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Comparative Design Analysis of Motorcycle Braking Systems to Decide the Most Appropriate System According to The Traffic Context of Bangladesh

B.Sc. Engineering (Mechanical) Thesis

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Candidate's Declaration

It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or professional qualification.

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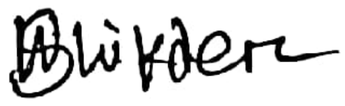

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We seek excuse for any errors that might be in this report despite our best efforts.

Md.Azmain Mahtab

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Abstract

The road accident rates in Bangladesh has increased by 42% since last 4 decades. Apart from all other socio-economic reasons, lack of appropriate usage of motorcycle braking system is one of the obvious reasons in this phenomenon. Hence, suitable braking system can contribute vastly in reducing accidents and accident rates. As there are lots of braking systems available for motorcycle in today's market, it is difficult for general people to identify the proper vehicle which is compatible to the road and traffic conditions in our country. In this paper, design aspects and working methods of different types of motorcycle braking system have been scrutinized based on data and graphical analysis. And finally authors have tried to reach a probable decision about the most fit braking system in Bangladesh that can be incorporated with the motorcycle. The result of this paper can help further research on the country specific motorcycle braking system in Bangladesh as it represents a comparative analysis between Anti-Lock braking system and other systems. And eventually proved the Probable higher efficiency rate of ABS in terms of Theoretical discussion.

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Chapter 1: Introduction

This paper discusses and compares the braking performance of motorcycles and analyze the probable most suitable breaking system according to the context of traffic condition of Bangladesh. A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction. The function of the brake system is to stop the vehicle within the smallest possible distance and hence this is done by converting the kinetic energy of the vehicle into the heat energy which is dissipated into the atmosphere. Motorbikes have two usually independent braking systems - one on the front wheel and one on the rear wheel. The brakes on the front wheel are usually quite a lot more powerful than those on the rear wheel, because the front wheel has more traction under braking. The less powerful rear brakes are therefore more useful for making small adjustments to speed and making slow maneuvering more precise. Braking systems are defined into Four main categories: Drum, Disc, Combined Braking System (CBS) and Anti-Lock Braking System(ABS). Introducing different motorcycle braking systems, performance analysis based on simulation and survey has been done here to find out most appropriate braking condition.

1.1 Objectives of the Study

- To carry out primary level survey on usage of motorcycle brakes in Bangladesh.
- To scrutinize the key problems of Braking system of Motorcycles in this country.
- To come up with possible best Braking system of motorcycle in terms of the traffic condition of Bangladesh.

Chapter 2: Literature Review

A drum brake is a brake that uses friction caused by a set of shoes or pads that press outward against a rotating cylinder-shaped part called a brake drum. The term drum brake usually means a braking system in which shoes press on the inner surface of the drum.

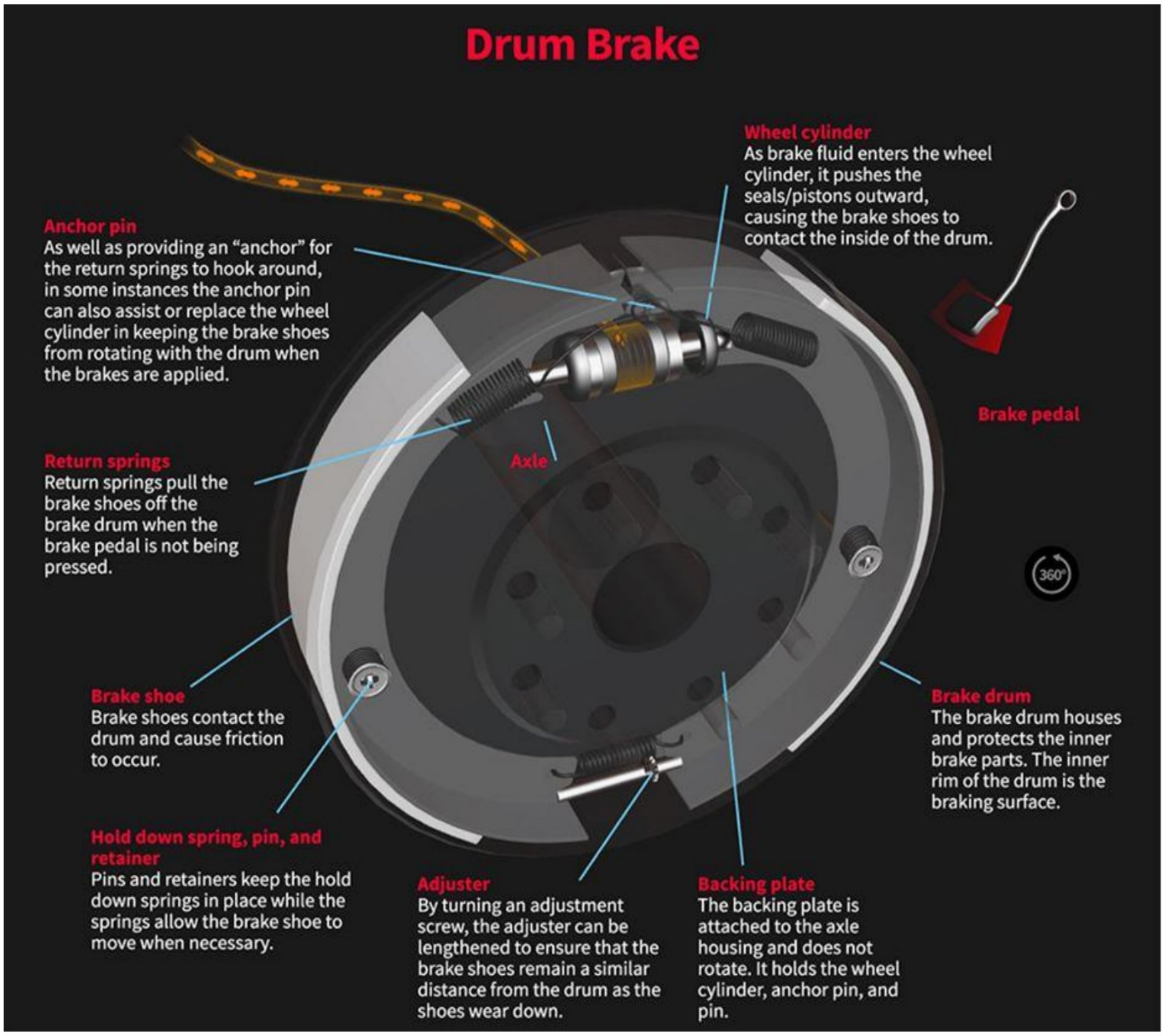


Figure 1 Drum Brake

2.1 Drum Brake Components:

A drum brake comprises the following components:

1. Backing plate:

Provides a solid base for other components in the drum brake attached to the axle sleeve.

2. Brake drum:

Bolted to the wheel hub and spins with the wheel. Often made of cast iron, and is resistant to heat and wear. This is what you see when you look at an assembled drum brake and is the component upon which braking force is applied to slow or stop the car.

3. Wheel cylinder:

Contains two pistons, one at each end of the cylinder, to operate the brake shoes. The cylinder applies pressure to the pistons, which pushes the brake shoes towards the drum, slowing or stopping the car. One cylinder is needed per wheel.

4. Brake shoe:

Pushes into the drum to create the friction necessary to slow or stop the car. Secured to the backing, but able to slide when pressure from the wheel cylinder is applied. It has a lining attached to it, made up of organic or metallic compounds. The lining is what actually comes in contact with the drum and wears away with use. Each brake contains two shoes. The primary shoe is closer to the front of the vehicle, while the secondary shoe is closer to the rear. Depending on the type and brand, the brake shoes may be interchangeable.

5. Automatic adjuster:

Keeps the brake shoes at a consistent distance away from the drum, even as the lining wears away.

6. Return springs:

Pulls the brake shoes back away from the drum when the driver lets off the brake pedal.

The brake drum is fixed to the wheel and turns with it. On braking, the wheel cylinder forces the fixed brake shoes apart and presses them against the brake drum, thus slowing it down. When the brake is released, the return springs move the brake shoes back to their original position.

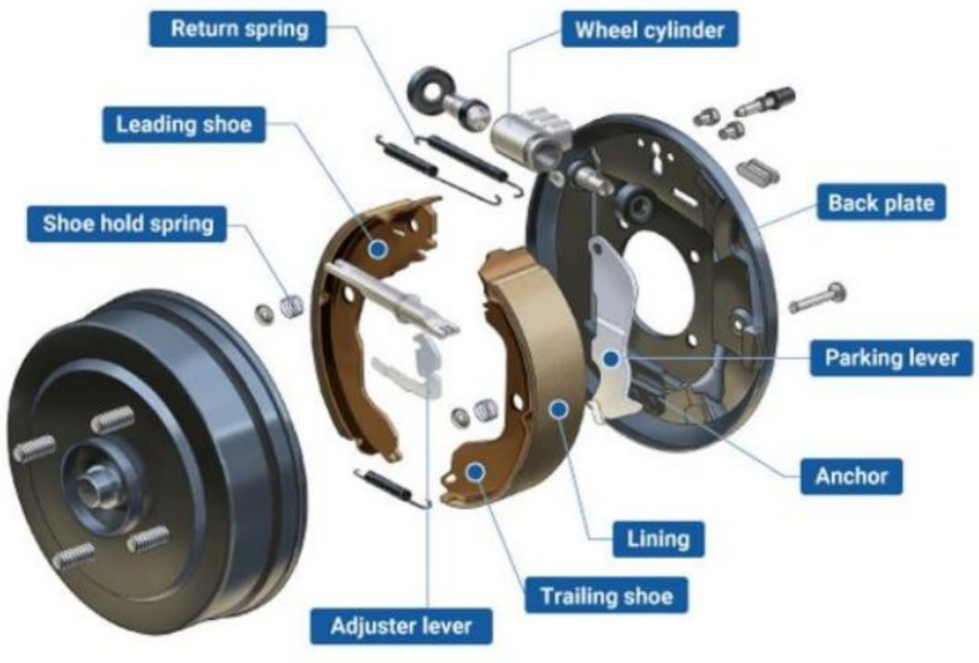


Figure 2 Components of Drum Brake

2.1.1 Working Principle Of Drum Brake:

When the driver steps on the brake pedal, the power is amplified by the brake booster (servo system) and changed into hydraulic pressure (oil-pressure) by the master cylinder. The pressure reaches the brakes on the wheels via tubing filled with brake oil (brake fluid). The delivered pressure pushes the pistons on the brakes of the four wheels. The pistons press the brake linings, which are friction materials, against the inside surfaces of the brake drums which rotate with the wheels. The linings are pressed on the rotating drums, which in turn decelerate the wheels, thereby slowing down and stopping the vehicle.

