

## **Unit 1: VEHICLE STRUCTURE AND ENGINES**

### **Module 1: Types of automobiles vehicle construction and different layouts, chassis, frame and body**

#### **Introduction of Automobile or Vehicle:**

An Automobile is a self-propelled vehicle which contains the power source for its propulsion and is used for carrying passengers and goods on the ground, such as car, bus, trucks, etc.,

#### **Types of Automobile:**

The automobiles are classified by the following ways,

##### **1. On the Basis of Load:**

- Heavy transport vehicle (HTV) or heavy motor vehicle (HMV),
- Light transport vehicle (LTV), Light motor vehicle (LMV),

##### **2. On the Basis of Wheels:**

- Two wheeler vehicle, for example: Scooter, motorcycle, scooty, etc.
- Three wheeler vehicle, for example : Autorickshaw,
- Three wheeler scooter for handicaps and tempo, etc.
- Four wheeler vehicle, for example: Car, jeep, trucks, buses, etc.
- Six wheeler vehicle, for example: Big trucks with two gear axles.

##### **3. On the basis of Fuel Used:**

- Petrol vehicle, e.g. motorcycle, scooter, cars, etc.
- Diesel vehicle, e.g. trucks, buses, etc.
- Electric vehicle which use battery to drive.
- Steam vehicle, e.g. an engine which uses steam engine.
- Gas vehicle, e.g. LPG and CNG vehicles, where LPG is liquefied

##### **4. On the basis of body style:**

- Sedan Hatchback car.
- Coupe car Station wagon Convertible.

- Van Special purpose vehicle, e.g. ambulance, milk van, etc.

**5. On the basis of Transmission:**

- Conventional vehicles with manual transmission, e.g. car with 5 gears.
- Semi-automatic
- Automatic : In automatic transmission, gears are not required to be changed manually.

**6. On the basis of Drive:**

- Left hand drive
- Right hand drive

**7. On the basis of Driving Axle**

- Front wheel drive
- Rear wheel drive
- All wheel drive

**8. Position of Engine:**

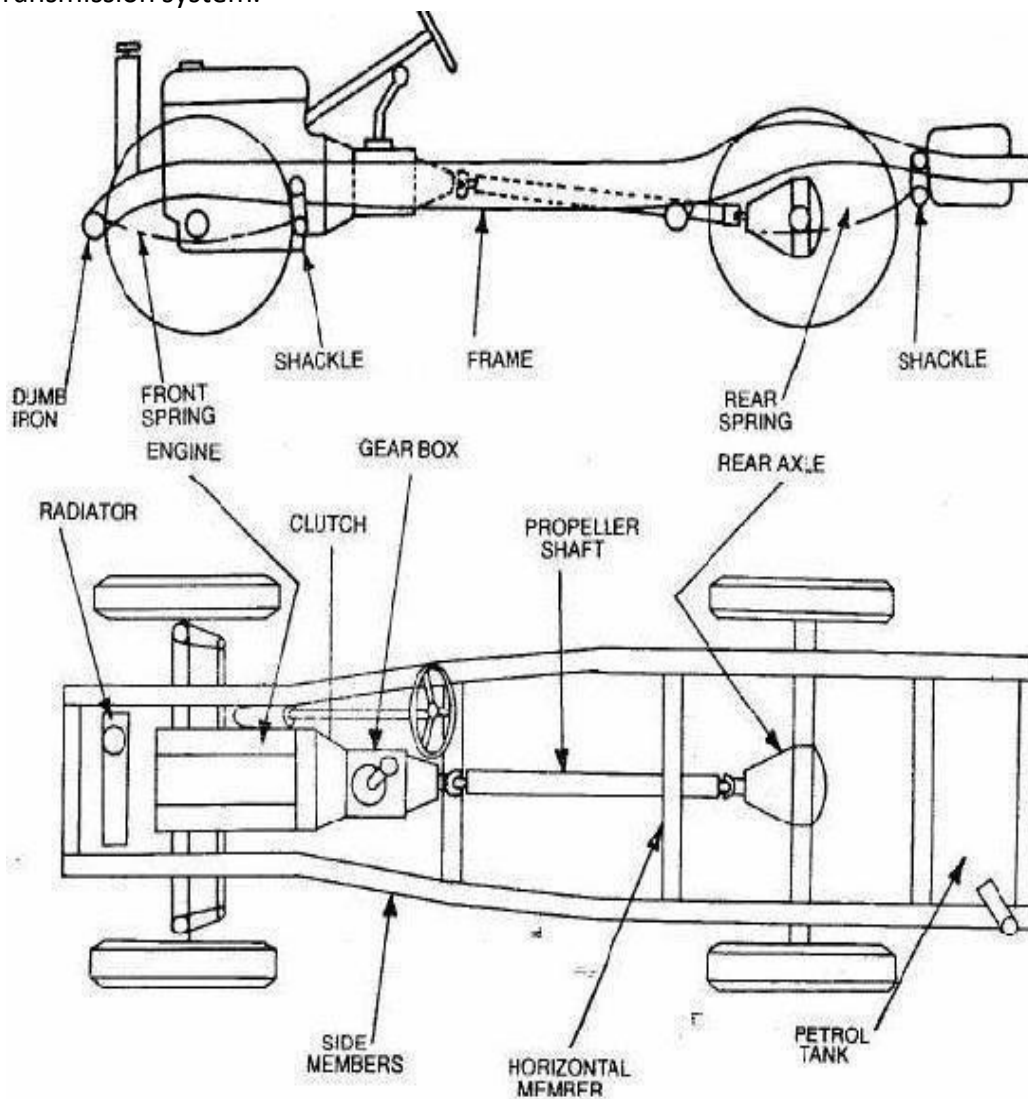
- Engine in Front - Most of the vehicles have engine in the front. Example : most of the cars,
- Engine in the Rear Side Very few vehicles have engine located in the rear.  
Example : Nano car.

