Historical Development - Passenger Coaches

- First generations coaches
- - Fully from Timber
- - Serious consequences in accidents
- 1948- 50 Hindustan Air Crafts Ldt Banglore
- started Steel bodied coaches
- 1955 ICF Was Set - Collaboration with Swiss Car & Elevator Manufacturing Corporation, Zuric, Switzerland for integral design.
  - Fabricated bogie Coil primary springs
  - Laminated secondary springs
  - Speed potential of 96 km/h

Historical Development - Passenger Coaches

- Length of bolster hanger increased to 410 mm in place of 286 mm
- Secondary suspension modified to Coil springs
- Side bearers to transfer body weight in place of centre pivot
- 16t bogie for AC coaches
- Adoption of Air brakes
- Bogie mounted air brake system
- Composition brake blocks in place of Cast Iron

Historical Development - Passenger Coaches

- RCF set up at Kapurthala to make coaches to ICF design
- Variants developed like:
  - AC self-generating and End-on-generating
  - MG versions
  - 2-tier AC, AC chair cars, 3-tier AC

ICF coach - Speed Upgradation

Speed	Year	Remarks
96	1955	Original design of Schlieren
105	1965	All coil spring, weight transfer through side bearer
120	1969	Improved track standards to C&M 1(Vol 1)
130	1971	Trials - Introduction of Rajdhani
140	1988	Trials - Introduction of Shatabdi

Design Objectives

- Corrosion Control
- Weight Reduction
- Increase in speed potential
- Increased Payload
- Increased train length
- Passenger amenity
- Safety and Maintainability