2.1.2 Types of Drum Brakes:

There are mainly three types – mechanical, hydraulic and pneumatic assisted Drum Brakes

1. Mechanical:

In the mechanical Drum brake system such as in two-wheeler & auto rickshaw, the brake shoes are actuated by a cam, which is attached to the brake linkage & pedal. When you press the brake pedal, the cam turns. Thus, it causes the brake shoes to expand outwards and rub against the drum.
The friction between the brake linings and the drum causes the drum to stop rotating, thereby the wheel to stop. When you release the brake pedal, the retracting springs bring the brake shoes back to their original position. This results in a gap between them and the drum and to again spin it freely.

2. Hydraulic:

The hydraulic Drum brake system such as in cars is a bit superior to a mechanical one. In this design, the hydraulic wheel cylinder replaces the cam. In the hydraulic system, instead of a cam, the wheel cylinder's pistons push the brake shoes outwards. The brake shoes fit on the anchor plate or braking plate. It holds the brakes system parts together and on to the car's axle. When you press the brake pedal, the oil in the brake master cylinder multiplies the hydraulic force sent to the wheel cylinders. Thus, it causes its pistons to push outwards. The pistons, in turn, cause the brake shoes to expand and rub against the drum. The friction between the brake linings and the drum causes the drum to stop rotating, thereby the wheel to stop.

3. Pneumatic assisted:

The third type – pneumatic assisted Drum-brake system; actuated by air-pressure, which works on the same principle of that of the mechanical Drum brake system. It is also operated by a bigger size cam or the 'S' shaped cam and is popularly known as the "S-Cam" brake system. However, high-pressure compressed air actuates a pneumatic piston which turns the cam. Mostly the medium to heavy commercial vehicles use this type of drum brake system.

2.1.3 Advantages of Drum brake system:

1. Simple design.
2. Fewer parts.

3. Easy & cheaper to manufacture
4. Low maintenance cost.
5. Comparatively longer life

2.1.4 Disadvantages of Drum brake system:

1. Low braking force compared to disc.
2. Brakes 'fade' when the driver applies them for a prolonged time.
3. The brake shoe lining made of asbestos is harmful to humans.
4. When wet, the braking grip reduces considerably.
5. Non-asbestos linings catch moisture; causing the brakes to grab suddenly.

2.2 Disc brake:

Disc brakes are found on most vehicles today. They are mounted on the front axle and often the rear as well. In order stop a wheel a disc brake uses a caliper fitted with brake pads to grab a spinning disc..

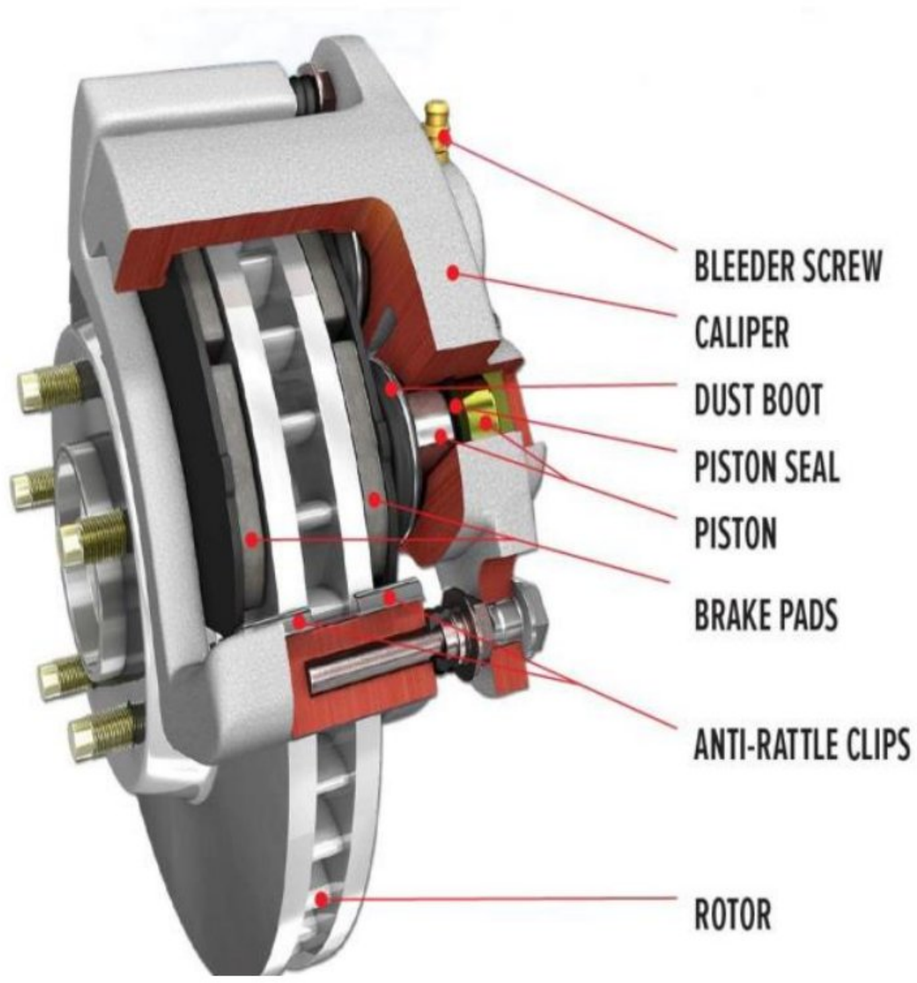


Figure 3 Disc Brake

2.2.1 Disc Brake Component:

The caliper is an assembly mounted to the vehicle with a bracket so it frames the rotor. It looks and functions like a c-clamp. It contains:

1. Brake pads: metal plates bonded with material that provides stopping friction.
2. One or two pistons to push the brake pads against the rotor when you brake.
3. A bleeder screw to allow for servicing the brakes and replacing the fluid.
4. A rubber piston seal that prevents brake fluid leakage and retracts the piston when the brakes release.

5. A dust boot to keep contaminants out of the cylinder.

6. Anti-rattle clips that keep the brake pads stable.

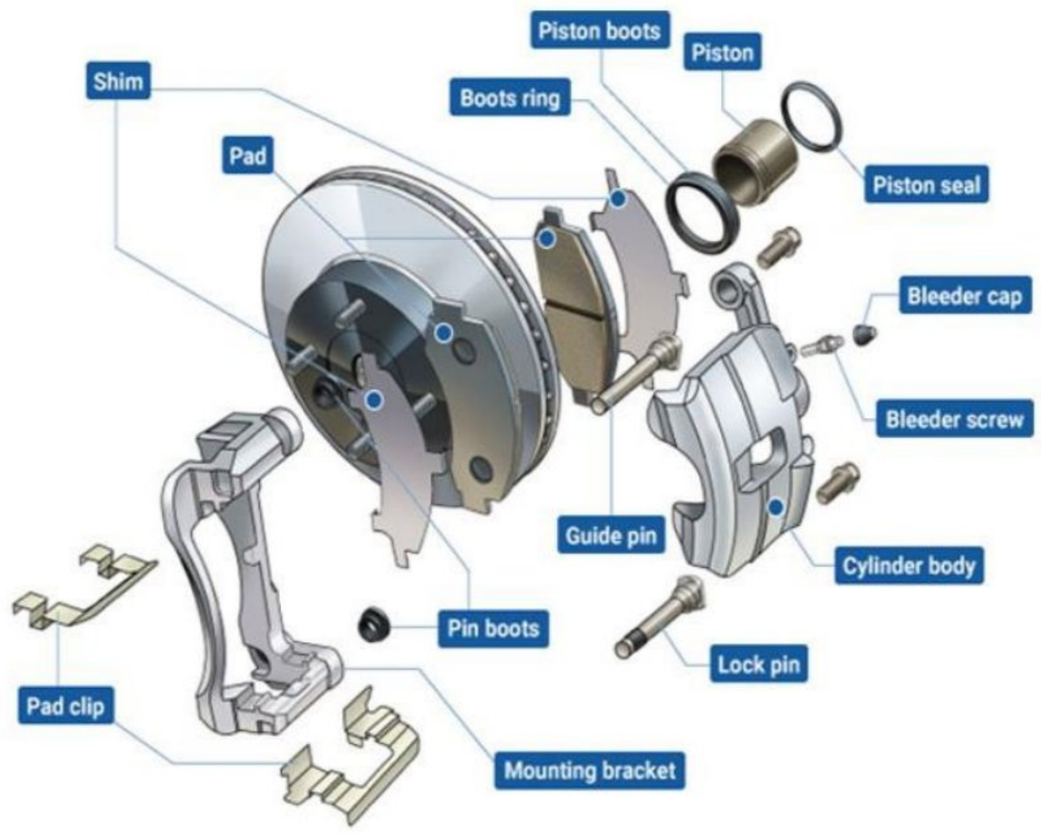


Figure 4 Disc Brake Components

2.2.2 Working principle Of Disc Brake:

When the driver steps on the brake pedal, the power is amplified by the brake booster (servo system) and changed into a hydraulic pressure (oil-pressure) by the master cylinder. The pressure reaches the brakes on the wheels via tubing filled with brake oil (brake fluid). The delivered pressure pushes the pistons on the brakes of the four wheels. The pistons in turn press the brake pads, which are friction material, against the brake rotors which rotate with the wheels. The pads clamp on the rotors from both sides and decelerate the wheels, thereby slowing down and stopping the vehicle.

• When the brake pedal is pressed, the high-pressure fluid from the master cylinder pushes the piston outward.

• The piston pushes the brake pad against the rotating disc.

• As the inner brake pad touches the rotor, the fluid pressure exerts further force and the caliper moves inward and pulls the outward brake pad towards the rotating disc and it touches the disc.

• Now both the brake pads are pushing the rotating disc, a large amount of friction is generated in between the pads and rotating disc and slows down the vehicle and finally, let it stop.

• When a brake pad is released, the piston moves inward, the brake pad away from the rotating disc. And the vehicle again starts to move.

