# UNIT 8 FRAME AND CHASSIS

**Structure**



## 8.1 INTRODUCTION

The automobiles such as cars, buses and trucks, etc. are generally considered to be consisting of two major assemblies, chassis and body.

### Objectives

After studying this unit, you should be able to

- define chassis, frame, springs, shock absorbers,
- explain the various types of frames, springs, and
- describe the advantages and disadvantages of tyres, springs and shock absorbers.

## 8.2 CHASSIS

Chassis is a French term which is now denotes the whole vehicle except body in case of heavy vehicles. In case of light vehicles of mono construction, it denotes the whole vehicle except additional fittings in the body.

“Chassis consists of engine, power train, brakes, steering system and wheels mounted on a frame”.

## 8.3 FRAME

The frame is the main part of the chassis on which remaining parts of chassis are mounted. The frame should be extremely rigid and strong so that it can withstand shocks, twists, stresses and vibrations to which it is subjected while vehicle is moving on road. It is also called underbody.

The frame is supported on the wheels and tyre assemblies. The frame is narrow in the front for providing short turning radius to front wheels. It widens out at the rear side to provide larger space in the body.

## 8.4 TYPES OF FRAME

There are three types of frames :

(a) Conventional frame,

(b) Semi-integral frame, and

(c) Integral frame (or unit frme).

### 8.4.1 Conventional Frame

It is non-load carrying frame. The loads of the vehicle are transferred to the suspensions by the frame. This suspension in the main skeleton of the vehicle which is supported on the axles through springs. The body is made of flexible material like wood and isolated frame by inserting rubber mountings in between. The frame is made of channel section or tubular section of box section.

**Example :** This type of frame is used for trucks.

### 8.4.2 Semi-integral Frame

In this case the rubber mountings used in conventional frame between frame and suspension are replaced by more stiff mountings. Because of this some of the vehicle load is shared by the frame also. This type of frame is heavier in construction.

**Example :** Popular in European and American car.

### 8.4.3 Integral Frame or Frame-less Construction

In this type of construction, there is no frame. It is also called unitized frame-body construction. In this case, the body shell and underbody are welded into single unit. The underbody is made of floor plates and channel and box sections welded into single unit. This assembly replaces the frame. This decreases the overall weight compared to conventional separate frame and body construction.

## 8.5 TYPES OF SECTIONS USED IN FRAMES

Three types of steel sections are most commonly used for making frames :

(a) Channel section,

(b) Tubular section, and

(c) Box section.

The cross-section of all the three types of section is shown in Figure 8.1.

**(a) Channel** **(b) Box** **(c) Tubular**

**Figure 8.1 : Different Steel Sections used for Making Frames**

The channel section is best suited for bending loads. Box section is good for both bending and torsion and tubular section is good for torsion.

## 8.6 SUSPENSION SYSTEM

The frame and body of an automobile are mounted on front and rear axles through springs and shock absorbers. If it is mounted directly on axles, all the socks and vibrations will be transmitted to body causing discomfort to the passengers. The springs and shock absorbers are used to damp the shocks and vibrations. The suspensions system includes all those parts which are used to perform the damping action. Besides, springs and shock absorbers, a suspension system includes other mountings also. The suspension system of a vehicle is divided into front suspension and rear suspension.

## 8.7 FUNCTIONS OF SUSPENSION SYSTEM

(a) The main function of a suspension system is to prevent the socks to transmit to car or vehicle body so that passengers may ride comfortably.

(b) To maintain the stability of vehicle during pitching and rolling actions while the vehicle is in motion.

(c) To provide better road holding at the time of driving, braking and cornering.

(d) To allow proper steering geometry.

## 8.8 SPRINGS

Different types of springs are used in the suspension system of an automobile. Springs absorb the energy which is generated due to force which comes when vehicle moves over bumps and trenches. Springs are required to absorb the energy of shocks very quickly and release it slowly and slowly. For this a absorber is also used. Coil springs and leaf springs are used in the automobiles. Besides this some other devices are also used such as torsion bars and shock absorbers. Description of these devices is given in the following sections.

## 8.9 LEAF SPRINGS

These springs are made by placing several flat strips one over the other. These are made of steel plates. One flat strip is called a leaf. Lowest leaf is of smallest length and the length of other leaves placed above this keeps on increasing progressively. In this way, the length of top most leaf (main leaf) largest. Main leaf has eyes at the ends. All the leaves are clamped together at centre and sides by the centre bolt and side clamps respectively. The centre portion of the leaf springs is connected to the axle with the help of U-bolt. A simple sketch of leaf springs is shown in Figure 8.2.

