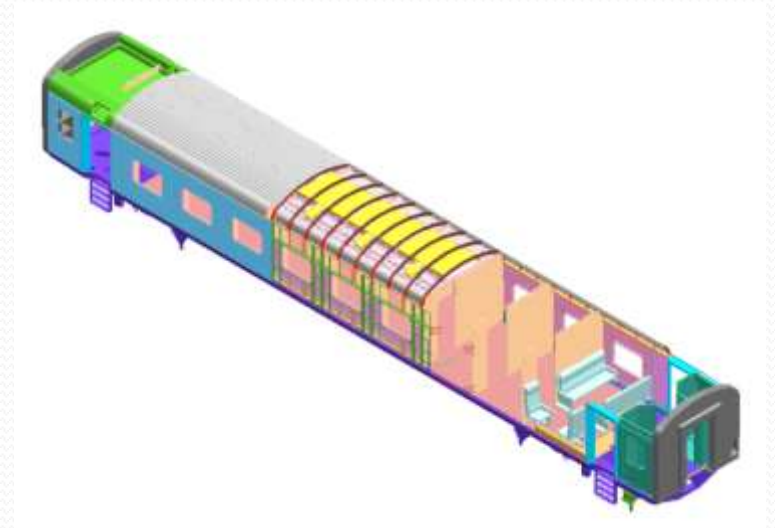


Presentation on LHB Coach Design Features



By : Balwant Singh - SME/Design/RCF

Shotcomings with existing IR Coach technology

Higher Tare weight to pay load ratio.

Proneness to corrosion.

Low availability and reliability due to frequent requirement of maintenance .

Poor Ride comforts.

Restricted operating speed.

Passanger Amenities not modular type.

LHB Coaches Contract

M/s. ALSTOM LHB/Germany
Supplied 24 coaches
consisting of 19. AC chair cars,
2 AC Executive Class Chair cars and
3 Generator cum Brake vans.

The bogies supplied by M/s. FIAT -SIG
Switzerland.

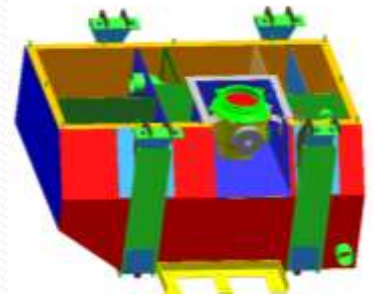


Main design Features of LHB Coach

- **Corrosion Free Coach**
 - Extensive use of Stainless steel and surface protection measures
- **Longer Coach**
 - Longer By Approx. 2.2 Meters than Conventional Coaches.
- **Light Weight Coach**
 - 10% lesser weight per meter length lesser than conventional coach
 - Better Pay to Tare Ratio
- **Higher passenger comfort:**
 - Ride Index 2.5 (Not exceeding 2.75)
- **Suitable To Higher Speed potential –160 kmph**
- **upgradable to 200 Kmph**

Main Features of LHB Coach

- Superior Shell and furnishing Design
 - Complete shell interlocked
- Better Acoustic and Vibration Measures
 - Superior Insulation
 - Damping elements
- Axle Mounted Disc Brakes With WSP
- Centre Buffer Coupler
- Controlled Discharge Toilet Systems,
Now replaced with DRDO
Bio retention tanks filled with
Anerobic Bacteria .



Main Features of LHB Coach

- Auto Closing Sliding Doors
- Wider Windows
- Modular Interiors
- Improved Air Conditioning System with micro processor controlled.
- Use of Fire Retardant Materials .