2.2.3 Types of disk brakes:

There are two types of disc brakes. One is called the “opposed piston type disc brake” which has pistons on both sides of the disc rotor, and the other is the “floating type disc brake” which has a piston on only one side. The floating type disc brakes are also called the sliding pin type disc brakes.

1. Opposed Piston Type Disc Brakes

The opposed piston type is a disc brake which has pistons on both sides of the disc rotors.
The opposed piston type disc brake features stable braking force as well as a high level of controllability. The swept areas of the brake pads are enlarged to increase braking force, and here opposed piston types are favored. This is because of its advantage where the number of pistons can be increased to realize even distribution of pressure on the rotors from both sides. Depending on the size of the brake pads, there are several types, including the 4-pot type which has two pistons on each side for a total of four, and the 6-pot type which has three pistons on each side for a total of six.

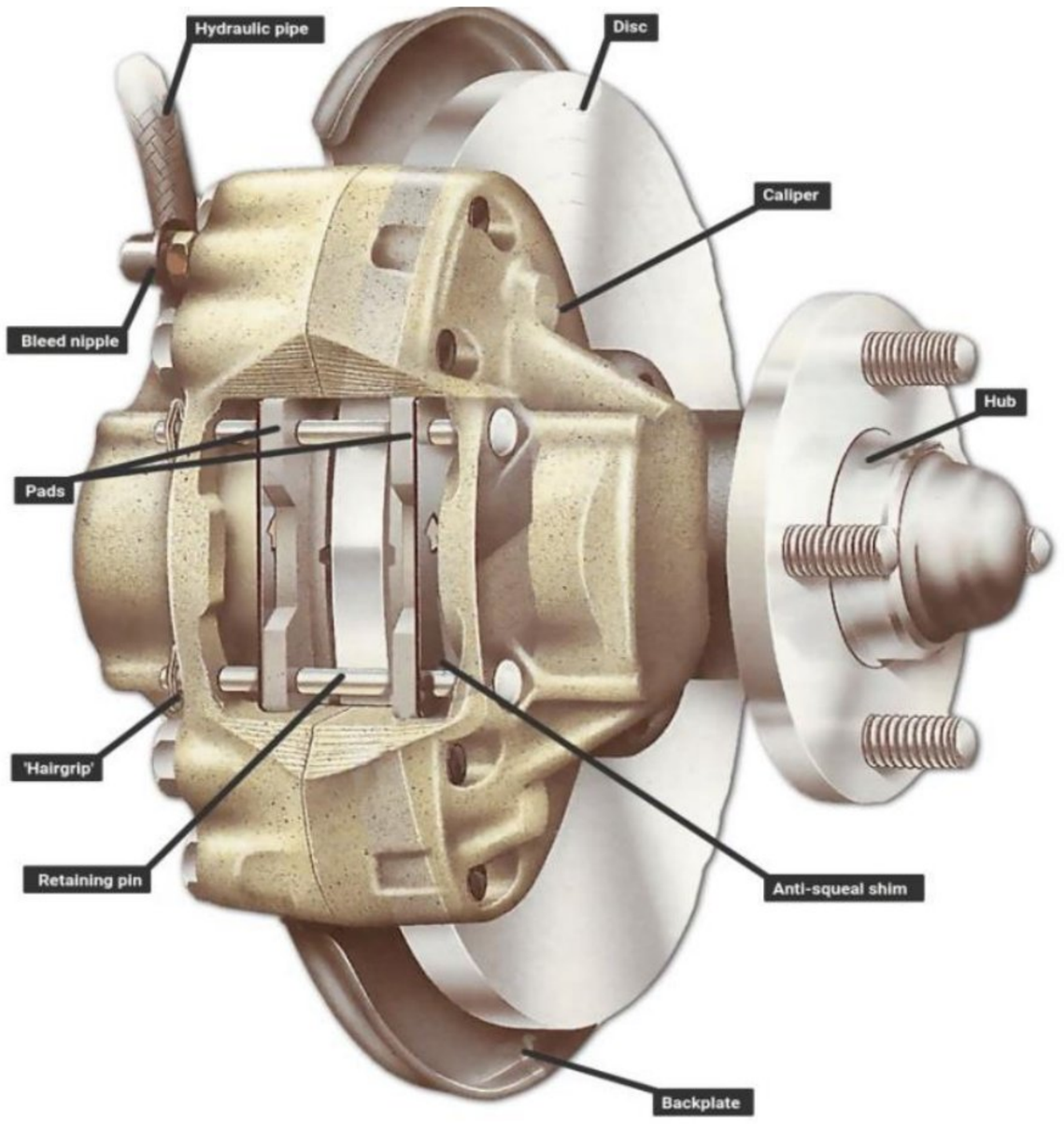


Figure 5 Opposite Piston Type Disc Brake

2. Floating Type Disc Brakes

Floating type is a disc brake which has a piston on only one side and is also called the sliding type disc brake.

On the floating type disc brakes, the piston pushes the inner brake pad against the rotor when the brakes are engaged. This generates a reaction force that moves the caliper itself along with the slide pin, pushing the outer pad against the rotor to clamp it from both sides.

Figure 6 Floating type disk brake

2.2.4 Advantages of Disc Brakes:

1. It is lighter than drum brakes.
2. It has better cooling (because the braking surface is directly exposed to the air).
3. It offers better resistance to fade.
4. It provides uniform pressure distribution
5. Replacement of brake pads is easy.
6. By design, they are self-adjusting brakes.

2.2.5 Disadvantages of Disc Brakes:

1. It is costlier than drum brakes.
2. Higher pedal pressure is required for stopping the vehicle. This brake system is installed with vacuum booster.
3. No servo action is present.
4. It is difficult to attach a suitable parking attachment

2.3 Disk Brake vs Drum Brake:

Disk Brakes	**Drum Brakes**
More stopping Power	Less stopping Power
Apply quicker for shorter stopping distance	Apply slower for shorter stopping distance
Better at managing heat	Retain heat that can reduce breaking force
Perform better in wet conditions	Poor performance in wet conditions
Lighter	Heavier
Hard to add a parking brake	Easier to add a parking brake
Less hardware & easier to service	More complex, but less expensive to replace
Self-cleaning	Require cleaning
More durable	Less durable
Less prone to grabbing or pulling	More prone to grabbing or pulling
Self-adjusting as friction material wears	Self-adjusting as friction materials wears

Table 1 Disk Brake Vs Drum Brake

Chapter 3: Braking System

3.1 Integrated Or Combined Brake System (CBS):

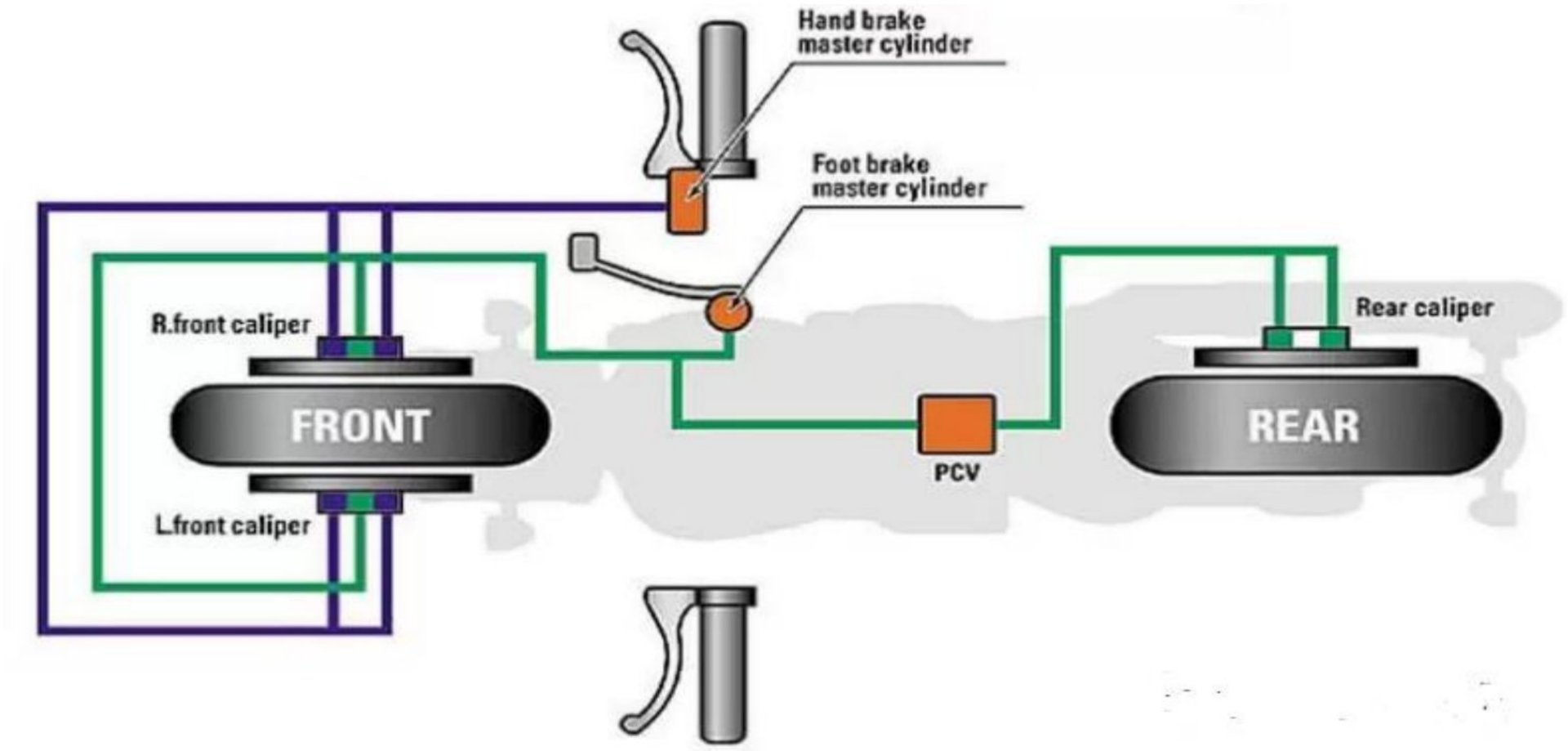


Figure 7 Combined braking system

Combined Brake System is known as CBS or LBS that is linked braking system. The principal of such braking system in motorcycle is engaging both front and rear brakes with applying single brake lever pressure. In CBS featured motorcycle only a brake lever works for both wheel braking. This feature is quite suitable for armature or inexperienced or for those users who are not frequent with standard braking habit of the motorcycle.

