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Comparison of automated speed breakers with conventional speed breakers

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ABSTRACT

The latest advancement in ITS (Intelligent Transportation System) is modernizing the manner in which we see the world at a quicker rate. Automated speed breaker system is a little introductory or basic environment-friendly ITS tool or device, which utilizes modern-day instrumentality to resolve to the sole purpose of traffic calming. The methodology and it's operating are easy to adapt to, however, it also reduces modern-day issues. This technology can be beneficial or convenient in counterparts world issues like pollution, growing traffic congestion, rise in fuel consumption and outflow of gases (CO and NOx), and safety to the road or street users in a much advance and trouble-less way. The emission of dangerous gases mentioned above by the vehicles has to be minimized and counterpart. These modern lives should adopt and learn to this current technology for a healthy and sustainable living surrounding. In this research, a study on speed behavior (breakers) of different class vehicles (two wheeler, four wheeler, and heavy vehicles) on conventional breaker system and automated breaker system is done; delay on CBS, travel time for both CBS and ABS, fuel consumption and emission rates through vehicles in the heart of Goa (Panjim) and at-last deployment rate of conventional breaker system and automated breaker system was carried out, it was observed that the delay, travel time, fuel consumption and emission rate is more in CBS than that of the ABS, but the deployment cost of ABS was higher than that of CBS.

Keywords— *Conventional breaker system and automated breaker system, Delay analysis, Fuel consumption, Fuel emission, Deployment cost*

1. INTRODUCTION

Road plays an essential role for the general population all over the world to travel from one place to a different with the help of different modes of vehicle thus, there safety, security is significant; so for the correct working of the roads "controlling driving velocity" is taken under consideration to be an effective methodology for enhancing vehicular safety because increase speed of vehicles can lead to the possibility of serious mishaps. An issue regarding loss of life due to mishaps well-being and safety of road is very essential, so for the decrease of vehicular speed and furthermore mishaps many TEM are utilized and these are "speed bumps and speed humps" which is speed breakers (Conventional Breaker System) and there are also "dynamic speed bumps" which is called as automated or advanced speed breakers (Automated Breaker System) that are totally different from usual CBS this is absolutely new idea to control the vehicular velocity and serious mishaps over the speed breakers. ABS is the "time demand" according to the requirements and also ABS comprises of ITS i.e. Intelligent Transportation System tools, the tools it comprises of as shown in figure 1 below:

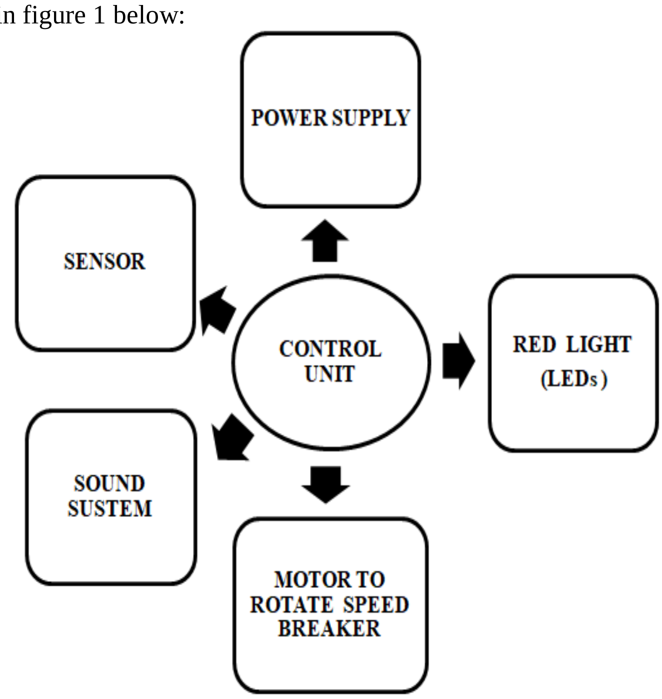

Fig. 1: ABS flow diagram

ABS can function as both speed breaker in peak hour (when there are vehicles in the road) and May subject to road level in non- peak hour (when there are no vehicles in the road), ABS only works in peak.