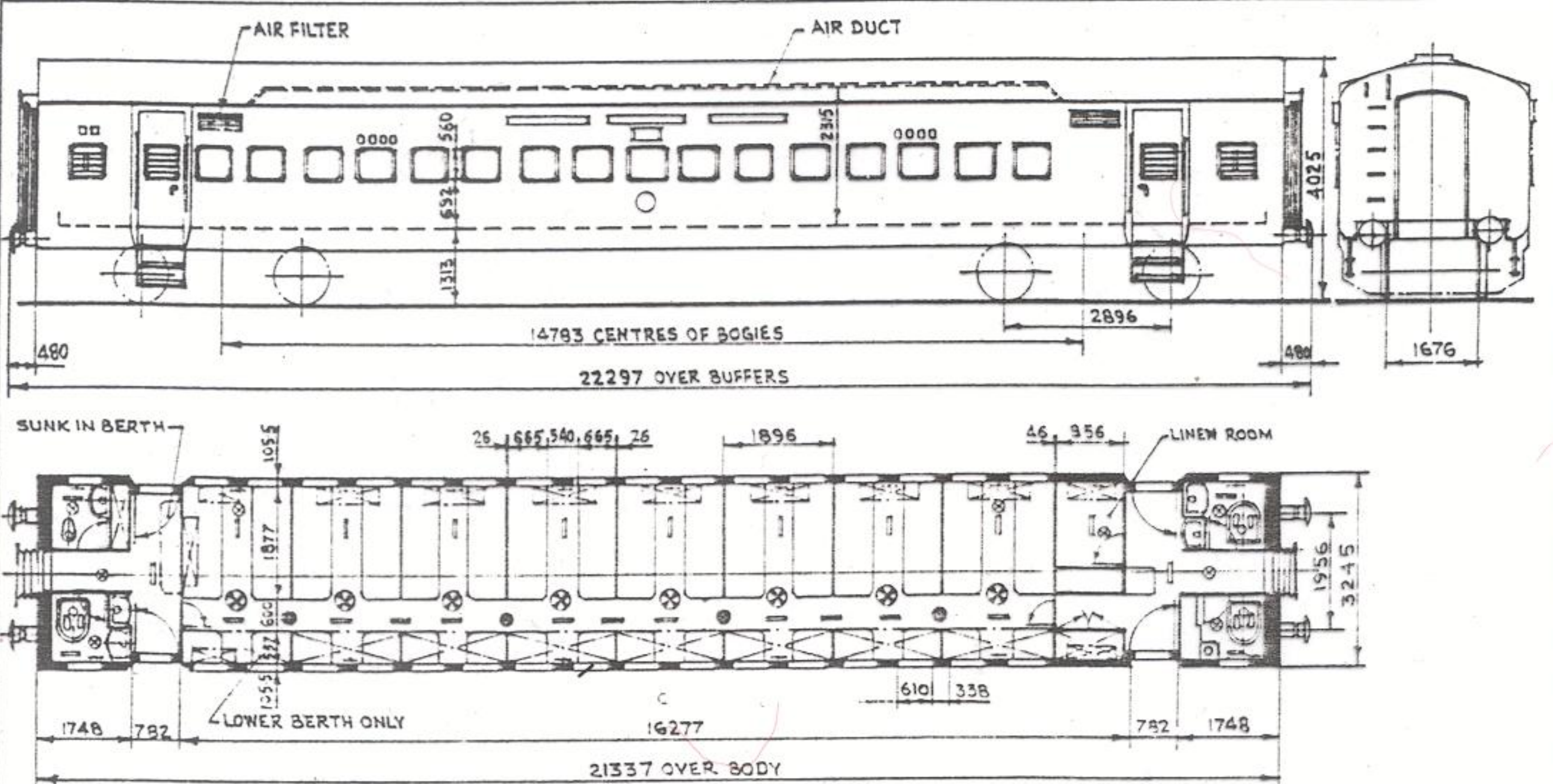
SALIENT FEATURES- ICF COACHES

- **ALL METAL**
- **ALL WELDED**
- **INTEGRAL DESIGN, SKIN STRESSED**
- **LIGHT WEIGHT**
- **ANTI TELESCOPIC**
- **BETTER BOGIE DESIGN**
- **ANTI-TELESCOPIC**
- **REDUCED WHEEL DIA**
- **REDUCED FIRE HAZARD**
- **BETTER INTERIOR**
- **STANDARDISATION**

1. No. OF PASSENGERS TO SEAT — 46
2. No. OF PASSENGERS TO SLEEP — 46
3. No. OF DOORS ASIDE — 2
4. No. OF LAVATORIES — 4
5. No. OF PASSENGERS PER DOOR — 23
6. No. OF PASSENGERS PER LAVATORY — 12

NOTE :-

1. COACH PROFILE & MAX. MOVING DIMENSIONS TO SKETCH-66064.
2. EXTERIOR MARKING TO DRG. No. CSC 970.



APPROVED VIDE RAILWAY BOARD'S LETTER No. 75/M (C) 139/1
DATED 25-5-76 (R.D.S.O. FILE REF. MC/CB/SC/BG, S.No. 714)

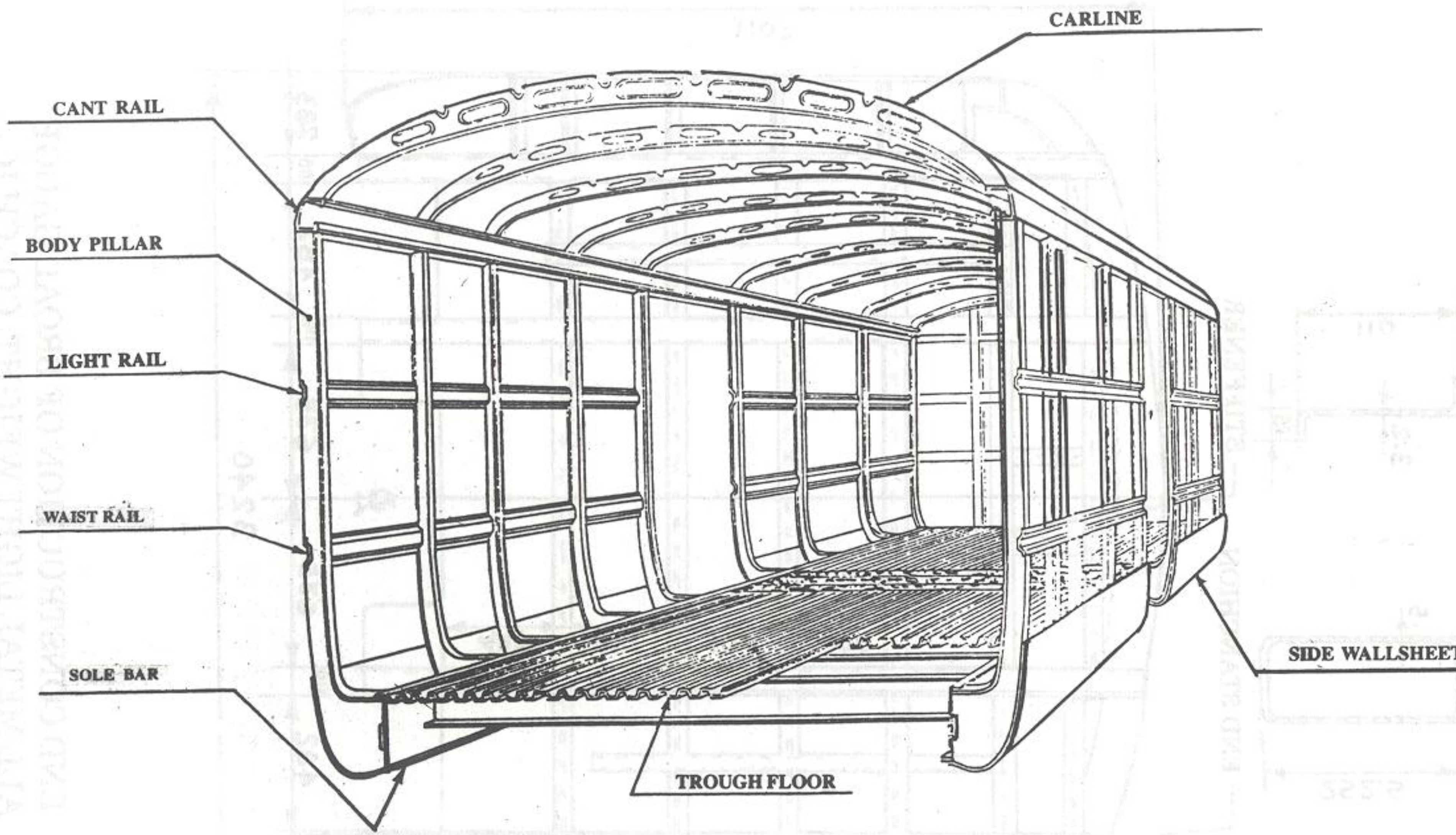
DRAWN BY	SUSHIL	LAYOUT OF SELF GENERATING A/C SLEEPER CAR I.C.F. COACHES	CODE WGACCW	B.G.	CSC 1617
CHECKED BY	(signature)				
APPROVED BY					