3.1.1 Working Principle of CBS:

• By pressing the front brake lever.

• The hydraulic pressure is applied to pvc (pressure control valve) then the pressure is supplied to both front and rear disc.

• Then front disc is connected with pvc so we can able to control the pressure to max and minimum as our requirement.

• The pressure receives directly from the oil tank to rear disc without any control valves

3.1.2 Characteristics of CBS:

1. **Peak force** The peak force is the maximum decelerating effect that can be obtained. The peak force is often greater than the traction limit of the tires, in which case the brake can cause a wheel skid.

2. **Continuous power dissipation** Brakes typically get hot in use, and fail when the temperature gets too high. The greatest amount of power (energy per unit time) that can be dissipated through the brake without failure is the continuous power dissipation. Continuous power dissipation often depends on e.g., the temperature and speed of ambient cooling air.

3. **Fade** As a brake heats, it may become less effective, called brake fade. Some designs are inherently prone to fade, while other designs are relatively immune. Further, use considerations, such as cooling, often have a big effect on fade.

4. **Smoothness** a brake that is grabby, pulses, has chatter, or otherwise exerts varying brake force may lead to skids. For example, railroad wheels have little traction, and friction brakes without an anti-skid mechanism often lead to skids, which increases maintenance costs and leads to a "thump thump" feeling for riders inside.

5**. Power Brakes** are often described as "powerful" when a small human application force leads to a braking force that is higher than typical for other brakes in the same class. This notion of "powerful" does not relate to continuous power dissipation, and may be confusing in that a brake may be "powerful" and

brake strongly with a gentle brake application, yet have lower (worse) peak force than a less "powerful" brake.

6. **Pedal Feel Brake** pedal feel encompasses subjective perception of brake power output as a function of pedal travel. Pedal travel is influenced by the fluid displacement of the brake and other factors.

3.1.3 Advantages of Combined Brake System (CBS):

1. Safety: It is relatively good and safe than the regular bike braking system. It helps to maintain the balance of the bike during brake.

2. Availability: The price of this braking systems price is comparatively low and easy to use for regular bikes.

3. Braking Distance: It reduces bike braking distances compared to regular brakes and its help to prevent accident in sudden braking.

4. **Slippery Surface:** CBS gives better performance in slippery and rough road conditions and provides safe braking.

3.1.4 Disadvantages of Combined Brake System (CBS):

1. It somewhat puzzling for frequent and experienced motorcycle user.

2. It hampers common and frequent motorcycle user's concentration and can cause bad situation dealing with sudden and extreme situations.

3. Not good for serious motorcyclist.

4. Not good feature for high profile and high performance sports motorcycles.

5. It's not applicable for off road or stunt sports motorcycles.

6. Maintenance and brake activity ratio customization is not so easy and it can cause uncomfortable situation on braking.

7. CBS is a mechanical feature; so it cannot be switched off. Hence it's the biggest drawback of this feature

3.2 Anti-lock Braking System (ABS):

Anti-lock Braking System refers to a safety feature to avoid skidding of vehicles.

It works by stopping the wheels from locking up while braking, thus maintaining tractive contact with the surface of the road. ABS operates by preventing the wheels from locking up during braking, thereby maintaining tractive contact with the road surface and allowing the driver to maintain more control over the vehicle.

Figure 8 Toothed-wheel ABS sensor on a BMW K75 motorcycle

3.2.1 Description of ABS:

On a motorcycle, an anti-lock brake system prevents the wheels of a powered two wheeler from locking during braking situations. Based on information from wheel speed sensors the ABS unit adjusts the pressure of the brake fluid in order to keep traction during deceleration to avoid accidents. Motorcycle ABS helps the rider to maintain stability during braking and to decrease the stopping distance. It provides traction even on low friction surfaces.

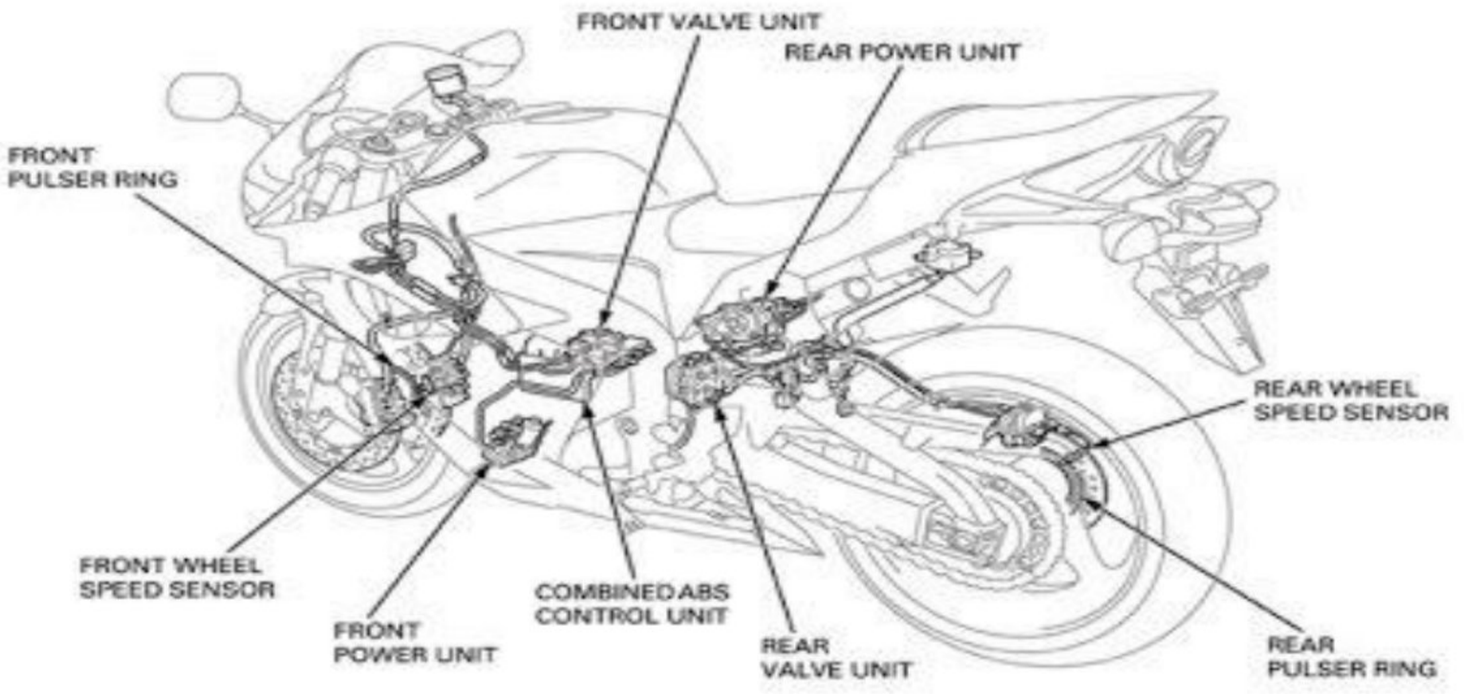


Figure 9 ABS on a Bike

3.2.2 How ABS Works:

This kind of braking system comprises of three parts, namely ECU kit, Brakes and Wheel Speed Sensors. It is usually installed on the rear wheel. These speed sensors are mapped in such a way that they keep monitoring the possible lock-up of the wheel. So, the sensor is, in turn, connected to the Electronic Control Unit, which allows the wheel to roll for some distance and lock in regular intervals of time. This is how ABS works in bikes.

Chapter 4: Skidding Mechanism

Skidding of a vehicle leads to disastrous accidents. Skidding starts when force applied by the rider on the brake lever is more than required. Skidding results when friction in brakes become more than the friction between the tire and the road surface. That means that the wheel gets locked and starts skidding on the road surface. Less force leads to poor braking and more force leads to skidding. So to avoid the skidding of vehicle, the braking force should remain in limit.

In conventional bikes, the brake lever is directly connected with the caliper. The force applied by the rider on the lever is directly exerted on the caliper & disc without any interrupt. In the case of ABS, this braking force is exerted through ECU and Hydraulic valve.

The ABS prevents the wheels from locking during braking. It does this by constantly measuring the individual wheel speeds and comparing them with the wheel speeds predicted by the system. This speed measurement is done by individual speed sensors.

- If, during braking, the measured wheel speed deviates from the system's predicted wheel speed, the ABS controller takes over, correcting the brake force to keep the wheel at the optimum slip level and so achieving the highest possible deceleration rate.
- This is carried out separately for each wheel. Controller is nothing but an ECU with appropriate programming. This program avoids the rotational speed of wheel to become zero (locking). This is done by temporary releasing the brake force by shutting off the valve in the oil reservoir.
- The ECU constantly monitors the rotational speed of each wheel. When it detects that any wheel is rotating slower than the other (this condition will bring the tire to lock), it moves the valves to decrease the pressure on the braking circuit, effectively reducing the braking force on that wheel.
- The wheels turn faster and when they turn too fast, the force is reapplied. This process is repeated continuously, and this causes characteristic pulsating feel through the brake pedal.

4.1 Motorcycle ABS Statistics:

The Insurance Institute for Highway Safety reported that fatal crashes on a motorcycle are 31% lower when motorcycles are equipped with ABS (this is a direct comparison between the same model of motorcycle, one with optional ABS and one without.)

Highway Loss Data Institute reported that accident insurance claims for motorcycles using ABS are filed 20% less often than for motorcycles without ABS. That figure jumps to 31% when the models fitted with ABS have combined controls (when the front and rear brakes are applied together).

The Insurance Institute for Highway Safety released another report noting that motorcycles with engines 250cc and higher without ABS are 37% more likely to be involved in a fatal crash.

The Swedish Road Administration noted that all severe and fatal motorcycle accidents involving motorcycles above 125cc could have been reduced by 48% if the motorcycle had an ABS unit.