At a glance comparison of

Weight and passenger carrying Capacity

	No	Weight t	Capacity		Weight t	Capacity
LHB/EOG				ICF/EOG		
FAC	1	43.3	24	FAC	46.2	18
ACCW	4	44.6	52	ACCW	44.8	48
ACCN	7	45.6	72	ACCN	48.3	64
CB	2	40.9	0	CB	47.9	0
WLRRM	2	53	0	WLRRM	60	0
	16	728.7	736		779.3	658

LHB Weighs Less by 50.6 t

Capacity more By 78 passengers

Passenger Concerns



Sound Control Measures – within 65 db Achieved Inside The Passenger Area

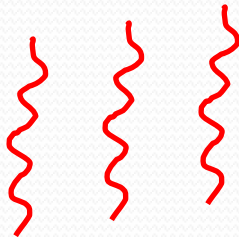
- Sound Insulating Paint
- Rubber D-coupling – Floating Floor
- Sandwich Floor Board - 4mm cork
- Melamine foam Insulation for Ducting
All Round the duct
- Non-Metallic Interiors - FRP
- Sealed Auto closing Vestibule
- No direct opening of lavatories pans.

Passenger Concerns

Vibration Control Measures



- Dampers in Bogies
- Rubber metal bonded parts In bogies
- Floating Floor
- Pillars mounted on Rubber elements
- Non-Metallic Interior -such as FRP
- Higher passenger comfort:
 - Ride Index 2.5 (Not exceeding 2.75)



PASSENGER CONCERNS

Safety Aspects



- **Superior Braking System**
- **Emergency Openable Window**
- **Fire Retardant Materials**
- **Anti Climbing Feature**
- **Fire Alarm System**
- **Proper Coach Earthing**
- **Public Address System**
- **Emergency Accident light**

Passenger Concerns



- Wider windows for Panoramic View
- Screwless Modular interiors

Passenger Concerns

Coach Interior Environment **Thermal Insulation Measures**



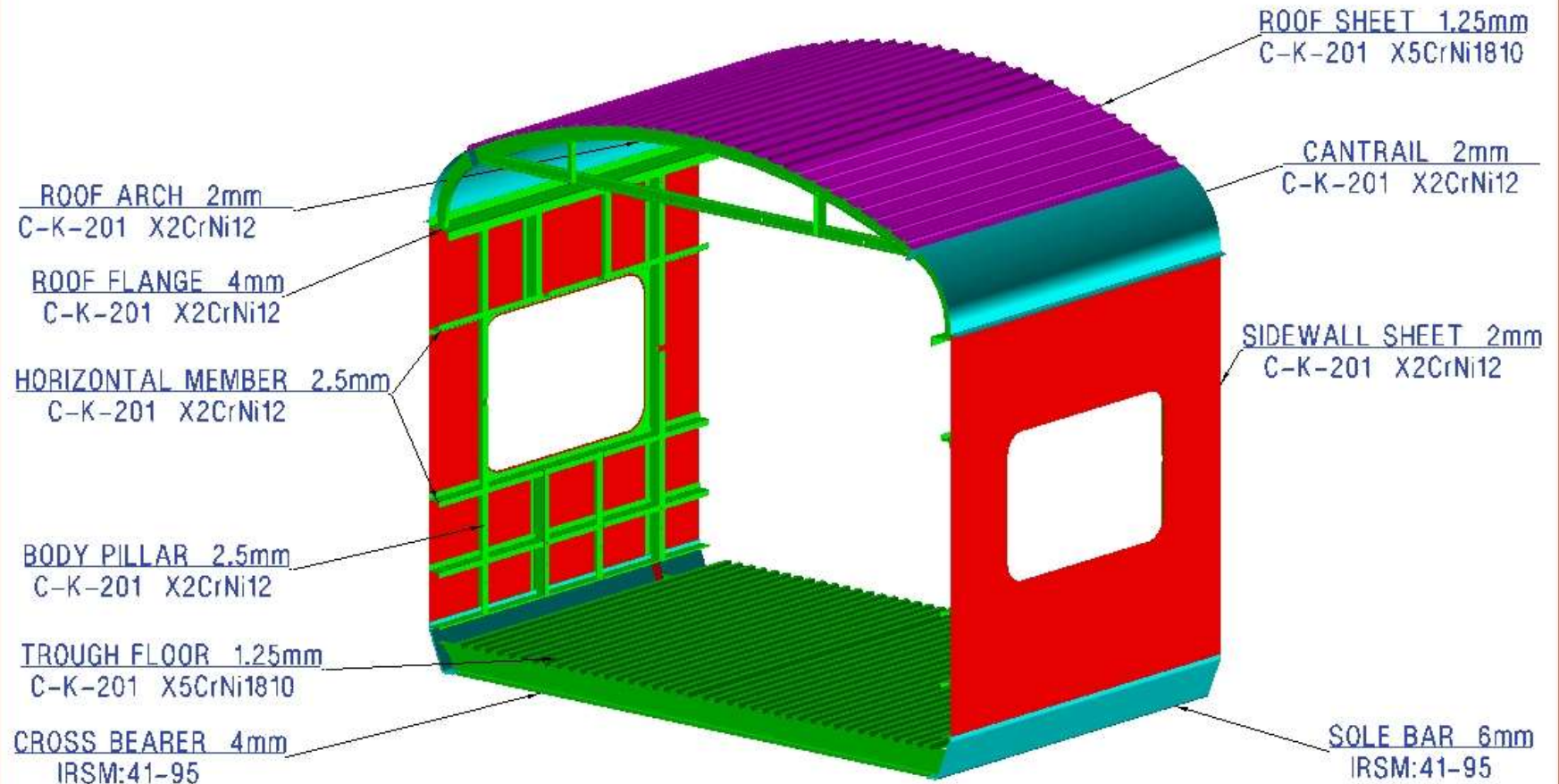
- **Bary Skin V 60 DB**
- **Cork-sandwich floor board**
- **PVB Film in Window**
- **Melamine foam in duct**
- **Phenolic foam in doors**
- **Non metallic interior**
- **Glass wool**