Construction of ICF Coach

- Coach
  - Shell - Coach Body
  - Running Gear
    - Bogie
    - Braking
  - Furnishing
  - Train Lighting & Air conditioning

Design & construction

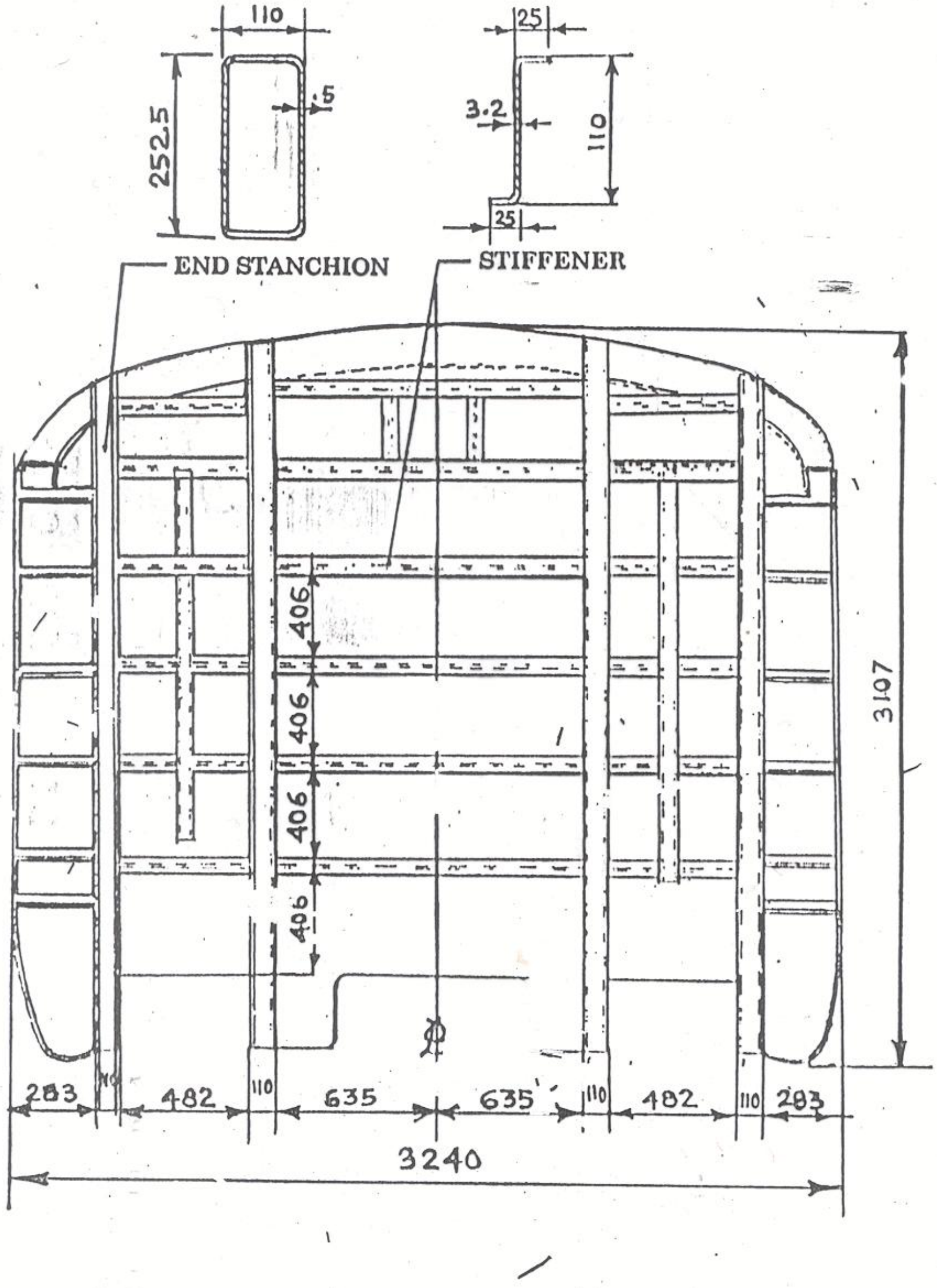
- Static tubes- formed of
- \- side wall
- \- Under frame
- \- Roof - similar to hollow tube
- Bracing to the tube by a series of hoops made of
  - Side Pillars
  - Carlines
  - Floor cross bearers
- Hoop rings are connected together by sole bar, waist rails, cant rail, and stiffeners longitudinally
-



