



BITS Pilani
Pilani Campus

Automotive Vehicles AEL ZC441

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Automotive Vehicles

Lecture 2

Today's Topic

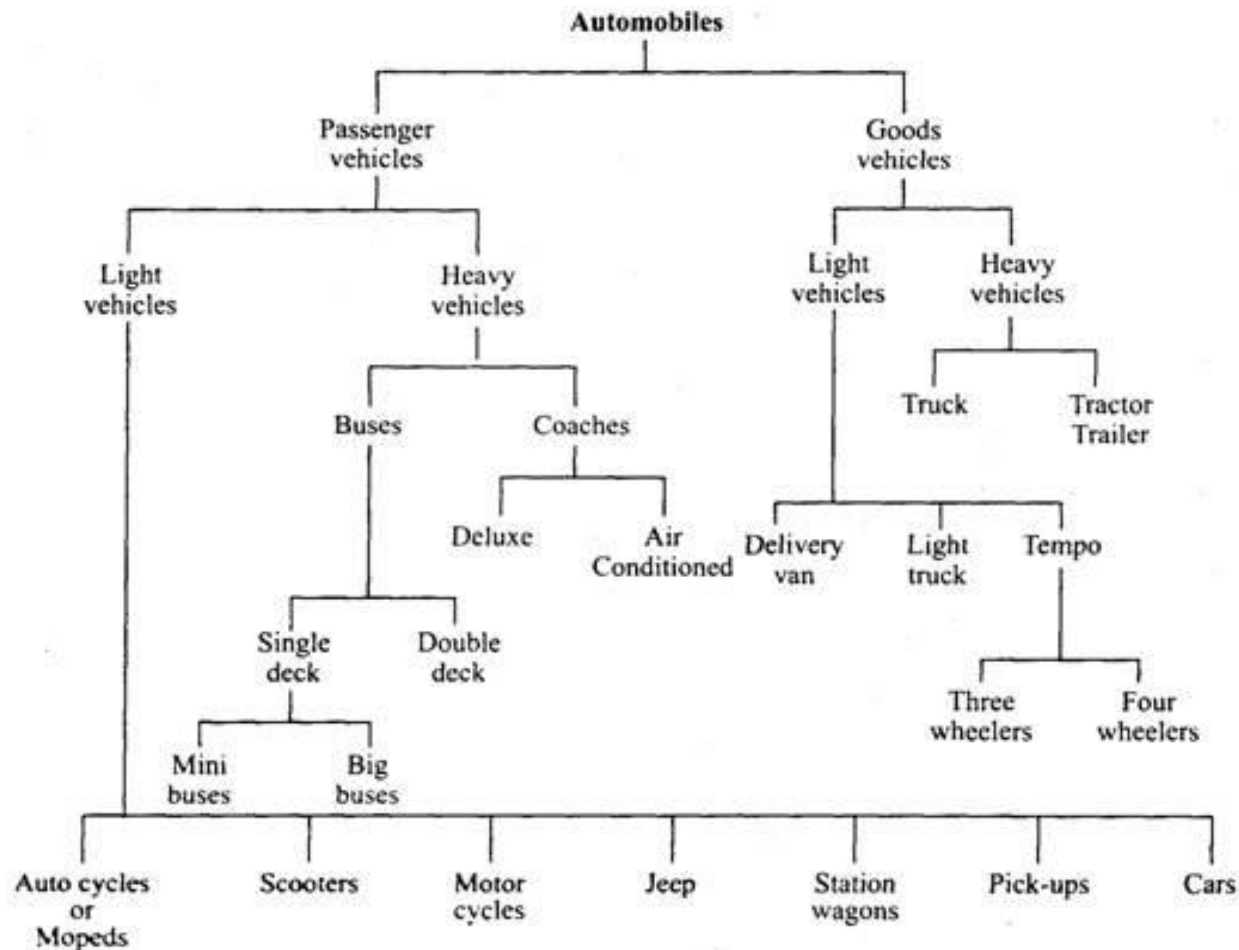


Lect No.	Learning Objectives	Topics to be covered	Reference to Text
1	An introduction to automobiles	Overview of the course and evaluation scheme Development of automobiles, General classification, Basic structure and components of automobile	1TB1,1TB2
2	The chassis Construction and Body	Classification, Conventional construction, Sub frames, Frame less constructions, Classification of body, Numerical problems on chassis member bending.	11TB1, 1 TB2
3	Reciprocating Engine Construction and basics	Constructional details, Calculation of displacement velocity and acceleration of piston and connecting rod, Working of 2 and 4 stroke engines. Numerical problems on the above topics	3TB1
4	Cooling systems	Need. Variation of gas temperature. Piston temperature distribution. Theory of engine heat transfer and correlation. Parameters affecting engine heat transfer. Air-cooled systems.	8TB1, 12RBa
5	Cooling systems	Types of water-cooling systems. Radiators. Fans. Correlation for the power required for engine cooling. Numerical problems on the above topics	8TB1, 12RBa
6	Lubrication systems	Causes of engine friction. Function of lubrication. Mechanism of lubrication. Journal bearing lubrication.	7TB1, 11RBa
	Lubrication systems	Types of lubrication systems. Lubrication of engine components.	7TB1, 11RBa
7	Clutch	Definition of clutch, requirements, classification, principle of working of friction clutches, Driving system and Plate clutch (uniform pressure and uniform wear).	14TB1, 3TB2

