6.1 Types of wheels, rims and tyres.
6.2 Tyre materials, construction.
6.3 Necessity and types of treads.
6.4 Tyre inflation and its effect. Tyre rotation and nomenclature

**Wheel:**

Wheels can be defined as “a disc or spoke with hub (revolving around axle) at centre & has a rim around the outside of disc for mounting the tyre”.

**Necessity of wheel’s:-**

1) Wheel must sustain vehicle & passenger load.
2) It provides cushioning effect & cope’s with steering control.

**Requirement of wheel’s:-**

1) It should be light in weight
2) It should be possible to remove or mount the wheel easily.
3) It must be balanced both statically & dynamically.
4) Wheels material should not deteriorate. It must have better corrosion resistance.
5) It should have good load carrying capacity, it must resist bending, tensile, compressive & torsional stresses.
6) Cushioning effect is necessary to absorb shock load (due to road irregularities) & damp the vibration faster.

**Type’s of wheels:-**

There are 3 types of wheels, namely: 1) Pressed steel disc wheel.

2) Wire wheel.

3) Light alloy cast or forged wheel.
1) **PRESSED STEEL DISC WHEEL:**

Presses steel disc wheels consist of two parts, I) Steel rim

II) Pressed steel disc

Construction of pressed disc wheel is as below;

a) The rim & disc may be integral, permanently attached or attachable (above figure shows disc welded to rim).

b) The rim has a well, which allows the tyre to go over the edge of opposite side of rim.

c) A 5° taper is given at edge of rim on which tyre seats.

d) Pressed steel disc performs function of spokes.

e) Ventilation slots are provided on disc for better cooling of brake drums.

f) Holes are provided on pressed disc & rim for mounting of wheel & air valve resp.
Features:-

1) Pressed disc wheel are simple in design.
2) These wheels are robust in design.
3) These wheels have economical prices.
4) Better cooling is possible in this type of wheels.

Application:- These wheels are used in heavy motor vehicle (tuck, tractor’s etc.) & car’s.

2) **WIRE WHEEL**:

Wire Wheels have Separate hub, which is attached to rim through no. of wire spokes.

Various components of wire wheels are as follows:

A) Spoke

B) Hub

C) Rim

A) **SPOKE’S**:

1) Spoke's one end of spoke is hooked to hub while other end is attached to wheel rim
2) Spoke carries vehicle’s & passengers weight. It transmits driving & breaking torque & withstands side forces while cornering (i.e.: cornering load & side thrust)

B) **HUB**:

1) Hub is provided with internal splines & is mounted on the axle shaft.
2) One end of spoke is hooked to hub end.

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C) Rim:

1) Rim has holes at the centre for attaching spokes.
2) The only disadvantage of this rims are, tubeless tyre cannot be mounted on it because of holes on the rim.

Advantages of wire wheels:

1) Wire wheels are light in weight.
2) Wire wheels provide better cooling of break drum.
3) They have high strength.
4) They have better changeability as only 1 nut needs to be opened for mounting & dismounting of wheel.

Application: 2 wheelers & bicycles.

3) LIGHT ALLOY CAST OR FORGED WHEEL:

Above shown is a light alloy cast or forged wheel. Latest trend in automobile is use of wheel made from Aluminium & magnesium alloy. These wheels are lighter than steel wheels.

Its advantages are as follows;

1) Light alloy wheels are better conductor of heat, which helps to dissipate heat generated by breaking.
2) Wider rims are possible in this wheels which improves stability on cornering.
3) Cast or forged wheels need to be machined yet it helps to maintain close tolerance.
4) These wheels are lighter as compared to steel wheels.
5) Magnesium alloy have high impact & fatigue strength, so they can stand vibration & shock loads.
6) Aluminium alloy are easier to cast or forged & are less prone to corrosion.

   The only disadvantage of this wheel is, they have highly priced.

   Application: Cast wheels are used in cars & Forged wheels are used in heavy duty vehicle’s.

**Rim’s :**

   **Necessity:** Rim is outer circular part of wheel on which tyre is mounted & supported.

   Types of rims are as follows:  
   A) Well base rim.
   B) Flat base rim.
   C) Semi drop centre rim.
   D) Flat base divided rim.

**A) WEEL BASE RIM:-**

![Well Base Rim Diagram]

This type of rim is used for passenger car tyre’s. The well enables tyre to pass over the edge of opposite side of rim.

   The tyre gets locked to rim on inflation, a slight taper (5 °) is provided for this purpose.
B) FLAT BASE RIM:-

The flange at one end is held in position by pushing the flanges inward. This tyre can be mounted & removed easily.

Flat based rim are used in tyres of heavy duty vehicle’s.

C) SEMI DROP CENTRE RIM:-

This type of rim are used in light commercial vehicle’s. It gives advantage of both well base & flat base rim.

The detachable flange makes tyre removal easy, while slight taper helps the tyre lock on rim.