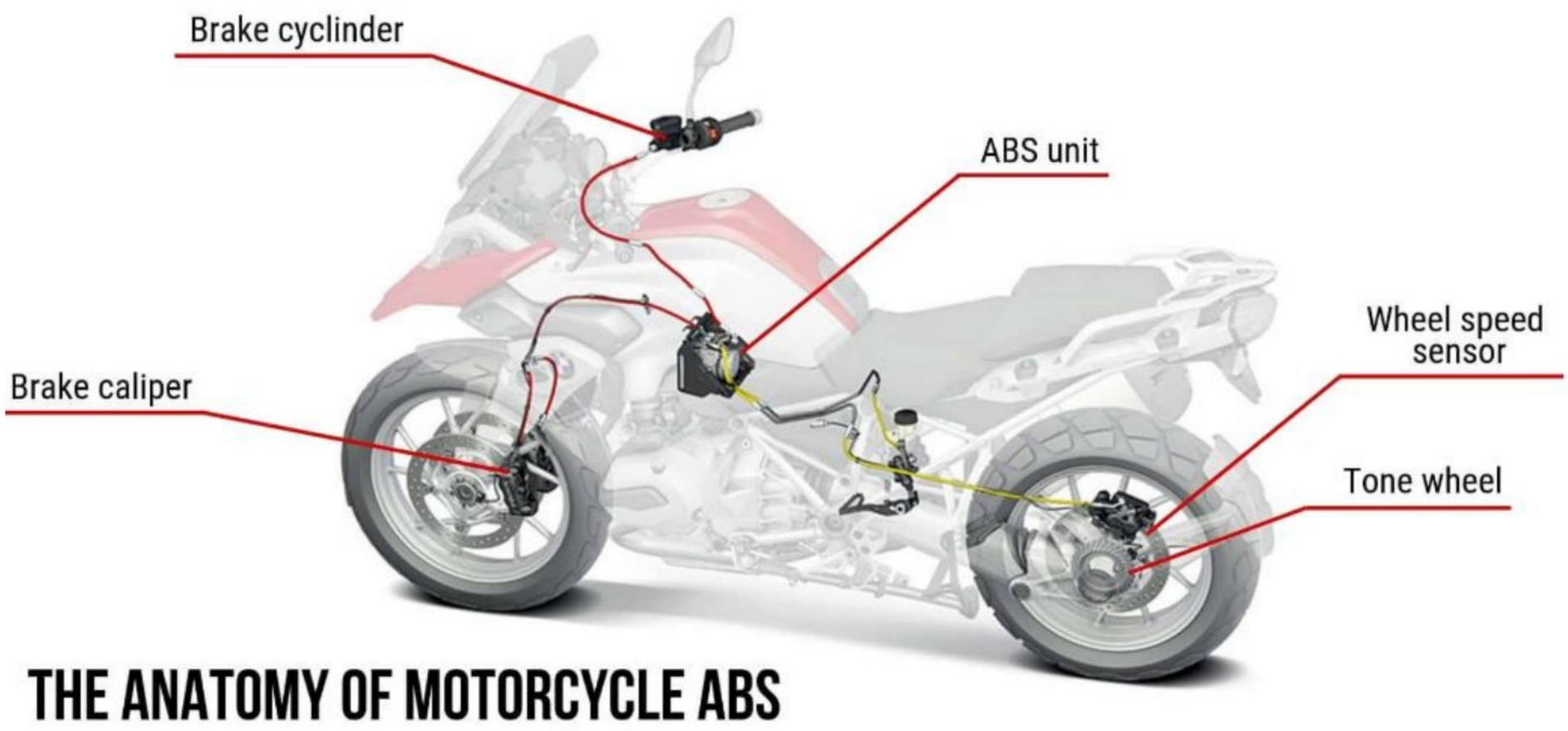


Figure 10 The Anatomy of Motorcycle ABS

4.2 The following contents are the major parts of an Antilock Braking System:

1. Electronic Speed Sensor: This sensor will measure the wheel velocity and vehicle acceleration.

LOCATION: On wheel Hub.

2.Toothed Disc: It helps the speed sensor to read the speed of wheel.

LOCATION: With Brake Disc.

3.Electronic Control Unit (ECU): ECU is a microprocessor based system which contains programs.

LOCATION: Under the rider's Seat.

4.Electrically Controller Valve: This controller valve will control the pressure in a brake cylinder.

LOCATION: With ECU

4.3 Benefits of ABS:

The following are the 3 major benefits of ABS

1. Stopping Distance

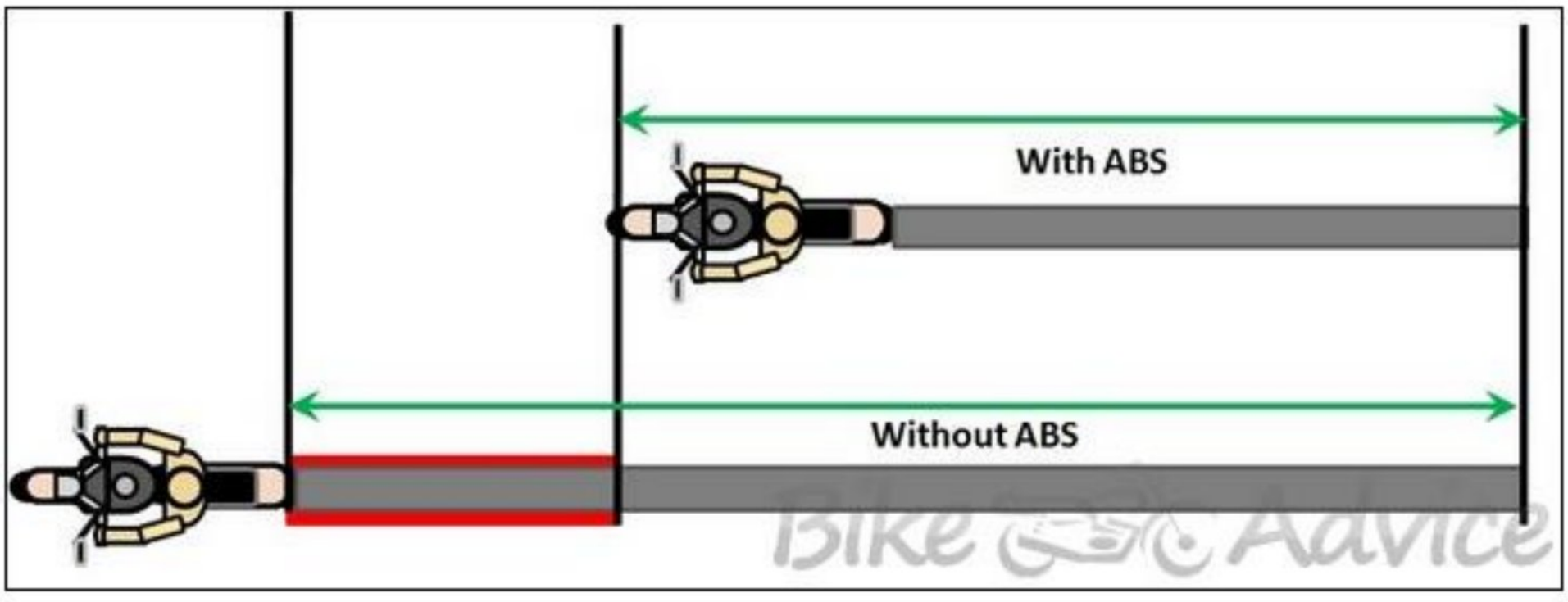


Figure 11 Stopping Distance

As the braking force is controlled and applied electronically, the stopping distance reduces considerably as compared to non-ABS bikes

Table 2 Wet Surface Braking Results

			Honda VFR800		
Brake System Operation			with ABS and CBS	w/o ABS, with CBS	
Brakes	Test Weight	Speed (km/h)	Dist. (m)	Dist. (m)	Diff. (%)
Both	Lightly loaded	48.3	12.78	13.65	+ 6.8
	Loaded	48.3	14.99	15.36	+2.5
Front	Lightly loaded	48.3	15.24	14.60	- 4.2
	Loaded	48.3	16.36	16.01	- 2.1
Rear	Lightly loaded	48.3	14.32	17.44[1]	+21.8
	Loaded	48.3	16.44	18.88[1]	+14.8

Table 3 Dry Surface Braking Results

			Honda VFR800		
Brake System Operation			with ABS and CBS	w/o ABS, with CBS	
Brakes	Test Weight	Speed (km/h)	Dist. (m)	Dist. (m)	Diff. (%)
Both	Lightly loaded	48.3	11.37	11.18	- 1.7
		128.8*	70.67	71.84	+ 1.7
	Loaded	48.3	13.60	13.44	- 1.2
		128.8*	93.43(1)	90.09	- 3.6
Front	Lightly loaded	48.3	11.72	12.76	+ 8.9
		128.8*	77.66	82.12	+ 5.7
	Loaded	48.3	14.12	13.75	- 2.6
		128.8*	99.38(1)	94.15	- 5.3
Rear	Lightly loaded	48.3	13.78	16.54(2)	+20.0
		128.8*	85.59	111.46(2)	+30.2
	Loaded	48.3	16.24	17.57	+ 8.2
		128.8*	105.63(1)	122.03	+15.5

2. Sudden Braking

In the case of ABS, braking is intermittent in nature. So vehicle remains easily steerable during braking also. Following figure shows the comparison of normal bike and ABS-laden bike upon sudden braking.

