A DISSERTATION REPORT

ON

AUTOMOTIVE SAFETY SYSTEMS

Submitted to:

UNIVERSITY OF PETROLEUM & ENERGY STUDIES

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B.Tech (Automotive Design Engineering)

A

MAJOR PROJECT

ON

AUTOMOTIVE SAFETY SYSTEMS

A report submitted in partial fulfilment for the award of the degree

Of

BACHELOR OF TECHNOLOGY

(Automotive Design Engineering)

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UNIVERSITY OF PETROLEUM & ENERGY STUDIES
(ISO 9001:2000 Certified)

CERTIFICATE

This is to certify that the work contained in this project report titled "*AUTOMOTIVE SAFETY SYSTEMS*" has been carried out by **Abhinav Singh Rawat (R140205002) & Rahul Kumar Gupta (R140205035)** under my supervision and has not been submitted else where for a degree .

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CONTENT

LIST OF FIGURES

LIST OF ABBREVIATIONS

LIST OF ABBREVIATIONS

Vehicle Safety Technology (VST)

Supplemental Restraint Systems (SRS)

Electronic brake force distribution (EBD)

Traction control system (TCS)

Emergency brake assists (EBA)

Electronic stability control (ESP)

Frontal Protection System (FPS)

ABSTRACT

This report being a part of the fulfilment of the academic curriculum focuses on automotive safety system. The Project included contains both study and suggestions.

This report is a medium of our understanding of the advanced automotive safety system. It is a commonly held view that a safe car cannot be cheap. In the entire history of automobile there has never been a period when the design and development of automobiles was governed solely by safety concerns. In the past five decades automotive safety systems (both active and passive) have undergone tremendous transformations. Although they are totally effective but they have failed to become the part of the standard automobile. In the present scenario a safe car is synonymous to a luxury car. More expensive an automobile more will be the number of safety systems incorporated by it. The automobiles used by the masses are designed for economy and not primarily for safety.

The objective of this project work is to find such methods of increasing automobile safety that can become part of the standard automobile without any appreciable rise in cost.

OBJECTIVES

1. STUDY OF AUTOMOTIVE SAFETY SYSTEMS.
2. TO INTRODUCE FOAM IN SEAT BELT TO REDUCE THE COLLAR BONE INJURY PROBLEM ESPECIALLY FOR OLD OCCUPANT.
3. TO REDUCE THE IMPACT OF THE FRONTAL COLLISION & INJURY FOR PEDESTRIAN BY INTRODUCING IMPACT ABSORBING MATERIAL IN THE FRONT BUMPER.
4. TO REDUCE THE WHIPLASH INJURY IN THE NECK REGION OF THE PASSENGER.


CHAPTER-1

INTRODUCTION
TO
AUTOMOTIVE SAFETY SYSTEM

AUTOMOTIVE SAFETY SYSTEM

Automobile safety is the avoidance of automobile accidents or the minimization of harmful effects of accidents, in particular as pertaining to human life and health. Numerous safety features have been built into cars for years, some for the safety of car's occupants only, and some for the safety of others (pedestrian). Safety of transportation vehicles, especially passenger cars, has to meet permanently Increasing demands. Developments in active and passive security systems in vehicles have already lead to high standards. Nevertheless, weak points are still passenger as well as the Pedestrian protection in various crash situations. Passenger vehicle safety is separated into three major areas: pre-crash safety performance (often called crash avoidance); protection of vehicle occupants when crashes occur (usually referred to as crashworthiness); and post-crash integrity of the vehicle and emergency response in the event of a crash.

Vehicle Safety Technology (VST) is a term used by the automotive industry applied to technologies focused on ensuring safety and security of automobiles and passengers. Although the category creates a broad umbrella to which many auto-related aspects may apply, VST most typically refers to car-to-computer communication devices which utilize GPS tracking features, capabilities, remote speed sensing, theft deterrent, and service alerts.

- **ACTIVE SAFETY**: Prevention of accident
- **PASSIVE SAFETY**: Reduction in the consequences of accidents

ACTIVE SAFETY SYSTEMS

- Anti-Lock Brake System (ABS)
- Traction Control System (TCS)
- Electronic stability control
- Tire pressure monitoring system
- Braking assistance
- Steering Assist Systems

PASSIVE SAFETY SYSTEMS

It helps during or after Collision/ Crash & Minimizes injuries or Extent of Damage to occupant.

- Airbags
- Seatbelts
- Crumple zone technology

Air Bags are Supplemental Restraint Systems (SRS) Supplemental to the seat belt system.
Air bags are dangerous without a seat belt.

AUTOMOTIVE TECHNOLOGIES

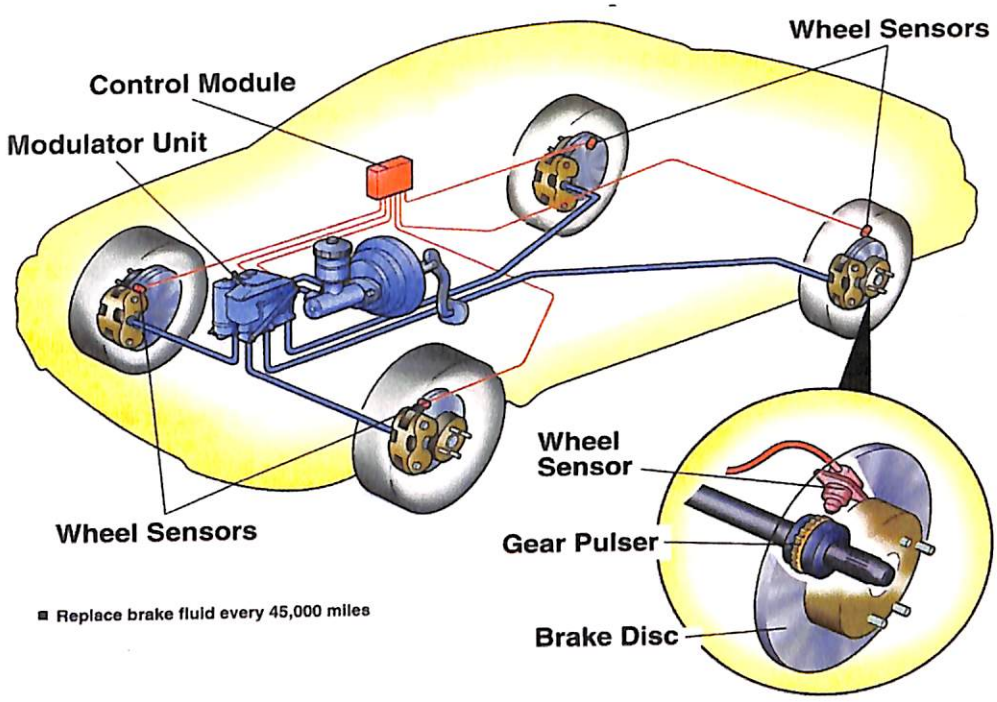
ANTI-LOCK BRAKING SYSTEM

An anti-lock braking system or ABS is a safety system which prevents the wheels on a motor vehicle from locking while braking. ABS closed loop control devices which prevent wheel lock when braking and as a result retain the vehicles steer ability and stability. In general they also shorten braking distance compared with braking scenarios when the wheel locks completely. A rotating road wheel allows the driver to maintain steering control under heavy braking by preventing a skid. While ABS offers improved vehicle control in some circumstances, it can also present disadvantages including increased braking distance on slippery surfaces such as ice, packed snow, gravel, steel plates and bridges, or anything other than dry pavement. ABS has also been demonstrated to create a false sense of security in drivers, who may drive more aggressively as a result. Since initial widespread use in production cars, anti-lock braking systems have evolved considerably. Recent versions not only prevent wheel lock under braking, but also electronically control the front-to-rear brake bias. This function, depending on its specific capabilities and implementation, is known as electronic brake force distribution (EBD), traction control system (TCS or ASR), emergency brake assist (BA, EBA or HBA), or electronic stability control (ESP, ESC or DSC).