D) FLAT BASE RIM:-

Flat base divided rims are in two sections, which are bolted together. This rims are used in military & heavy duty applications.
**TYRE:**

Tyre is a cushion provided with an automobile wheel. It consist of outer cover (i.e.:- tyre proper) which has tube inside. This tyre tube is mounted on wheel rim.

**Necessity of tyre:-**

1) Tyre reduces road shocks & provides cushioning effect.
2) Tyre is responsible for improved traction (i.e.: better friction between tyre & road surface)

**Requirement of tyre:-**

Requirement of tyre’s are as follows.

1) Load carrying capacity:-

   Tyre should be able to carry weight of vehicle & passenger without distortion. Tyre must resist bending, tensile, compressive & torsional stresses.

2) Cushioning:-

   Tyre should absorb shock loads caused due to due road irregularities & damp the vibration faster.

3) Uniform wear:-

   Uniform wear reduces tyre skidding & vibration due to road irregularities.

4) Non – Skidding:-

   Tread pattern must be such that tyre must not skid. The tyre must have high coefficient of friction

5) Power consumption:-

   Tyre must have low rolling resistance & therefore must consume least power of engine.

6) Noise:-

   Tyre noise must be minimum. It depends on tread pattern & type of road.

7) Balance:-

   The tyre must be statically & dynamically balanced or it may cause wheel wobbling.
Apart from above properties a tyre must provide better durability, good abrasive resistance, safety & have low cost.

**Types of tyre’s:**

Pneumatic tyres are of 2 types:  
A) Conventional tube tyre  
B) Tubeless tyre

A) **Conventional tube tyre:**

Above shown is a conventional tub tyre, its construction is as below;

1) Tread :

   The shoulder to shoulder portion of tyre that comes in contact with road surface is known as tread.
Its primary function is to transmit driving & breaking torque. Tread are bonded on carcass & material used are natural or synthetic rubber.

2) Breaker’s:

Top two plies of tyre are known as breakers. This plies are widely spaced to help in spreading the shocks from road & to prevent radial growth of tyre during inflation.

3) Carcass/ Casing:

Carcass is made up of layers of cord impregnated with rubber. The number of layers of cord varies according to the use of tyre (carcass have 4-6 plies, heavy duty vehicles have 22 plies).

Carcass bears shock load, side thrust & vehicle’s weight.

4) Flippers:

A number of layers of additional cords are wound around bead wired for extra strength & avoid stress concentration.

Flippers are wound up to small distance on the side wall.

5) Sidewall:

It serves as protective covering to carcass, but it is subjected to maximum flexing action, creating large amount of heat building.

6) Beads:

Coil of wires represent the bead. A number of highly tensile steel wires which are built in the edge of tyre in order to give strong edges to press against the inner edge of the rim.

This plies of cord are fastened to them & therefore serve as metal foundation of tyre.
B) Tubeless tyre:

![Section of Tubeless Tyre](image)

**Construction:**

The material & design of carcass & tread remains similar to tubed type tyre.

The inside of casing is lined with soft rubber lining which forms an air tight seal with rim, it is known as “air- retainer liner”. This lining retains the air & seals itself on being puncture.

A “non return valve” is fitted to rim thorough which the air is forced inside the tyre.

**Advantages of tubeless tyre are:**

1) Temporary puncture repairs are made without removing the wheel. A rubber plug is inserted at place of puncture.
2) Tyre deflates slowly; air is retained for longer period even after being punctured.
3) Tubeless tyres are lighter in weight & run cooler than tubeless tyre.
4) Tubeless tyre imparts more resistance to impact load.
5) Better air sealing qualities are obtained.
6) It has simpler assembly, only tyre has to be fitted over rim (no tube).

The only disadvantage of this type of tyre is, its unsuitable for spooked & corroded wheel’s.

**Tyre material:**

Basic constitute of tyre are as follows:

A) Rubber- natural or synthetic.
B) Cord of stabilizer belt.
C) Steel for high tensile steel bead wires.

A) Rubber- natural or synthetic:

1) Natural rubber:-

It was used to impregnate the carcass cotton cords.

2) Styrene butadiene rubber ( SBR):-

SBR was used to impregnate on nylon cords. It provides better road grip, better abrasive resistance & smooth ride.

3) Poly butadiene (PB):-

PB is mixed with SBR & additives like carbon black, oil & sulphur imparts anti wear, anti- skid & anti heat properties.

B) Cord of stabilizer belt:

The material used is rayon, terylene, glass fibre or steel. Steel is commonly used in case of radial tyre belt.

C) Steel for high tensile steel bead wires:

Bronze plated highly tensile steel wire is used, on which special rubber is insulated.

Above given are material used for various tyre component.
Carcass:

Carcass is main structure of wire which takes stresses while operation & tyre is named on the basis of carcass used.

There are three types of carcass, A) Cross ply type
B) Radial ply type
C) Belted bias type

A) Cross ply or bias ply type:

Above shown is a cross ply structure.

