

Advanced Pneumatic Braking System for Hill Climbing Heavy Vehicles to Avoid Collision

Senthil Kumar¹, Santhosh Kumar¹, Shanmuga Priyan¹, Uma Manikandan¹,

Arthur Jebaraj²

U.G. Student, Department of Mechanical Engineering, Francis Xavier Engineering College, Vanarpettai, Tirunelveli,
Tamil Nadu, India¹

Associate Professor, Department of Mechanical Engineering, Francis Xavier Engineering College, Vanarpettai,
Tirunelveli, Tamil Nadu, India²

ABSTRACT: Automobiles are now becoming most essential parts of our day-to-day life. However the increased production, they are facing lots of problem like traffic, fuel efficiency, blends, exhaust gas analysis etc., In this project we made a simple and economical solution to the above mentioned problem. We used ABS an equipment which can be attached to any automobiles that it prevent unwanted reverse motion when it is at rest or in motion.

The attachment is to be welded with the wheel rim and frame. A rectangular frame is weld with the shaft and a pneumatic piston is connected to the brake drum. Here we are using the tilt sensor to detect the vehicle moving in plane surface or climbing in hill.

I. INTRODUCTION

1.1 General

A rapid growth in transportation and vehicles have resulted in an increase of accident everyday. Accident mainly occur due to carelessness, breaking traffic rules and bad condition of the road. According to a survey, crashes on a curved segment accounted for 10% of total number of traffic crashes.

With increasing parking difficulties and heavy traffic problems, equipping the reverse system with more facilities. In addition to that vehicles in gradients and mountain roads occur often due to drivers approsemia. We used an ABS equipment which can be attached to any automobile that it prevents unwanted reverse motion when it is at rest or in motion. Correspondingly, the number of death accounted for 13% of total number of death.

II. LITERATURE REVIEW

REVIEW 1

Recommendation About The Alignment Survey And Geometric Design Of Hill Roads
Prafulla Kumar (Convenor), Director General(Road Dev.) & Addl. Secretary to the Govt. of India. Ministry of Road Transport & Highways, Transport Bhavan, New Delhi- 110001.

Hilly region generally have extremes of climatic conditions, difficult and hazardous terrain, topography and vast high altitude areas. The region is sparsely populated and basic infrastructure facilities available in more developed plains of interland are mostly absent. The areas and therefore the roads are affected by flood consequent to torrential rainfall, landslide, snowfall, avalanche etc., compelling certain roads to kept closed in part of the year, especially in winter month. However the areas are rich in natural resources, flora and fauna are important to launch development projects, industrial, tourism etc.,

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REVIEW 2

Smart transport system signalling sensor system near hairpin bend

Ravikumar. R (Asst. Professor, Department of civil engineering, SMVITM, Udupi)

Often modern cars have a collision avoidance system built into them known as pre-cash system or collision mitigation system. Forward collision warning system in order to reduce the severity of collision. But majority of vehicles on the road, especially heavy motor vehicles lacking such a system. In this paper, the implementation of the collision avoidance system is aimed to reduce the risk of collisions at the hairpin bend on a hilly track, ghats or other zero visibility turn. The proposed system contains a set of tilt sensors, warning light combined with a convex mirror is installed by the side of the road. It uses four ultrasonic sensors which are placed on either side of the hairpin bend. The sensors are mutually exclusively and are connected by wires. The priority algorithm intelligently controls the moment of vehicles at the hair pin bend based on sensor value giving approximate warning on detection. DESCRIPTION OF

THE PROJECT COMPONENTS

Components used,

- Wheel frame
- Tilt sensor
- Double acting pneumatic cylinder
- Wiper motor
- Chain sprocket
- Square rod (1 inch)

III. WORKING

In this project, we made a simple and economical solution to the above mentioned problem. We used ABS an equipment which can be attach to any automobile that it prevents unwanted reverse motion when it is at rest or in motion. The attachment is to be welded with the wheel, rim and frame. Due to cost factor the small prototype of this project was done. Here we did a model with a metal wheels connected with a shaft. A rectangular frame is welded with a shaft and a pneumatic piston is connected to the brake drum.