OPERATION

A typical ABS is composed of a central electronic unit (ECU), four wheel speed sensor one for each wheel and two or more hydraulic valves within the brake hydraulics. The ECU constantly monitors the rotational speed each wheel, and when it detects a wheel rotating significantly slower than the others a condition indicative of impending wheel lock it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel. The wheel then turns faster; when the ECU detects it is turning significantly faster than the others, brake hydraulic pressure to the wheel is increased so the braking force is reapplied and the wheel slows. This process is repeated continuously, and can be detected by the driver via brake pedal pulsation. A typical anti-lock system can apply and release braking pressure up to 20 times a second. If a fault develops in any part of the ABS, a warning light will

Usually be illuminated on the vehicle instrument panel, and the ABS will be disabled until the fault is rectified.



ADDITIONAL DEVELOPMENTS

Modern electronic stability control (ESC or ESP) systems are an evolution of the ABS concept. Here, a minimum of two additional sensors are added to help the system work: these are a steering wheel angle sensor, and a gyroscopic sensor. The theory of operation is simple: when the gyroscopic sensor detects that the direction taken by the car does not coincide with what the steering wheel sensor reports, the ESC software will brake the necessary individual wheels), so that the vehicle goes the way the driver intends. The steering wheel sensor also helps in the operation of cornering brake control (CBC), since this will tell the ABS that wheels on the inside of the curve should brake more than wheels on the outside, and by how much.

TRACTION CONTROL SYSTEM

A traction control system (TCS), also known as Anti-Slip Regulation (ASR), on current production vehicles, are typically electro hydraulic system, designed to prevent loss of traction of the driven road wheels, and therefore the control of the vehicle, when excessive throttle is applied by the driver, and the condition of the road surface (due to varying factors) is unable to cope with the torque applied. Although similar to electronic stability control (ESC) systems, traction control systems do not have the same goal.

The intervention can consist of any, or all, of the following:

Retard or suppress the spark to one or more cylinders

- Reduce fuel supply to one or more cylinders
- Brake one or more wheels
- Close the throttle, if the vehicle is fitted with drive by wire throttle.
- In turbo-charged vehicles, the boost control solenoid can be actuated to reduce boost and therefore engine power.

Typically, the traction control system shares the electro-hydraulic brake actuator (but does not use the conventional master cylinder and servo), and the wheel speed sensors with the anti-lock braking system. When starting off, accelerating and braking, the efficiency required to transfer forces to the road depends on the traction available between the tires and the road surfaces. The adhesion / slip curves for accelerating and braking have the same basic patterns. When braking wheel locks within a few tenth of second. When accelerating one or both of the driven wheels start to spin more and more as the drive torque exceeds the adhesion by an ever increasing amount. ABS responds in the first case braking by inhabiting wheel lock. TCS reacts to the second scenario by holding drive slip within acceptable levels to prevent wheel spin. The system actually performs two functions:

- Increasing traction.
- Maintaining vehicle stability.

USE OF TRACTION CONTROL

In road cars: Traction control has traditionally been a safety feature in high-performance cars, which would otherwise need very sensitive throttle input to keep them from spinning the driven wheels when accelerating, especially in wet, icy or snowy conditions. In recent years, traction control systems have become widely available in non-performance cars, minivans, and light trucks.

In race cars: Traction control is used as a performance enhancement, allowing maximum traction under acceleration without wheel spin. When accelerating out of turn, it keeps the tyres at the optimum slip ratio.

In off road vehicles: Traction control is used instead or in addition to the mechanical limited slip or locking differential. It is often implemented with electronic limited slip differential, as well as other computerized controls of the engine and transmission. The spinning wheel is slowed down with short applications of brakes, diverting more torque to the non-spinning wheel.

TRACTION CONTROL IN CORNERING

Traction control is not just used for moving a vehicle from stationary without slippage. During hard manoeuvres in a front-wheel drive car, there is a point where the wheels cannot both steer and drive the car at the same time without losing traction. With traction control, it's less likely for this loss of control to occur. There is a limit though, when the tires lose grip. In some front-wheel drive cars, traction control can induce lift-off over steering due to its throttle retarding capabilities. This can keep some cars stable in long manoeuvres. In rear wheel drive cars, traction control can prevent over steering.

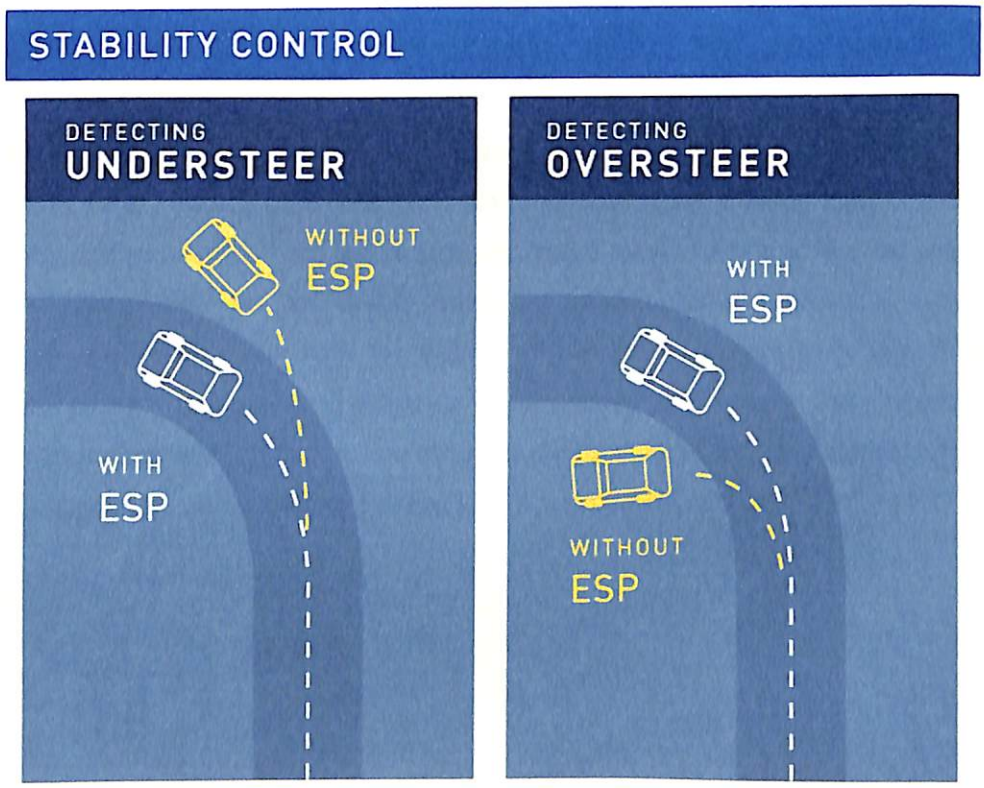
ELECTRONIC STABILITY CONTROL

An electronic stability control (ESC) is an active safety system that reduces the risk of a driver losing control of the vehicle. Also known as electronic stability programs (ESP), ESC builds upon features such as anti-lock braking systems (ABS) and traction control to stabilise the

vehicle when it changes direction from that intended by the driver. ESC helps you remain in control of your vehicle when you skid, swerve suddenly or when road conditions change. It improves handling on gravel and unmade roads and improving traction on slippery or icy roads.