Lecture 1 - Recap

- Development of Automobile (1769 to 2005)
- General Classification (Type I & II)
- Basic Structure &
- Components of Automobile (Basic Structure, Power Plant, Transmission System, Auxiliaries, Controls, Superstructure)

General Classification of Automobile

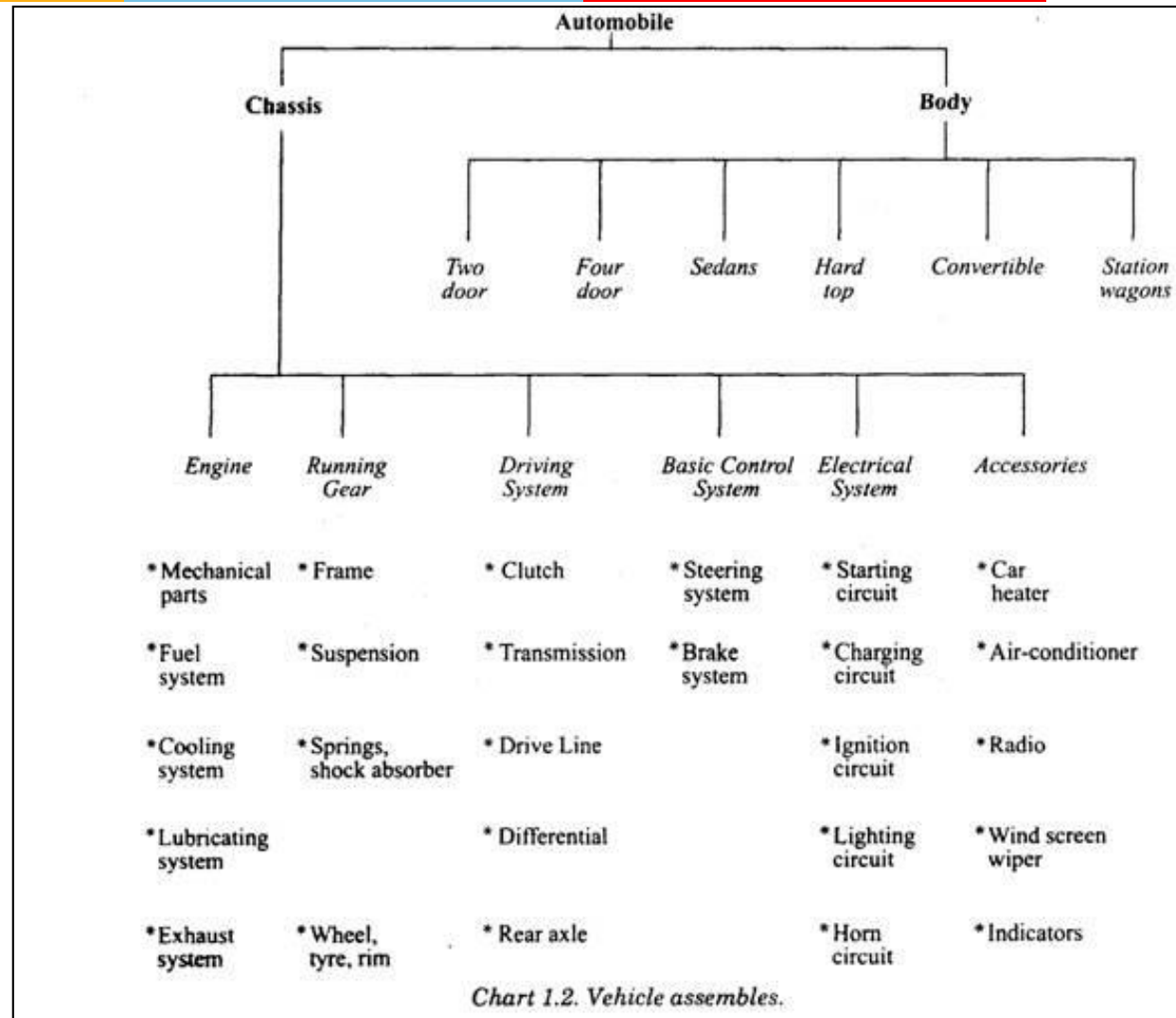


Components of Automobile



- The Basic Structure
- The Power Plant
- The Transmission System
- The Auxiliaries
- The Controls
- The Superstructure

Components of Automobile



L2 - Chassis Construction and Body



- Classification
- Conventional Construction
- Sub frames
- Frameless Constructions
- Classifications of Body
- Numerical problems on Chassis member bending

Chassis!!!