Maintenance Aspects



- Corrosion free
 - Extensive Use Of Stainless Steel
- Better Design Concepts
 - Better rigidity and dimension control
- Reliable Hi-Tech Systems:
 - Axle mounted disc brake system with wheel slide protection device
- Modular units
- Superior Mounting of under slung equipment
 - Fail safe mounting due to interlocked members

Extensive use of Stainless Steel



TFR-ISO WORK

Steels used in LHB Coaches

Shell Sub Assemblies	Steels used and their %age compositions	UTS N/mm ²	Yield Stress N/mm ²
Side wall, End wall and Roof structure	X2 Cr12 Ferritic Steel (C < .03%, Cr 10-12%, Si 1%, Mn 1.5%, Ni 0.3- 1.0 %) -- 409M	450-600	320
Roof sheet and Trough floor	X5 Cr Ni 18 10 Austenitic Steel (C < .07%, Cr 18%, Ni 10 % Si 1%, Mn 2%) --- 304	700-850	235
Underframe	IRS M-41 (C < .01%, Cr .35 -.6%, Ni .2 - .4% Cu .3 - .6% Si .3 - .7%, Mn .25%) – Corten Steel	440-480	320

ANTI TELESCOPIC , LIGHT WEIGHT, HIGH STRENGTH TUBULAR INTEGRAL STAINLESS STEEL SHELL

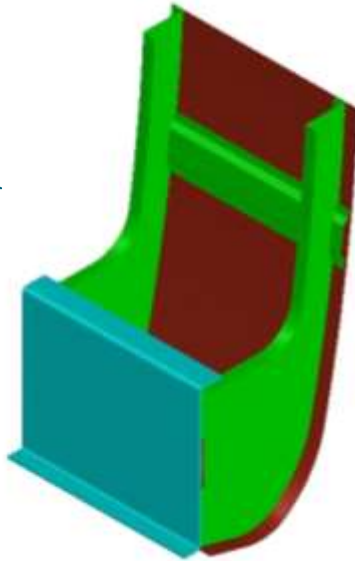


Stainless Steel Shell