**Figure 8.2 : Leaf Spring**

Spring eye is used to attach spring to the body frame by passing a bolt through one eye. Other end of leaf spring is attached to a shackle through its eye. Shackle is in turn attached to chassis. The shackle is used to accommodate any change in length of spring due to its expansion and contraction. The contraction and expansion takes place when the vehicle passes over road surface irregularities. Semi-elliptical springs are generally used in all the vehicles particularly n trucks. In case, leaf springs were used in rear suspension and independent suspension in the front. But, leaf springs are not used n cars also.

## 8.10 COIL SPRINGS

Coil springs are in the form of helix. These are made from special steel. It is made from steel wire in the form of a coil. The coil springs absorb energy when this spring is compressed while vehicle moves over road bump. The coil springs are mainly used in independent suspension. However, these can also be used in the conventional rigid axle suspension. Coil springs are capable of resisting shear and bending stresses but not torsion and side thrust.

When coil springs are used in the suspension system, other arrangements are made to bear torsion and side thrust.

**Advantages of Coil Springs**

(a) Coil springs are better than leaf springs as hey can absorb almost double energy per unit volume as compared to leaf springs.

(b) They also require less space than leaf springs and can be used in very restricted spaces.

(c) Coil springs are lighter in weight for the same load.

(d) Compact in size.

## 8.11 TORSION BARS

Torsion bar is a steel rod which an take torsional and shear stresses. Torsion bar acts as spring and keeps the lower and upper control arm parallel. The torsion bar is shown in Figure 8.3. One end of the rod is made of hexagonal x-section which fits into lower control arm. Other end is also hexagonal x-section which fits into an anchor attached to an anchor. When any force acts on the wheel assembly, the torsion bar gets twisted. The wheel axle is supported by lower control arm. The torsion bar is connected to lower control arm. The torsion bar is used to keep the lower arm at a given height. This suspension (torsional bar) provides cushion to road shocks by allowing the lower arm to twist the torsion bar. The torsion bar occupies normal condition when the wheels are not under any stress. When the wheels move up and down the torsion bar is twisted and it absorbs the vibrations so generated.

**Figure 8.3 : Simplified Figure of Torsion Bar**

# 8.12 SHOCK ABSORBERS

If only springs are used to absorb shocks, the oscillations of springs continue even after the vehicle has passed over a bump. The oscillations cause the wheels the jumps up and fall down till the oscillations die out. Thus, dampers or shock absorbers are used to arrest the oscillation of springs after the vehicle passes over irregular road surface.

Shock absorbers are necessary used with coil springs. In case of leaf springs, the friction between leaves provides some dampening effect. However, this is not sufficient sometimes, depending upon friction between leaves. Hence, shock absorbers are necessarily used as additional damping devices.

**Function of Shock Absorbers**

As explained earlier, the function of the shock absorber is to dampen the vibrations of coil and leaf springs used in the suspension system. These vibrations are generated when vehicle passes over a road bump.

**Working of Telescopic type Shock Absorber**

In modern cars, hydraulic shock absorbers are used. These absorbers use a piston and a cylinder where cylinder is filled with a suitable oil. The oil is used to dampen the oscillations of piston by a suitable arrangement. The construction of a telescopic type shock absorber has been shown in Figure 8.4.

**(a) Shock Absorber under Compression** **(b) Shock Absorber under Expansion**

**Figure 8.4 : Sectional View of Telescopic Type Shock Absorber**

The telescopic shock absorber, mainly consists of a piston a cylinder tube and a reservoir tube. The piston has been provided with through orifices or opening so that fluid can pass from top to bottom or from bottom to top reservoir.
Figure 8.4(a) shows the condition when absorber is compressed. This happens when vehicle passes over a bump. Under this condition the shock absorber becomes short in length. The piston rod forces the piston down into cylinder tube. Therefore, fluid under the piston is compressed to high pressure. The fluid passes forcefully through small orifices (in piston) into the moves ahead of bump or drops into a depression in the road, the shock absorber expands. Under this condition the piston moves up in the cylinder tube. Because of this, fluid is forced from upper part of cylinder tube to the lower part through the orifices provided in the piston.

In both the cases, i.e. expansion and compression, fluid is forced through orifices. Because of this the motion of the piston is slowed down. This puts restriction over the spring action and vibrations of the frame are arrested in shortest time. In this way, shocks (of bump and depression of road) are absorbed by the shock absorber. It also prevents excessive oscillations of wheel when it passes over a bump and depression on the road.

Shock absorbers are always provided along with springs in the suspension system of automobiles to prevent oscillations of springs.

## 8.13 TYRES

Tyres are mounted on the rims of wheels. They enclose a tube between rim and itself. Air is filled at a designated pressure inside the tube. The tyre remains inflated due to air pressure inside tube. The tyre carries the vehicle load and provides cushioning effect. It absorbs some of the vibrations generated due to vehicle's movement on uneven surfaces. It also resists the vehicle's tendency to over steer or turn which cornering. Tyre must generate minimum noise when vehicle takes turn on the road. It should provide good grip with the road surface under all conditions.

