

Design and Development of Safety Jacket

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Abstract--The work deals with design and develop a rider's safety jacket that is useful for the motorbike, horse riders and also applicable as safety jacket for the workers who are working in high raised buildings. These systems involve the same principles as vehicle mounted air bags, which are deployed automatically to minimize injury in case of accidents. In present world every second of people die due to accidents involving both 2 & 4 wheelers and construction sites (Painters, electricians, masons). The new designed life saving jacket is connected to pressure cylinder through pneumatic valve, conduits and connectors. The pneumatic valve actuates due to impact of accident and pressurized air inflates the jacket within few milliseconds and acts as cushion between human body and colliding structure. This absorbs the maximum impact and reduces injuries.

Keywords: jacket, pressure cylinder, solenoid valve Non return valve, air

INTRODUCTION

The main aim is to design this safety jacket is for horse riders , horse riders , high altitude workers like construction site workers, electricians , painters and so on to reduce the high impact and to save the life from major impact. Considering major accident in two wheel riders have concentrated more on bike riders and designed more applicable for them. Two-wheelers can be extremely convenient when traveling a short distance with one or two people. Thanks to their light-weight mechanism and affordable price, two-wheelers have always been the preferred choice for many. During the year 2010, there were around 5 lakh road accidents, which resulted in deaths of 134,513 people and injured more than 5 lakh persons in India. These numbers translate into 1 road accident every minute, and 1 road accident death every four minutes.1.5 The loss to the Indian economy due to fatalities and accident injuries estimated at 3% of GDP in 1999-2000 is particularly severe as 53.1% of road accident victims were in the age group of 25 to 65 years in 2010, with pedestrians, bicyclists and two-wheelers, who comprise the most unprotected road users, accounting for around 40% of all fatalities.

1. LITERATURE SURVEY

1.1 STATEMENT SHOWING THE NUMBER OF FATAL AND NON-FATAL CASES REPORTED PERSONS KILLED & INJURED FROM THE YEAR 2003 TO 2014 IN BANGALORE CITY

Accident Statistics					
YEAR	Fatal	Killed	Non-Fatal	Injured	Total
2004	875	903	8226	6921	9101
2005	796	836	6782	5899	7578
2006	880	915	6681	6048	7561
2007	957	981	7469	6591	8426
2008	864	892	6908	6150	7772
2009	737	761	6138	5668	6875
2010	816	858	5667	5343	6483
2011	727	757	5297	4976	6024
2012	740	760	4767	4471	5502
2013	737	771	4493	4289	5230
2014	231	236	1438	1370	1669

During 2010, 499,628 road accidents were reported by all States/ Union Territories (UTs). Of these, about 23.9% (119,558) were fatal accidents. The number of persons killed in road accidents was 134,513, i.e. an average of one fatality per 3.7 accidents. The proportion of fatal accidents in total road accidents has consistently increased since 2001 from 17.6% to 23.9% in 2010 (Table 2). The severity of road accidents, measured in terms of persons killed per 100 accidents, has also increased from 19.9 in 2001 to 26.9 in 2010

1.12 PIE CHART ANALYSIS

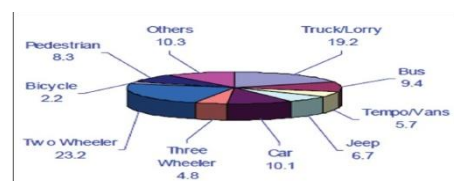


Figure 1.1: Pie chart showing road accident death by various mode of transport during 2012[g]

Analysis of pie chart

- The pie chart shows road accident deaths by various mode of transport.
- The deaths in accident in 2 wheelers are more (23.2%) as compared to either 4 wheelers (10.1%) or trucks/lorry (19.2%).
- This means 2 wheelers are less safe compared to other modes of transport systems.
- The 2 wheelers are less safe because there is no much safety except HELMET, JACKET, KNEE PADS and few other things. Where as in 4 wheelers safety systems such as ABS, ESP, EBD is available which makes a living being secure compared to 2 wheeler.
- This means a safety device must also be made to secure lives of 2 wheelers.
- The above scenario initiated us to develop a modern safety device for 2 wheelers to protect the motor cyclist from severe injuries caused during accidents.

