

AUTOMOBILE

ENGINEERING - 5<sup>th</sup> Sem

(Mechanical Engg)

B. CHAMPATIRAY.

**AUTOMOBILE**

The automobile is defined as a self-propelling vehicle. In the past, the automobile was only required to serve as the legs for the people, but today many more things are demanded such as comfort and convenience, high mobility and maneuverability, running safety, economy and personnel safety.

The automobile has five basic components or parts:

1. The power plant or engine, which is the source of power.
2. The chassis, which supports the engine and body and includes the brake, steering and suspension systems.
3. The power train or drive train, which is the power-transmission system that carries power from the engine to the drive wheels. This unit includes clutch, gearbox, drive axle assembly, final drive, differential and the wheel axles.
4. The car body.
5. The car-body accessories, which include the heater and air conditioner, lights, radio and music player, windshield wiper and washer, power windows and seat adjusters.

**VEHICLE LAYOUT**

The following Fig.1.1 shows a basic structure and simplified layout of various transmission components used on a vehicle.

**Transmission system**

The transmission system covers the complete drive-line between the engine and the road wheels. However, in many countries the term "transmission" refers to the gearbox unit.

**Power unit**

The normal source of power is provided by an internal combustion engine. The gasoline (petrol) engine is the most popular for its superior performance, but if the vehicle is used extensively, the excellent fuel economy given by a diesel engine makes this type attractive. The economy feature of the diesel engine offsets the higher initial cost and slightly reduced output.

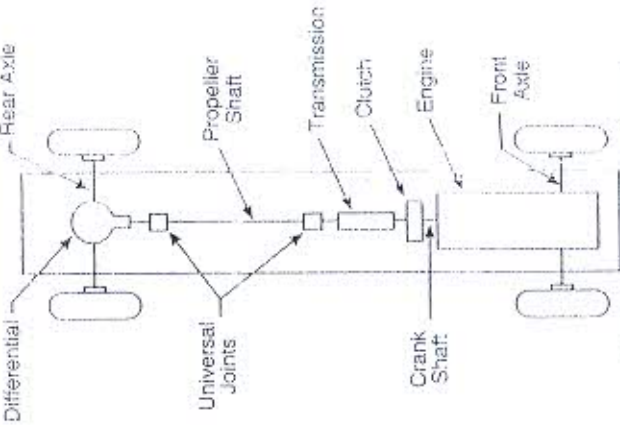


Fig. 1.1: Transmission layout

tyres 317  
tyres 318  
pressure tyres 319

3 system 320

ing) 322  
323

3 324

**CONTROL**

327

329

sion standards 332  
rol measures 334

.5

348

of MEV 349

327-339

340-352

353-356

**Clutch**

The gears in a manual gearbox have to be changed. This action should only be performed when the gears are not under load, so a clutch is fitted to meet this need. This enables the driver to disconnect the engine from the gearbox.

**Gearbox**

Gearbox consists of sets of gears that amplify the engine torque to enable the driving force at the road wheels to be increased sufficiently to overcome the resistance to movement of the vehicle. Also the gearbox enables the engine speed to be kept within its working limits irrespective of the speed of the vehicle. In addition it provides neutral, where the engine can run without moving the vehicle and a reverse to drive the vehicle backwards.

**Propeller shaft**

This is the long tubular shaft which links the gearbox to the final drive. Normally an open type arrangement is used in which the shaft is exposed.

**Universal joints**

Universal joints are fitted to each end of the propeller shaft to enable the drive to be transmitted through a varying angle. This is to allow for the flexing of the chassis components that occurs when the vehicle is traveling over a bumpy surface.

**Front axle**

This arrangement supports the front of the vehicle and is also used for steering.

**Rear axle**

This carries the wheels and supports the weight of the rear of the vehicle. The axle is tubular in section and contains two axle shafts (half shafts) to drive the road wheels in rear wheel drives.