## 8.14 TYPES OF TYRES

Two types of tyres are used in vehicles :

(a) Tube tyres, and

(b) Tubeless tyres.

Both these tyres are called pneumatic tyres because air is filled in them.

**Tube Tyres**

Tube tyres encloses a tube which is wrapped on the wheel rim. Air is forced into tube which inflates the tube and tyre. The outer side of tyre which comes in contact of road is made from rubber. It is called tread. Tread provides resistance to slipping. It is very thick at the outer periphery. Beads are made at the inner bide by reinforcing it with steel wires. Beads are very strong which have good resistance to wearing against the wheel rim. Rayon cords are also formed into a number of piles. Beads are cords provide good strength to tyres.

**Tubeless Tyres**

These tyres do not require any tube. The air at pressure is filled into the tyre itself. The construction of tyre is same as that of tube tyre. For filling the air, a non-return valve is filled in the tyre itself.

*Advantages of Tubeless Tyres*

(a) Tubeless tyres are lighter in weight.

(b) They remain cooler compared to tube tyres.

(c) The main advantage of tubeless tyre is that they remain inflated for long time even if these are punctured by a nail if the nail remains inside the tyre.

(d) Any hole in the tyre, due to puncture, can be repaired by rubber plugging.

(e) A simple puncture can be repaired without removing tyre from wheel.

## 8.15 TYRE SPECIFICATION

Every tyre is specified by its size. Its specification is given as follows :

$8.25 \times 30 \times 6$ PR

**Meaning of these Numbers**

(a) **8.25 :** It mean that thickness of tyre from shoulder to shoulder is 8.25 inches.

(b) **20 :** It means that diameter of bead circle is 20 inches.

(c) 6 PR : It means that six ply rating. It means that tyre cosists of 6 plies. Different type of tyres have different plies. Number of plies increase as load increases, e.g. a ca tyre has 4 to 6 plies and a light truck may have 6 to 10 plies.

## 8.16CAUSES OF TYRE WEAR

Excessive tyre wear is caused due to reasons discussed below :

(a) **Lower or Higher Tyre Pressure :** It is recommended by manufacturer's to maintain correct tyre pressure. If the tyre pressure is perfect, there will be full tread contact with the road. If tyre pressure is lower than required, severe flexing of tyre piles, and side walls take place. In this case, excessive heat is generated which causes excessive wear. Tyres wear out more on both sides of tread and less of centre.

If tyre pressure is higher, the tyres wear out more at centre and les son sides.

(b) Tyres wear out more one on side than the reason is incorrect caber setting.

(c) Toe-out causes remarkable wear on tread inner end of both front wheels.

(d) High speed of vehicle is also the cause of more tyre wear and failure.

## 8.17 REMEDIES FOR REDUCING TYRE WEAR

(a) Maintaining correct tyre pressure.

(b) Correct camber.

(c) Proper wheel alignment.

(d) If vehicle is to be run at very high speeds tyre must be little over inflated to reduce wear.

(e) Steering must be properly adjusted.

(f) Avoid habit of turning at higher speeds.

### SAQ 1

(a) What do you mean by Chassis? Describe.

(b) What are the functions of frame?

(c) List various types of frame and describe in brief the conventional frame.

(d) What do you mean by frameless construction? Describe in brief.

(e) Differentiate between integral and semi-integral frame.

### SAQ 2

(a) What are functions of suspension system of an automobile?

(b) What is the function of torsion bar suspension? How does it work? Explain in brief.

(c) Describe a leaf spring suspension system.

(d) Describe a coil spring suspension system.

(e) What is the function of a shock absorber? How does a hydraulic shock absorber work?

**SAQ 3**

(a) Describe in brief various types of tyres?

(b) List the advantages of tubeless of tyres?

(c) How the tyres are specified? Explain with the help of an example.

(d) What are different causes of tyre wear? Describe.

(f) How can you reduce type wear of your vehicle?

## 8.18 SUMMARY

In this unit, you must have gain the knowledge about the chassis and frame. Chassis and frames are the two main parts of the automobiles. Any automobile engineering should have the knowledge about the automobile parts and its main functions. You must have understood about the functions and uses of chasses, frame, springs, tyres and shock absorbers. This unit given you the knowledge on different types of spring, tyres, shock absorbers and its functions as a automobile parts and components.

## 8.19 KEY WORDS

## 8.20 ANSWERS TO SAQs

efer the preceding text for all the Answers to SAQs.

# FURTHER READING

William H. Crouse and Donald L. Anglin, *Automotive Engines*, McGraw Hill.

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# AUTOMOBILE ENGINEERING