2. BRIEF PERSPECTIVE OF METHODOLOGY

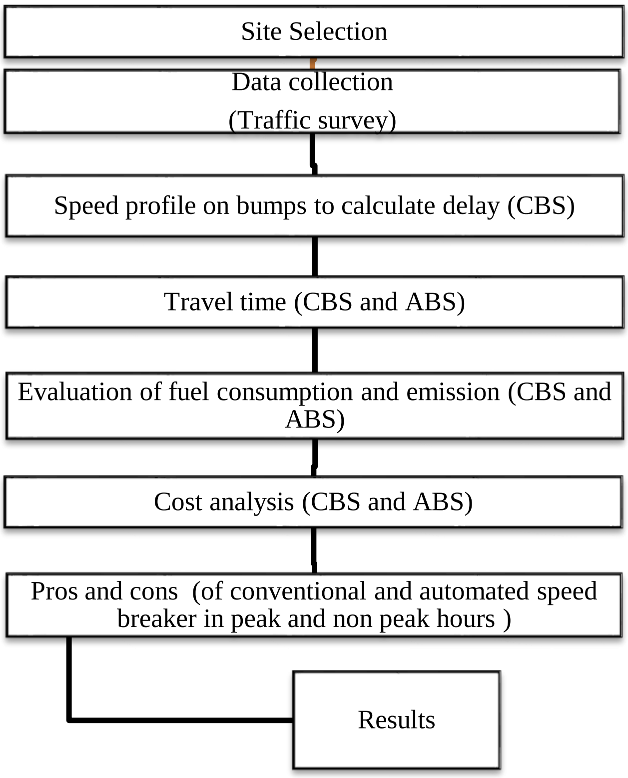

Fig. 2: Outline of methodology in flow diagram

3. RESULTS, GRAPHS AND INTERPRETATION ON CBS AND ABS

The information was taken from the site; Panjim to Airport via Vasco to check the traffic survey i.e. "daily variation of traffic and hourly variation of traffic, Composition of traffic, peak hour and Average Daily Traffic (ADT)", delay for CBS, fuel emission and fuel consumption for CBS and ABS, cost analysis for CBS and ABS, pros and cons for CBS and ABS for peak and non-peak hour are calculated, the results and interpretation are given below.

3.1 Study and Analysis of Traffic Survey Based on Traffic Characteristics

From the figure 3 below, shows daily variation in traffic "number of vehicles and Passenger Car Unit" (PCU's) and an average number of daily traffic for vehicles are 37,079 and for Passenger Car Unit (PCU's) are 34,216 which is shown by a straight line in the graph.

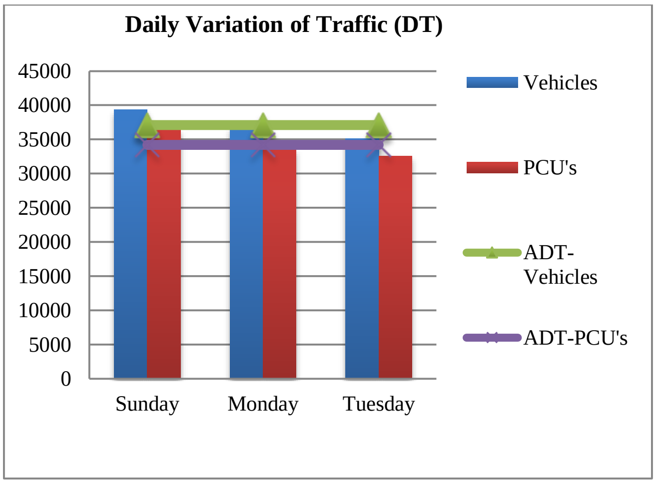

Fig. 3: Daily traffic and Average Daily Traffic (ADT)

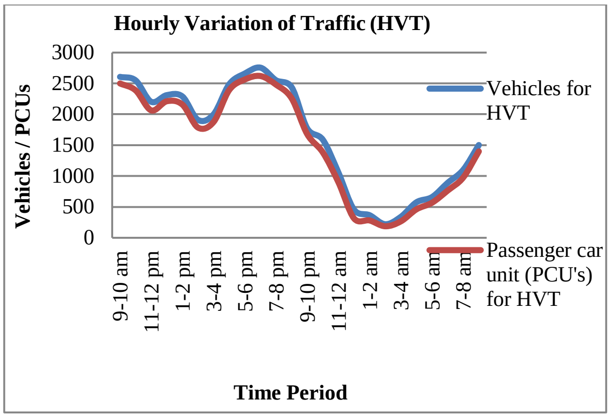

Fig. 4: Hourly Variation of Traffic (HVT)