**Final drive**

On the vehicle centre line the axle is enlarged to house the final drive. This pair of gears turns the drive through 90° and reduces the driving speed which is suitable for the size of the road wheels.

**Differential**

When the vehicle is turning a corner, the inner and outer road wheels travel at different speeds. When the two road wheels are both rigidly connected to single axle shaft, the greater distance covered by the outer wheel causes one or both wheels to slip on the road. In addition to causing excessive tyre wear, this action makes the vehicle difficult to steer. Also axle shaft may break due to twisting of the shaft because of speed difference between the outer and inner wheels. These problems are overcome by using a differential. This unit ensures each wheel can rotate at different speed that suits the cornering conditions.

**Wheels**

Most light vehicles run on four wheels fitted with hollow rubber tyres filled with air under sufficient pressure to support the load they have to carry. These provide grip to the road and absorb shocks caused by small road irregularities.

**TYPES OF AUTOMOBILES**

Fig. 1.4.1

Vehicles classified in this category have a laden mass of less than the different body shapes and sizes come into this light vehicle category. Trucks cars to personnel carriers (mini-buses) and small trucks.

**Commercial vehicles**

Commercial vehicles are used to transport goods and people safely. Vehicles can be divided up not only according to the position of their engine, their body or their trailer type.

**Light commercial vehicles**

These small commercial vehicles are used for the conveyance of goods locally over short distances, e.g. the type of vehicles used by tradesmen to call on shopkeepers to make local deliveries to their customers. Common types are trucks and mini-buses.

**a. Vans**

Vans are light commercial vehicles with a maximum weight of 7.5 t. They are generally used for short-range distribution of goods and passengers. Most vans have a load-carrying capacity of about 0.5 tonnes.

**b. Pick-up**

When a vehicle is required for the transportation of bulky equipment, e.g. materials carried by builders and decorators, an open body is often preferred. A light vehicle having this partly enclosed body is called a pick-up.

**c. Light trucks and mini-buses**

Larger vehicles such as light trucks and mini-buses need to carry heavier loads, so they require a stronger construction and have to be specially designed to suit the application. Since low-cost operation is an essential factor, most of these vehicles are fitted with a diesel engine.

**Heavy commercial vehicles**

Although this book concentrates mainly on light vehicles, a review of heavy commercial vehicles is included for comparison purposes. Common types are:

- Tractor
- Road trains (truck and trailer units)

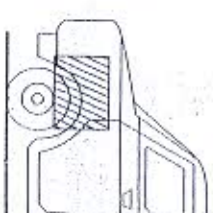


Fig. 1.3

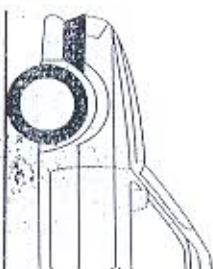


Fig. 1.3

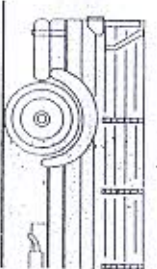


Fig. 1.4.1

### e. Special-purpose vehicles

These are large vehicles for the transportation of very heavy loads. They also include fire engines and trucks with crane or concrete-pump bodies. Because of their high permissible gross weight and their unusual dimensions, special-purpose vehicles often require a special operating license.

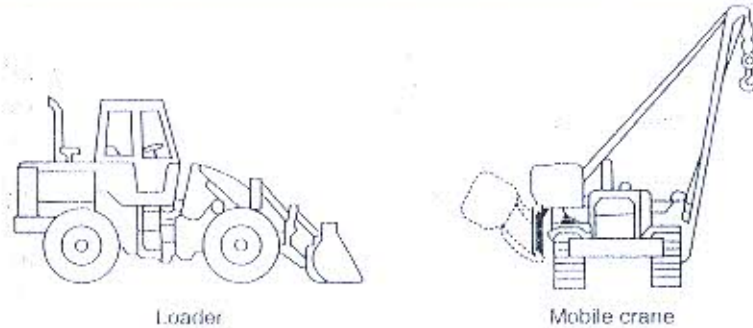


Fig. 1.9 Special-purpose vehicles

## VEHICLE WEIGHTS & DIMENSIONS

Major weights and dimensions of a vehicle are explained below:

### Weights

#### Payload

The total weight of passengers and cargo that a vehicle carries or can carry.