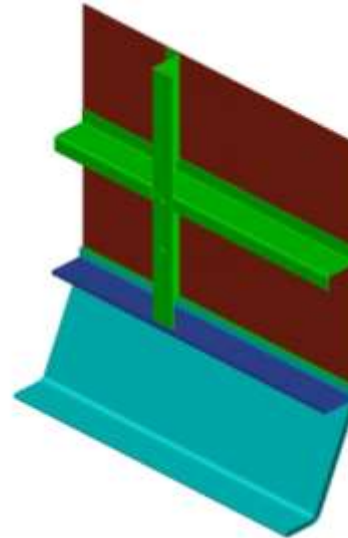
Sole Bar Sidewall Connection

Conventional Design

Body pillar with
turn under



LHB Design

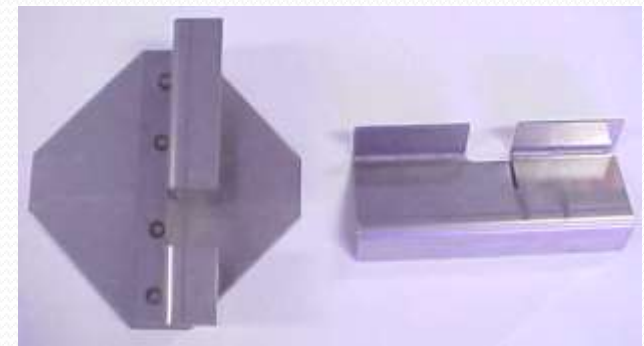
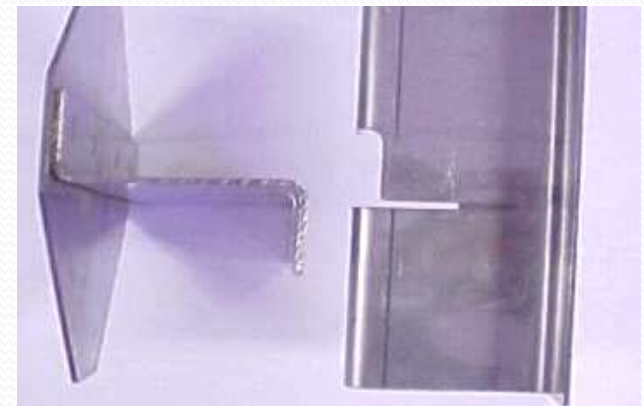


Elimination of pockets

- Turn Under Has Been Eliminated
- Clear Approach For Sand Blasting And Painting
- No Accumulation Of Water And Muck
- Pillar Rests On Solebar As Compared To Load Transfer Through A Vertical Welded Joint In Conv. Coaches

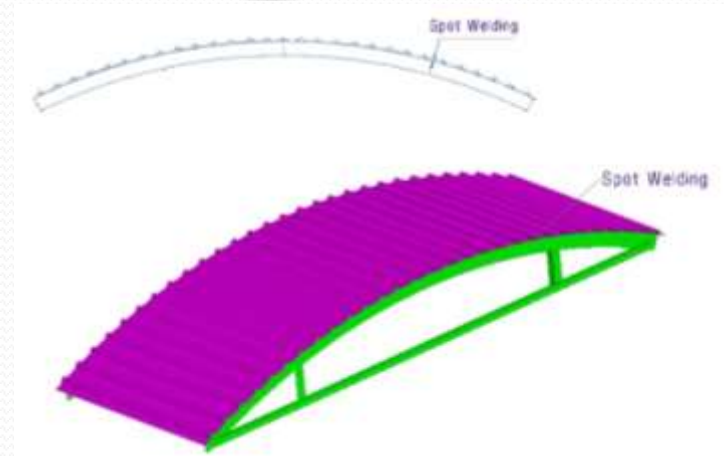
Interlocking of members

- Interlocking between the horizontal and vertical stiffening members of sub-assemblies like sidewall, endwall, underframe, etc.
- Reduction of side wall width from 90 mm to 60mm
- Better geometrical integrity



Roof

- ❑ Corrugated roof sheet spot welded to z-section roof arches
- ❑ Uniform height of arches along its length
- ❑ Roof weighs only about 1000kg
- ❑ Spot welded austenitic steel cladding
- ❑ Pocket free



End Wall

Vertical Z- stiffeners for absorption of accidental loads.