- Chassis Frame supports the various components and the body , keep them in correct positions.
- Light and Sufficiently strong to withstand weight
- Less distortion

Chassis Contains!



- Engine and Radiator
- Transmission System (Clutch, Gear box, Propeller shaft, Rear axle)
- Suspension system
- Road Wheels
- Steering system
- Brakes
- Fuel Tank

Types of Frame



Conventional

- Separate Frame to attach all components

Eg. Trucks, Heavy vehicles



Non Conventional (Frameless)

- No separate frame is used

Eg. Cars



Classification : Chassis

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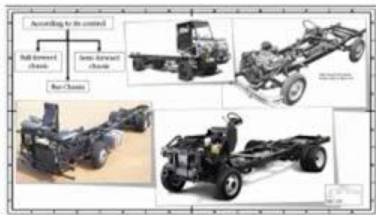
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Classification of Chassis?

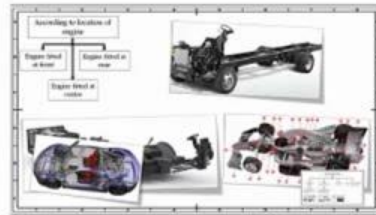
According to its control

- Full forward chassis
- Semi-forward chassis
- Bus Chassis



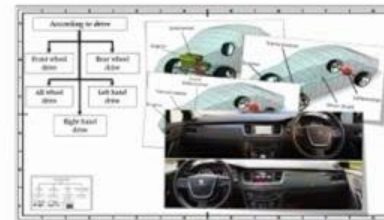
According to location of engine

- Engine fitted at front
- Engine fitted at rear
- Engine fitted at centre



According to drive

- Front wheel drive
- Rear wheel drive
- All wheel drive
- Left hand drive
- Right hand drive



Based on no. of wheels and no. of driving wheels

- 4 X 2 drive chassis
- 4 X 4 drive Chassis
- 6 X 2 drive chassis

Classification : Chassis



- Conventional control
 - Engine is mounted in front of driver's cabin
 - Less space is utilized
 - Example : Heavy vehicles
- Semi forward control chassis
 - Engine is mounted inside drive cabin partially
 - Example : Tata SE Series
- Full forward control chassis
 - Engine is mounted inside driver cabin completely
 - More space is utilized
 - Example : Tata E Series