From the figure 4 it shows the hourly variation of traffic (HVT) with peak hour 2756 around 6 to 7 pm and also we can see during night time there is heavy drop of traffic volume and non-peak hour 221 around 2-3 am and also we can see that around day time the average of hourly variation of traffic is more than "2000 passenger car unit (PCU's)" actually it is more than the "design service volume".

Table 1: Annual Average Daily Traffic (AADT) for motorised vehicles

S no.	Different motorised vehicles	Motorised vehicles volume for Annual Average Daily Traffic (AADT)
1	Two Wheeler	13259
2	Car (Jeep/Van/Taxi)	21402
3	Auto Rickshaw	93
4	Mini Bus	364
5	Buses (Government/Private/School)	1159
6	Mini LCV (Light Commercial Vehicles)	1703
7	LCV (Light Commercial Vehicles)	1253
8	Two Axle	44
9	Three Axle	11
10	MAV(Micro Aerial Vehicle)	4
11	HMV (Heavy Motor Vehicle)	0
12	Others	0
13	Tractors	0
14	Tractors with Trailer	0

Table 2: Annual Average Daily Traffic (AADT) for non-motorised vehicles

S no.	Different non-motorised vehicles	Non-motorised vehicles volume for Annual Average Daily Traffic (AADT)
1	Bicycle	8
2	Cycle Rickshaw	0
3	Animal Hand Drawn (AHD)	0
Total Vehicles are 39300		Total Passenger Care Unit (PCU's) are 36463

From the table 1 and 2 we can see "AADT" for motorised and non- motorised vehicles, "AADT" is overall volume count of vehicular traffic of an expressway or street consistently (year) and the AADT is achieved by evaluating month to month variation.

3.2 Speed Profile across Speed Bumps for Different Class Vehicles.

From the figure 5, shows the time taken to transverse for different vehicles classes over chain ages and clearly, we can see that time taken by heavy vehicles is greater than 4-wheelers and 2- wheelers.

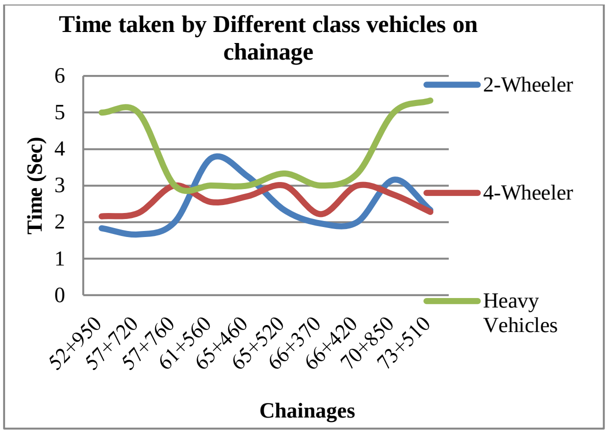

Fig. 5: Comparison of time taken by different vehicles across speed bumps

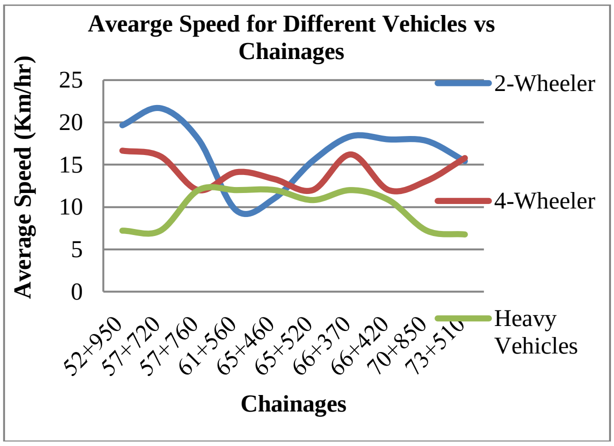

Fig. 6: Comparison of average speed of vehicles during 10m intersection

From figure 6, shows the average speed of different vehicle class over chainages and clearly, we can see the average speed of 2- wheelers is greater than 4-wheelers and heavy vehicles.

