school buses. The bus seats are constructed to improve the vehicle design and maximum comfort and safety. Bus seats are comfortable for drivers; the following equipment with different functions can be met in the bus seat: height adjustment memory, rapid air release and reduction, adjustable shock-absorber, the extended seat cushion, precise adjustment of slope to recline, air suspension with dual hydraulic shock-absorber, air lumbar support. It is covered with high quality fabrics. The highest 3-point seat belt system.

Mechanical suspension seats are designed for small, medium and large range tractors. The built-in control unit combines the major tractor functions which are easy accessible by a tractor driver.

The tractor seats can be equipped with many features; mechanical suspension with a small imprint,

70, 90, 100, 175 mm vertical suspension travel, driver's manual control, weight 50 – 120 kg; one piece foam with PVC trim; ventilation and surface drainage grooves; lumbar support; adjustable angle backrest; adjustable height 75mm.

Air suspension seats are made for heavy equipment, bulldozers, dump trucks, forestry equipment, excavators, front loaders.

There are various functions in the seats depending on the equipment: air suspension; low air speed with hydraulic shock-absorbers, strengthened seat frame, length, tilt adjustment; 160mm vertical suspension travel, 60, 100 mm height adjustment, headrest, lumbar support, adjustable angle backrest, left hand control unit, 5 position lumbar support. The bicycle saddle is a separate group. The saddle is anticipated for different biker's weights. The perfect bicycle saddle type forms help increase comfort and agility, to control cycling. A classic bicycle saddle consists of the saddle base, upholstery and leather upholstery. The racing saddle is made of titanium material, powerful with high-speed grooves. The racing bicycle saddle is narrow, lightweight, more flexible in wide or tense curves. The narrow shape of the saddle, medium-thick upholstery allows moving on the saddle in such a way to adjust for cycling down the escarpments or going up. Gel bicycle saddle is a new ergonomic seat cushion type. The gel material is in the cell foam form when air bubbles in the saddle are higher than standard pressure. The gel cushion helps make cycling more comfortable. The motorbike saddles have different shapes and sizes, but the main task is to provide comfortable and stable sitting for a driver in order to get the balanced weight distribution. The motorbike saddle may consist of the following features: saddle base; structural foam core; water-permeable membrane; encapsulated gel capsule; seat cover. The motorbike saddle foam is selected by two features: foam density and strength, flexural deformation. The motorbike saddle foam is produced from the highest quality material.

The motor vehicle seat is subjected to different loads, environment effect, friction, natural wear and tear. The seat has to hold not only a single overload, but it also has to resist multiple overloads. After the repeated overloads the material is exhausted. At the beginning the seat base material may be microstructurally damaged then chaps in the seat base or in weld connections might appear.

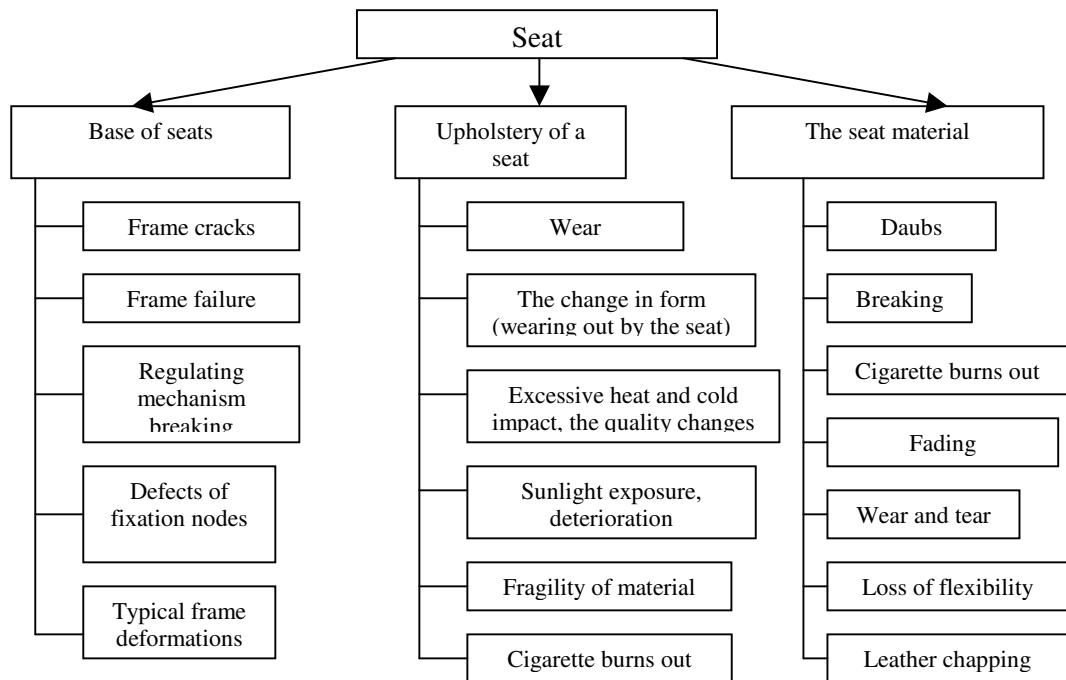


Fig.3. Classification of seat defects

The seating foam is regularly exposed to severe conditions, excessive heat, extreme cold and high humidity which significantly affect the condition of seat foam.

The seat upholstery and the material are subjected to friction, every time when a driver boards and leaves a vehicle, friction between a driver and a vehicle seat is formed. Because of friction the material gets thinner, begins to split and holes appear.

Conclusions

1. The seat construction affects the vehicle vibration impact on the driver.
2. According to the developed classification there is no methodology for evaluating the seat defects in Latvia and this aspect is not evaluated as well.
3. The porolone seat cannot comply with all different anthropological specific characters of the driver.
4. The porolone cushion is degrading over time, reducing the vibrational defence capability of a seat.
5. Future research direction should be guided to investigation of the vibration level affecting the driver that depends on the seat construction and its technical condition.

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