#### Gross Vehicle Weight (GVW)

GVW is the weight of the vehicle, plus the weight of all passengers the vehicle is designed to carry, plus the maximum allowable payload (passengers and cargo) or luggage load. It is also known as laden weight.

#### Curb Weight (CW) or Kerb Weight (KW)

CW is the weight of a vehicle wet, meaning with a full tank of fuel and all fluids filled, but without passengers or cargo (luggage).

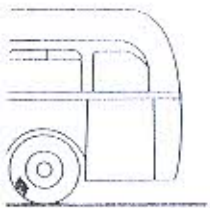
### Dimensions

- (a) **Overall length:** The distance between the front and rear of the vehicle measured along the longitudinal centre line, including bumper guards, if the vehicle has them.
- (b) **Overall width:** The maximum lateral distance measured between the sides of the vehicle. It includes bumpers, moldings, sheet metal protrusions, etc., measured to the outside of the metal.
- (c) **Overall height:** The maximum vertical distance from the top of the roof to the road surface, measured with the vehicle in a curb weight condition.
- (d) **Wheelbase:** The distance between the center lines of the front and rear axles.
- (e) **Wheel tread (or) wheel track:** The distance between the longitudinal axes of the impressions (on the road surface) of the right and left wheels of a single axle of a vehicle.
- (f) **Minimum running ground clearance:** The minimum clearance measured from ground with the vehicle in a gross vehicle weight condition.
- (g) **Room length:** The horizontal distance along the vehicle's longitudinal (lengthwise) center line from the top of the instrument safety pad to the point directly above the top of the rear seatback.

long-distance  
Depending on  
or driven.