Classification : Chassis



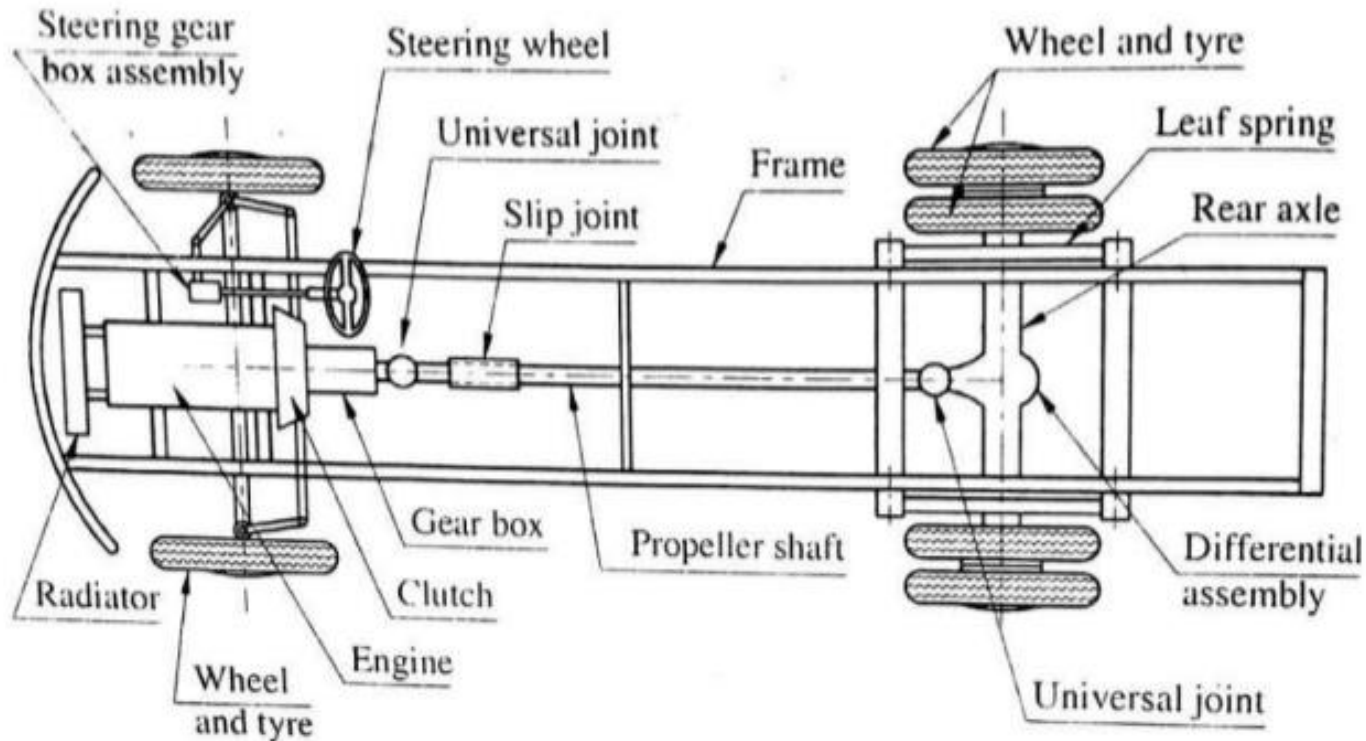
Semi Forward Chassis



Conventional Construction



SIMPLE CONSTRUCTION OF TRUCK CHASSIS

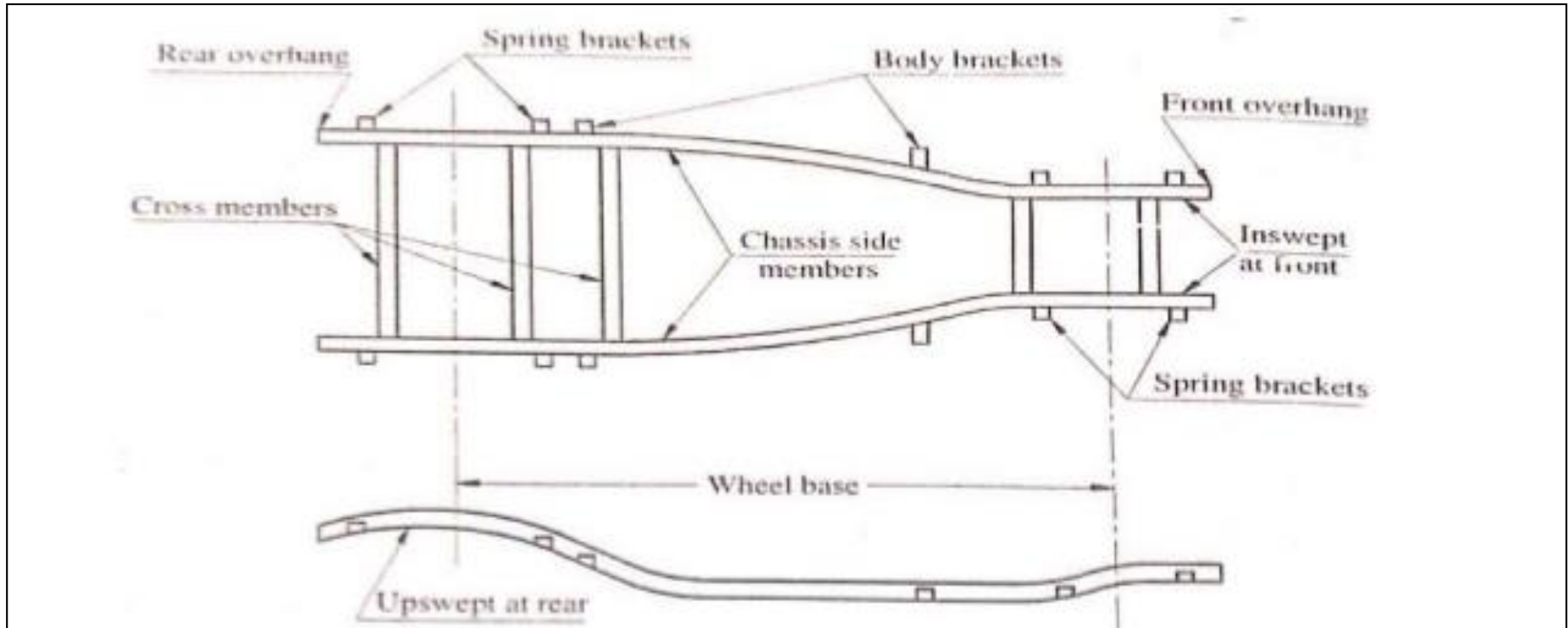


Conventional Construction



- Frame is the basic unit which has various components attached and bolted on to the frame
- Functions of Frame
 - Support Chassis components and Body
 - Withstand static and dynamic loads without undue deflection / distortion
- Loads on the Frame
 - Weight of the vehicle and passengers (Vertical bending)
 - Vertical loads when the vehicle comes across bump or hollow (longitudinal torsion)
 - Loads due to road chamber, side wind, cornering force while taking turn (Lateral bending)
 - Loads due to wheel impact with road obstacles (Horizontal Lozenging)
 - Engine torque and Braking torque tending to bend side members
 - Sudden impact loads during a collision

