The Shirpur Education Society's

R. C. Patel College of Engineering & Polytechnic, Shirpur

QUESTION BANK OF CHAPTER – 4

AUTOMOBILE SUSPENSION ,WHEELS AND TYRES

Program Name: Diploma in Mechanical Engineering — Program Code: ME

Name of Subject & Code : Automobile Engineering (315372) — Semester : FIFTH

Instructions: (1) Illustrate your answers with neat sketches wherever necessary.

Q.1.	Two marks questions.	Previous Exam	CO PO Mapping
1.	Differentiate tube type and tubeless tyres.	W25-1.e	CO4-TL04.6-A
2.	State the functions of wheel in automobile.	S26-1.g	CO4-TL04.4-R
3.	State different types of Rims	W24-1.d	CO4-TL04.4-R
4.	State necessity of wheel alignment.	W25-4.d	CO4-TL04.7-R
Q.2.	Four marks questions.	Previous Exam	CO PO Mapping
1.	With neat sketch explain Macpherson strut suspension system with advantages.	W25-2.d S26-2.d	CO4-TL04.3-U
2.	Compare Rigid Axle and independent suspension system	W25-3.c	CO4-TL04.2-A
3.	Explain procedure of wheel balancing and wheel alignment.	W25-3.d W24-5.c W25-4.d	CO4-TL04.8-U
4.	Draw and explain with neat sketch of telescopic shock absorber and label it.	W25-4.a S26-5.b	CO4-TL04.1-U
5.	Describe with neat sketch the construction and working of leaf spring.	S26-3.d S25-3.c	CO4-TL04.1-U
6.	Write any four advantage of tubeless tyre over tube tyre.	S26-4.b	CO4-TL04.6-R
7.	Differentiate cross ply tyre and radial ply tyres with the help of following points :- i) Stiffness ii) Comfort iii) Grip iv) Direction of ply v) Life vi) Cost	S25-5.c	CO4-TL04.5-A
8.	Describe with neat sketch Air suspension system. State advantages of it.	S25-2.d	CO4-TL04.3-U
9.	State function of suspension system in automobile. Describe working of wishbone type suspension system with neat sketch.	S25-1.d W24-2.d	CO4-TL04.1-U

10.	State various factors affecting tyre life.		CO4-TL04.5-R
11.	State the meaning of all terms involved in following tyre designation.		CO4-TL04.6-R
	* **Best of Luck* **		

04/08/26

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05/08/2026

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HOD(ME)

* Automobile Engineering *

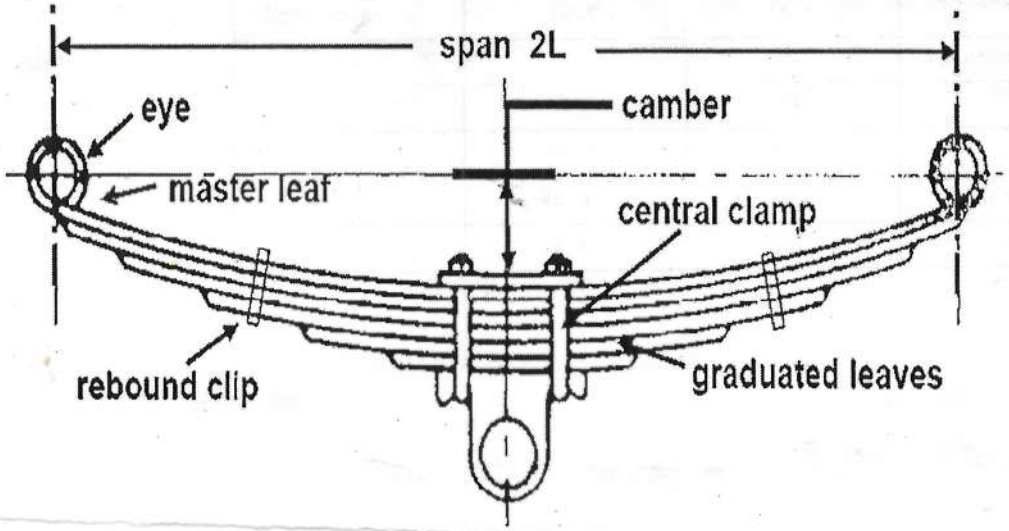
Chapter 4 : Automobile Suspension, Wheels & Tyr

4.1 Suspension systems: function & requirement, Rigi axle suspension system (Leaf Spring) construction.

* Suspension System -

- function of suspension system -
  - Absorbs road shocks & vibration.
  - Provides comfort to passengers.
  - Maintains road contact of tyres.
  - Ensures vehicle stability & control.
  - Reduces wear & tear of components.
- Requirements of good suspension system -
  - High shock absorbing capacity.
  - Good stability while turning & braking
  - Minimum maintenance.
  - Proper load carrying capacity.
  - Ensures tyre-road contact always.