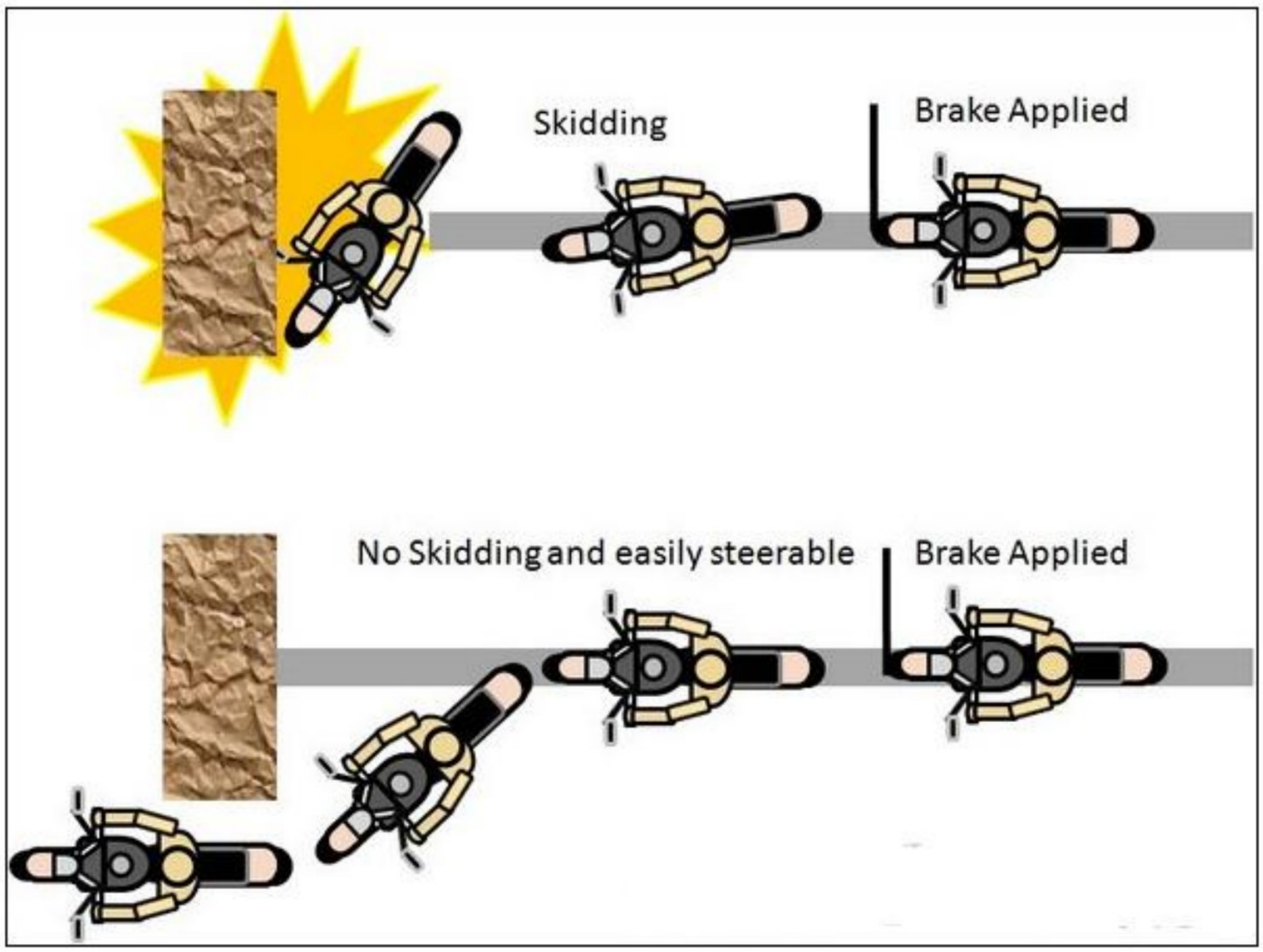


Figure 12 Sudden Braking

3. Braking on Slippery surface

Most of the riders must have experienced this condition with their bikes and also know the results. ABS provides equal distribution of braking force on each wheel and provides straight line stopping of vehicle.

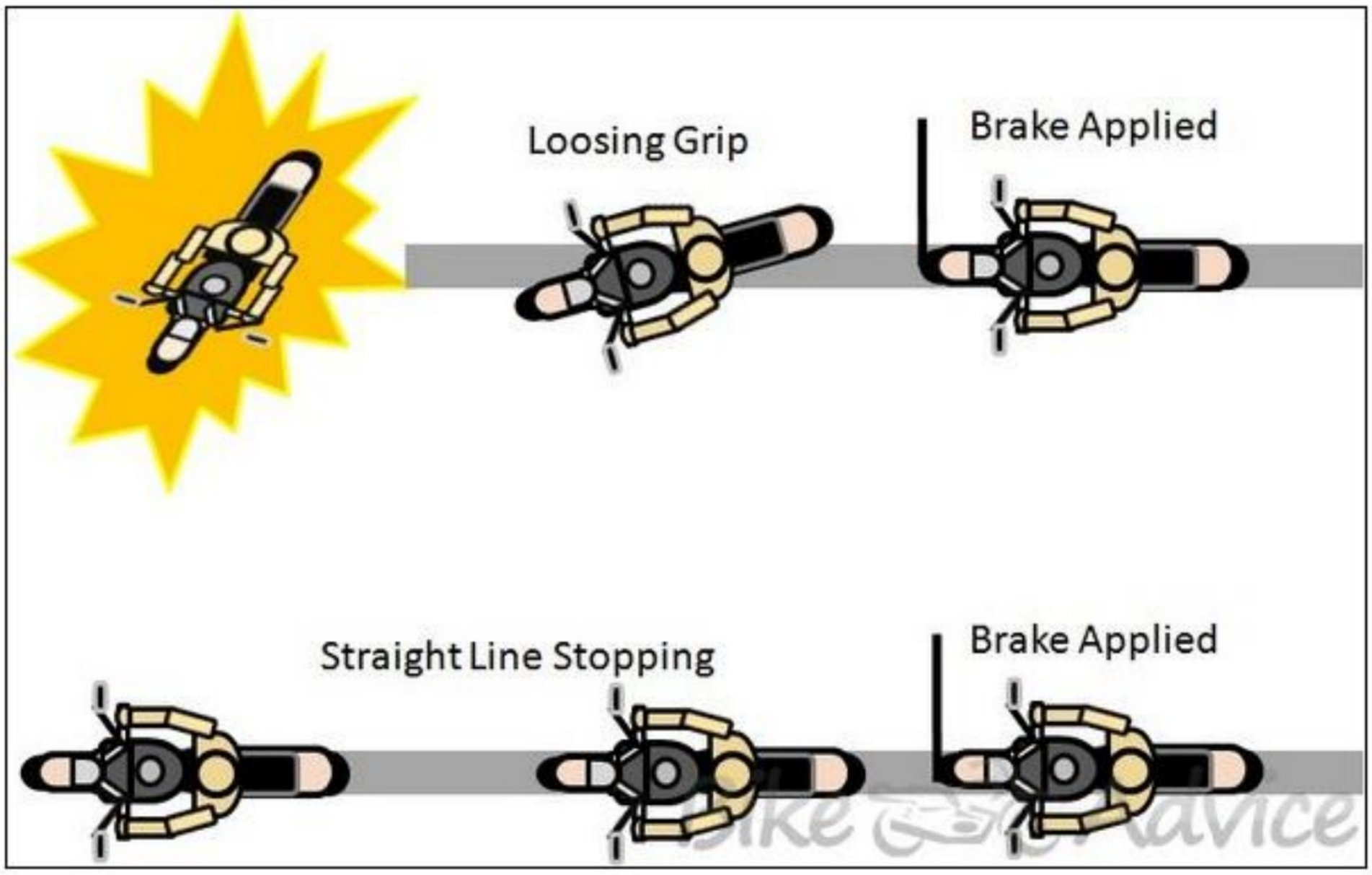


Figure 13 Braking on slippery surface

4.4 Simulation Analysis

The wheel rotates with an initial angular speed that corresponds to the vehicle speed before the brakes are applied

$$\omega_v = \frac{V}{R} \text{ (equals the wheel angular speed if there is no slip)}$$

