Headlight Glare Reduction Using Parallel Beam Technique

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Abstract: The headlight glare becomes one of major causes for road accidents. This headlight glare causes the vision obstruction of opposite driver for a while which leads to minor or major road accidents. Out of average annual accidents due to headlight glare is about 30%. The current headlight system consists of either of the "Parabolic reflector or Narrow angled reflector (short focal distance), or Wide angled reflector (long focal distance). In these types of conventional reflectors, point source of light is converted into parallel light of beams then it is magnified i.e., light beam is diverged by using the concave lens, which leads to glare. The motto of the proposed project is to reduce the glare by using parallel beam headlight system. The system not only consists of parallel beams but also some amount of diverged beam to ensure downside visibility. This combined system leads to effective visibility of the objects and vehicles in the road area. The combined system consists of a parabolic reflector, filament, concave lens, protective torch glass. That is the single concave lens is replaced by protective torch glass and the concave lens which gives combined effect of both parallel and diverged beams.

Keywords: Glare- road accidents, reflectors, concave lens, diverged light source, parallel beam of light, protective glass

1 INTRODUCTION

By accounting various researches and statistical news, accidents that occurs in night time are most likely due to the headlight glare. According to an article published in the Times of India (march 26, 2019) clearly shows that over the first four months of the year have seen 42 cases being booked on average daily. In this about 5,045 cases are totally against the people using high beam headlights. The glare from these lights are known to cause temporary blindness and consequently affect night vision of the driver for a few seconds, a perfect situation for an accident. Drivers often confront vehicles in front, from behind, or from both directions that emit blinding glare. Although it has been a concern of drivers since electric headlamps replaced oil lamps, in recent years an increasing number of drivers have complained to the National Highway Traffic Safety Administration about glare from headlamps. Many drivers described being "blinded" for a few seconds after exposure to the glare and needed to slow down, while others mentioned their involvement in a crash or a near miss. Glare, especially due to increasing intensity, often causes discomfort to the driver as well as vision obstruction that may contribute to the occurrence of an accident. The total production of vehicles in India is about 30,915,420 including passenger vehicles, commercial vehicles, three wheelers, two wheelers in April-March 2019 as against 29,094,447 in April-March 2018, leads to a growth of 6.26 percent over the same period last year. This shows that there is an increment in the production of commercial vehicles.

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2. LITERATURE REVIEW

2.1 Literature Introduction

With the increase in production and usage of vehicles, every vehicle should mandatorily consist of the headlights, this leads to the higher probability of accidents due to headlight glares. In focus of reducing the accidents due to headlight glare, manufacturers and researchers are undergoing the different kind of researches in headlight systems. The World Forum for Harmonization of Vehicle Regulations (ECE Regulations) develops and maintains the regulations on the light sources that is acceptable for use in the vehicles. In the vehicle there is two types of headlight beam bulbs are available. They are Single Beam Bulb and Dual Beam Bulb. The two has different styles with new beam of light of bulb and they are most probably editable Single Beam Bulb and Dual Beam Bulb content or interchangeable. The bulbs used are either Halogen or High Intensity Discharge (HID) or Light Emitting Diode (LED), where LED has greater features comparatively than other two types in terms of life time, energy efficiency and life span.

Adaptive front lightening system

As the name implies it is adaptive with the situation and weather conditions around the vehicle. In this adaptive front lightening system has the ability to work as a cornering light, dynamic bend light, adverse weather light, motorway light. These were one of the reasons for calling it as an intelligent headlight system.

2.2 Review Conclusion

The above mentioned contents give a brief idea on introduction of headlight beams on to the market, the components involved in headlight system and the parameters involved in designing an headlight system. Though the contents were contrary among various authors, the core design remains to be the same. The contents from the above mentioned reviews are taken into consideration for the design and development of parallel beam headlight system.

3 OBJECTIVE OF THE WORK

To justify the selection of light source suitable for the parallel beam headlight system. To justify the usage of protective glass and concave lens together. To design and model a

parallel beam headlight setup for appropriate dimensions using desired software. To measure and analyze the intensity of the proposed parallel beam headlight system. To fabricate the parallel beam headlight system for the calculated dimensions. Protective lenses increases tensile strength, thermal shock resistance, and safety of normal lenses. It also increases its heat withstanding capacity. Because of these properties, protective lenses is preferred in applications where strength, safety and optical visibility are important considerations.

- Strength & Safety Considerations.
- Four to five times stronger than annealed glass.
- Two to three times stronger than strengthened glass. Fragments into small, relatively harmless pieces, reducing the damage.

Protective lenses is specifically designed for use in areas where there is a high risk of contact and breakage. It is not harder or softer than annealed glass but is tougher lens. This lens does not make lens more porous more prone to scratches than normal lenses. Tempered glass offers a wide variety of uses in industries including building, manufacturing, automotive, to name a few.

4 METHODOLGY

Step 1 : Identification of Glass material
Step 2 : Analyzing the angle of glass material to be blown
Step 3 : Analyzing method for merging
Step 4 : Testing the visibility
Step 5 : Fabrication of selected doom with glass
Step 6 : Measuring the intensity of light beam
Step 7 : Measuring the divergence of beam
Step 8 : Optimization of the Results of emitted beam
Step 9 : Implementing it on commercial vehicles

5 DETERMINATION OF LENS GEOMETRY

Material : transparent amorphous solid
The dimensions were obtained keeping considering the goal of achieving a light intensity is given by
Outer diameter of lens is given by 140 mm.
Thickness of the lens is given by 2 mm.
Lens is chosen based on the light propagation through their surface.
Area of lens is given by the formula; $A = \pi r^2$
Which is given by, $A= 3.14*(70)^2$
Thus area of lens is given by 15,386 mm^2

Dimension of parabolic reflector:
The outer diameter of the parabolic reflector is 145 mm. Thickness of the reflector is 5 mm. Outer depth of cut is 5 mm. Centre of reflector is to be designed for bulb carrier. Diameter of bulb carrier is 45 mm. The depth of reflector from outer surface to inner edge is 52 mm.