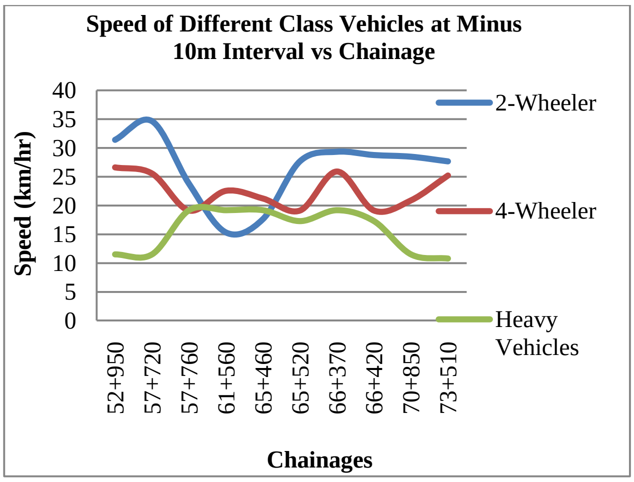

Fig. 7: (a) Speeds of different class vehicles at minus 10m interval

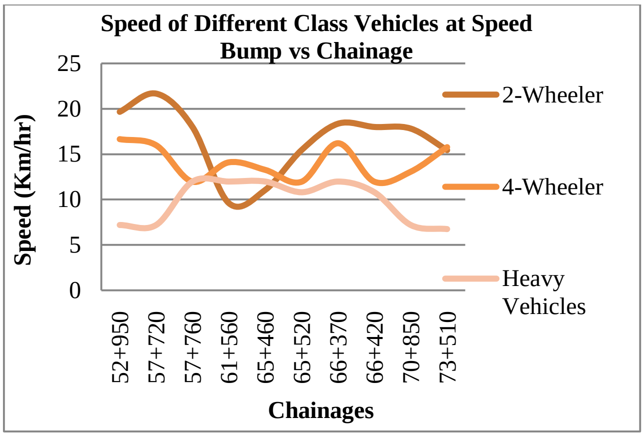

Fig. 7 (b) Chainages and speed bump vs. chainages

From figure 7, (a) graph and (b) show the speed of different class vehicles at -10m interval from speed breaker vs. Chainages and clearly it is observed that speed of 2- wheeler at -10m interval is greater than 4- wheelers and heavy vehicles. We can also observe from both the figure 4.9, there is a reduction of speed of vehicles at speed breaker as compare to speed at -10m interval from speed breaker.

3.3 Delay Calculation for Conventional Breaker System for Peak and Non- Peak Hour

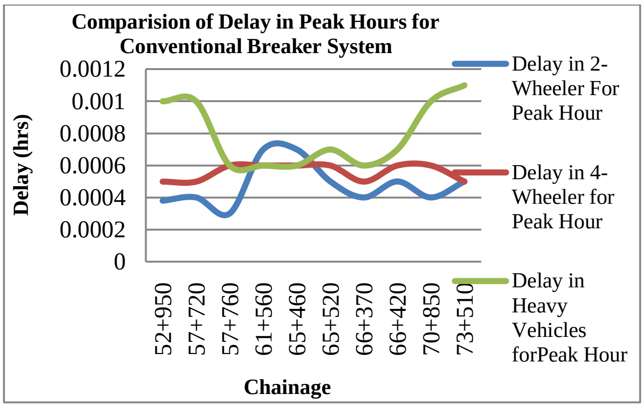

Fig. 8: Comparison of delay calculation in peak hour for CBS

From figure 8, shows delay (in the y-axis) for different class vehicles in Conventional Breaker system vs. chainages (in x-axis) and from the graph clearly, we can observe that delay for heavy vehicles is greater than 4- wheelers and 2- wheelers for peak hour. Total delay for heavy vehicles is 28.44 sec while for 4-wheelers and 2- wheelers total delay is 20.16 sec and 17.28 sec for peak hour.