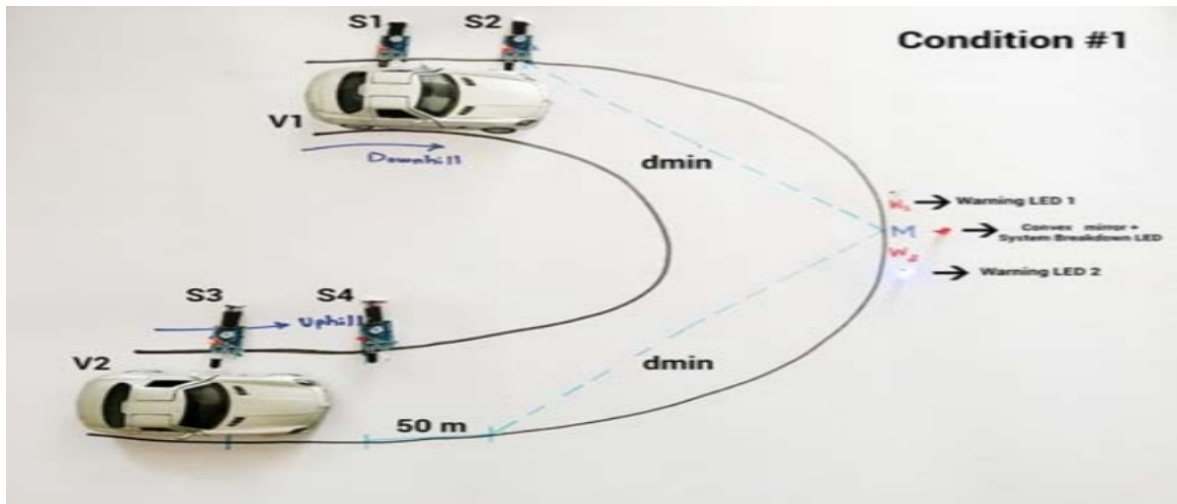


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Here we are using tilt sensor to detect the vehicle is moving in plane surface or climbing in hill. The pneumatic piston act normally and the piston stroke get back. One the tilt sensor get the feedback after climbing the hill the brake apply remains lock. Once we push the acceleration pedals, the ABS release and the automobile moves ON

IV. CHAIN DRIVE CALCULATION

Number of teeth on sprocket pinion $z_1 = 14$ teeth
Sprocket pinion pitch circle diameter $d = 60$ mm
Number of teeth on sprocket wheel $z_2 = 43$ teeth
Motor speed $N = 40$ rpm

Step 1:- Calculation of transmission ratio (DDB P.NO: 774)

$$i = z_2/z_1$$

$$= 43/14$$

$$i = 3.07$$

transmission ratio $i = 3.07$

Step 2:- Determine the number of teeth (DDB P.NO: 774)

$$Z_2 = iz_1$$

transmission ratio $i = 3.07$, so the corresponding the value of $z_1 = 27-25$

$$z_2 = 27 * 3.07$$

$$z_2 = 83 \text{ teeth}$$

Step 3:- Selection of standard pitch (DDB P.NO: 774)

Optimum centre distance, $a = (30 \text{ to } 50)$
 $p =$ pitch of chain, mm
 $a =$ centre distance, mm
 $P_{max} = a/30$
 $P_{min} = a/50$
Pinion pitch diameter $d = 60$ mm
pitch, $P = d \sin(180/T) = 60 * \sin(180/14)$
 $P = 13.351$ mm
Standard pitch = 15.875
 $a = 30 * p = 30 * 15.875$
 $a = 476.25$ mm

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$$P_{max} = 476.25/30 = 15.875\text{mm}$$

$$P_{min} = 476.25/50 = 9.525\text{mm}$$

Step 4:- Calculation of service factor (DDB P.NO: 776)

$$K_s = k_1 * k_2 * k_3 * k_4 * k_5 * k_6$$

$$k_1 = k_6 = 1.25$$

$$k_2 = k_3 = k_4 = k_5 = 1$$

$$K_s = 1.25 * 1 * 1 * 1 * 1 * 1.25 = 1.56$$

Step:5 Selection of chain

For pitch value of 15.875 mm. So DR 50 Rolon chain may be selected .