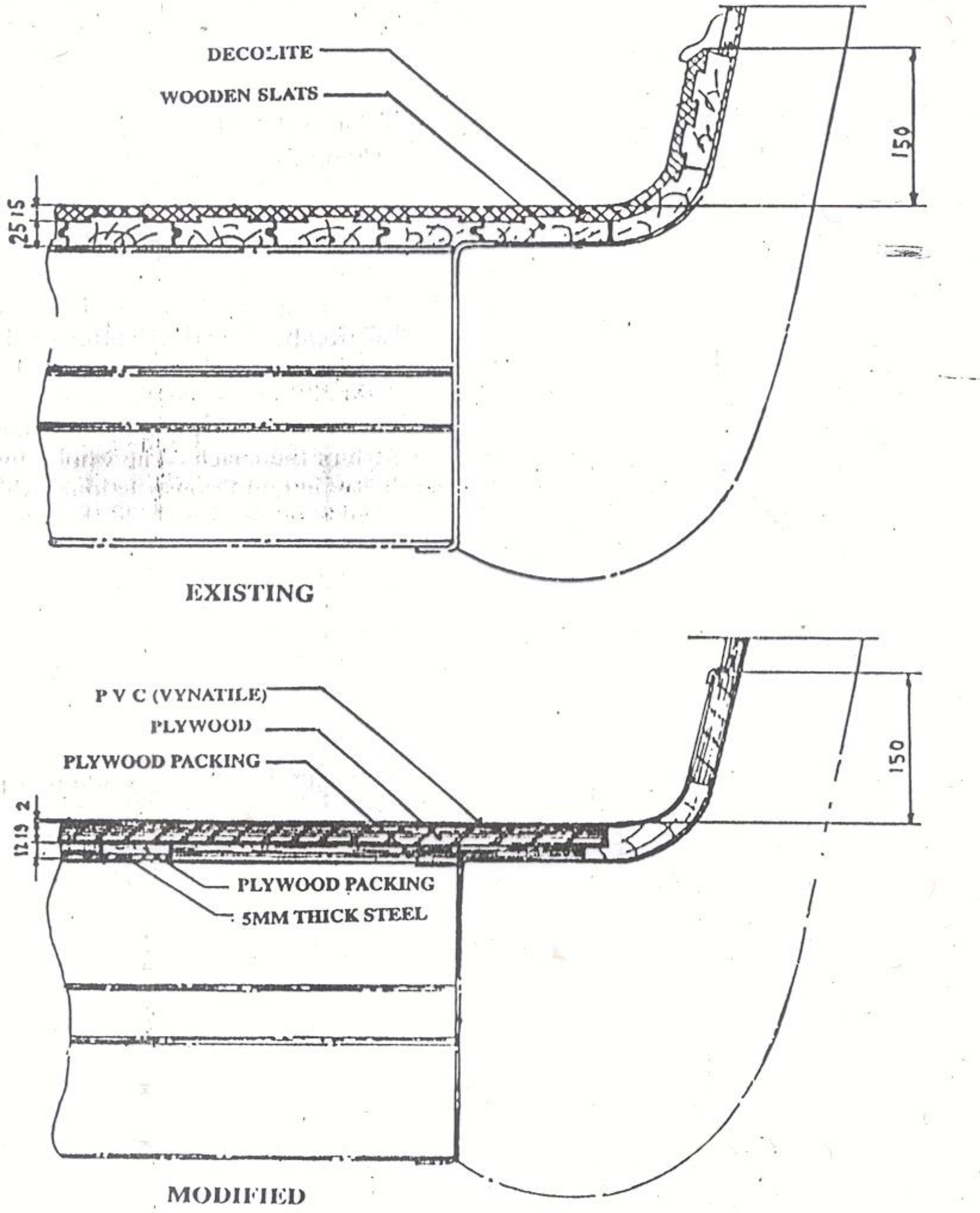
SHELL FOR ICF COACHES
(CROSS SECTIONAL VIEW)