* Rigid Axle Suspension System (Leaf Spring) :-



Main Parts -

- Leaf springs (semi-elliptical type)
- Axle (rigid axle)
- U-bolts (to fix axle with spring)
- Shackle (allow spring movement)
- Frame (Chasis)
- leaf spring consist of multiple steel plates (leaves) of diff. lengths stacked together.

Working -

- When vehicle moves on uneven road → axle moves up/down.
- leaf spring flexes (bends) & absorbs shock.
- Energy is stored & released smoothly.
- Shackle allows change in spring length during motion.

Advantages -

- simple & strong construction, ~~can~~
- Can carry heavy loads.
- Low cost & maintenance.

Disadvantages -

- Less comfort compared to independent suspension
- More unsprung weight.
- Not suitable for high-speed vehicles.

* Classification of Suspension System.

1. Conventional or Rigid System
2. Independent system
3. Rear end Suspension system
   a) Longitudinal leaf spring rear end suspension,
   b) Transverse leaf spring rear end suspension,
   c) Coil spring rear end suspension,

4. front end ~~susp~~ independent suspension.
   a) Wishbone type or parallel link type.
   b) Mac-pherson strut type.
   c) Vertical guide type.
   d) Trailing link type.
   e) Swing half axle type.

5. Interconnected suspensions.
   a) Air or pneumatic suspension system.
   b) Hydro elastic suspension system.
   c) Hydrogas suspension system.

6. Self leveling suspension system.

4.2. Independent suspension system Introduction, Types of Independent suspension system, construction & working of Mac-pherson strut type, wishbone type of suspension system.

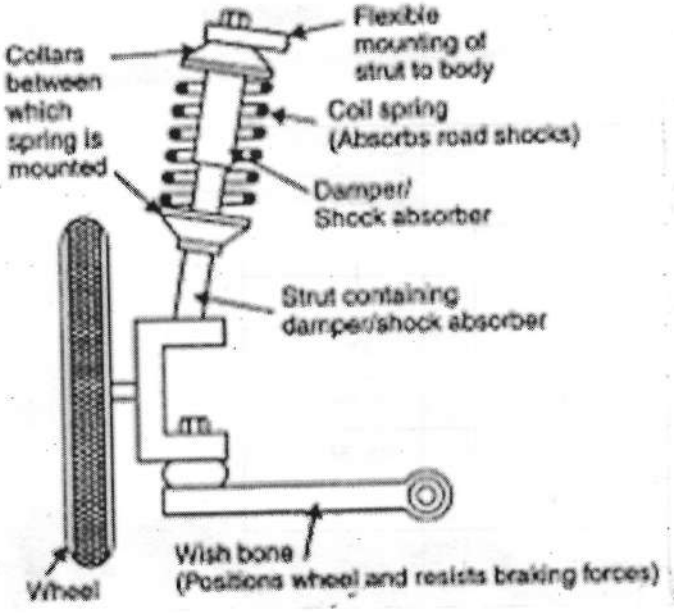
* Types of front wheel Independent suspension.

1. Mac-pherson strut type or single wishbone sy
2. Wishbone type or parallel link type or double wishbone type.
3. Trailing link type.
4. Vertical guide type.
5. Swing-half axle type.

* Independent suspension system:

- In this system, each wheel moves independently of the other.
- Shock on one wheel does not affect the other wheel.
- Used in modern cars for better comfort & control.

* Mac-pherson strut Type suspension system:



Construction -

- Consists of a strut unit (Coil spring + Shock absorber combined)
- Upper end of strut is fixed to vehicle body (Top mount)
- Lower end connected to steering knuckle.
- A lower ~~end connected to steering~~ control arm connects wheel assembly to chasis.
- Ball joint allows movement & steering.
- The strut acts as both shock absorber & structural support.