**Vehicle construction and Components;**

The main components of an automobile refer to the following components;

- Frame,
- Chassis,
- Body,
- Power unit,

- Transmission system.



An automobile is made up of mainly two units, these are Chassis and Body.

$$\text{—Frame} \parallel + \text{—Base components} \parallel = \text{—Chassis} \parallel$$

$$\text{—Chassis} \parallel + \text{—Body} \parallel = \text{Vehicle}$$

- Chassis include the following
  - Springs and Shock absorbers
  - Steering System
  - Brakes
  - Frame
  - Tyres and Wheels
- Transmission Units includes
  - Clutches
  - Gear box
  - Universal Joint
  - Final Drive
  - Axle and Differential
- Engine Units Includes

**Frame:**

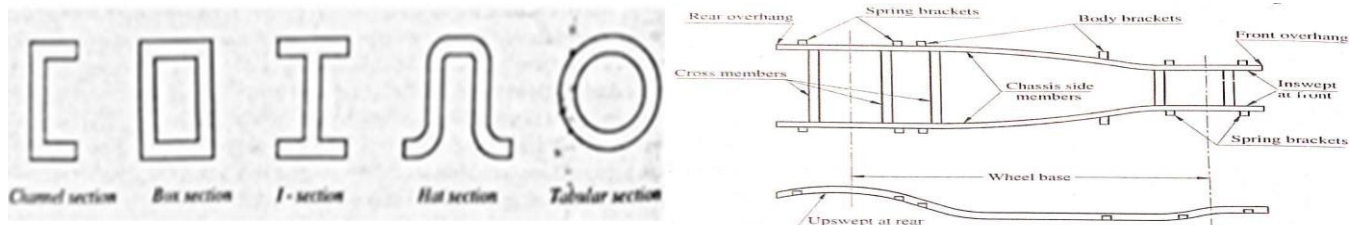
The frame is the skeleton of the vehicle. It serves as a main foundation and base for alignment for the chassis.

Types;

- Conventional frame,
- Semi integral frame;
- Integral or unitized frame.

**Conventional Frame**

- Most of the heavy vehicles.
- Made up of steel section.
- 2 long side members & 5 to 6 cross members joined rivets or bolts.
- Cross members increased strength.
- Front – inswept (narrow): Steering lock, pivoting & swinging of the front wheels.
- Rear – upswept (Board): vertical movement of the rear axles, road bumps & inequalities.