Conventional Construction



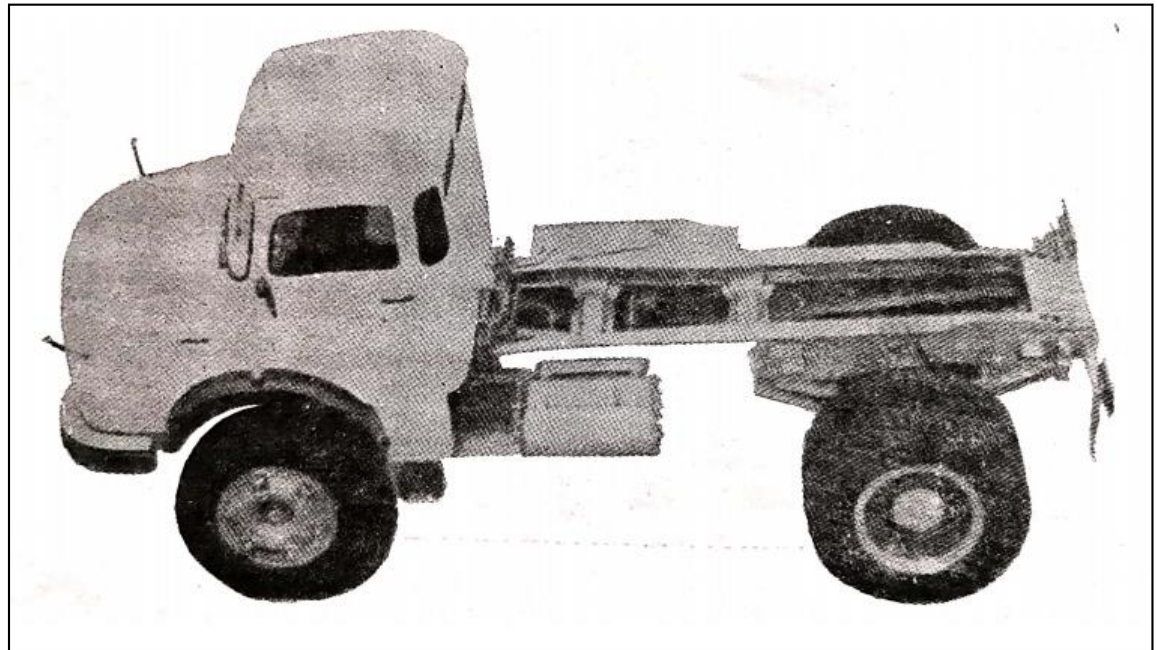
- Upswept at Front & Rear (To accommodate movement of axles due to springing)
- Frame is narrowed (To have better steering lock & small turning circle)
- Brackets (To support body)
- Dumb irons (To act as Bearings for spring shackles & Mounting springs)
- Only used in Commercial vehicles to carry heavy loads
- Ground clearance is high and Sufficient space

Conventional Construction



Double Frame :

- Increases Resistance to bending
- Ensures even distribution of the load
- Eliminates the need for subframe

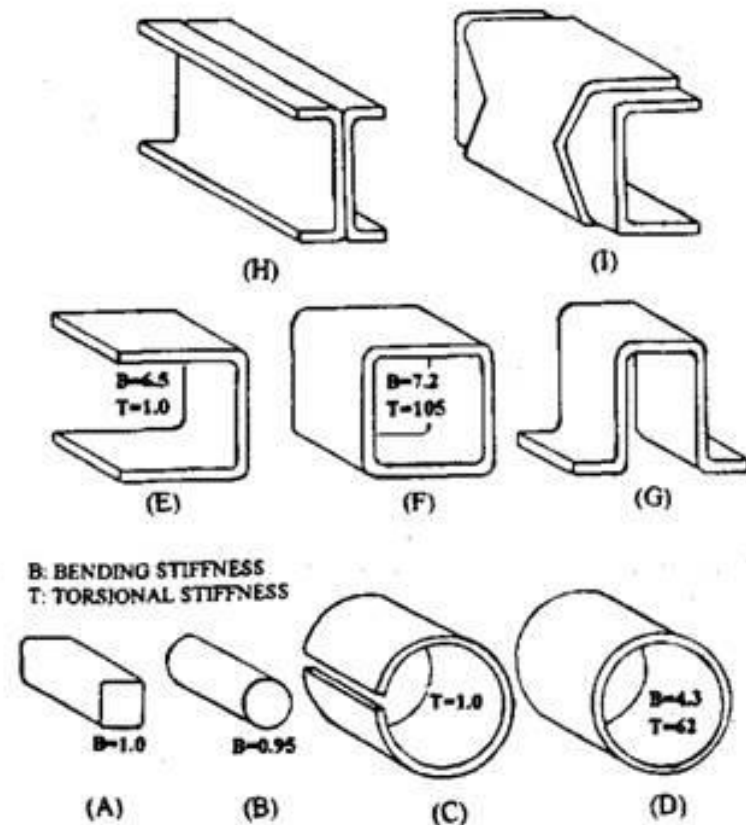


Conventional Construction



Cross section of Side Members / Cross Members:

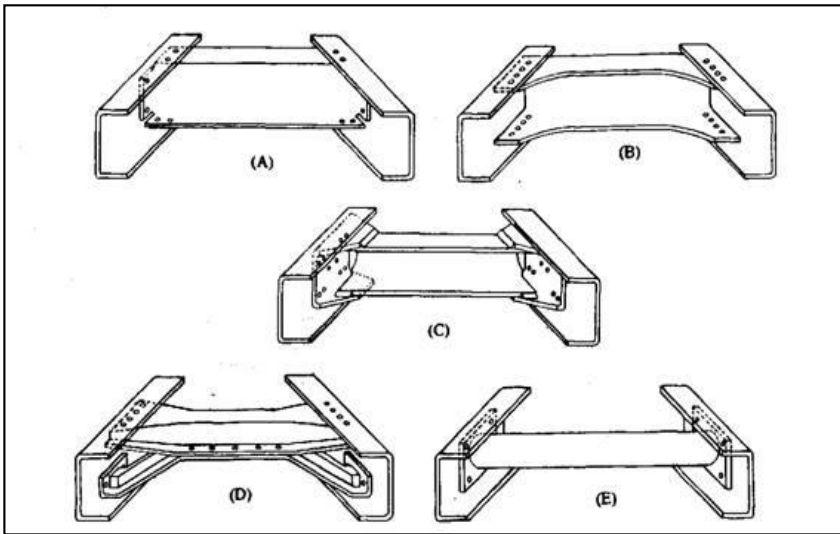
- A – Square solid bar
- B – Round solid bar
- C – Circular tube with slit
- D – Circular closed tube
- E – C Section
- F – Rectangular Box
- G – Top Hat Section
- H – I Section
- I – Circular flitch plate



Conventional Construction



Chassis Cross Member and Side Member joints:

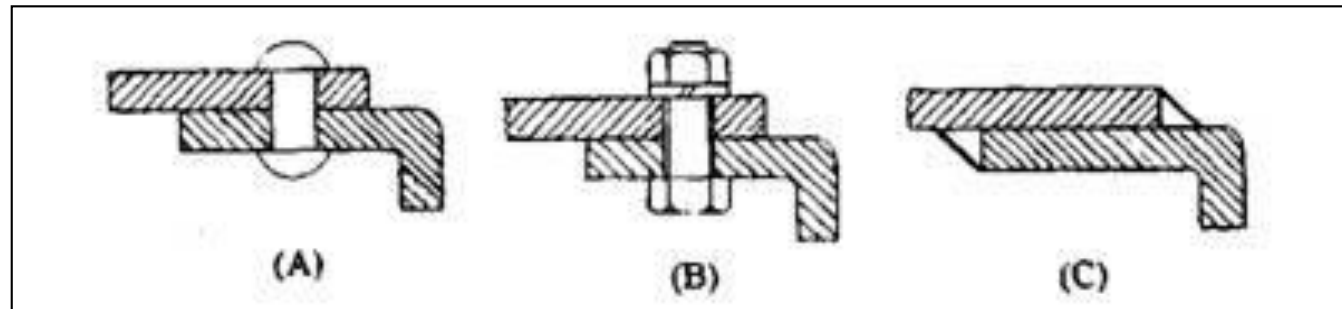


Chassis side- and cross-member reinforcement joints.

- A.** Top-hat-section cross-member joined to side-member flanges and web.
- B.** C-section cross-member with extended flanges joined to side-member flanges.
- C.** C-section cross-member with reinforcement gussets joined to side-member web.
- D.** 'Top-hat'-section cross-member with alligator-jawed enforcement joined to both flanges and web.
- E.** Tubular-section cross-member with reinforcement flat bracket joined to side-member web.

Chassis Member Joints:

1. Riveted Joint
2. Bolted Joint
3. Lap-welded Joint



Conventional Construction



Materials for Frame :

1. Steels

- Mild Sheet steel
- Carbon Sheet steel
- Nickel alloy Sheet steel
 - Carbon (0.25 – 0.35%)
 - Manganese (0.35 – 0.75%)
 - Silicon (0.3% Max)
 - Nickel (3%)
 - Phosphorous (0.05% Max)
 - Sulphur (0.5% Max)