Working -

- When vehicle passes over a bump - wheel moves upward.
- Coil spring compresses & absorbs shock.
- Shock absorber reduces vibrations.
- Energy is released slowly → prevents bouncing.
- Wheel returns smoothly to normal position.

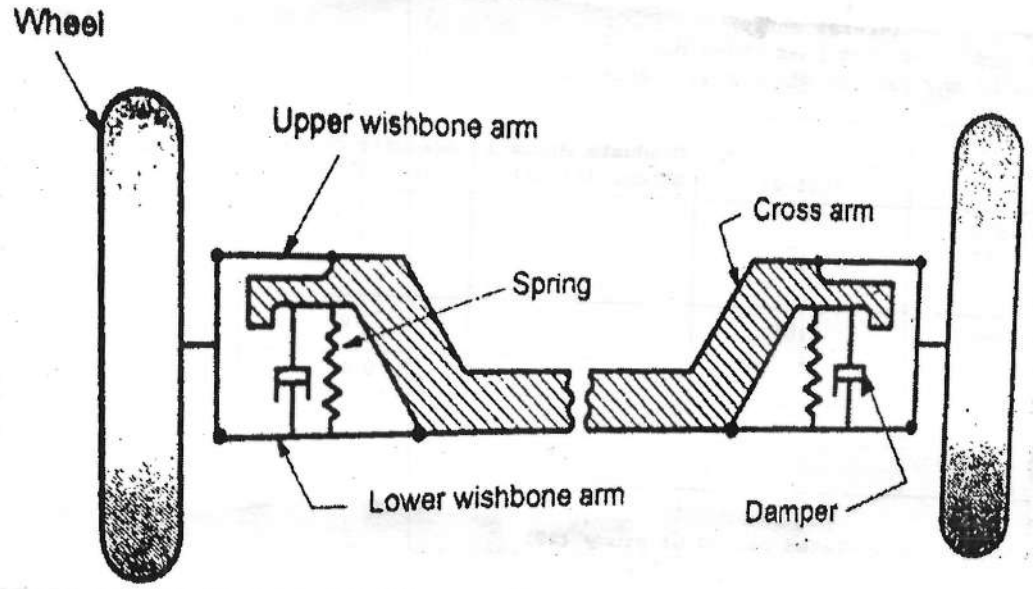
Advantages -

- Simple & lightweight
- Low cost & compact, Good ride comfort

Disadvantages -

- Less suitable for heavy vehicles.
- Limited stability at high speed.

* Wishbone Type Suspension System :



Construction -

- Consists of two wishbone-shaped arms
  - Upper control arm - Lower control arm
- Both arms connected to the chasis/frame
- The outer ends are connected to the steering knuckle.
- A coil spring & shock absorber are placed bet^n lower arm & frame.
- Includes ball joints for flexible movement.
- called "wishbone" because arms are Y-shaped (like a wishbone)

Working -

- When vehicle passes over a bump → wheel moves upwar
- Both wishbone arms move up & down.
- Coil spring compresses & absorbs shock.
- Shock absorber controls vibrations.
- Maintains proper wheel alignment (Camber control)
- Wheel returns smoothly to original position.

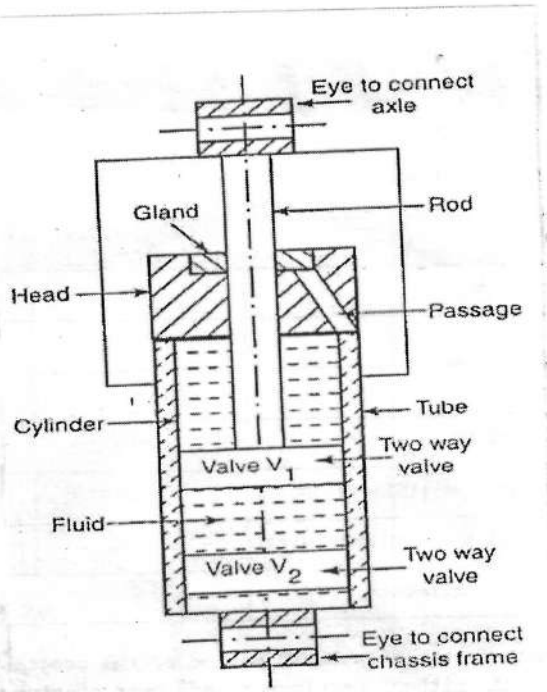
Advantages -

- Better stability & control
- Maintains correct wheel alignment.
- Suitable for high-speed vehicles.