Design & Construction - ICF shell

- Anti telescopic - end wall box structure to absorb major portion of the collision energy
- destructive tubular structure is added between Trough floor and head stock to have a comp. Weaker section.
- Trough floor made of corrugated sheet to absorb a large portion of buffing forces



END CONSTRUCTION OF BROAD GAUGE
ALL METAL LIGHT WEIGHT. COACH ICF.



FLOORING WITH PVC SHEET ON PLYWOOD

BASIC ASSUMPTIONS OF INTEGRAL SHELL

TARE & PAY LOAD ARE EQUQLLY DISTRIBUTED OVER THE BODY SHELL

WEIGHT OF THE SHELL IS DISTRIBUTED OVER THE ENTIRE PHERIPHERY OF THE SHELL

WT OF THE EXTRA FLOORING & PAYLOAD IS CARRIED BY THE FLOOR & LOWER PORTION OF THE SIDE WALL

HORIZONTAL SQUEEZ LOAD AT THE BUFFER CENTRE LINE TAKEN BY THE TROUGH FLOOR & SIDE LONGTUDINAL

SHELL TREATED AS **THIN WALLED HOLLOW GIRDER.**

Advantages of Integral Design

- Ability to withstand higher dynamic force, hence greater safety in an accident
- Weight 20 % less than ordinary steel shell & 25 % less than timber coach, hence less operating cost
- Superior Resistance against torsion & Bending stress
- Extra-ordinary compression rigidity
- less fire hazard
- more amenable to mass production

Design Characteristics- coach Body

- Adequate resistance to Horizontal Shearing forces – Connection between SW & UF

- End Wall to Absorbs to collision energy before any other part of coach body are deformed.

- No resonance Under all loading conditions -

FOR LOADS FOR COACHES UIC - 566

- The coach body load should with stand the following test loads without permanent deformation and without exceeding the permitted stress:
- **A - STATIC COMPRESSIVE LOEDS**

At buffer level	200 t
Diagonally at buffer level	50 t
At 350 mm above buffer level	40 t
At centre Rail	30 t
At cant rail	30 t

INTERNATIONAL STANDARD FOR LOADS FOR COACHES

- B. uniformly distributed load

- P =k (P1 + P2)
- where k = 1.3 (a coefficient of Dynamic augment)
- P1 = wt of body in tare condition
- P2 = 2 X no of seats x 80 kg

Crashworthiness

Crashworthiness of rail coach body is its characteristic to absorb the collision energy in controlled and predictable manner such that maximum safety is imparted to traveling passengers

Crashworthiness- ICF SHELL

- Anti-telescopic shell of Schileren design
- Energy absorption capacity of 10 kJ per side buffer
- Squeeze load up to 102t at each side-buffer level
- Vertical load of 2.165t per meter run, uniformly distributed
- Squeeze load of 60t at height of 305 mm above buffer center line
- Horizontal load of 31t uniformly distributed over entire over end wall

Crashworthiness- ICF SHELL

At reaction of 203 t – 10 g acceleration developed

Higher acceleration > more injury to passenger

Design to aim for controlled Deformation keeping force below 2000 kN

Crashworthiness-Improvement & Design Considerations

- CBC coupler with tight lock & anti climbing features
- Energy absorption capacity 30 KJ in LHB, now being increased to 45 KJ
- **45 KJ provide protection for impact speeds up to 9.5 Kmh**
- **Stainless shell shell for better energy absorption capability**.

Crashworthiness-Improvement & Design Considerations

Design Considerations:

- Managing collision energy
- Collapse & occupants zones
- Buckle imitators
- Anticlimbing
- Train Impact Simulationn