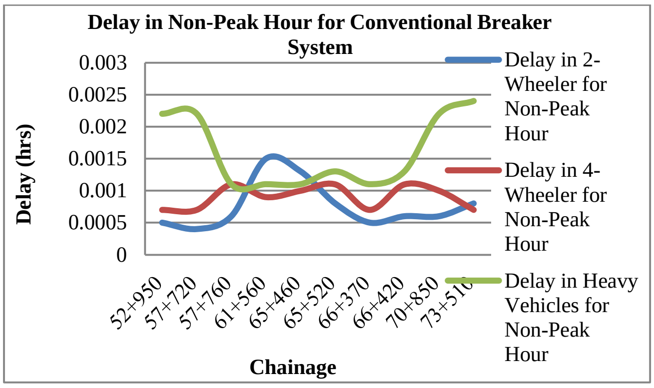

Fig. 9: Comparison of delay calculation in non-peak hour for CBS

From figure 9, shows delay (in the y-axis) for different class vehicles in non- peak hour in Conventional Breaker system vs. chainages (in x-axis) and from the graph clearly, we can observe that delay for heavy vehicles is greater than 4-wheelers and 2- wheelers for peak hour. Total delay for heavy vehicles is 57.16 sec while for 4-wheelers and 2- wheelers total delay is 32.4 sec and 27.36 sec in non- peak hour.

3.4 Travel Time for Conventional Breaker System and Automated Breaker System for Peak and Non- Peak Hour

Table 3: Travel time journey in CBS for peak and non-peak hour

Travel Time for Conventional Breaker System	
Peak Hour	Non- Peak Hour
3.1698 hr	1.542 hr

Table 4: Travel time journey in ABS for peak and non-peak hour

Travel Time for Automated Breaker System	
Peak Hour	Non- Peak Hour
1.2348 hr	1.029 hr

From the table 3, 4 below, we can clearly see that travel time of vehicles in automated speed breaker in both peak and the non-peak hour is better than in conventional speed breaker. This is due to the fact that average journey speed in automated speed breaker is better than in conventional speed breaker. The value shown is the total of time take by two wheeler, four wheeler and heavy vehicles.

3.5 Fuel Consumption in Conventional Breaker System and Automated Breaker System for Peak Hour and Non- Peak Hour

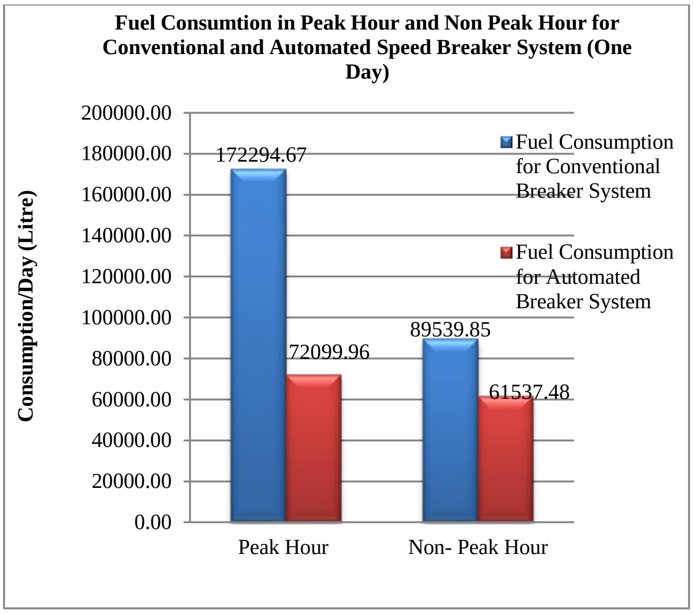

Fig. 10: Differences in fuel consumption for peak and non-peak hour for CBS and ABS (per day)

From figure 10 and 11 shows fuel consumption per day and per year (in y-axis) in CBS and ABS vs. peak and non- peak hour and we can clearly see from both the graphs that the difference in fuel consumption in Conventional Breaker System (CBS) and Automated Breaker System (ABS), as fuel consumption by automated breaker system is less than a conventional breaker system. CBS consumed more fuel.