OPERATION

Using a number of intelligent sensors, ESC immediately identifies when a car has deviated from the drivers steered direction and the driver has lost control of the vehicle. As soon as impending instability, over steering and under steering are registered, ESC stabilises the vehicle by selectively braking individual wheels and reducing engine torque to bring the vehicle back on course.



TIRE PRESSURE MONITORING SYSTEM

A Tire Pressure Monitoring System (TPMS) is an electronic system designed to monitor the air pressure inside all the pneumatic tires on a motor vehicle. The system is sometimes referred to as Remote Tire Pressure Monitoring System (RTPMS), or simply as a run flat indicator. **Direct** TPMS, or direct tire pressure monitoring systems (direct sensor TPMS) refers to the use of a pressure sensor directly mounted on the wheels or tires of a vehicle. The pressure inside the tire is measured using a pressure transducer with the pressure information being subsequently sent to the vehicle to warn the driver of under or over inflation of a tire. The pressure information is commonly transmitted to the vehicle using radio frequency (RF) technology, through systems using mechanical, electrical or magnetic methods have been used over recent years

DIRECT

Direct sensor TPMS delivers real time tire pressure information to the driver of the vehicle - either via a gauge, a pictogram display, or a simple low pressure warning light. These systems employ physical pressure sensors inside each tire, and a means of processing and sending that information from inside the tire to the vehicle instrument cluster. Direct sensor TPMS are designed to specifically cope with the effects of changes in tire pressure due to ambient temperature changes and road to tire friction based temperature changes. Friction between the tire and road surface heats up the tire and increases the pressure in the tire. Another advantage of this technology is that no maintenance of the TPMS is necessary.

Tyre pressure monitoring system

HAND BRAKE

The hand brake (also known as the emergency brake, parking brake) is a latching brake usually used to keep the car stationary. Automobile hand Brake usually consist of a cable (usually adjustable for length) directly connected to the brake mechanism on one end and to some type of lever that can be actuated by the driver on the other end. The lever is traditionally and more commonly a hand-operated system.

POWER STEERING

Power steering is a system for reducing the steering effort on vehicles by using an external power source to assist in turning the road wheels. Most power steering systems work by using a hydraulic system to turn the vehicle's wheels. The hydraulic pressure is usually provided by a rotary vane pump driven by the vehicle's engine. A double-acting hydraulic cylinder applies a force to the steering gear, which in turn the pumps employed are of the positive displacement

type; the flow rate they deliver is directly proportional to the speed of the engine. This means that at high engine speeds the steering would naturally operate faster than at low engine speeds.

A pressure relief valve is also used to prevent a dangerous build-up of pressure when the hydraulic cylinders piston reaches the end of the cylinder.

Electric power steering (EPS or EPAS) is designed to use an electric motor to reduce effort by providing assist to the driver of a vehicle. Most EPS systems have variable assist, which allows for more assistance as the speed of a vehicle decreases and less assistance from the system during high-speed situations. This functionality requires a delicate balance of power and control that has only been available to manufacturers in recent years. The EPS system has replaced the hydraulic steering system (HPS or HPAS) in many passenger cars recently:

CRASH AVOIDANCE

Crash avoidance systems and devices help the driver; help the vehicle itself to avoid a collision. This category includes:

- The vehicle's headlamps, reflectors, and other lights and signals
- The vehicle's mirrors
- The vehicle's brakes, steering, and suspension systems

AIRBAG

An airbag is a vehicle safety device. It is an occupant restraint consisting of a flexible envelope designed to inflate rapidly in an automobile collision, to prevent vehicle occupants from striking hard interior objects such as steering wheels. The use of airbags as a supplementary restraint system (SRS) results in a reduction in injuries from glass splinters, impact with interior fittings and reduced chance of head, neck and shoulder injuries. The large energy -absorbing area of the airbags spreads the impact and controlled deflation results in gradual dissipation of energy. Airbags provide a certain amount of protection to occupants not wearing seat belts. Airbags and pyrotechnic pretensioners are safety devices, but as they contain explosives they are capable of causing injury if mishandled. Protection irrespective of the direction of crash. It is reported that more than half of the severe injuries and deaths in automobile accidents are due to frontal

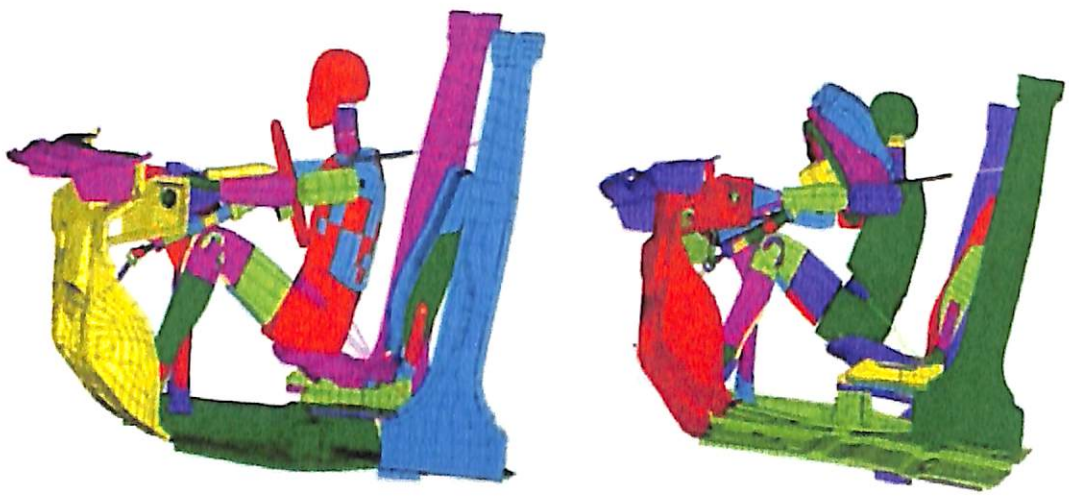
collisions. Compared to seat belts alone, airbags along with seatbelts have reduced deaths by 28% and hospitalization by 24%.