Disadvantages -
- More complex design.
- Higher cost & maintenance.
- Requires more space.

4.3 Shock Absorber & Air suspension: construction & working of Telescopic shock Absorber, constru: & working of Air suspension system.

* Telescopic shock Absorber:



Construction -
- Consist of a cylindrical tube (outer body)
- Inside it, a piston moves up & down.
- piston is connected to a piston rod.
- Contains hydraulic oil.
- Has valve / orifices to control oil flow.
- Upper end connected to vehicle frame.
- Lower end connected to axle or suspension arm.

Working -
- When vehicle hits a bump → piston moves inside cylinder.
- Oil flows through small valves.
- This creates resistance (damping effect)
- converts vibration energy into heat
- During rebound, oil again flows → controls spring return

- Thus, oscillations are reduced & smooth ride is obtained.

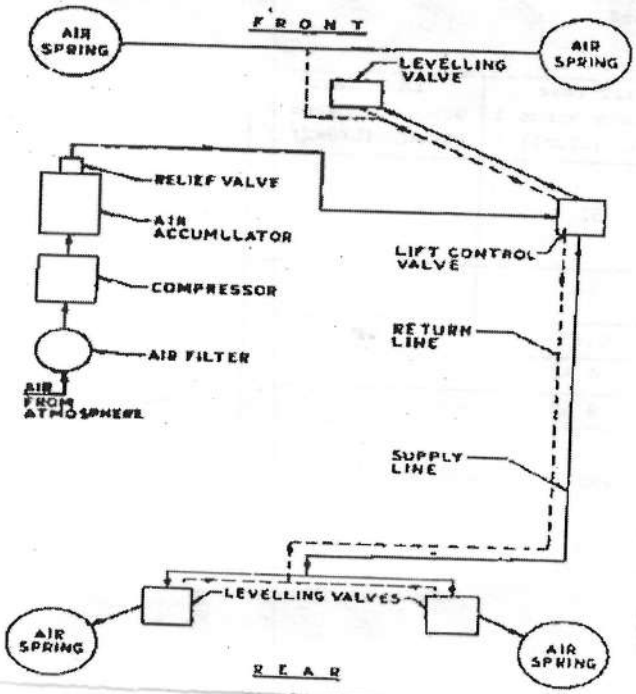
Types of Motion -

- Compression (Bump stroke) → piston moves downwar
- Rebound stroke → piston moves upward.

Advantages -

- Provides smooth & comfortable ride,
- Reduces vibrations & bouncing
- Improves vehicle stability.

* Air Suspension System -



Construction -

- Air spring (rubber bag) instead of metal spring
- Air compressor to supply compressed air
- Air reservoir (tank) to store air,
- Control valves to regulate air pressure,
- Height control mechanism / sensor,
- Pipes & fittings to carry air,
- Air spring is placed betn axle & vehicle frame,

Working -

- Compressor fills air into air spring.
- Air ~~compre~~ pressure supports vehicle load.

- When vehicle hits bump → air spring compresses.
- Air absorbs shock & provides smooth cushioning.
- Height control valve maintains constant vehicle height.
- Excess air is released when load decreases.

Advantages -
- Very smooth & comfortable ride
- Maintains constant vehicle height
- Suitable for luxury cars & buses.

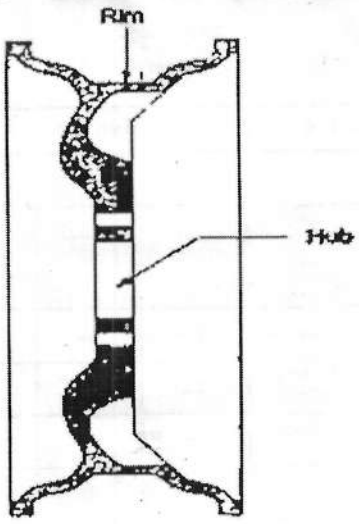
Disadvantages -
- Costly system, requires maintenance.
- Failure of compressor affects system.

4.4 Wheels, Rims & Tyres: function & requirement of wheels. Types of wheels.

* Functions of Wheels -
- Support the weight of vehicle.
- Provide rolling motion with minimum friction.
- Transmit driving torque from engine to road.
- Help in steering & direction control.
- Absorb road shocks (with tyres).