When a four wheeler meets with an accident



Fig 1.2: Accident in four wheelers[g]

When a two wheeler meets with an accident



Fig 1.3: Accident in 2 wheelers[g]

2. MATERIALS AND METHOD

1. Jacket materials.
2. Pressure cylinders.
3. 5/2 way normally closed Direction Control Valve (DCV)
4. Hose pipes and 6mm connectors.
5. Helium

2.11. Jacket materials:

- a. 1000D Cordura Nylon (TPE coated).
- b. 6/6 PU coated.
- c. 6/6 nylon

1000 Denier (1000D) Coated cordur Nylon Fabric. Cordura material is a versatile nylon fabric with more strength. Cordura Nylon is a textured nylon for a natural spun-like appearance, with excellent resistance to fading, abrasion, rot and mildew. Quick drying, and highly water repellent. Suggested Uses: Courier bags, insulated food service carriers, gun cases, stuff bags, camera bags, wallets, duffel bags, soft-sided luggage, purses, handbags, horse blankets, police and air and sea rescue supply bags, surfboard/ski carrying bags, sporting goods, stall curtains, dog beds and equipment.



Fig 2.1 showing 1000D cordura nylon & PU coated

2.12. Pressure cylinders.

A pressure vessel is a closed container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. The air which is to be sent inside the jacket must be stored inside the container. Hence we make use of pressure cylinder to store the required quantity of air.



fig 2.2: fabricated pressure cylinder of preferred specifications.

2.13. 5/2 way normally closed DCV.

- A valve is a device that regulates the flow of fluid (gases, liquids, fluidized solids, or slurries) by opening and closing or partially obstructing passage ways.
- A 5/2 way directional valve from the name itself has 5 ports equally spaced and 2 flow positions. It can be used and simultaneously bypass a passage way for the fluid.



Fig 2.3. way normally closed push button operated spring return type

2.14. Hose pipe and connectors.

Pneumatic pipes are used for the connection between pressure cylinder to pneumatic valve and from pneumatic valve to jacket vent.

One touch pneumatic connectors are used for the connection from cylinder and vent for the jacket.



Fig 2.4: Hose pipe and 6mm one touch connector

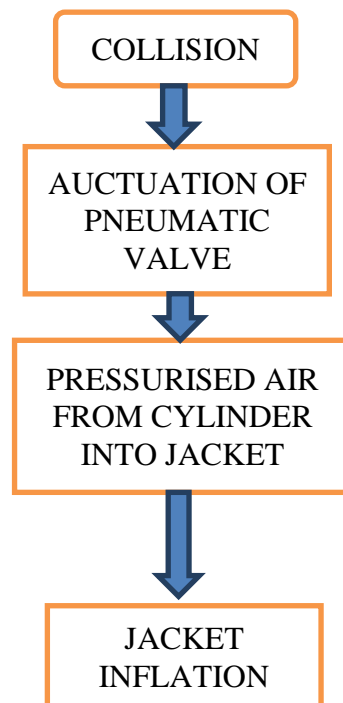
2.15. Helium

Helium has a number of application in the world today Helium is commonly used to pressurized and purge system of unwanted gases Helium has a density of 0.169kg/m³ and the density of air is 1.255kg/m³. Air is the another form of oxygen, helium is an unreactive element that is even lighter than normal air This set of properties is the reason for helium unique behavior in natural conditions. Unlike other gases this element moves easily within the earths crust, escapes into the atmosphere along with hydrogen and then escapes from the earth s gravitational field altogether .Helium reserves are thus non renewable and there is no natural resource that can duplicate its property .helium unique properties are widely employed in science ,technology and production helium unique properties include chemical inertness, high thermal conductivity , a

low liquefaction point , nontoxicity and low nuclear reactivity .

3. METHODOLOGY

One end of the pressure cylinder is fitted with non -return valve through which pressurized air is fed into the cylinder and the other end is fitted with 6mm connector, which connects the pressure cylinder and 5/2 way DCV.The input for 5/2 way dcv is pressurized air from the cylinder and the output is connected to the jacket vent.This is how air moves from cylinder into the jacket.The 5/2 way DCV is closed using a small metal piece and the metal piece is tied with a thread and this thread is connected to bike in normal condition.The thread is connected to the bike in such a way that when accident occurs and he/she is about to topple of the bike the thread is pulled which in turn pulls out the metal piece which was blocking the push button of the valve. Once metal piece is pulled out the valve actuates and allows the air to flow from the cylinder into the jacket



4.10. CONCEPTUAL DESIGN-1 (1000D Cordura Nylon (TPE coated)).

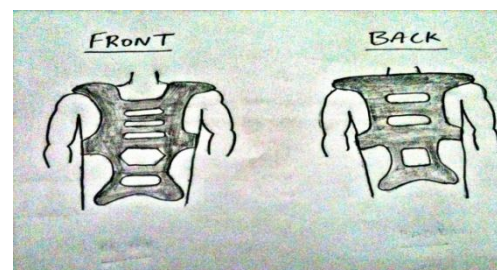


fig 4.1. conceptual design

5. ASSEMBLY

The various components used in this project are: jacket ,pressure cylinder ,5/2way DCV ,A metal piece to block the push button of DCV, piping and connectors.