HOW AIRBAGS WORK

The design is conceptually simple; a central "Airbag control unit" (ACU) (a specific type of ECU) monitors a number of related sensors within the vehicle, including accelerometers, impact sensors, side (door) pressure sensors[, wheel speed sensors, brake pressure sensor, and seat occupancy sensors. When the requisite 'threshold' has been reached or exceeded, the airbag control unit will trigger the ignition of a gas generator propellant to rapidly inflate a nylon fabric bag. As the vehicle occupant collides with and squeezes the bag, the gas escapes in a controlled manner through small vent holes. The airbag's volume and the size of the vents in the bag are tailored to each vehicle type, to spread out the deceleration of (and thus force experienced by) the occupant over time and over the occupant's body, compared to a seat belt alone. Each restraint device is typically activated with one or more pyrotechnic devices, commonly called an initiator or electric match.

The electric match, which consists of an electrical conductor wrapped in a combustible material, activates with a current pulse between 1 to 3 amperes in less than 2 milliseconds. When the conductor becomes hot enough, it ignites the combustible material, which initiates the gas generator. In a seat belt pre-tensioner, this hot gas is used to drive a piston that pulls the slack out

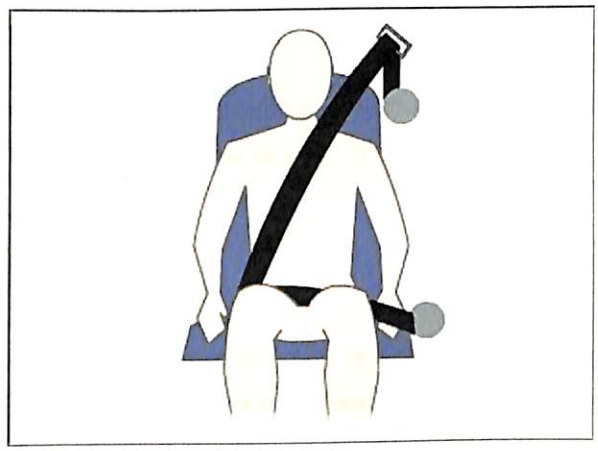
of the seat belt. In an airbag, the initiator is used to ignite solid propellant inside the airbag inflater. The burning propellant generates inert gas which rapidly inflates the airbag in approximately 20 to 30 milliseconds. An airbag must inflate quickly in order to be fully inflated by the time the forward-travelling occupant reaches its outer surface. Typically, the decision to deploy an airbag in a frontal crash is made within 15 to 30 milliseconds after the onset of the crash, and both the driver and passenger airbags are fully inflated within approximately 60-80 milliseconds after the first moment of vehicle contact. Safety belts help reduce the risk of injury in many types of crashes. They help to properly position occupants to maximize the airbag's benefits and they help restrain occupants during the initial and any following collisions.



a.) COLLISIONS WITHOUT AIRBAG CHEST BONE & HEAD ARE AFFECTED.
b.) AN AIR BAG PROTECTS HEAD COLLISION & CHEST BONES.

SEAT BELT

A seat belt, sometimes called a safety belt, is a safety harness designed to secure the occupant of a vehicle against harmful movement that may result from a collision or a sudden stop. As part of an overall occupant restraint system, seat belts are intended to reduce injuries by stopping the wearer from hitting hard interior elements of the vehicle. The seat belt is an energy-absorbing device that is designed to keep the load imposed on a victim's body during a crash down to survivable limits. Fundamentally, it is designed to deliver non-recoverable extension to reduce the deceleration forces, which the body encounters in a crash. All occupants should maintain at least 10 inches between your breastbone and the centre of the steering wheel.



Modern Seat Belts

- Prevents occupant from being thrown from vehicle
- Applies force to rigid parts of occupants body
- Increases stopping time on body by stretching belt
- Places occupant in optimal crash position

TYPES OF SEAT BELTS

LAP

Adjustable strap that goes over the waist. Used frequently in older cars, now uncommon except in some rear middle seats.

THREE-POINT

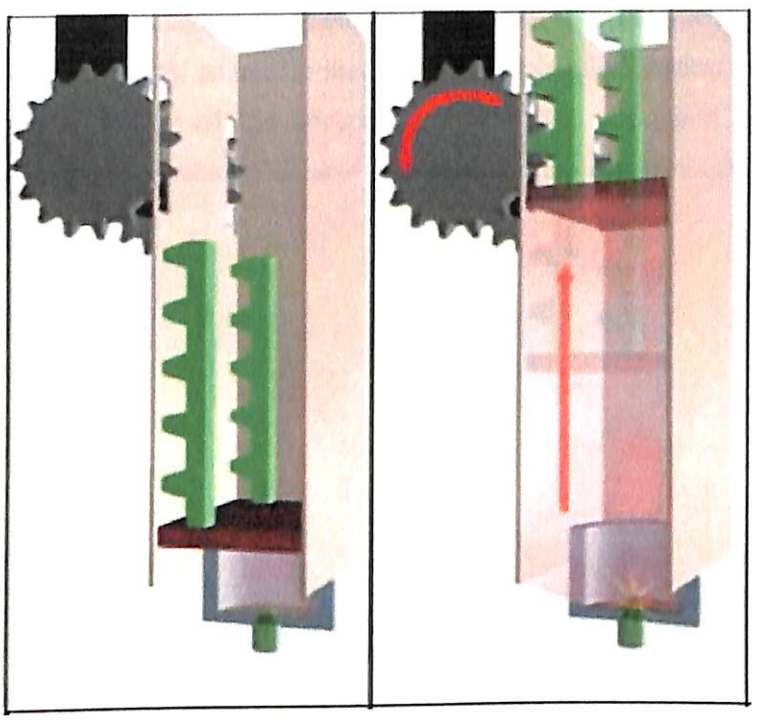
Similar to the lap and shoulder, but one single continuous length of webbing. Both three-point and lap-and-sash belts help spread out the energy of the moving body in a collision over the chest, pelvis, and shoulders.

FIVE-POINT HARNESSES

Safer but more restrictive than most other seat belt types. The lap portion is connected to a belt between the legs and there are two shoulder belts, making a total of five points of attachment to the seat. (Strictly speaking, harnesses are never to be fastened to the seat—they should be fastened to the frame/sub-frame of the automobile.)

TECHNOLOGIES

Most seat belts are equipped with locking mechanisms (or inertia reels) that tighten the belt when pulled fast (e.g. by the quick force of a passenger's body during a crash) but do not tighten when pulled slowly. This is implemented with a centrifugal clutch, which engages as the reel spins quickly. Alternatively, this function may be secured by a weighted pendulum or ball bearing: when these are deflected by deceleration or roll-over they lock into pawls on the reel.



SEATBELT WITH PRETENSIONER

CRUMPLE ZONE

The crumple zone of a vehicle such as an automobile is a structural feature designed to compress during an accident to absorb energy from an impact. Typically, crumple zones are located in the front part of the vehicle, in order to absorb the impact of a head-on collision, though they may be found on other parts of the vehicle as well.

FUNCTION

Crumple zones work by managing the crash energy so that it is absorbed within the frontal section of the vehicle (energy is transformed by the deformation instead of being directly transmitted through the body of the occupants), while also preventing intrusion into or deformation of the passenger cabin. This acts to ensure that car occupants are better protected against injury.