* Requirements of Wheels -
- Must be strong & durable
- Should be light & weight.
- Properly balanced.
- Provide good grip with tyres.
- Resist wear & corrosion.
- Easy to mount & maintain.

* Types of Wheels -
- Wire or Spoke wheel
- Pressed Steel Disc wheel
- Light alloy casting wheel.



Working -

- Load is transferred from rim → spokes → hub → axle.
- Lightweight structure improves vehicle performance & handling.
- Open design helps in better heat dissipation,

Advantages -

- Light weight (better fuel efficiency)
- Attractive appearance.
- Better heat dissipation,
- Improved handling & braking.

Disadvantages -

- Costly compared to steel wheels,
- Less strong for heavy loads.
- Can crack under severe impact.

4.5 Tyre cross section : Cross ply, Radial ply & belted bias, Tyre designation. factors affecting tyre life.

* Types of Tyres -

A) Solid Tyre

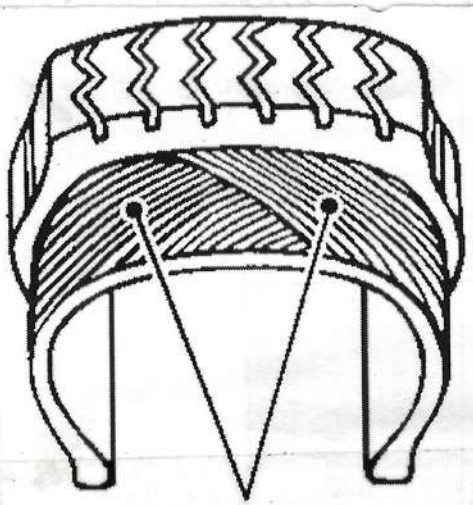
B) Pneumatic or Air filled Tyre,

1. On the basis of pressure & volume,
   - i) High pressure tyre
   - ii) Conventional tyre.
   - iii) Super cushion tyre.

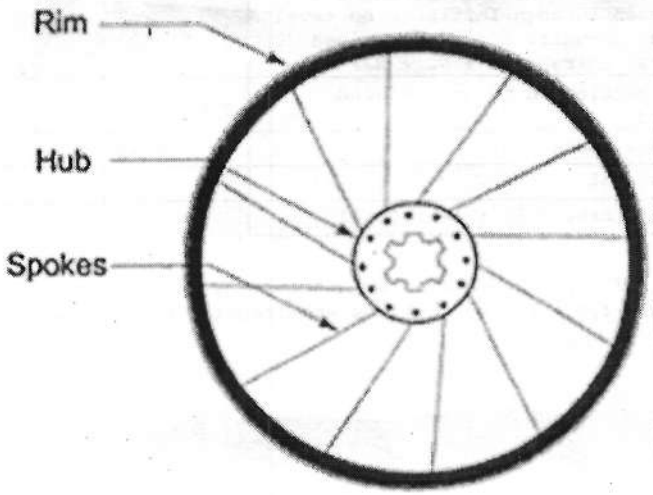
2. On the basis of construction -
   i) Tube tyre.
   ii) Tubless tyre.

3. Carcass types tyre.
   i) Cross ply tyre
   ii) Radial ply tyre
   iii) Belted bias tyre.

* Difference betn Cross ply (Bias carcass type) & Radial Ply Tyre.

Point	Cross Ply Tyre	Radial Ply Tyre.
Diagram	 Bias Ply	 Radial
Cord arrangement	• Cords are placed diagonally (30°-40°) & overlap each other in criss-cross pattern	• Cords are placed radially (90°) from bead to bead.
• Number of plies	More number of plies req^d for strength	Fewer plies req^d
• Construction	Tread & sidewall are interconnected act as one unit.	Tread & sidewall are seperated, work independently.
• Belts (reinforcement)	No steel belts used	Steel belts provided under tread.
• sidewall flexibility	Stiff sidewall	Flexible sidewall.

*. Wired (Spoked) Wheel -



Construction -
- Hub - Central part mounted on axle
- Spokes - Steel wires connecting hub & rim
- Rim - Outer circular part where tyre is fitted.
- Nipples - Used to tighten spokes.

Working -
- When load is applied, spokes under tension support the rim.
- Load is transferred from rim → spokes → hub → axle
- Spokes distribute load evenly & maintain wheel shape

Advantages -
- Light weight, Easy to repair
- Flexible & absorbs shock.