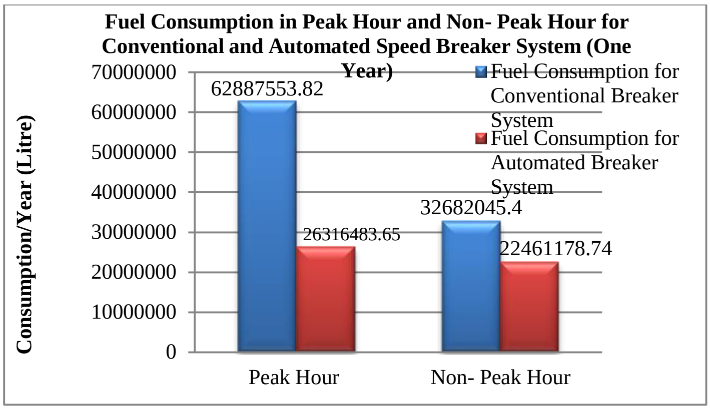

Fig. 11: Differences in fuel consumption for peak and non-peak hour for CBS and ABS (Per Year)

3.6 Fuel Emissions (Carbon Monoxide and Nitrogen Oxide) in Conventional Breaker System and Automated Breaker System for Peak Hour and Non- Peak Hour

From figure 12 and 13 shows fuel Emissions carbon monoxide (CO) and nitrogen oxide (NOx) per day and per year (in y-axis) in CBS and ABS vs. peak and non- peak hour and we can clearly see from both the graphs that the difference, fuel emissions that are carbon monoxide (CO) and nitrogen oxide (NOx) released by conventional breaker system (CBS) is more as compared to automated breaker system (ABS). These fuel emissions will harm the environment, which automatically is not good for human's health.

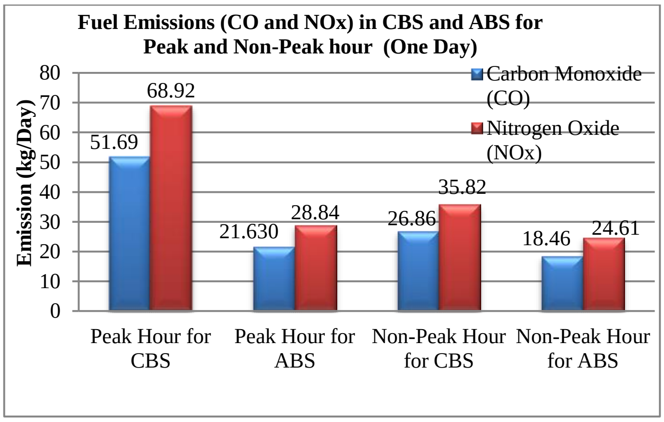

Fig. 12: Differences in fuel emission for Carbon Oxide (CO) and Nitrogen Oxide (NOx) in peak and non- peak hour for conventional and automated speed breaker system (per day)

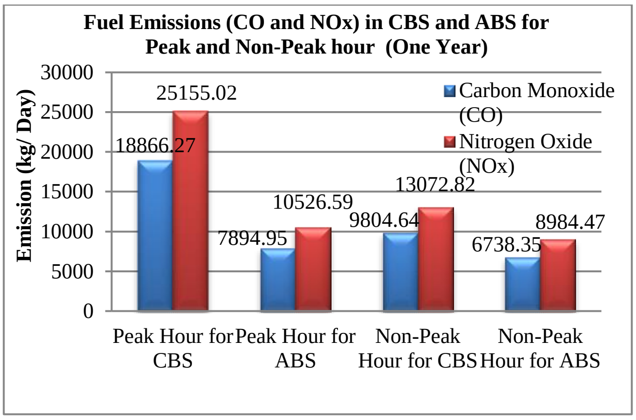

Fig. 13: Differences in fuel emission for Carbon Oxide (CO) and Nitrogen Oxide (NOx) in peak and non- peak hour for conventional and automated speed breaker system (per day)

From figure 14 below, clearly, we can see that in "Automated Speed Breaker System" there is a reduction in fuel emission and fuel consumption as compared to using "Conventional Speed Breaker System" in Peak and Non-Peak Hour (i.e. 31.72% and 58.15%).