IDENTIFICATION OF PROBABLE PROBLEM AREAS AND SUGGESTED IMPROVEMENTS

PROBLEM 1

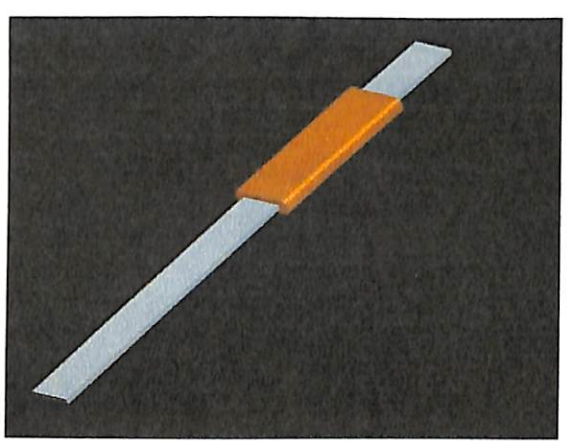
REDUCE THE INJURY IN COLLAR BONE DUE TO SUDDEN JERK OR REAR END COLLISION.

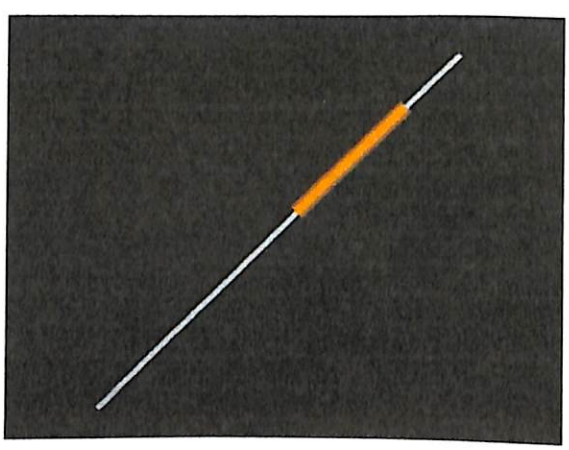
PROBLEM STATEMENT

Present seat belt made up of polyester or nylon can cause collar bone injury due to applied high brake for old occupant specially.

MODIFICATION

By introducing a foam or cushion able material in the seat belt, which can reduce the injury and provide more comfortable.





a.) Introducing Foam or Cushion able Material with

b.) A foam material increases the contact area The occupant body at the collar bone.

- Protects your shoulder or chest with comfort.
- Soft protective felt with foam cushion.

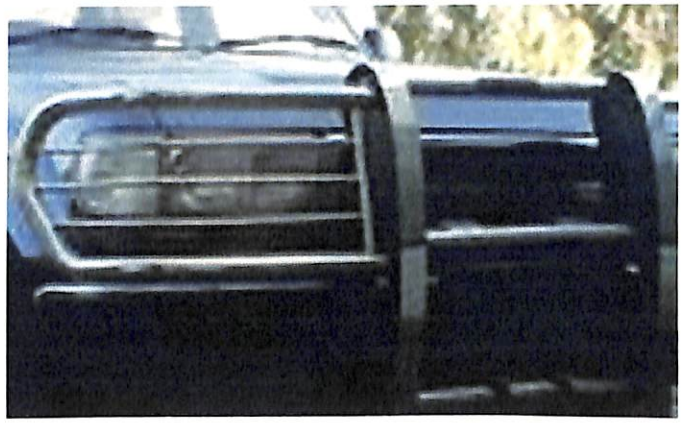
PROBLEM 2

TO REDUCE THE IMPACT OF THE FRONTAL COLLISION & INJURY TO THE PEDESTRIAN.

PROBLEM STATEMENT

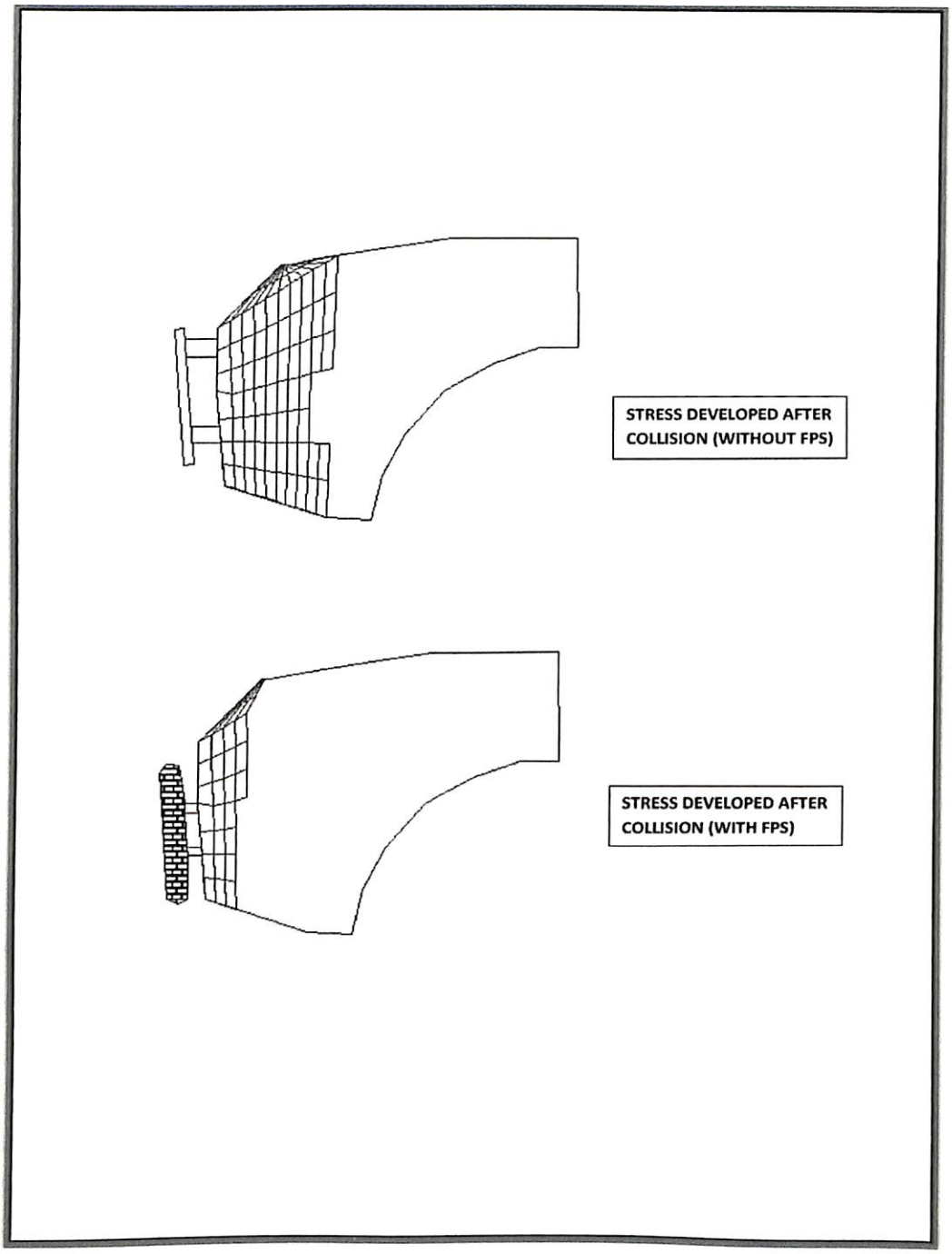
Walking is a significant mode of transport and all human beings are pedestrians for varying time periods on roads, even though motorization is increasing at a rapid pace. People who use cars and motorcycles, depending on their need, walk for shorter or longer distances.