Disadvantages -
- Less strong than disc wheels.
- Requires frequent maintenance (tightening spokes)
- Not suitable for heavy vehicles.

* Pressed Steel Disc Wheel -

This wheel is made from pressed steel sheet, in which a solid steel disc connects the hub & rim.

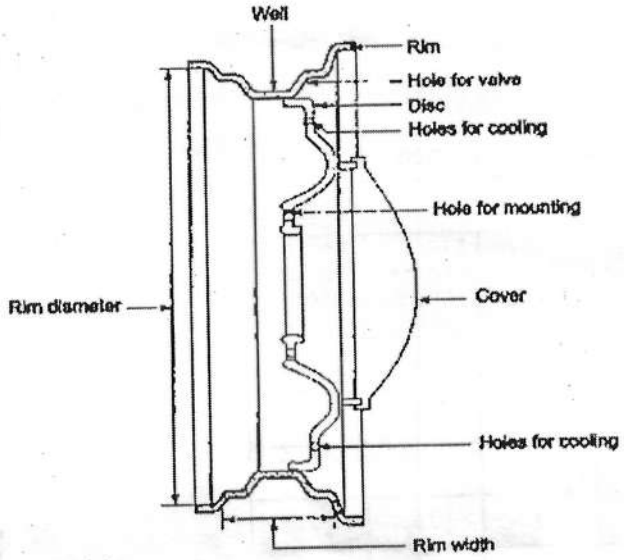
Construction -
- Rim - Outer circular part for tyre mounting
- Disc plate - Pressed steel plate connecting rim & hub
- Hub Hole - Center ~~for~~ hole for axle mounting.

- Bolt Holes – Used to fix wheel to hub.
- Ventilation Holes – for cooling brakes.

Working –
- Load from vehicle is transferred from rim → steel disc → hub → axle
- The solid disc provides high strength & rigidity.
- Vent holes allow heat dissipation during braking.

Advantages –
- strong & durable, low cost
- Requires less maintenance
- suitable for heavy vehicles.

Disadvantages –
- Heavier than alloy wheels.
- less attractive appearance.
- Poor heat dissipation compared to alloy wheels.



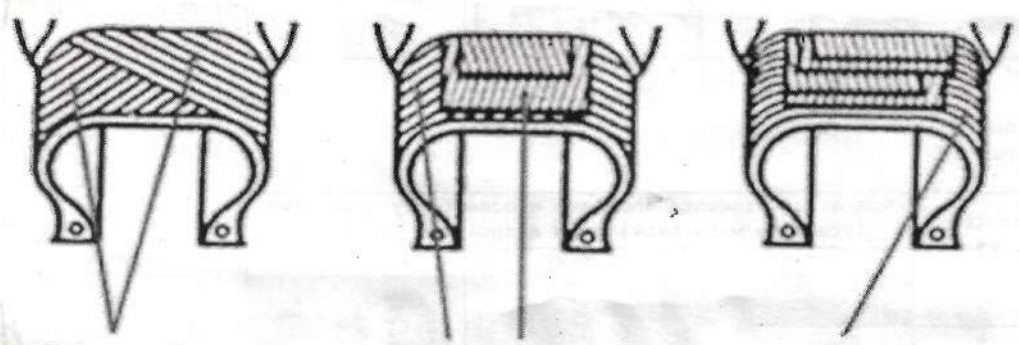
* Light Alloy Casting Wheel / Alloy Wheel –

An alloy wheel which is made from light metal alloy such as aluminium or magnesium, instead of steel.

Construction –
- Rim – Outer part for tyre mounting
- Spokes / Arms – Connect rim to hub (stylish design)
- Hub – Central portion fixed to axle.
- Made by casting or forging process.

Point	Cross Ply Tyre	Radial Ply Tyre.
• Heat generation	More friction bet plies → more heat generation	Less friction → less heat generation
• Tyre life	Shorter due to wear & heat	Longer life due to better design.
• Road grip	Less grip, especially at high speed.	Better grip & road holding
• Rolling resistance	High rolling resistance	Low rolling resistance
• Fuel economy	Lower Mileage	Better fuel efficiency
• Ride comfort	Less comfortable, more vibrations	Smooth & comfortable ride.
• Cost	Cheaper & economical	Costly but efficient
• Appl^{n}	Trucks, tractors, off-road vehicles	Cars, buses, high-speed vehicles.