All the above components should be connected sequentially to achieve the inflation of the jacket during collision.

5.11. HOW IT IS ARRANGED.

- We have decided to place both the cylinders on the jacket.
- One end of the pressure cylinder is fitted with non-return valve through which pressurized air is fed into the cylinder and the other end is fitted with 6mm connector, which connects the pressure cylinder to 5/2 way DCV.
- The input for 5/2 way dcv is pressurized air from the cylinder and the output is connected to the jacket vent.
- This is how air moves from cylinder into the jacket.

5.12. HOW AIR IS INFLATED INTO THE JACKET WHEN COLLISION OCCURS?

- Our jacket has to be inflated only when a motorcyclist meets with an accident and topple of the bike.
- The 5/2 way DCV is made as 3/2 way normally closed DCV by blocking one input port and one output port of the valve.
- The push button of the DCV is Closed using a small tapered metal piece and the metal piece is tied with a thread and this thread is connected to the bike in normal condition.
- The thread is connected to the bike in such a way that when accident occurs and he/she is about to topple of the bike the thread is pulled which in turn pulls out the metal piece which is blocking the push button of the valve.
- Once metal piece is pulled and push button is set free, the DCV which was normally closed now acts as a normally open DCV. That is actuation of DCV is achieved when push button is set free by ejecting the metal piece and allows the air to flow from the cylinder into the jacket.



Fig 4.2 area calculated for this design
Volume consumed by this conceptual design-1 is 17 liters .

4.11. CONCEPTUAL DESIGN-2 (6/6 PU coated).

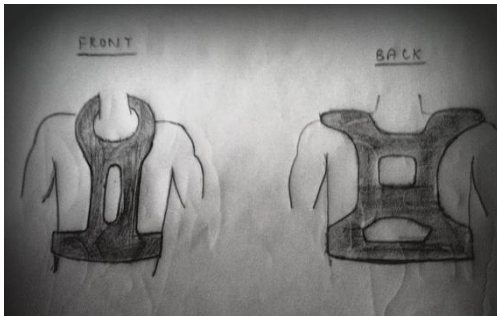


Fig 4.4 area calculation fo this design
Volume consumed by this conceptual design-2 is 15 liters .

4.12. IMPROVED DESIGN

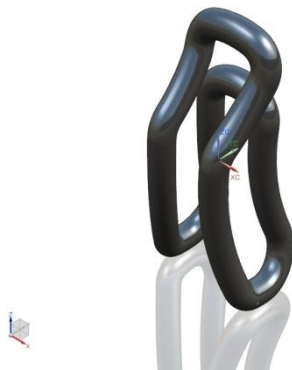


Fig 4.5 3d model of improved design

The volume consumed by this design is 5lts and main aim is to design inflation time should take very less time with in a sec so avoided curves and bends ,and reduces the volume compared to the other design .the volume is so less compared to the other design because of pipe like design and the dia will be 5cm.



5.1. when air inflated

6. TESTS CONDUCTED ON JACKET MATERIALS.

Following are the tests conducted on the jacket materials to know its ability to withstand the above causes.

1. Tensile strength test.
2. Tearing strength test.
3. Air permeability test.

The above three tests will tell us whether we can rely on our materials or not. Testing was carried out in textile department .the below tabular column was tested with full compressed air fed into the jacket on different pressures the time will be calculated on the stop watch .each test conducted with different pressures .the test conducted for the improved design in the labouratory.

PRESSURE (bars)	TIME (sec)
15	0.30
14	0.38
13	0.41
12	0.50
11	0.64
10	0.78
9	0.97
8	1.10
7	1.88
6	2.5
5	2.7
4	3.0

6.11. CFD ANALYSIS.

Computed fluid dynamics analysis I have opted to do the flow analysis. considering atmospheric pressure 1 bar and varying the inlet pressure calculated the speed of the velocity and the flow through curves bending analysis we have found out in this design. And intial flow curves and normal and turbulent flow we can see the flow lines visibly

by those figures. this is one of the efficient analysis in the market .material analysis cant be done in this analysis due to the cloth material .only flow analysis can be done in the computed fluid dynamics .