Pedestrian safety has assumed greater importance as reports indicate that pedestrians are the single largest category of those injured and killed in road crashes in India. Recent reports indicate that pedestrians in Bangalore face a daunting task in using roads and footpaths. A national review has shown that nearly 60 per cent of deaths and injuries on national highways are among pedestrians .The precise number of pedestrians injured and killed is difficult to ascertain and could be approximately 40,000 deaths annually in India.



Generally vehicle uses the bull bar or grill in the front of the vehicle for ex. Toyota Innova, Tata ace magic etc. the steel grill can cause more injury when they hit the pedestrian.

When two vehicles collide at high speed, vibration transfers to the body at high amplitude.


STRESS DEVELOPED AFTER COLLISION (WITHOUT FPS)
STRESS DEVELOPED AFTER COLLISION (WITH FPS)

FRONTAL PROTECTION SYSTEM

Frontal Protection System is the name given to any separate structure or structures fixed to the front of a vehicle above or below the original bumper intended to protect the outer surface of the vehicle from damage in the event of a collision. A Frontal Protection System (FPS) is a device fitted to the front end of a vehicle to protect both pedestrians and cyclists who are involved in the unfortunate event of a front end collision with a vehicle. Frontal Protection Systems (FPS) has become a popular accessory for passenger Vehicles.

Frontal protection systems offer the same functions of bull bars, though without the worry of pedestrian accidents, and safer head-to-vehicle impact. With SUVs becoming popular in urban areas as well as rural areas, safety is of greater importance than ever.

Safety of transportation vehicles, especially passenger cars, has to meet permanently increasing demands. Developments in active and passive security systems in vehicles have already led to high standards. Nevertheless, weak points are still passenger as well as the Pedestrian protection in various crash situations. So there is a vital necessity for the development of energy absorbing structures and materials not only to meet legal regulations on e.g. side impact, head impact or pedestrian protection (by so called "soft noses"). For this reason, the energy absorption potential of cellular structures made from various materials has to be investigated and evaluated.

IMPACT ABSORBING MATERIALS

It has long been recognized that the bumper of an automobile is fairly inefficient in absorbing the energy of an impact. Many devices have been proposed in the past to solve the problem of protecting the driver of an automobile and its passengers from personal injury. Most of these have taken the form of utilizing energy absorbing materials which are incorporated into the bumper of the automobile or which become part of the outer vehicle walls. Twenty-eight selected materials, including foams, honeycombs and balsa wood are tested and evaluated. The materials are subjected to a sequence of tests in order to thin out the array systematically. The

quasi-static test results show that balsa wood has by far the highest energy absorption capacity per unit weight but the yield strength is too high to make it suitable for the current application.

As a consequence of the increasing demands in automotive industry concerning crashworthiness and passive safety, the concern for energy management and safety demands also increases. The goal of energy management is to reduce the forces and stresses on an occupant or a pedestrian during a crash event; in some cases it may be possible to reduce the forces by a factor of two.

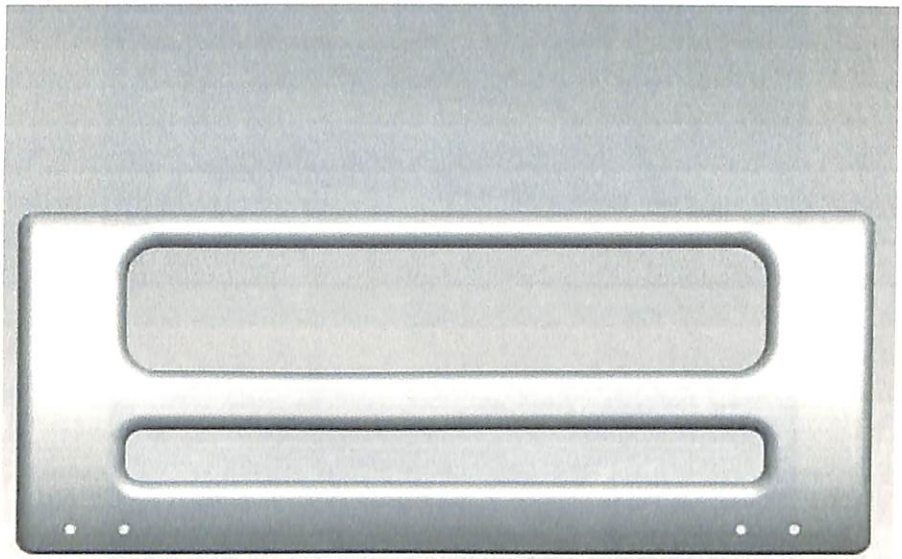
This requires usage of new advanced materials components. Energy absorbing foams and other lightweight materials like plastics and polymer composites are increasingly used in automotive industry. Hence, extensive study of energy absorbing behaviour of these materials as well as the automotive components is needed.

An automotive impact absorbing member integrally formed of synthetic resin material having lengthwise shape that extends with a constant hollow cross section. The impact absorbing member includes: plate-shaped rib portions each extending in a direction perpendicular to an impact load input direction; and load transmitting portions connecting with rib portions at either width wise end thereof for transmitting a width wise direction component force of the impact load to the rib portions.

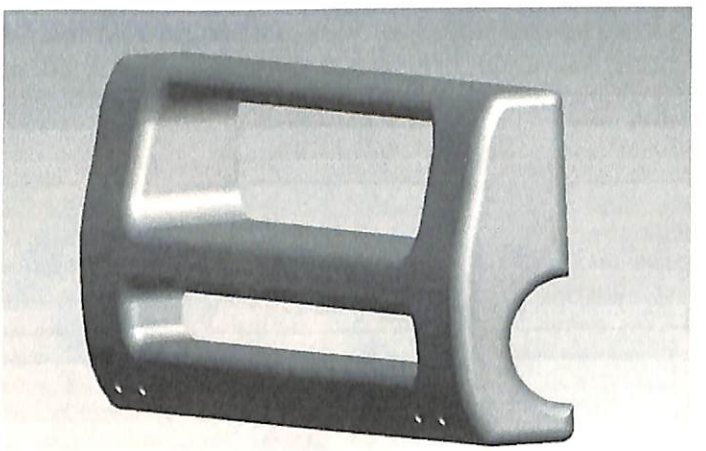
Impact absorbing body is required to have a capability of absorbing energy against a compressive load occurring at the time of collision. Therefore, there is frequently used a moulding, so-called a beads-foam-moulding, which is produced first, by preparing a preliminarily foamed beads by adding a foaming agent to a polypropylene resin or a polystyrene resin material.

SCREENING OF MATERIALS AND CHARACTERIZATION METHODS

The focus of the materials presented is put like Polymeric foams and deformable structures (honeycombs, naps).