Equation 1

$$\omega_v = \frac{V_v}{R_r}$$

$$slip = 1 - \frac{\omega_w}{\omega_v}$$

$\omega_v =$ vehicle speed divided by wheel radius

$V_v =$ vehicle linear velocity

$R_r =$ wheel radius

$\omega_w =$ wheel angular velocity

4.4.1 Running the vehicle in ABS Mode:

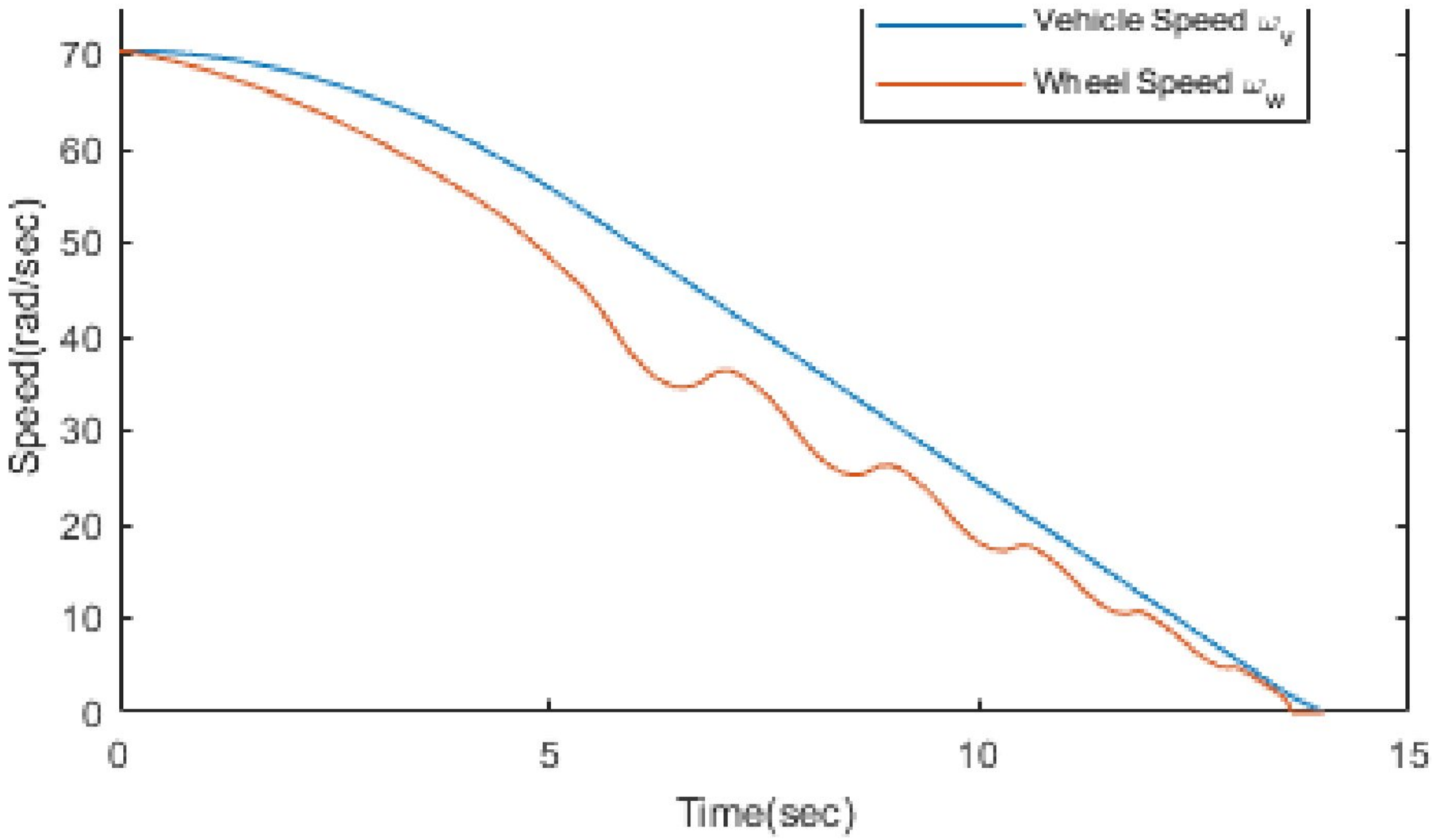


Figure 14 Vehicle Speed VS Wheel Speed

4.4.2 Running the vehicle without ABS Mode

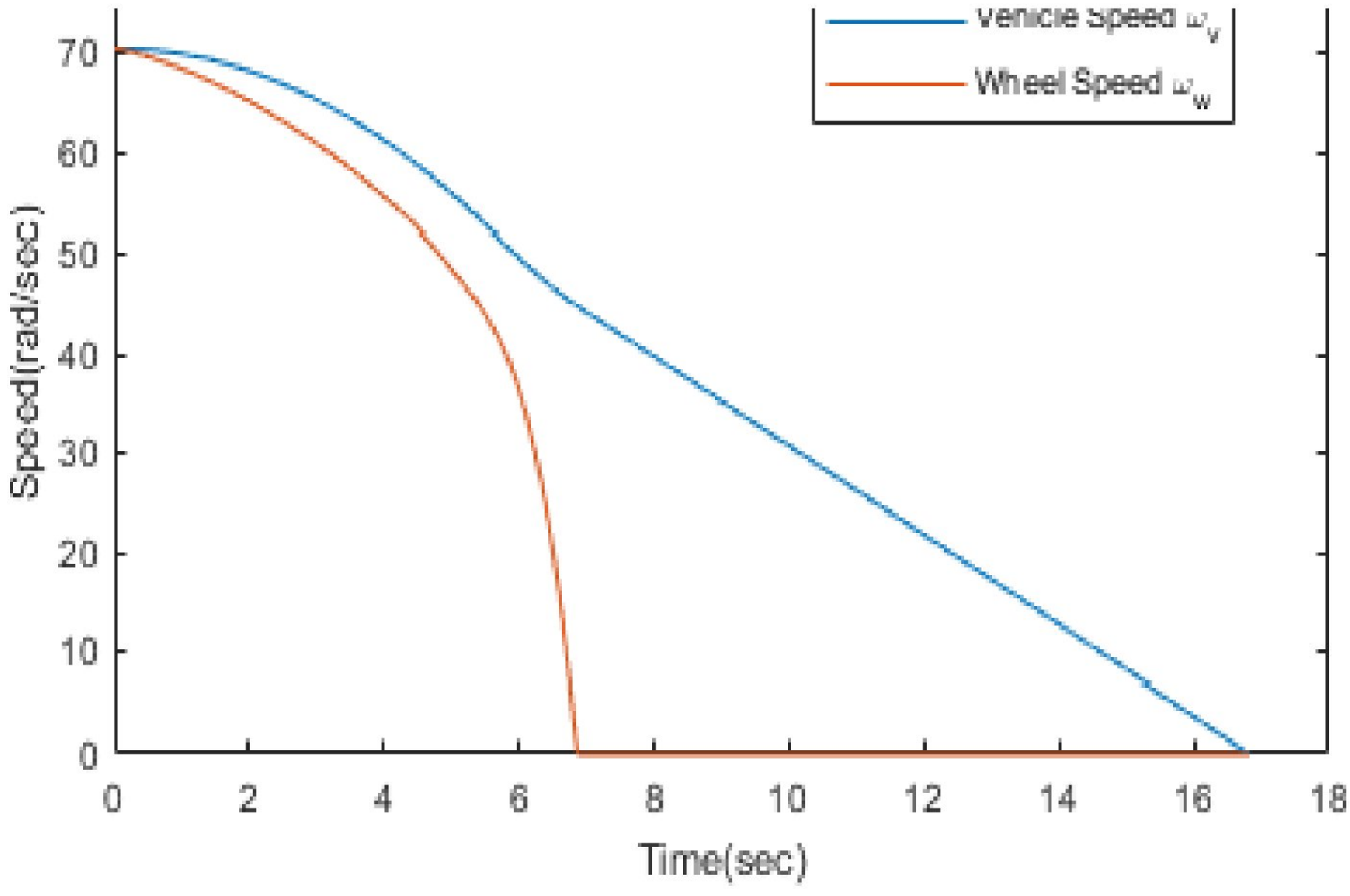


Figure 15 Vehicle Speed VS Wheel Speed

4.5 Antilock Braking System – Disadvantages:

- The feature is quite cost maximizing. So its not suitable for low priced motorcycles.
- Not perfect feature for serious off road motorcycles.
- Not suitable for sports stunt motorcycles.
- It may increase braking distance on extreme slippery surface like ice, oily or muddy surface.
- It's quite complicated setup with electronic device and sensors. Hence its further maintenance is not easy.

4.6 ABS vs Disk Brake

ABS	**DISK BRAKE**
Low brake stopping distance	High brake stopping distance
High-speed performance when pressing the brake pedal	Low-speed performance when pressing the brake pedal
Prevent the diversion of car on slippery roads during heavy braking	Slip vehicle on slippery distances
Well balanced	Imbalance in the car
No sensitivity issue	Sensitive to dust and moisture
Increase vehicle stability and steering	Reduced brake system efficiency because of the rising temperatures

Table 4 ABS vs Disk Brake

Chapter 5: Traffic Condition of Bangladesh:

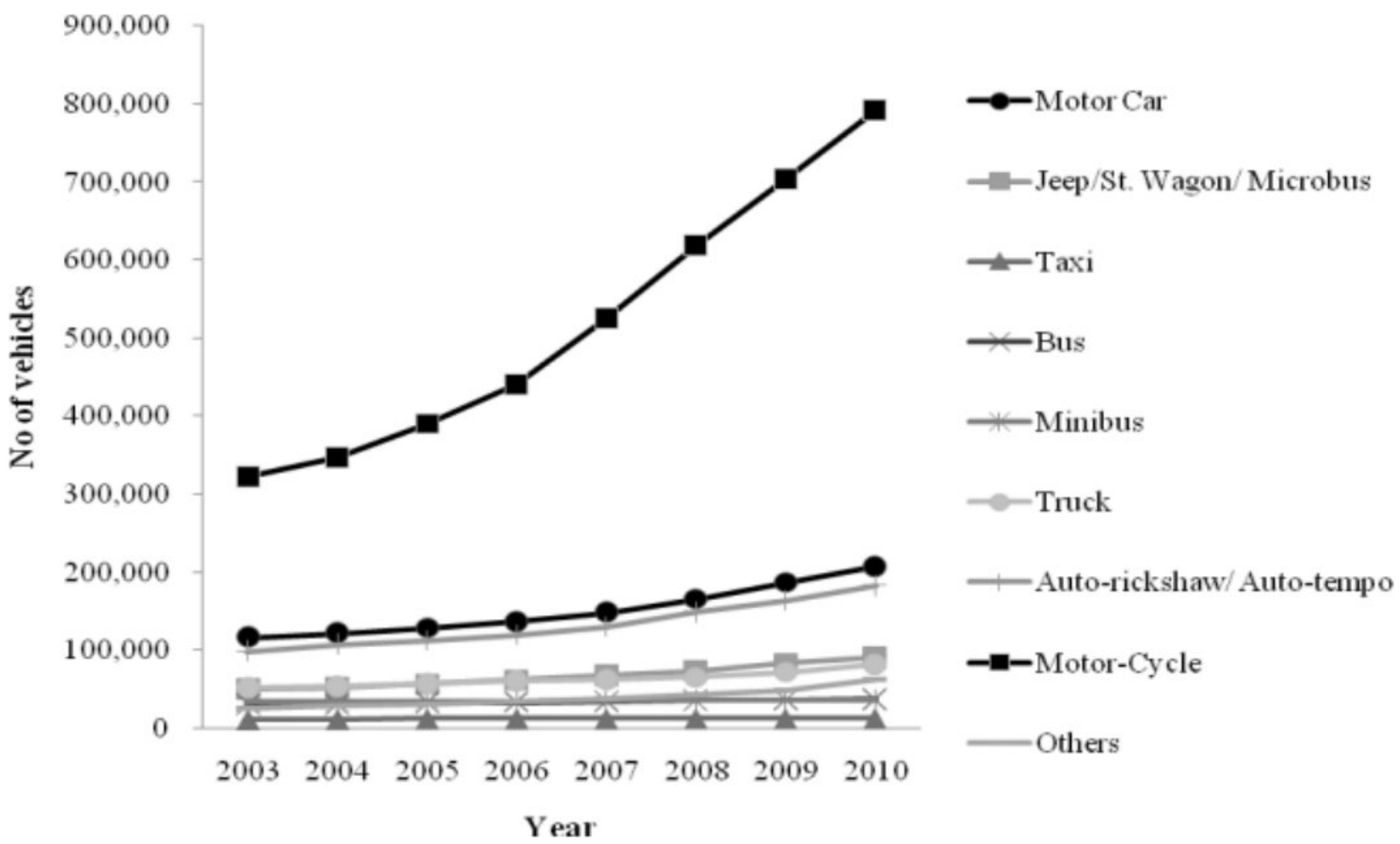
The population of cities increases very rapidly due to the opportunities of better social and economic activities. Urban transportation is quite challenging to maintain the increasing demand among peoples. When transportation system becomes failure to maintain a satisfactory level of services to the people, several problems arise including congestion, delay and consequent emission of pollutants.

In case of road accidents, according to the police statistics, road accident in Bangladesh claims on an averages 4,000 lives and injure another 5,000 in a year. However, WHO estimates that the actual fatalities could well be 20,038 each year (WHO, 2009).

At least 124 pedestrians died after being hit or run over by motorcycles in the 1st 10 months of 2020, says Road Safety Foundation (RSF). At least 1,026 people lost their lives across Bangladesh in 1,011 motorcycle accidents from January to October that year.

As many as 378 accidents -- 37.38% -- occurred due to the riders losing control of their vehicles, meaning that the motorcyclists were solely responsible for the crash.