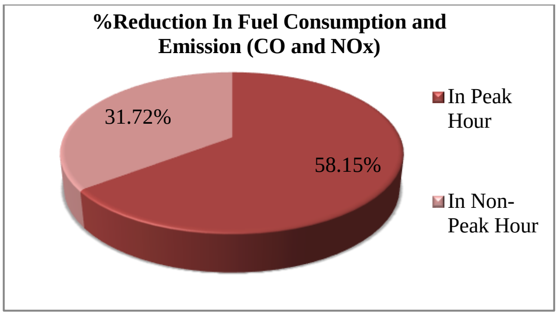

Fig. 14: Percentage reductions in fuel consumption and fuel emission for Carbon Oxide (CO) and Nitrogen Oxide (NOx) in peak and non- peak hour

3.7 Cost Analysis of Conventional Breaker System and Automated Breaker System

$$Area\ of\ cross\ section\ =\ 0.2334\ m2$$

$$Volume\ of\ 1\ speed\ breaker\ system\ =\ 0.2334\ *\ 7\ =\ 1.6338\ m3$$

$$Number\ of\ speed\ breaker\ =\ 10$$

Therefore $total\ volume\ =\ 1.6338\ *\ 10\ =\ 16.338\ m3\ {\sim}17\ m3$

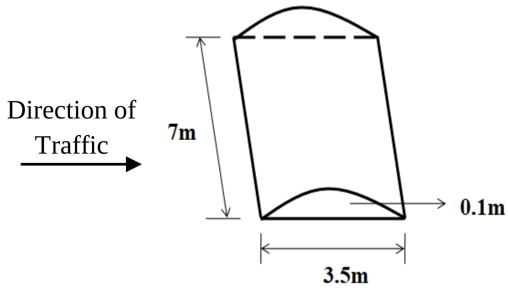

Fig. 15: CBS

$$Rate\ of\ Bituminous\ Concrete\ (BC)\ =\ Rs\ 21250\ /\ m3$$

Therefore

$$Total\ Material\ Cost\ for\ CBS\ =\ 21250\ *\ 17\ =\ Rs\ 361{,}250$$

Therefore cost analysis of conventional breaker system is comes out to be Rs 361,250

Table 5: Cost analysis of ABS

Cost Analysis of ABS		
S no.	**Materials**	**Material Cost**
1	Teak wood	2200 / m^3
		Required for 10 breakers = 16.338 m^3 ~17 m^3
		Therefore cost = 17*2200
		= Rs 37400
2	Stepper motor	Rate, 340/ Piece *10
		= Rs 3400
3	Metal road	Rate, 199/Piece *4*10
		= Rs 7960
4	Pole	Rate, 2500/Piece*10
		Rs 25000
5	Relay	Rate, 161/ Piece*10
		= Rs 1610
6	Controlling Card	Rate, 8000/Piece*10
		= Rs 80000
7	Buzzer	Rate, 30/Piece*10
		= Rs 300
8	LED's	= Rs 40*10
		= Rs 400
9	Micro-controller	Rate, Rs 760/ Piece*10
		= Rs 7600
10	Rectifier	= Rs 15/Piece*10
		= Rs 150
11	Regulator	= Rs 5/ Piece*10
		= Rs 50
12	Screw Jack	=10000/ Piece*2*10
		= Rs 200000
13	Transforma	= Rs 660*10
		= Rs 6600
14	Oscillator	= 4*4*4*10
		=Rs 640
15	Resistor	= 5*4*10
		= Rs 200
16	Capacitor	= 349*4*10
		=Rs 139600
Total material cost		= Rs 510910
Cost to fabricate		1500/ Breaker
Total cost analysis of ABS		= 510910+1500*10 =Rs 525,910

3.8 Pros and Cons of Conventional Breaker System (CBS) and Automated Breaker System (ABS)

Table 6: Pros and cons of Conventional Breaker System (CBS)

S no.	Pros of CBS	Cons of CBS
1	CBS gives safety to vehicular drivers and people moving on the roadside	CSB is pernicious to the environment, as it forces the vehicular driver to slow down the vehicle and therefore speedily accelerated due to which there is an increase in the emissions of harmful gases
2	In CBS less maintenance is needed	Due to CBS, and also sometimes unnecessary breakers leads (Diverts) traffic to the different routes.
3	Accessibility of CBS in nearness spaces and vehicles blind spot like car parking and very narrow driveway which leads to lessen the vehicle velocity (speed)	CBS increase the noise pollution wherever they enforced as the vehicular driver passing over it due to which not simply engine but also brakes causes noise, however additionally by trucks and lorries conveying substantial loads (heavy loads) by moving over CBS.
4	CBS as it helps to lower the velocity of vehicle (Speed); due to lower speed, it reduces the noise and causes fever impact (i.e. collision) that	Due to CBS, it damages the vehicles and particularly sports vehicle i.e. sports car (even when the speed of the vehicle is less).