Holes provided in all stiffeners of end wall to reduce weight



End Wall

End wall overhangs
beyond head stock

-Releasing more space
inside

-Reducing space and
hence wind resistance
due to turbulence
between coaches.

-Gap between end walls of two coupled
coaches is 300 mm only



Vestibule Foot Plate



- Vestibule Fall Plate Can take later movement
- Vestibule fall plate can slide and also lift up.
- When fall plate is up, the vestibule door can not be opened more than 150mm

Underframe

Underframe front part is made by joining together head stock and body bolster



UNDERFRAME



Spot welding of austenitic trough floor with cross bearers



Aluminium based weld able primer used for welding Corten steel to SS to prevent bi-metallic corrosion



Underframe



Flooring Support Members
On Underframe



Provision for CBC as well a side
buffer mounting in head stock



Underframe

Water Tank Mounting Bracketts
Welded On The Under Frame



Yaw Damper Bracketts
Welded On The Underframe



Body Shell



- Separate Door Frame
- Easy shell manufacture
- No Camber provided .



Modern Manufacturing Techniques

By : Balwant Singh - SME/Design/RCF

Manufacturing Techniques

- ❑ Laser Profile Cutting Of Component
- ❑ Sidewall/Roof Spot Welding
- ❑ Magnetic Skin Tensioning Of Shell



Manufacturing Techniques

- ❑ Gluing Of Window Frame To Shell Body
- ❑ Use Of MIG/MAG welding with Argon mix (90% Argon, 5% Co₂, 5% O₂) Shielding Gas
- ❑ Robotic Garnet Blasting Of Shell





Superior Insulation

By : Balwant Singh - SME/Design/RCF

Heat Insulation

**GLASS WOOL
ON ROOF AND SIDE WALL
PROVIDE HEAT INSULATION**

-



**GLASS WOOL PADS HELD BY
PINS, WELDED ON THE ROOF**



Sound Insulation Paint

- ❑ “Baryskin v60dB” or eq. Sound insulation PU paints on full coach shell interior, provide anti drumming sound insulation as well as corrosion resistance
- ❑ Coating of 2-3 mm thickness in the coach interior, 6-8 mm in body bolster area
- ❑ Extremely good fire retardant.