* Belted Bias Type Tyre -



A belted bias tyre is an improved form of cross ply (bias) tyre in which strong belts (usually fiberglass or steel) are added below the tread to increase strength & performance.

Construction -

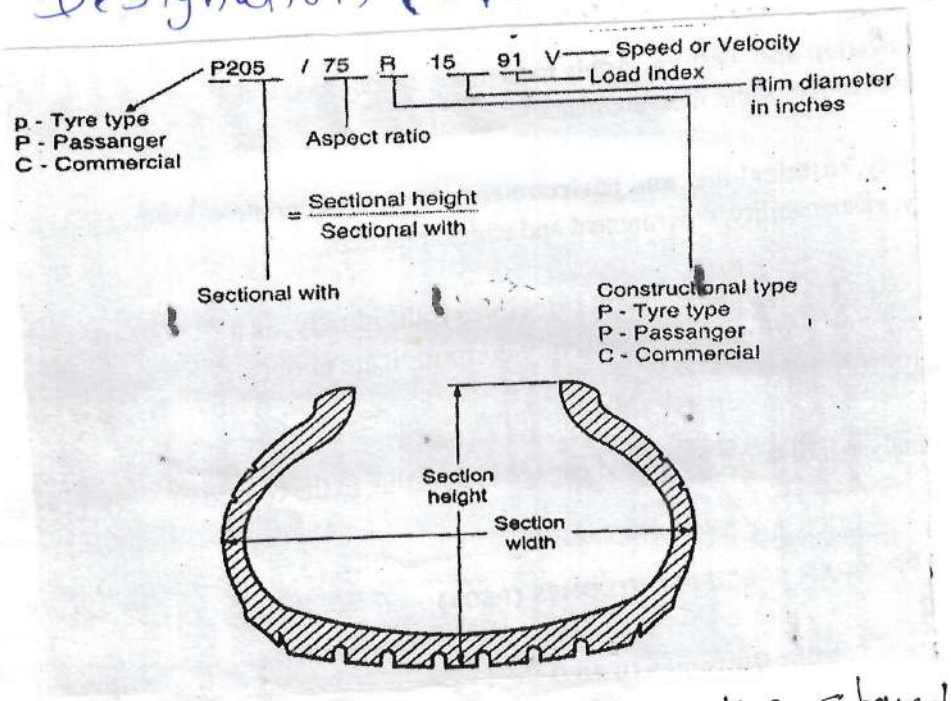
- Bias plies - Arranged diagonally (like cross ply tyre)
- Belts - Placed under the tread (Circumferential dir^{n})
- Tread - Road contact surface.
- Sidewall & Bead - Same as normal type.

Working -
- Diagonal plies provide basic strength.
- Belts stiffen the tread area.
- This reduces tread deformation & improves stability.

Advantages -
- Better tread life than cross ply.
- Improved road grip, better stability at high speeds.
- Less heat generation compared to bias tyre.

Disadvantages -
- More costly than cross ply.
- Not as efficient as radial tyre.
- Still generates more heat than radial.

* Tyre Designation (Specification of Tyre):



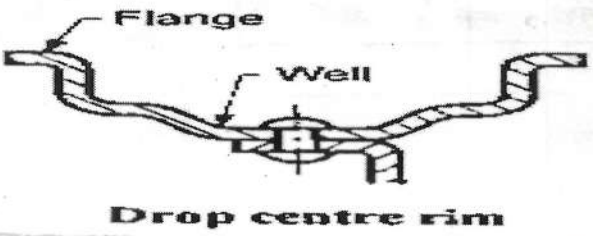
Definition - Tyre designation means the standard code written on tyre sidewall which gives information about size, type & construction.

Example - 195 | 65 R15 91H
- 195 → Tyre width in mm
- 65 → Aspect ratio (height = 65% of width)
- R → Radial construction
- 15 → Rim diameter (in inches)
- 91 → Load index
- H → Speed rating.