is or truck-and-

trailer. This type  
the semi-trailer



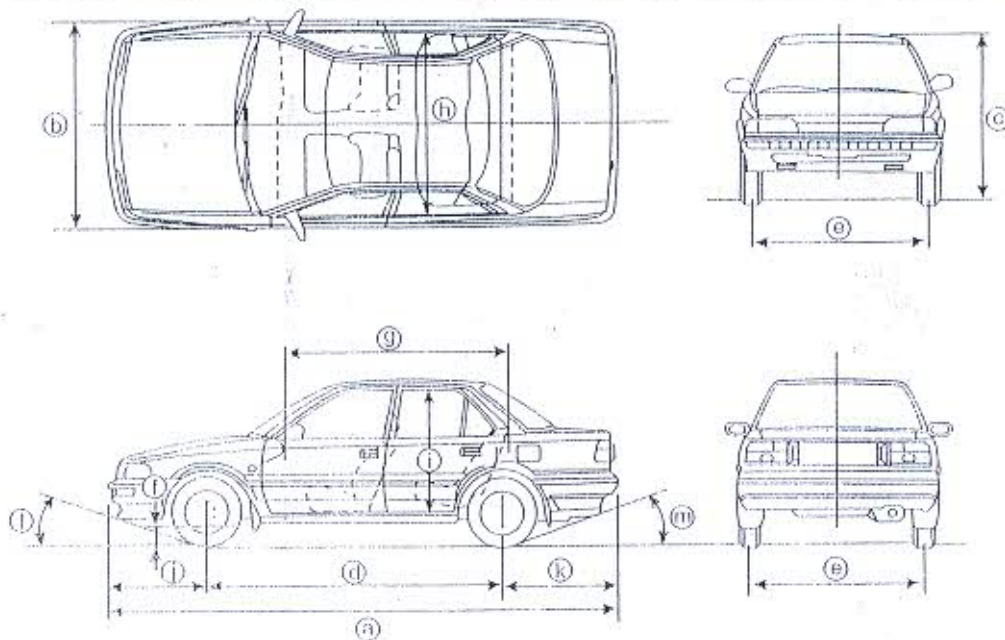


Fig. 1.10 Vehicle dimensions

- (h) **Room width:** The maximum lateral distance between the trimmed interior body surfaces.
- (i) **Room height:** The maximum vertical distance from the top of the floor covering to the headlining.
- (j) **Overhang-front:** The distance from the center line of the front wheels to the front of the vehicle, including bumper guards if they are standard equipment.
- (k) **Overhang-rear:** The distance from the center line of the rear wheels to the rear of the vehicle, including bumper guards if they are standard equipment.
- (l) **Angle of approach:** The angle formed by the ground and the line tangent to the front tyre static loaded radius arc and the first point of interference (i.e. bumper, guard, gravel deflector, fender or other components excluding license plate).
- (m) **Angle of departure:** The angle formed by the ground and the line tangent to the rear tyre static loaded radius arc and the first point of interference (i.e. bumper, guard, gravel deflector, tail pipe, fender or other components excluding license plate).

### HISTORICAL DEVELOPMENT OF AUTOMOBILES

Development of the motor vehicle, that is to say a land based vehicle not limited to travelling on rails and driven by an engine or motor, received a decisive stimulus when the internal combustion engine was invented.

#### The pioneer years

- 1860 The Frenchman Lenoir constructs the first internal combustion engine capable of driving itself, with coal gas as a fuel. Efficiency was ~3%.
- 1867 Otto and Langen exhibit an improved internal combustion engine at the world exhibition in Paris. Efficiency was ~9%.
- 1878 Otto constructs the first gas engine using mixture compression and the four-stroke operating principle. Efficiency approx. 15%. Almost simultaneously, the Englishman Clerk builds the first two-stroke gas engine.

1883 D  
tu  
1885 C:  
1886 G:  
1887 B:  
er  
1889 D  
bc  
1891 P:  
1892 M  
1893 Tl  
pr  
1894 Tl  
th  
1895 P:  
th  
tr  
1897 M  
fr  
di  
1898 P:  
bt  
1899 D:  
ch  
re  
Tl  
1900 B:

#### Age of the

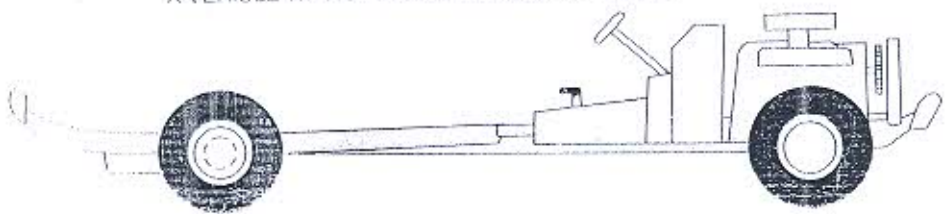
1901 D:  
1902 S:  
le  
1903 A:  
a  
er  
1904 St  
ar  
1905 A:  
1906 R:  
bt  
1907 Cl  
1908 F:  
tic  
1909 Cl  
w

**2**  
CHAPTER

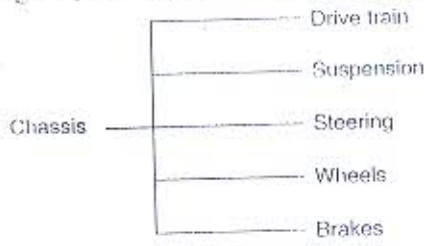
# VEHICLE STRUCTURE

## CHASSIS (OR) RUNNING GEAR

A VEHICLE WITHOUT BODY IS CALLED CHASSIS



The vehicle chassis includes the frame, engine, suspension system, steering system, and other mechanical parts with the body removed. These systems have direct impacts on riding comfort, the vehicle stability, steering feeling, etc, and vary widely in mechanisms and devices.