Initial Flow Development

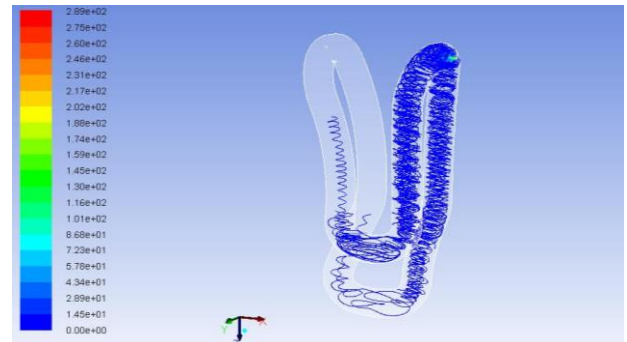


Fig 6.1 cfd analysis of initial flow

Flow Turbulent – Path line

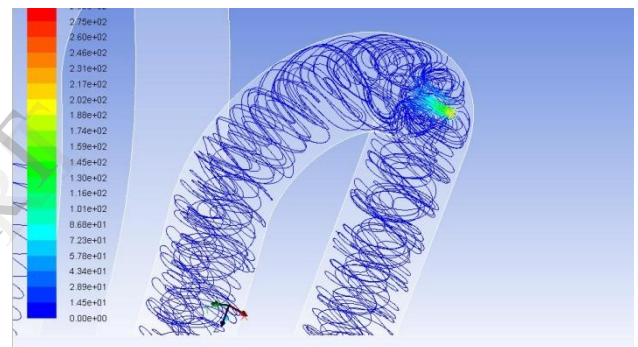


Fig 6.2 cfd analysis of turbulent flow

Full Developed Flow – Path line

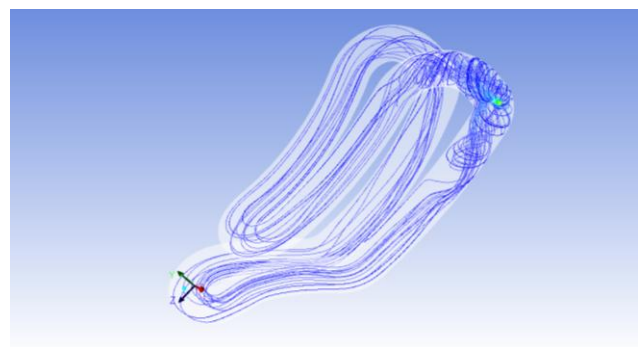


Fig 6.3 cfd analysis of fully developed pathline

Fluid curves and mesh quality:

- Maximum aspect ratio = 21
- Maximum orthogonal quality =0.215

Boundary condition:

- Method :pressure based on nodal solution(pbns)
- Outlet : atmospheric condition 1bar
- Turbulence model: standard k-epsilon
- Fluid material : helium

Software used

Mesh generation softwar : Asyn ICEM CFD

Solution and post processing : ANSYS Fluent

7. CONCLUSION

Two-wheelers can be extremely convenient when traveling a short distance with one or two people. However, the alarming increase in the number of two-wheeler related accidents and deaths has caused a serious concern in India and globally. This is because there are no much safety devices and this scenario initiated us to make a modern safety device so called "LIFE SAVING – JACKET".

The gas inside the jacket in fully deployed condition acts as the cushioning (resisting) medium between the body and the colliding structure hence absorbs the impact produced and safeguards the motorcyclists from injuries during accidents.

The time of inflation is the main concern and it depends on the pressure. The time taken for inflation of jacket is less at high pressures and takes more time at low pressures. Thus maintaining high pressure in the cylinder quick inflation can be achieved.

7.1 future work

In future jacket designs the bends and curves must be minimized so that during inflation the air flow is not restricted by these cross-sections. These cross-sections will contribute for increase in inflation time.

Air flow from cylinder to jacket is due to pressure difference and this pressure difference results in flow of compressible fluids from high pressure region to low pressure region. During the flow there may be losses like friction loss, leakage and so on and this must be looked upon carefully and nature of compressible flow study must be done.

There is a lot of more safety by using the rubber cylinder and sensors instead of the mechanical linkage inflation

By using the sodium azide can reduce the volume of the gas .

8. ACKNOWLEDGEMENT

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