FRONTAL PROTECTION SYSTEM



ENERGY ABSORBING MATERIAL

PROBLEM 3

REDUCE THE WHIPLASH INJURY IN THE NECK.

PROBLEM STATEMENT

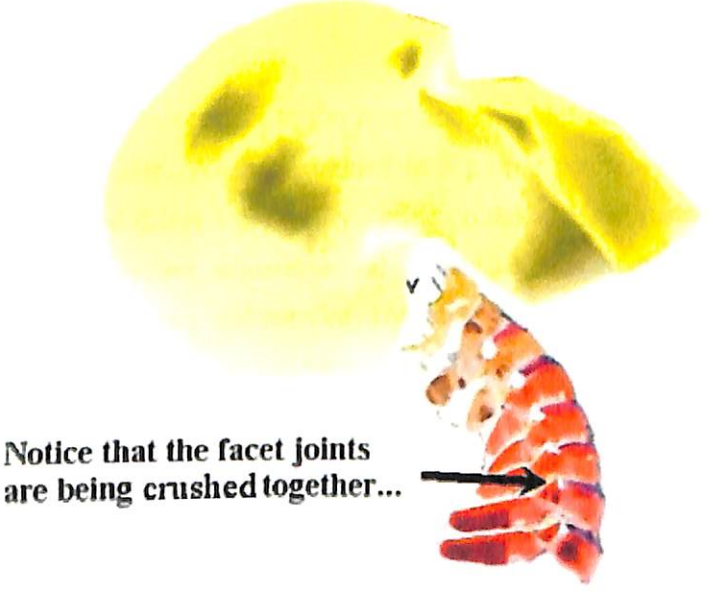
What happens during a rear end collision if

- Head restraint
- Seat position

Are not adjusted correctly?

- Body moves up - depending on angle of backrest and position of seat belt adjustor
- Head jerks back

WHIPLASH INJURY SAFETY MOMENT



WHIPLASH INJURY

Even minor accidents can leave you with whiplash, a condition affecting the ligaments and muscles of the neck and shoulders, typically caused by rear-end collisions. Whiplash can cause lasting distress and discomfort, but a properly configured head restraint system can reduce or even prevent such an injury.

WHIPS also feature a fixed head restraint with effective geometry, meaning it sits high and close to the head; this restraint catches the head in an accident. Quick reduction of head movement mean that the neck changes shape less and the change occurs more slowly in the collision than with a conventional seatback/head restraint. The result Whiplash is less likely to occur.

Real-life crash statistics show that necks injuries are one of the most common results of rear-end collisions, even at relatively low speeds. The triggering factor in these whiplash injuries is the violent movement of the head in relation to the body during an impact from behind, often leaving victims with long-term pain.

HEAD REST

Headrest provides comfort to the head and shoulder during journey. They also act as a safety device in vehicles. When positioned in a proper position behind the head, head rest protect passengers and driver from injury during collision. Head rests are available for both front and rear seats. They are adjustable and proper adjustment of headrest position is essential for attaining better safety and comfort. Head rest in vehicles are usually made of Foam PVC. Head restraints are designed to restrict head movement during a rear-impact collision and reduce the chance of neck and shoulder injury.

USES OF HEADREST

- Protect passengers and driver from injury during collision. .
- Provides full support of the back and encourages relaxed neutral posture.
- Also reduces fatigue and tension of the neck and lower back muscles during long trips.

The chief concern of most manufacturers, along with safety, is the comfort provided by their design. Manufacturers compete to be considered the most luxurious and to set the standard in ergonomic seat design. Comfort is very important to consumers: 5% of the population suffers from back pain. Whiplash is an acute injury of at least moderate intensity which causes a strain to the Bones, muscles, nerves, tendons, and vertebral discs of the neck region. It is caused by a sudden, unexpected impact which jerks the head back and then forward causing the neck to snap out of alignment. Whenever you get into a vehicle, you should ensure that a head restraint is properly adjusted. Seats are first examined to ensure that the head restraint can be adjusted to be in the optimum position. The optimum position is when the top of the head restraint is level with the top of the head, and there is little or no distance between the back of the head and the restraint. The geometry of the seat is rated as good, acceptable, marginal.

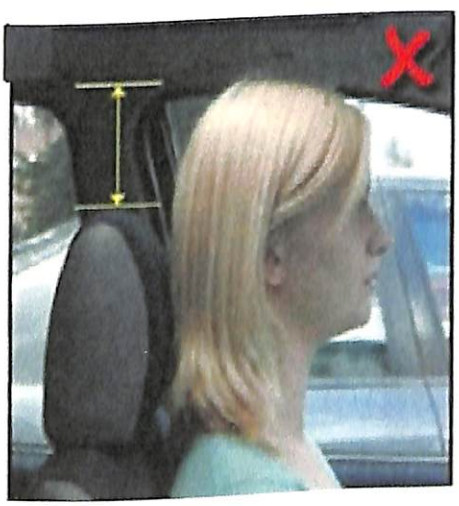
WRONG METHOD

There should be no gap between head rest and head of occupant, because at sudden break or rear end collision can cause whiplash injury.

This picture shows a poorly adjusted head restraint.

Even though the top of the head restraint is level with the top of the occupants head, a large gap exists between the back of the occupant's head and the head restraint.

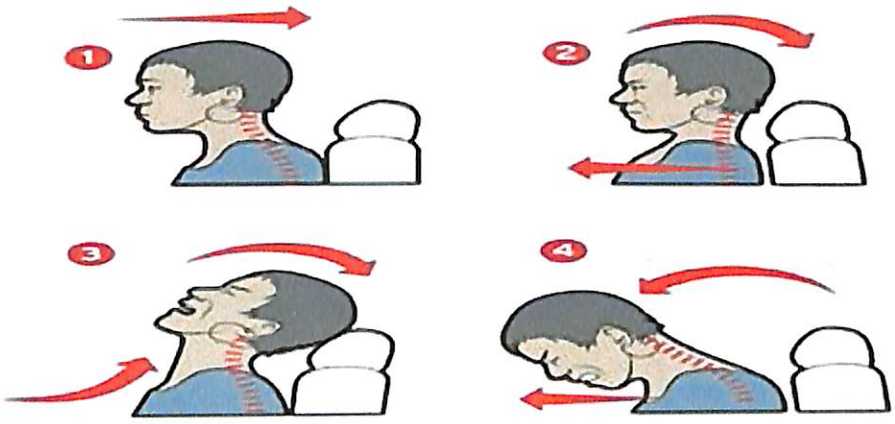
This gap – which is marked using the yellow arrow – means that the head can move and tilt further back, increasing the risk of injury.