## CHASSIS LAYOUT

Chassis layout refers to location of an engine and driveline components and also how power is transmitted from the engine to the drive wheels.

### Chassis layout with reference to drive

#### Rear wheel drive

This layout has the engine in the front, mounted longitudinally, and the drive axle in the rear. The transmission is usually right behind the engine, and a drive shaft transfers power back to the rear axle. In this arrangement the rear wheels act as the driving wheels and the front wheels swivel to allow the vehicle to be steered. Spacing out the main components in this layout makes each unit accessible but a drawback is the intrusion of the transmission components into the passenger compartment. These create a large bulge in the region of the gearbox and a raised long bulge, called a tunnel, down the centre of the car floor for the accommodation of the propeller shaft. Using the rear wheels to propel the car utilizes the load transfer that takes place from the front to rear of the vehicle when the car is climbing a hill or accelerating and therefore good traction is obtained.

#### Front wheel

The compact engine and transmission in one compartment bulges and tucks simplifies the transition to the steering gear, incorporation. The heavy drive mounting the

The major when the vehicle is subjected by placing liable to become. For this case the driving force handling especially

#### Four wheel

This arrangement load between the

- 1997 Present Toyota Prius was launched in the Japanese market, in September 2010, reached worldwide cumulative sales of 2.0 million units, becoming the most iconic hybrid electric vehicle in the world.
- 1998 Present Ford Focus is one of the most popular hatchbacks across the globe, that is also one of Ford's best selling world cars.
- 2008 Present Tata Nano is an inexpensive, rear-engined, four-passenger city car built by the Indian company Tata Motors and is aimed primarily at the Indian domestic market.
- 2010 Present, Nissan Leaf and Chevrolet Volt, an all-electric car and a plug-in hybrid correspondingly, were launched in the U.S. and Japanese markets in December 2010, becoming the first mass production vehicles of their kind.

### THE MOTOR VEHICLES ACT, 1988

This volume examines laws regarding motor vehicles and their operation, including traffic violations and infractions, with significant focus on two major areas of public interest: speeding, and drinking and driving. It covers laws related to victims of accidents, young drivers, licensing requirements, vehicle safety issues, helmet use laws, seat belts, child restraints, and air bags, and the Transportation Equity Act.

The first enactment relating to motor vehicles in India was the Indian Motor Vehicles Act, 1914, which was subsequently replaced by the Motor Vehicles Act, 1939. The Act of 1939 had been amended several times. In spite of several amendments it was felt necessary to bring out a comprehensive legislation keeping in view the changes in the transport technology, pattern of passenger and freight movements, development of the road network in the country and particularly the improved techniques in the motor vehicles management. Various committees as well as the Law Commission had gone into different aspects of road transport. Several members of parliament have also urged for comprehensive review of the Motor Vehicles act, 1939. A working group was, therefore, constituted in January, 1984 to review all the provisions of the act of 1939. This working group took into account the suggestions and recommendations earlier made by various bodies and institutions and made certain recommendations. On the recommendations of the working group state governments were asked to submit their comments. The recommendations made by the working group and comments received from the state governments were discussed at a special meeting of transport ministers of all states and union territories. Based on the conclusions reached in the meeting of transport ministers and suggestions made by the Supreme Court in a case the motor vehicles bill was introduced in the parliament.

### Review Questions

1. What is meant by Automobile?
2. List the components of an automobile.
3. Who invented automobile?
4. Who first commercially manufactured motor vehicles?
5. What are the different types of motor vehicles on the basis of their construction?
6. What are the main units of a motorcar?
7. Which car set the pattern for many of those in use today?
8. Define body of a car.
9. What are the nominal requirements of a body?
10. What is meant by a saloon body?
11. What is meant by a coupe in an automobile?