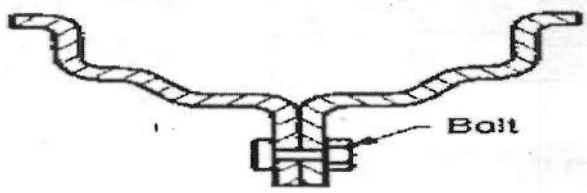
* Factors Affecting Tyre Life :

1. Inflation pressure -
   - under inflation → more wear on edges
   - Over inflation → wear at centre.
2. Load on Vehicle -
   - Overloading reduces tyre life.
3. Road conditions -
   - Rough roads cause faster wear.
4. Driving Habits -
   - Sudden braking, acceleration → more wear.
5. Wheel alignment -
   - Improve alignment causes uneven wear.
6. Wheel balancing -
   - Poor balancing leads to vibrations & damage
7. Speed -
   - High speed increases heat → reduces life.
8. Temperature -
   - High temp. accelerates wear.

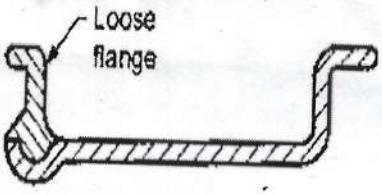
* Types of Rim :-



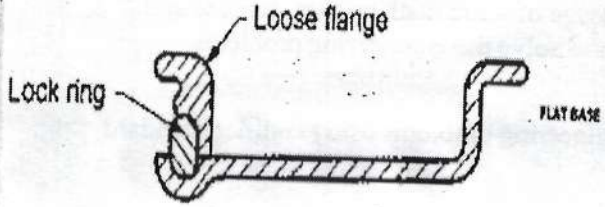
Drop centre rim



Semi-Drop centre rim



(a) Two piece



1. Drop Centre Rim (Well Base Rim) -
   - Has a depressed centre (well)
   - Makes tyre mounting & removal easy.
   - Mostly used in cars & light vehicles.

2. Semi-Drop Centre Rim -
- Similar to drop centre but less depth
- Used in medium vehicles.

3. Flat-Base Rim (Straight side Rim) -
- No central well
- Tyre is fitted using side rings.
- Used in heavy vehicles.

4. Split Rim -
- Rim is split into two parts.
- Easy to assemble & disassemble.
- Used in trucks & buses.

4.6 Wheel Alignment & Wheel balancing : Purpose of wheel alignment, Procedure of wheel alignment, Purpose of wheel balancing & procedure of wheel balancing.

* Wheel Alignment :-

Definition -
It is the process of adjusting the angles of wheels (camber, caster, toe) so that they are properly aligned with each other & with the road, as per manufacturer specifications.

* Purpose of Wheel Alignment -

- To keep wheels perfectly parallel to each other.
- To maintain correct steering geometry (camber, caster
- To ensure uniform tyre wear.
- To improve vehicle stability & control.
- To reduce fuel consumption.

* Procedure of Wheel Alignment -

1. Place vehicle on alignment machine/platform.
2. Check tyre pressure & condition.
3. Inspect suspension & steering parts.
4. Mesure alignment angles (camber, caster, toe)
5. Adjust angles using tie rods / shims / control arms
6. Recheck values as per manufacturer specifications
7. Tighten all components & perform test drive.

* Wheel Balancing -

- Definition -

  It is the process of equalizing the weight distributi of the wheel & tyre assembly so that it rotates smoothly without vibration.

- Types of Wheel Balancing -

* Purpose of Wheel Balancing -

- To ensure uniform weight distribution of wheel.
- To eliminate vibrations while driving.
- To increase tyre life.
- To provide smooth driving comfort.

* Procedure of Static Wheel Balancing -

1. Remove the wheel from vehicle.
2. Mount it on a static balancing stand (free to rotate)
3. Rotate wheel slowly & allow it to come to rest.
4. The heaviest point settles at the bottom.
5. Mark the top (light-side) of the wheel.
6. Add small balancing weighs on the top (light side)
7. Rotate again & repeat until wheel stays in any position.
8. Refit the wheel on the vehicle.

* Procedure of Dynamic Balancing -

1. Remove wheel & mount on balancing machine.
2. Enter wheel details (size, width, diameter).
3. Rotate (spin) the wheel using machine.
4. Machine detects imbalance in two planes.
5. Display shows exact position & amount of weighs.
6. Fix weights on inner & outer rim sides.
7. Spin again to verify balance.
8. Repeat if needed until zero imbalance.
9. Refit wheel on vehicle.

- Static → Heavy spot - add weight opposite.
- Dynamic → Machine-based, corrects both sides.

- Alignment ⇒ Angle correction
- Balancing = Weight correction.

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