2. Aluminum alloy (Alpax)

Conventional Construction



TABLE 2.1. SIDE MEMBER STEEL SPECIFICATIONS

	<i>Mild Steel Plate</i>	<i>Carbon Steel Plate</i>	<i>3 percent nickel Steel Plate</i>
Carbon (percent)	0.15 — 0.20	0.22 — 0.27	0.25 — 0.35
Manganese (percent)	0.40 — 0.6	0.50 — 0.70	0.35 — 0.75
Silicon (percent)	0.7 (max)	0.07 (max)	0.05 (max)
Phosphorous (percent)	0.5 (max)	0.05 (max)	0.05 (max)
Sulphur (percent)	0.05 (max)	0.05 (max)	0.05 (max)
Ultimate Strength (MPa)	450 — 500	500 — 670	550 — 720
Yield Strength (MPa)	225	250	320
Elongation	20 percent min. on 100 mm	20 percent min. on 100 mm	20 percent min. on 100 mm

TABLE 2.2. MATERIALS USED FOR FRAME BRACKETS

<i>Materials</i>	<i>Mechanical Properties (Average)</i>		
	<i>Yield strength (MPa)</i>	<i>Ultimate Tensile Strength (MPa)</i>	<i>Elongation</i>
Mild steel	240	350	20%
Medium carbon steel	400	650	24%
1% nickel	490	670	20%
Hard steel	260	570	15% on 50 mm
Soft steel	200	430	22% on 50 mm
Iron (Black heart)	260	370	13%

Conventional Construction



Sub Frames:

- Separate frame to Chassis Main frame
- Supported by Main frame at three points
- Sub frame Components will be isolated from effects of twisting and flexing

Advantages:

1. Mass of subframe helps to damp vibrations
2. Provision of subframe simplifies production on Assembly line
3. Facilitates overhaul and Repair



Front Chassis Subframe

Defects in Convectional Construction



- Misalignment due to accidents
- Dumb irons or Side members may be bent
- Cross members may be buckled
- Some rivets may be loose or broken

Frameless Construction

- Provides stiff and light construction
- Suitable for Mass production vehicles
- Capable of withstanding Frame stresses
- Floor and Roof panels resist the Sagging effect caused by weight of occupants
- High structural strength due to spot welding around panels / pillars
- Design proved successful on grueling roads

Frameless Construction



- Requirements
- Terminology
- Construction
- Body shape & Types
- Materials for Body work

Frameless Construction - Requirements



Requirements :

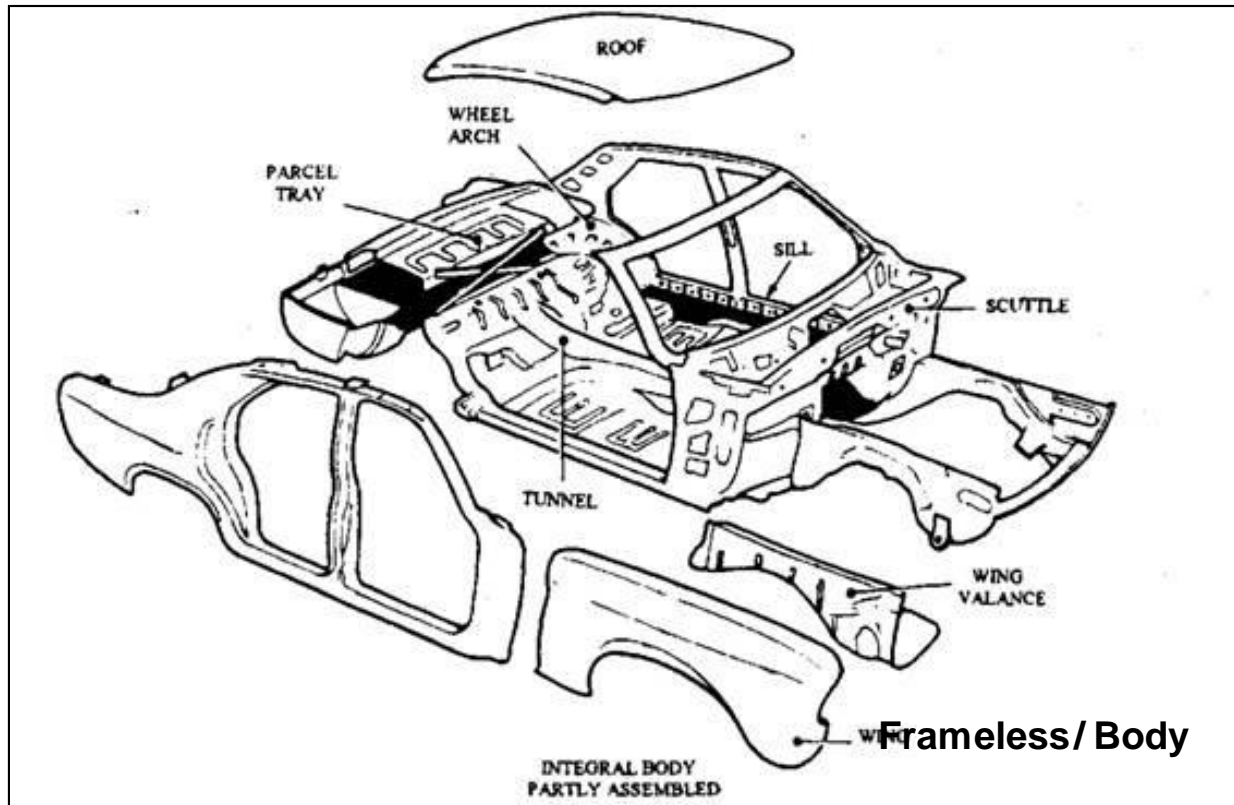
1. Strength
2. Stiffness
3. Torsional stiffness
4. Space
5. Air drag
6. Protection against weather
7. Lightness
8. Resistance to corrosion
9. Protection in accident