**Intergal Frame**

- In this type of construction, there is no frame. It is also called unitized frame-body construction.
- All the assembly units are attached to the body and all the functions of the frame carried out by the body itself.
- Here 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 frame is used now days in most of the cars. Due to elimination of long frame it is cheaper and due to less weight most economical also.
- The main disadvantage is repairing



### **Semi Integral Frame**

- In some vehicles half frame is fixed in the front end on which engine gear box and front suspension is mounted.
- 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.
- It has the advantage when the vehicle is met with accident the front frame can be taken easily to replace the damaged chassis frame.
- This type of frame is used in some of the European and American cars.



Fig.3 Semi Integral Frame

## **Chassis;**

If the frame contains the base components its called as chassis. The components are like Engine, radiator, clutch, gearbox, silencer, road wheels, fuel tank, wirings, differential units, etc.,

### **FUNCTIONS OF A CHASSIS**

1. Supports or bears the load of the vehicle body.
2. Provide the space and mounting location for various aggregates of vehicle.
3. Supports the weight of various systems of the vehicle such as engine, transmission etc.
4. Supports a load of passengers as well as the luggage.
5. Withstands the stresses arising due to bad road conditions.
6. Withstands stresses during braking and acceleration of the vehicle.

### **Types of Chassis**

- i. Ladder Chassis
- ii. Tubular Chassis
- iii. Monocoque Chassis

### **Ladder Chassis**

The ladder-frame chassis is one of the oldest chassis types. This chassis is characterised by two long heavy beams that are supported by two smaller ones. Its quality of being easily manufactured not only made it contemporarily popular but also eased the way for its mass production. Since ladder frame chassis is significantly heavy it's usually used for vehicles that transport heavy material.

#### **Benefits**

- Easy to manufacture and easy assembling of the car over it.
- Heavy and strong tensile strength.

#### **Drawbacks**

- Poor cornering ability due to weak torsional rigidity
- Its heaviness doesn't make it suitable for performance cars and hatchbacks.

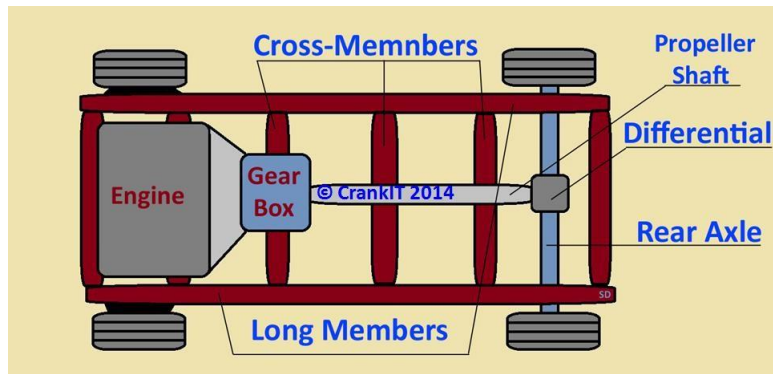


Fig.4 Ladder chassis frame layout

### Tubular Chassis

- Tubular space frame chassis employs dozens of circular-section tubes (some may use square-section tubes for easier connection to the body panels, though circular section provides the maximum strength), position in different directions to provide mechanical strength against forces from anywhere.
- This type of chassis is mostly used while manufacturing racing cars due to the enhanced safety they offer.

#### Benefits

- Its crafting allows better contact between the half axle and ground making it preferable for off-roading.
- A cylindrical tube covering the driveshaft saves it from any damage while off-roading.
- The structure's torsional toughness is relatively more supple than ladder chassis.

#### Drawbacks

- In case the driveshaft fails, the whole chassis needs to be dismantled as the driveshaft is covered with the cylindrical tube of the chassis.
- The manufacture of backbone chassis is costly and increases the overall cost of the car.