6 HELPFUL HINTS

6.1 Properties of Protective lens

Diameter of lens (mm)	Thickness of lens (mm)	Frontal area of lens (mm^2)
140	2	15386

Properties	Value
Thermal Shock Resistance	Up to 250°C
Mechanical Strength	Four to five times stronger than annealed glass
Tensile Strength	65 MPa
Bending Strength	120-200 N/mm^2
Surface Compression	> 95 MPa
Design Stress for Architectural Purposes	50 MPa
Fragmentation	Small round crystals
Conducive for Processing	Cannot be cut after Tempering

The focal length of the headlight is given by general formula

F = ((D/2)^2) / (4d)

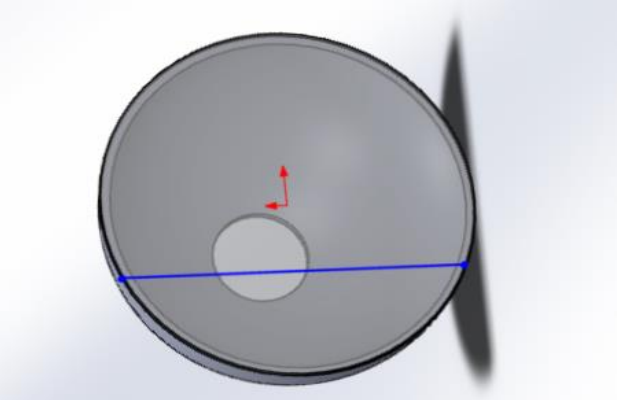
Where D is the diameter of aperture, d is the depth of reflector = (140/2)^2/(4*52)

F = 25 mm

6.2 Dimensions of HID Bulb

Brand	Philips Lightening
Model number	35MR16/FL36
Energy used	35 watts
Volts	12
Base	GU5.3
Bulb shape	MR-16
Color temperature (K)	3000
Brightness (lumens)	540
Bulb technology	Halogen
Average rated life (hr)	3000
Beam angle (degree)	36
Length (in)	1.875
Diameter (in)	2
Dimmable	Yes
No of filaments	2

6.3 Modelling



6.4 Experimental set-up

Measuring the headlight dome in order to obtain the diameter of the lens to be made. As per the calculations the protective lens and the concave lens were cut and taken for the further blowing process. Next step is to adjust the focal length of the headlight by moving the filament front and back to produce parallel beam of light. The merged lens will be fixed to the headlight dome where the light has been fixed by adjusting the focal length to produce the parallel beam of light. Thus the parallel beam headlight has been fabricated for the calculated dimensions. This can be done not only in the circular type headlights but also in the conventional different shaped (oval, elliptical, etc,.)headlights.The real time prototype was planned according to the time availability and the cost to be invested. Here the design includes usage of different components including protective lens, concave lens, filament and the headlight setup. The lenses are merged with the help of a process called glass blowing. And the focal length will be adjusted based on the requirement of parallel rays of light. The system was designed to produce parallel beams of headlight by using the two different lenses.

Glass blowing process

Glassblowing is a technique of glass forming that involves inflating molten glass into a passion (or bubble) with the help of a blow tube (or blowpipe).A lamp worker (often also called a glassblower or glassworker) manipulates glass with the use of a torch on a smaller scale, such as in producing precision laboratory glassware out of borosilicate glass. As a novel glass forming technique includes glassblowing exploits the working property of glass - inflation, which is the expansion of a molten blob of glass by introducing a small amount of air to it. Which is based on the liquid structure of glass, the atoms are held together by strong chemical bonds in a disordered and random order, therefore molten glass is viscous enough to be blown and gradually hardens as it loses heat. In order to increase the stiffness of the molten glass, which in turn facilitates the process of blowing, there will be a subtle change in the composition of glass. Lower concentration of natron would have allowed the glass to be stiffer for blowing. During blowing process, thinner layers of glass gets cooler faster than thicker ones and become more viscous than the thicker layers. This allows production of blown glass with uniform thickness instead of causing blow-through of the thinned layers. A full range of glassblowing techniques was developed within decades of its invention.

7 RESULTS

The fabricated light has better intensity than the conventional diverging type headlights. The intensity of the fabricated light is 450 lumens. The headlight glare is almost reduced up to 75% compared to the conventional type of diverging head lights. The objectives stated have been successfully obtained by the proposed type of parallel beam headlight system. This system will be a revolution in reducing the headlight glare, thus preventing the accidents due to headlight glare.

8 CONCLUSION

The paper was mainly focused on the design calculations and fabrication techniques of parallel beam headlight system. As much as the population increases, vehicular usage also gets increased. This leads to increased use of vehicles during the night travels that is headlight usage is increased. Thus the probability of accidents due to headlights also increased drastically. The main focus of the project is to reduce the vehicle headlight glare. This can be achieved by producing parallel beam of light instead of conventional diverging beam of light. The diverged beam is produced with the help of concave lens, which is the conventional type of lens used in most of the vehicle. The parallel beam of light can be produced with the help of combination of protective lens and concave lens together at the specific angle as per the calculations done previously. This might reduce the glare of the vehicle. As the beam produced will be parallel, the divergence of the beam will be considerably very minimum and it is negligible in nature. As the light rays are parallel, they would not fall on the opponent driver's eyes and hence eye instant blindness will be avoided thus reducing the headlight glare. This would enhance the better visibility of the driver.

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