1) In this type, the ply cord are woven at an angle (30 - 40°) to tyre axis.
2) There are 2 layers which run in opp. direction as shown in figure.
3) This construction allows carcass to retain its strength during tyre rotation & provides comfortable ride.
4) Thus carcass is able to resist stresses caused due to sudden acceleration, Cornering % breaking.
B) **Radial ply type:**

Above shown is radial ply tyre structure.

1) In this structure ply cords run in radial direction (i.e.: in diection of the tyre axis)
2) Over this basic structure run a number of breaker strips in circumferential direction. The material for breaker strip must be flexible but in extensible so that no change of circumference takes place with change in amount of inflation.
3) Breakers are widely spaced to help in spreading shocks from road & prevent radial growth.
4) The inextensible breaker strips provides lateral & directional stability.

C) **Belted bias type:**

Above shown is belted bias type structure.

1) This is a combination of cross ply & radial ply structure.
2) The basic structure is cross ply over which runs a number of breaker belts. This belt improves characteristics of bias ply tyre to a large extent.

Feature of belted bias tyre are;

1) The stresses in carcass are restricted & tread area is stabilized due to belts. This increases tire life.
2) Breaker belt holds the tread flatter against road surface & provides safe ride.
3) Belt increases resistance of tyre for cuts & punctures.

**Advantage of radial over cross ply:**

1) Treads of radial ply offers better stiffness & resistance resulting in better grip.
2) Radial ply have longer tread life.
3) Radial ply provide better breaking grip.
4) Radial ply have better steering characteristics as compared to cross ply.

**Comparison between Radial ply & Cross ply:**

<table>
<thead>
<tr>
<th>Radial ply type</th>
<th>Cross ply type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In radial ply type, the cords of tyre run in radial direction.</td>
<td>1. In cross ply type, alternate layers of cords run in opposite direction.</td>
</tr>
<tr>
<td>2. The cord ply are woven in radial direction of tyre axis.</td>
<td>2. The cord ply are woven at angle (30 - 40°) to the tyre axis.</td>
</tr>
<tr>
<td>3. Radial tyre are provided with breaker strip, thus a continuous flat contact is possible with road surface.</td>
<td>3. There is no breaker strip in this tyre. Thus continuous grip with road surface is not possible.</td>
</tr>
<tr>
<td>4. This tyre has low rolling resistance, thus better fuel efficiency.</td>
<td>4. The cross ply has more rolling resistance as compared to cross ply.</td>
</tr>
<tr>
<td>5. This tyre provides better directional stability.</td>
<td>5. This tyre has wobbling characteristics.</td>
</tr>
<tr>
<td>6. This tyre has greater sidewall flexibility &amp; treads stiffness.</td>
<td>6. Sidewall flexibility &amp; tread stiffness is lesser as compared to radial ply tyre.</td>
</tr>
</tbody>
</table>
**Tread:**

Tread can be defined as “Shoulder to Shoulder width of the tyre that comes in contact with the road surface”.

Necessity of treads:

1) It improves tyre ability to transmit driving & breaking torque.
2) It provides stability & non skidding characteristic to tyre.

A) Straight tread:

![Straight Tread Diagram]

It provides better adhesion, good grip & better steering stability.

B) Cross tread:

![Cross Tread Diagram]

It provides better grip but it has rapid, irregular wear & noisy running.

C) Square tread:

![Square Tread Diagram]

It provides straight & sideway grip but it has irregular wear on hard road & has noisy running.
D) Combination tread:

It is combination of cross & straight pattern. It has good wear resistance & steering characteristics.

Application- trailer’s & farming application.

E) V pattern – Deep groove pattern:

These tyre are used on rough & loose surface, giving maximum grip & sideways stability.

Application- Tractor’s rear wheel.

**Tyre inflation:**

The inflation pressure are recommended by the vehicle manufacturer depending upon tyre size, speed & load.

Under inflation causes the following defects:

1) Uneven tread wear, more wear at tyre sides.
2) Lack of directional stability.
3) Increased rolling resistance leading to increased fuel consumption.
4) Excessive flexing of sidewall causes build up.
5) The valve may be ripped out due to tyre punch.

Over inflation causes the following defect:

1) Reduced tread contact area with road surface.
2) Reduced tyre grip.
3) Reduced impact resistance.
4) Increased vibration resulting in uncomfortable ride.
5) Increased stresses may causes tread separation & crack in the sidewall.

**Tyre nomenclature:**

![Tyre Nomenclature Diagram]

- **Section Width**
- **Section Height**
- **Repairable Area**
- **Tire Type** (P: Passenger, T: Temporary, C: Commercial)
- **Aspect Ratio** (Section Height / Section Width)
- **Rim Diameter** (Inches)
- **Construction Type** (R: Radial, B: Bias Belted, D: Diagonal (Bias))

Metric tire-size designations. (ATW)