	improves traffic safety and also safety increase for the pedestrian.	
5	CBS if properly produced and placed (i.e. manufactured and installed), correct standard quality is preserved, due to which with time it will not rattle.	CBS leads to decrease in the “response time” of vehicles
6	CBS creates a visual that the realm isn’t meant for rushing the vehicles.	CBS cause uneasiness and back injury to the passengers and vehicular drivers, they likewise incorporate those travel on buses, which might walk down or using stairs making them fall and harm themselves
7	Due to CBS counteractive action (i.e. Prevention) of vehicles from skidding or slipping in wet surface areas.	CBS causes vibration to the vehicular drivers when the vehicle passes over it and through the ground it sends shockwaves to the vehicular driver as it navigates over them.
8	CBS is easy to build.	CBS costs a vehicular driver more cash due to the requirement of more petrol and brake cushions, additionally harm caused to oil sumps exhaust of vehicle, suspension system etc.
9		In CBS, sometimes we need to apply sudden breaks due to no easy demarcation due to which vehicles “collides or skids”, especially two-wheelers
10		In CBS at the point when vehicular drivers roll over them with their lights on and to the eye level the dipped beams up, this causes almost disturbances to the nearby houses as well as offers the illusion of headlights of vehicles begin flashed and due to which making perplexity to the other vehicular drivers and frequently causing mishaps.

Table 7: Pros and cons of Automated Breaker System (CBS)

S no.	Pros of ABS	Cons of ABS
1	ABS is environment-friendly.	The initial construction cost of ABS is high
2	Additional fuel emission of harmful gases because of constant “acceleration and deceleration” of the vehicle is lesson drastically due to ABS.	“Children and people” will misunderstand its operating construct or working idea which might cause issues.
3	Due to the use of ABS, there is significantly reduced in fuel consumption.	People with bad mentality can seriously harm breakers because it is simple to disassemble it (dismantle).
4	In ABS journey time for vehicular drivers and traveller (i.e. passenger) is decreased.	Maintenance is needed often to guarantee the legitimate (proper) working of breakers.
5	ABS gives safety to vehicular drivers and traveller, additionally along with increased in the safety of people moving on the roadside i.e. side-walkers.	An enormous measure of surveillance is required to influence individuals to make them understand about ABS.
6	Due to ABS, there is a decrease in the noise pollution drastically.	
7	Due to ABS, there is a decrease in the vehicle damage drastically.	
8	In ABS reaction time for emergency vehicles like ambulance, fire trucks and police vehicles are increased.	
9	ABS if maintained properly, the service life of this breaker system is increased than that of the CBS and also Solace of drivers and passengers is more.	

4. CONCLUSION

The present study on “Comparison of Automated Speed Breakers with Conventional Speed Breakers” leads to the following conclusion and remark are given below.

Delay in conventional speed breaker system is on an average 21.96 sec in peak hour and 38.97 sec in non-peak hour for different class vehicles comprising of 2-wheeler, 4-wheeler and heavy vehicles than that in automated speed breaker system. Travel time in automated speed breaker system is 61.26% faster than in the conventional speed breaker system in peak hour and 78.12% faster than in the conventional speed breaker system in non- peak hour.

Fuel consumption in automated speed breaker system is 58.1% lesser than compared to conventional speed breaker system in peak hour and 31.2% lesser in non- peak hour in one year. This is due to ABS only works in peak hours so the fuel requirement decreased so the emission of gases will be less which is good for the environment.

Fuel emission in automated speed breaker system is 58.1% lesser than compared to conventional speed breaker system in peak hour and 31.2% lesser in non- peak hour in one year. Cost of development of automated speed breaker system is 31.3% higher than compared to conventional speed breaker system.

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