Breaking strength $Q = 4440 \text{ kgf}$

Breaking area $A = 1.4 \text{ cm}^2$

Weight per meter $W = 1.78 \text{ kgf}$

Step 6:- Determine the factor of Safety DDB. P. No: 7.78

$$n = Q / \epsilon_p$$

$$\epsilon_p = P_t + P_s + P_c$$

$P_t =$ tangential force in kgf,

$P_c =$ centrifugal tension kgf, $P_s =$ tension in kgf

$$P_t = 102 * N / V$$

$N =$ power in KW, $V =$ velocity in m/s

$$V = Z_1 * P * N_1 / 60 * 1000 = (27 * 15.875 * 40) / (60 * 1000)$$

$$V = 0.285 \text{ m/s.}$$

(DDB.P.NO :7.77), Power $N = QV / 102 * n * K_s$

speed of rotation < 50 , so $n = 7.0$

$$N = (4440 * 0.285) / (102 * 7.0 * 1.56) = 1.136 \text{ KW.}$$

$$P_t = 102 * N / V = (102 * 1.136) / 0.285 = 449.11 \text{ kgf} \sim 450 \text{ kgf.}$$

$$P_c = WV^2 / g = 1.78 * (0.285)^2 / 9.81 = 0.0147 \text{ kgf.}$$

$$P_s = K * W * a = 6 * 1.78 * 0.47625 = 5.0863 \text{ kgf.}$$

DDB.P.NO : 7.78, Position of the chain is horizontal, so $K = b$.

$$\epsilon_p = 450 + 0.0147 + 5.0863 = 455.10 \text{ kgf}$$

$$n = 4440 / 455.10 = 9.75 = 10.$$

since the FOS is more than adopted minimum value. So the chain selection is correct.

Step:-7 Determine the design load (DDB.P.No: 7.78)

$$Q_0 = P_t * K_s = 450 * 1.56 = 702 \text{ kgf} = 702 * 10 = 7020 \text{ N/mm}^2.$$

Step:-8 Determine the bearing stress (DDB.P.No: 7.77)

$$N = \sigma AV / 102 K_s, \sigma = N * 102 * K_s / A * V = (1.136 * 102 * 1.56) / (1.4 * 0.285)$$

$$\sigma = 453.03 \text{ kgf/cm}^2$$

Step:-9 Length of the chain (DDB.P.No: 7.75)

$$L_p = 2a_p + (z_1 + z_2) / 2 + ((z_2 - z_1) / 2\pi)^2 / a_p$$

$a_p =$ approximate centre distance = a_0 / P .

$a_0 =$ centre distance, $a_p = 476.25 / 15.875 = 30 \text{ mm.}$

$(z_2 - z_1) / 2\pi$ value from the table (DDB.P.NO.7.76)

$Z_2 - Z_1 = 43 - 14 = 29$, so the corresponding value is 21.30.

$$L_p = 30 * 2 + (14 + 43) / 2 + (21.30 / 30) = 89.21 \text{ mm.}$$

$$L = L_p * P = 89.21 * 15.875 = 1416.25 \text{ mm}$$

Length of chain, $L = 1416.25 \text{ mm.}$

Step:-10 Determine the correct centre distance (DDB.P.No: 7.75)

$$a = (e + (e^2 - 8m)^{0.5}) / 4 * P, e = L_p - (z_1 + z_2) / 2.$$

$$e = 89.21 - (14 + 43) / 2 = 60.71 \text{ mm.}$$

m value from the table (DDB.P.No: 7.76), $m = 21.30$.

$$a = (60.71 + (60.71^2 - 8 * 21.30)^{0.5}) / 4 * 15.875 = 476.25 \text{ mm.}$$

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correct centre distance, $a= 476.25\text{mm}$.

Step:-11 Determine the pitch circle diameter (DDB.P.NO: 7.78)

Diameter of small sprocket, $d_1= P/\sin(180/z_1)= 13.35/\sin(180/14)$

$D_1= 59.99\text{mm} \sim 60\text{mm}$

Diameter of large sprocket, $d_2=P/\sin(180/z_2)=13.351/\sin(180/43)$

$D_2=182.90\text{mm} \sim 183\text{mm}$.

V. CONCLUSION

The simple and effective methodology will enable the driver to have a better sense of terrain and drastically reduce road accident in hairpin bend or other kinds of zero visibility turn.

This idea will make the future transport system smarter and use of upcoming technologies.

VI. EXPERIMENTAL SETUP



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