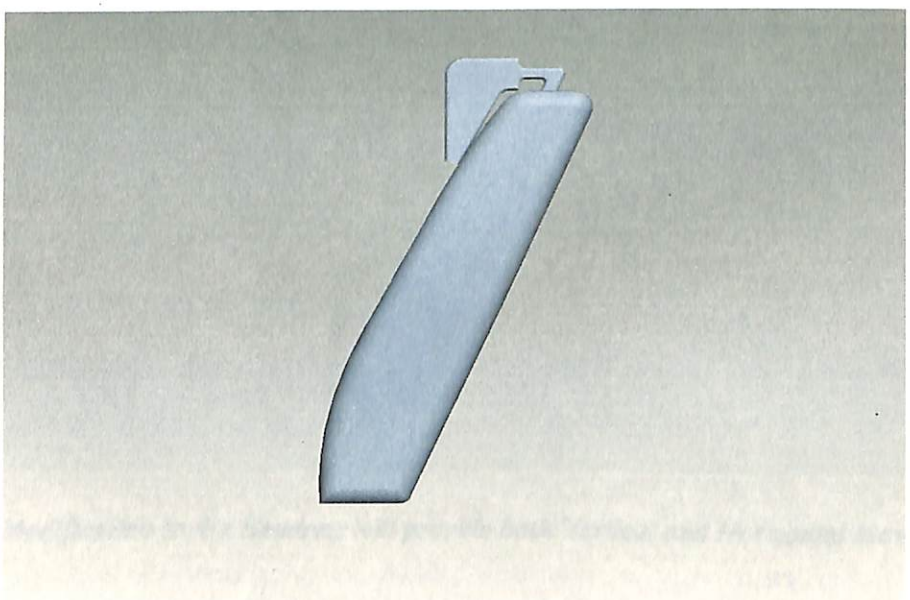
This picture is an example of a poorly adjusted head restraint.

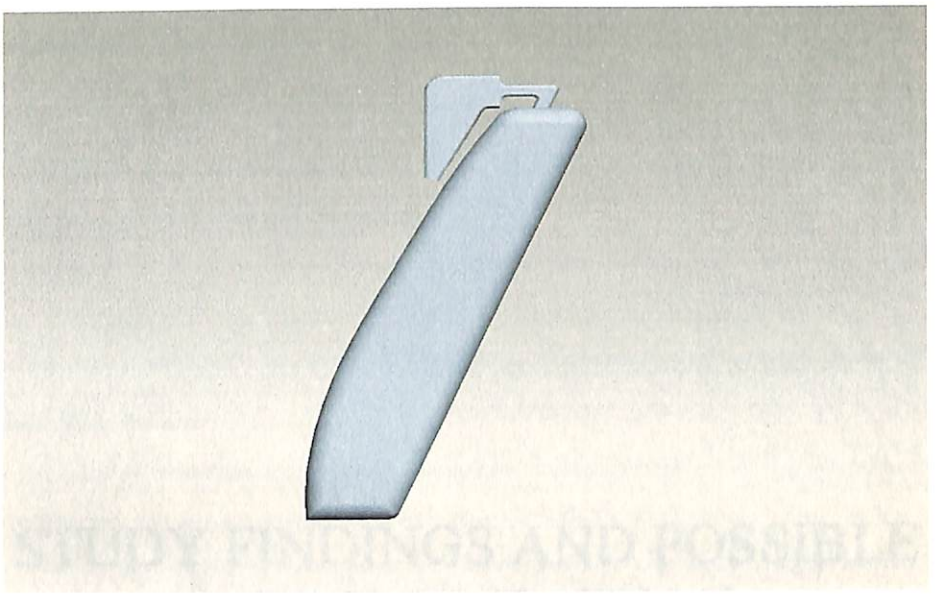
The yellow arrow shows the distance between the top of the occupant's head and the top of the head restraint, which would increase the risk of an injury.

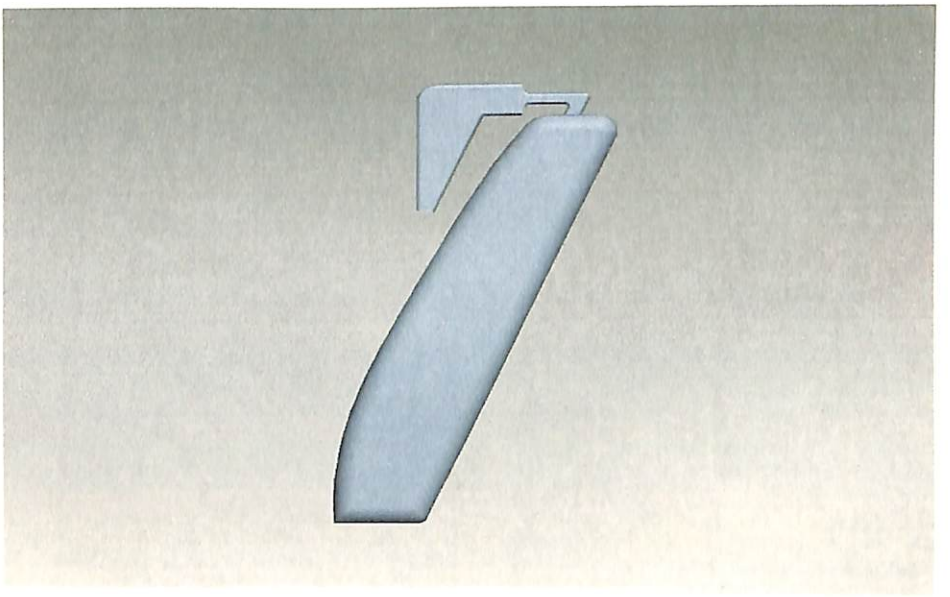
The head restraint should be moved higher in order to adjust it correctly, as shown in picture 3.



OCCUR OF WHIPLASH INJURY
DUE TO SUDDEN BREAK BY
POORLY ADJUSTED HAED REST







Slight Modification in the Headrest will provide both Vertical and Horizontal Movement

STUDY FINDINGS AND POSSIBLE IMPLEMENTATIONS

INFERENCES

1. By introducing a cushion able foam material in the seat belt, collar bone injury can be minimized specially for old occupants.
2. By using a frontal protection system (bumper made from energy absorbing material), the effective impact stresses generated after a collision can be reduced. It reduces the injuries to the pedestrian in case of a collision and also reduces impact forces inside the automobile cabin.
3. By modifying the head-rest design whiplash injury in the neck region (due to sudden acceleration, deceleration & sudden braking) can be minimized.

FURTHER STUDIES

FUTURE ASPPECTS

- AIR BAG FOR REAR SEAT OCCUPANTS MAY BE AVOIDED

Smart belt may be used for rear seat passengers. An inflatable plus pretension belt may be used which increase the contact area with occupant and belt. The consequence will be to minimize the effect of collision with cost effectiveness.

- PROTECTING PEDESTRIAN THROUGH VEHICLE DESIGN

In frontal protection systems there is a vast scope for further development in the field of material selection and geometry of the bull bar & hood material.

CONCLUSION

The general conclusion is that automobile safety is not necessarily a function of the esoteric and sophisticated technologies. Automobile safety can be greatly enhanced just by implementing certain design changes as discussed in this project work. Another key aspect to be taken care of is human capacities and limitations both physical and psychological. A safety design strategy that takes this into account can make automobiles both safer and comfortable.

The design improvements that could not reach production stage initially need not be finalized as a failure. Through this project it has been shown that with minor changes most design improvements may become feasible.

After the completion of this project it can finally be concluded that the automobiles used by the masses can be made safer by adopting a safety design strategy that focuses on human capability and capacity.

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