Frameless Construction - Terminology



1. Cab (Driver seat / cabin)
2. Fascia (Frontage visible to driver)
3. Dash board (Cluster, Control switches etc.,)
4. Legroom (Comfortable space for Movement of Legs)
5. Head room (Distance between floor to ceiling)
6. Shoulder room (Horizontal distance)
7. Boot space (Rear storage)

Frameless Construction



1. Body Safety
2. Bonnet
3. Side Pillars
4. Rear hood
5. Front side Panel
6. Rear side Panel
7. Door Pillars
8. Windshield Pillar
9. Rear Quarter Pillar
10. Body Sill
11. Roof
12. Door Panels
13. Front Bumper
14. Rear Bumper

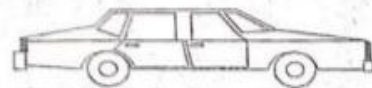
Frameless construction – Body shape & Types

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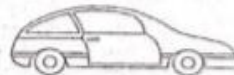
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TYPES OF BODIES FOR CAR



(a) Saloon



(b) Coupe



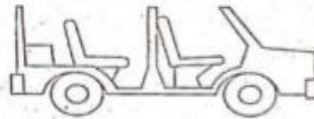
(c) Hatchback



(d) Limousine



(e) Sport



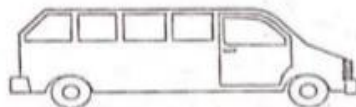
(f) Trax



(g) Jeep

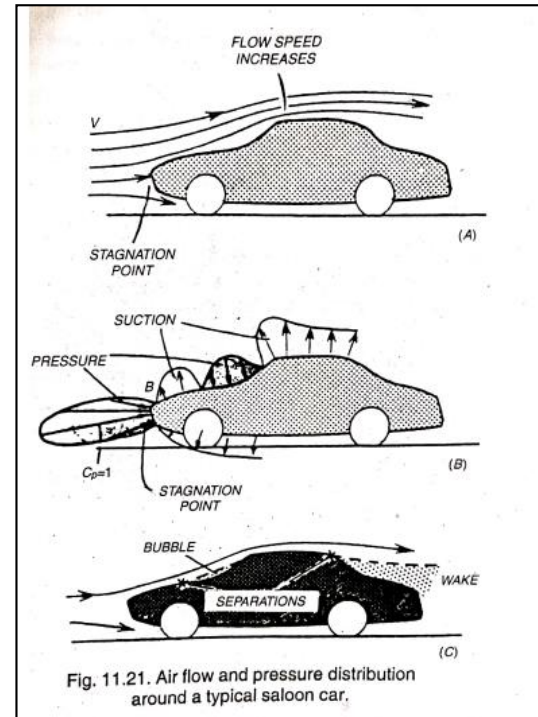


(h) Estate car



(i) Station wagon

Fig. 2.11 Different types of bodies for car



The air resistance is given by the expression, $R_a = (1/2) C_d \rho A V^2$,

where C_d = aerodynamic resistance coefficient that represents the combined effects of the above three components,

ρ = density of air,

A = projected area of the vehicle in the direction of travel,

and V = velocity of the vehicle relative to the wind.

Frameless construction – Body shape & Types



Vehicle Component Location & Attachment :

1. Engine , Clutch, Gearbox, Final drive (Three point Mounting System)

- Provides rigidity for withstanding torque during power development
- Cushion the rocking movement created by out of balance forces by Engine
- Prevent transmission of vibrations from engine and transmission systems to Body
- Accommodate any misalignment of the Engine and Transmission units

2. Propeller shaft & Universal joints

3. Driveshafts

4. Steering

5. Brakes

Frameless construction – Materials for Body



1. Steels (Cheapest, form any shape)
2. Aluminum (Adv - Better formability, Lightness, Anti rusting Quality; Disadv – Rigidity & Stiffness)
3. Thermo / Thermosetting Plastics (Carbon fibers – High cost)
4. Painting are done to protect body from corrosion and maintain its strength
5. Galvanized / Phosphatized steel / Zinc coated steel hardened at High temperatures to avoid corrosion
6. A layer of PVC is applied to protect from Road chippings

Bending Moment - Numerical



Next class!!! Along with L3