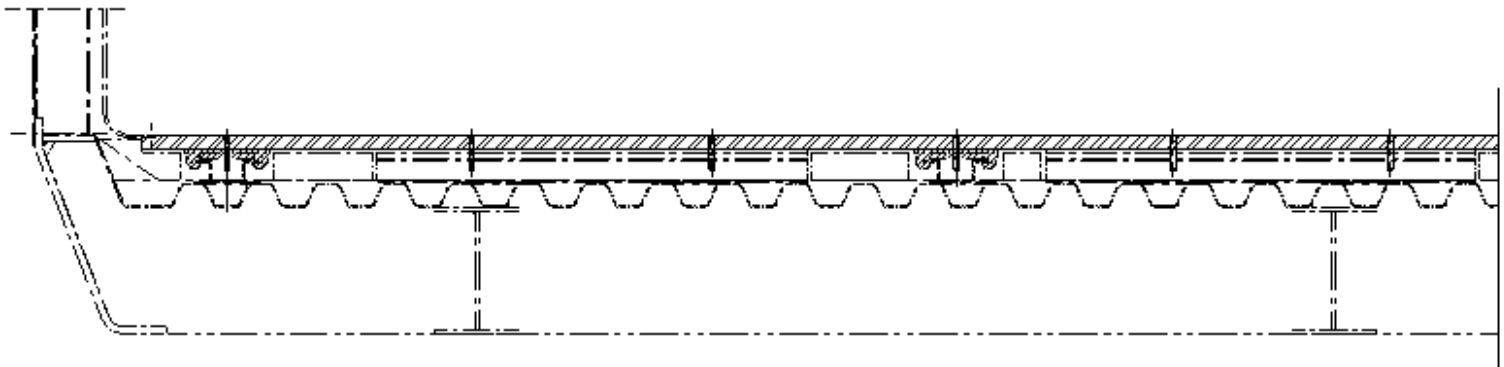
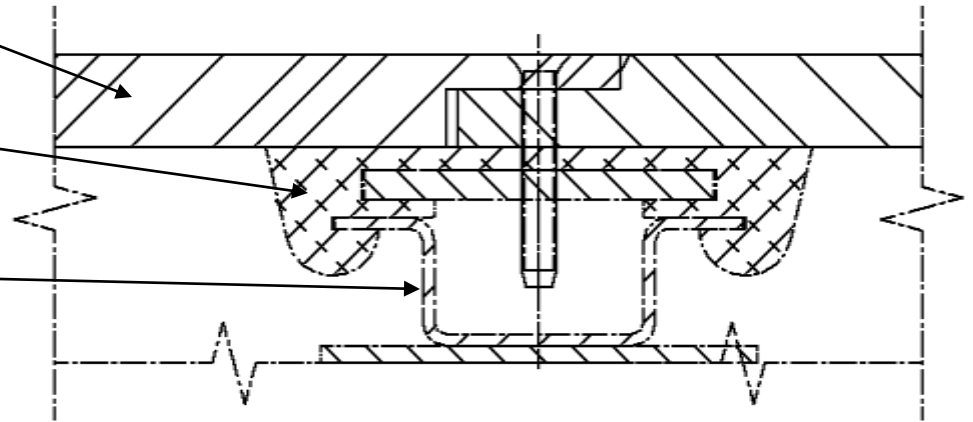


Rubber De-coupling Elements In Flooring

Floor board with sand
wiched cork layer

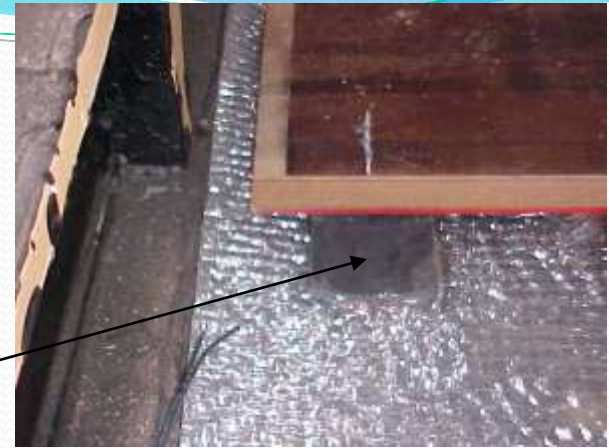
Rubber element

Metallic floor support
member



Rubber De-coupling Elements In Flooring

Flooring boards resting on rubber de-coupling elements



Flooring boards - cork sandwiched between compreg to absorb noise



USE OF COMPOSITE MATERIALS

“ALUCOBOND” LAVATORY CEILING PANEL & ALUMINIUM HONEY COMB PARTITION PANELS

- ❑ IMPROVED AESTHETICS
- ❑ VERY GOOD SURFACE FINISH
- ❑ CORROSION RESISTANCE
- ❑ BETTER RIGIDITY
- ❑ HIGHER STRENGTH TO WEIGHT RATIO



AC DUCT

- Superior 2 tier design
- No loss of cooling air
- Superior thermal insulation
- Better sound dampening
- No direct blast of cool air