In Case of the increase of motor cycle is highest in Bangladesh over the years 2003 to 2010. The next highest growth occurs for car and auto rickshaw. Following figure shows the growth rate of Different vehicles in Bangladesh.



In case of **Dhaka city** the picture is more crucial. Here again the highest number of vehicle is motorcycle but the growth of cars is much higher than that of whole Bangladesh. The average growth rate of vehicle is nine percent.

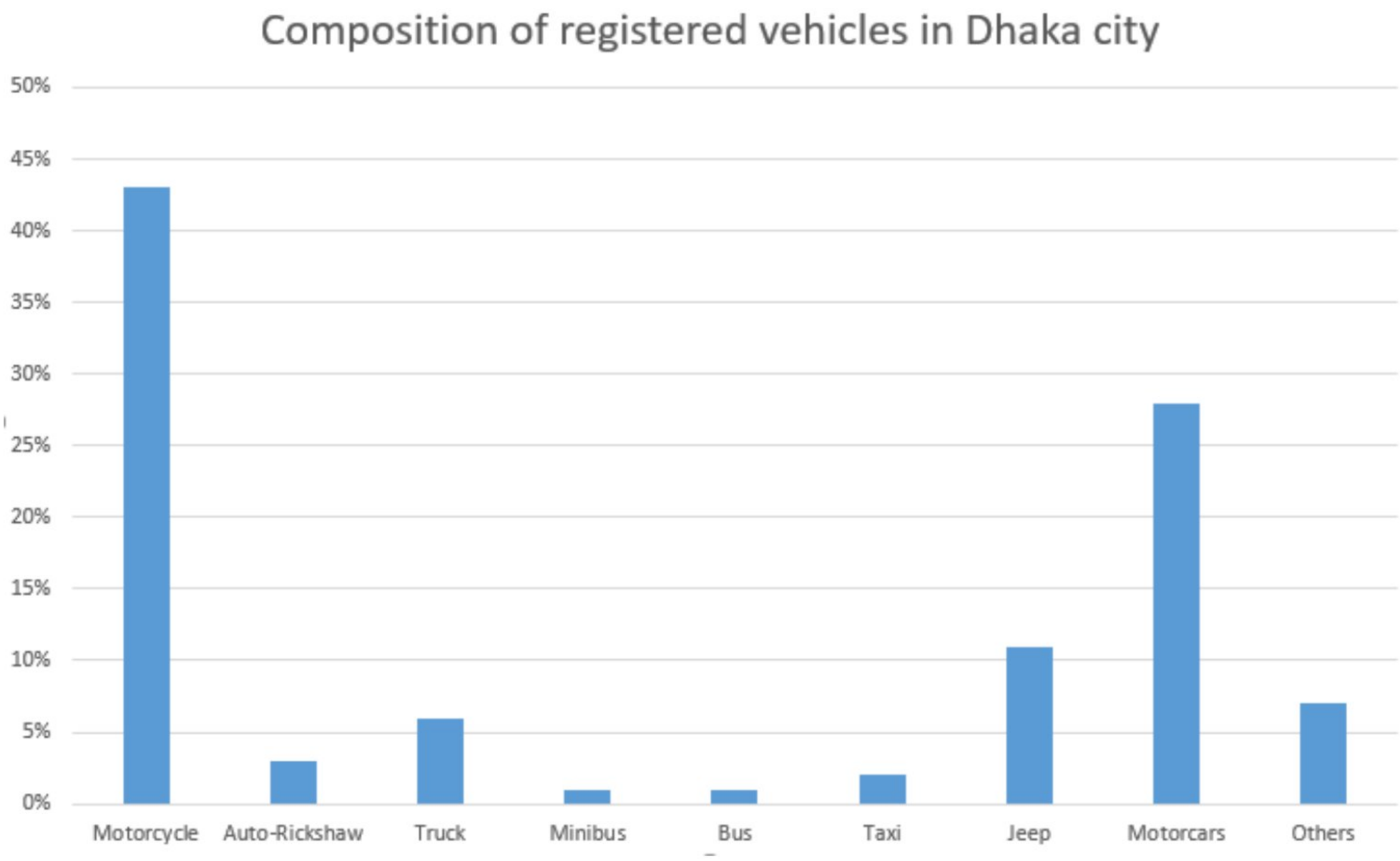


Table 5 Composition of Registered vehicles in Bangladesh

Our Thesis team conducted **an online survey** on the Motorcycle Braking System Condition Of Bangladesh. In this online survey more than 100 Bikers shared their views on Motorcycle braking Condition.

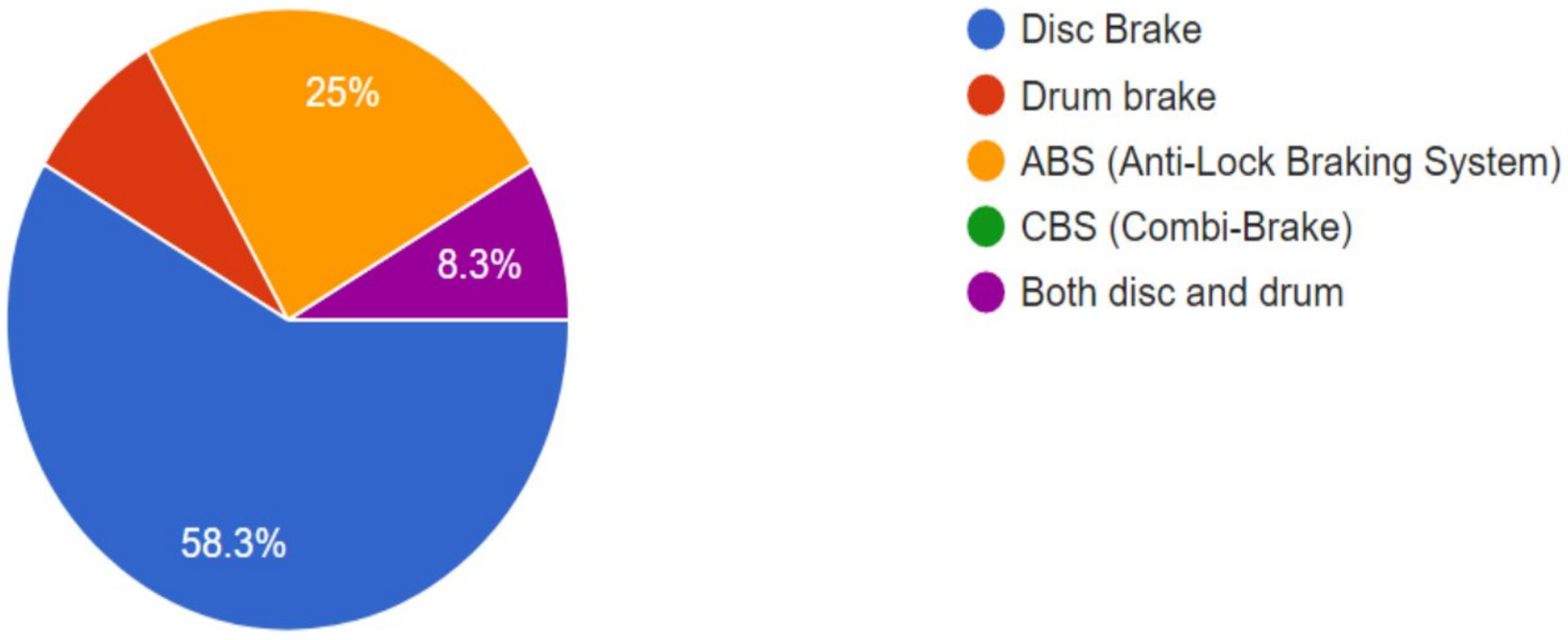


Table 6 Percentage of Brakes used in Bangladesh

5.1 Survey Analysis:

Most of the bikers shared their opinion regarding the braking problem they usually face in their regular days.

Their most common problems are –

- Skidding
- Braking should be more adjusted with the suspension
- Longer life of brake teeth
- In winter and rainy season teeth gets decayed easily
- Driving motorcycle after few days it takes time to brake.
- Brake fluid does not work that much in winter. Fluid flow should be more improved.
- No pre alarm for brake weakening.

As we previously showed that the skidding and slipping of the tire grip problem has been immensely solved by using the Anti-Lock braking system, so it can be easily suggested that Bangladeshi Bikers should use ABS Braking system in their motorcycle.

Due to rough road condition and indifference to the road safety rules, Bikers of Bangladesh certainly need to have more control over the Braking Distance and timing of their motorcycle. ABS System can serve those features for them in modern automobile technology.

Why using ABS (Anti-Lock Braking) is Better than using CBS (Combined Lock Braking) in motorcycles of Bangladesh?

ABS clearly prevents skidding of a vehicle by constantly squeezing and releasing the brake pads.

In Panic braking condition, CBS has a chance that the wheel gets locked and the rider may fell down. But in ABS, It doesn't allow the wheels to get locked. the sensor, applies brakes, leave before wheel gets locked and again applies.

This process continued till your vehicle stops. And it stops the vehicle in lesser distance as compared to CBS. Also, unlike CBS, ABS unit is costly and hence we can see it only in high end bikes. But nowadays even 150cc motorcycles are coming up with ABS which is indeed a great thing. So on direct comparison ABS is always better than CBS.

ABS lets you have control on your vehicle even in hard brakes avoiding locking of wheels. It uses Speed sensor and EU to apply intermittent braking on the wheel which is about to lock.

In Bangladesh, It is undoubtedly important to have control over brakes in emergency condition which is mostly provided by Anti-lock Braking System in motorcycle.

5.2 Thesis limitations:

- Online survey of Braking system condition was carried out within a certain area's bikers which does not represent the whole scenario of the country.
- There are lots of other braking system related problems. If those could be solved, then it would be much more efficient to reduce the accident rate and improve the braking system of an motorcycle.
- Design specific braking system development can be a lot helpful to reduce the increasing accident rates in Bangladesh where there are lots of scopes for future research.

Chapter 6 : Key findings and Conclusion:

The growth of motorcycle rate has always been higher in Bangladesh. From this study It's evident that braking system optimization and using modern technology brakes can certainly reduce the traffic accidents by improving motorcycle control capability. This study revealed the comparative analysis of different braking system of motor cycle.it also revealed the probable best suited brake for usage in our country. The comparative analysis revealed that the road fatalities in Bangladesh should be taken as an emergency problem. The integrated and comprehensive approach of stakeholders is essential to carry out furthermore design analysis in country specific braking system.

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