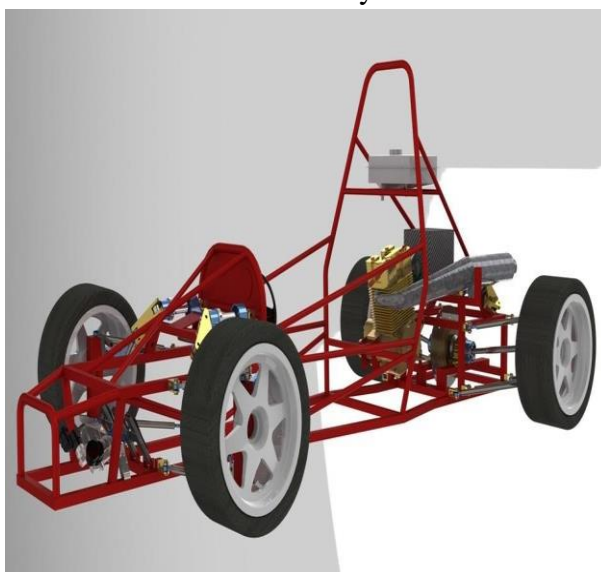


Fig.5 Tubular Chassis

## **Monocoque Chassis**

- The construction of a monocoque chassis is quite simple in the sense that the entire structure is one big construction.
- All components or mechanical parts constitute the frame, foundation and body of the car.
- The engine, gearbox, suspension, seats and exterior body panels are simply attached to the construction. This means that the overall construction is very lightweight and compact. There is quite a lot of safety element to it.
- The applications include all sorts of everyday vehicles ranging from small and compact hatchbacks to large and heavy SUVs. It must be noted that modern SUVs are using monocoque construction quite a bit which was not always the case in the past

### **Benefits**

- It's safer than both the other chassis due to its cage-like construction.
- The chassis is easy to repair as well.
- It has superior torsional rigidity.

### **Drawbacks**

- The chassis is obviously heavy as it's both the frame and chassis as one single entity.
- Producing it in small quantities is not financially feasible and thus it cannot be used for cars that are not mass-produced.

## **Body:**

- Body is the super-structure for all vehicles. It may either be constructed separately and bolted to the chassis or manufactured integral with the chassis (i.e. Frameless construction).
- The chassis and the body make the complete vehicle.
- A body consists of windows and doors, engine cover, roof, luggage cover etc. The electrical system in the body is connected to the chassis electrical units so that the battery and the generator/alternator can furnish the required electrical energy to the system.

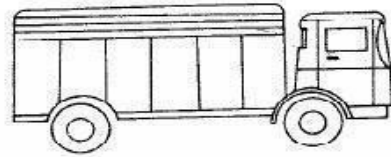
### **Types;**

- Car, Truck, Tractor, Delivery Van, Ambulance, jeep, Bus, etc.,

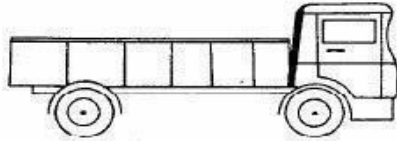




1. Car



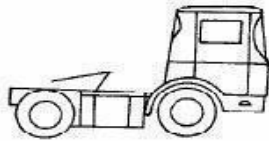
2. Truck Punjab body or Straight truck



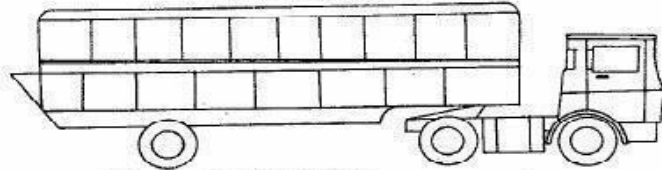
3. Truck half body



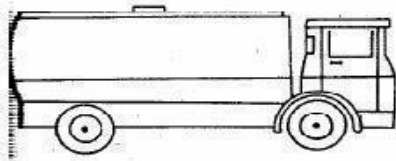
4. Truck platform type



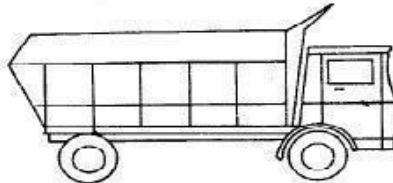
5. Tractor



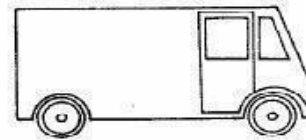
6. Tractor with articulated trailer.



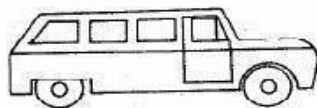
7. Tanker



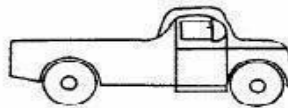
8. Dumper truck



9. Delivery Van



10. Station wagon



11. Pick-up



12. Jeep