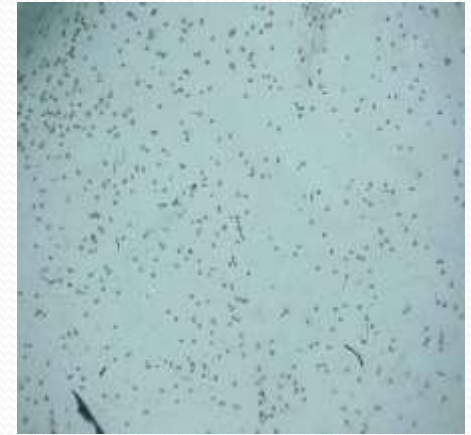
FRP ITEMS

A NO. OF FIRE RETARDANT FRP ITEMS HAVE BEEN USED IN THE INTERIORS FOR:

- IMPROVED AESTHETICS
- ABILITY OF FRP TO BE MOULDED INTO INTRICATE SHAPES/CURVED SURFACES, AVOID JOINTS
- BETTER STRENGTH TO WT RATIO
- SCRATCH RESISTANCE
- RESILIENCE TO SMALL DENTS
- EASY REPAIRABILITY
- NO VISIBLE SCREWS
- BETTER MAINTAINABILITY
- NO PROBLEM OF CORROSION



CORUNDUM GRAINS IN FRP RESIN FLOOR IN LAV FOR ANTI-SLIP PROPERTIES AND WEAR RESISTANCE



BRACKETS FOR MOUNTING LIGHT FITTINGS



Window Glass unit characteristics

- **Aluminum frame glued to car body**
- **Window glass secured by rubber profiles**
- **8.4 mm outer laminated and 4 mm tempered inner glass with 6 mm Argon gas filling**
- **Thermal conductivity not more than 1.6 W/M2K**
- **Transparency more than 39 %**
- **Reflection more than 40**
- **Total energy absorption less than 21%**



Emergency open able window



- Four units are provided each coach to allow emergency evacuation of passengers
- A handle connected to the rubber profile opens the glass unit of the emergency window



HOPPER WINDOW FOR LAVATOTRY

Luggage rack (Chair Car)

- Made from aluminium extrusions lengths and tempered safety glass
- Can with stand distributed load of 1000 N (100 kgs) per meter length and pint load of 850 N (85 Kgs) as per UIC 566.
- Halogen reading lights, for individual seats, fitted into outer extrusion and wiring hidden by polycarbonate cover
- Provided with movable coat hooks





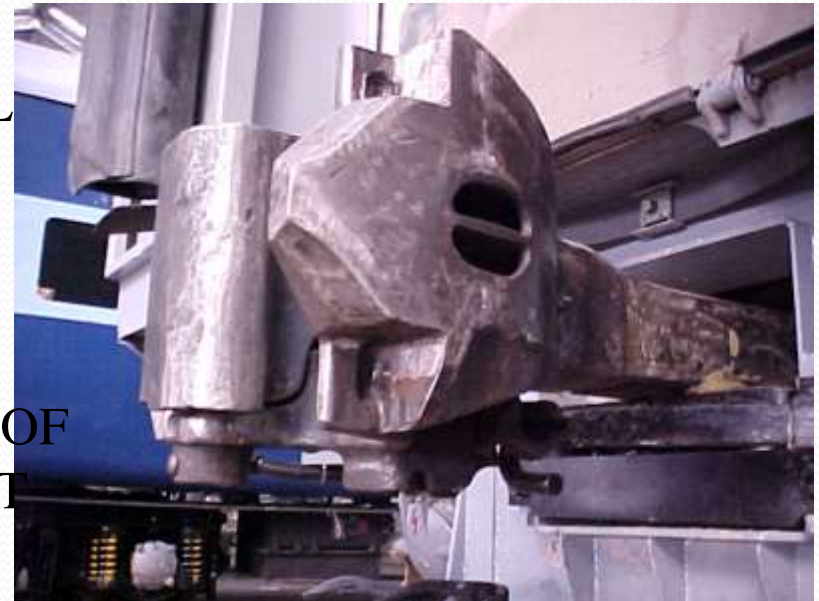
SAFER DUE TO CBC

LHB COACHES HAVE BEEN PROVIDED WITH TIGHT LOCK CENTRE BUFFER COUPLERS INSTEAD OF SCREW COUPLING.

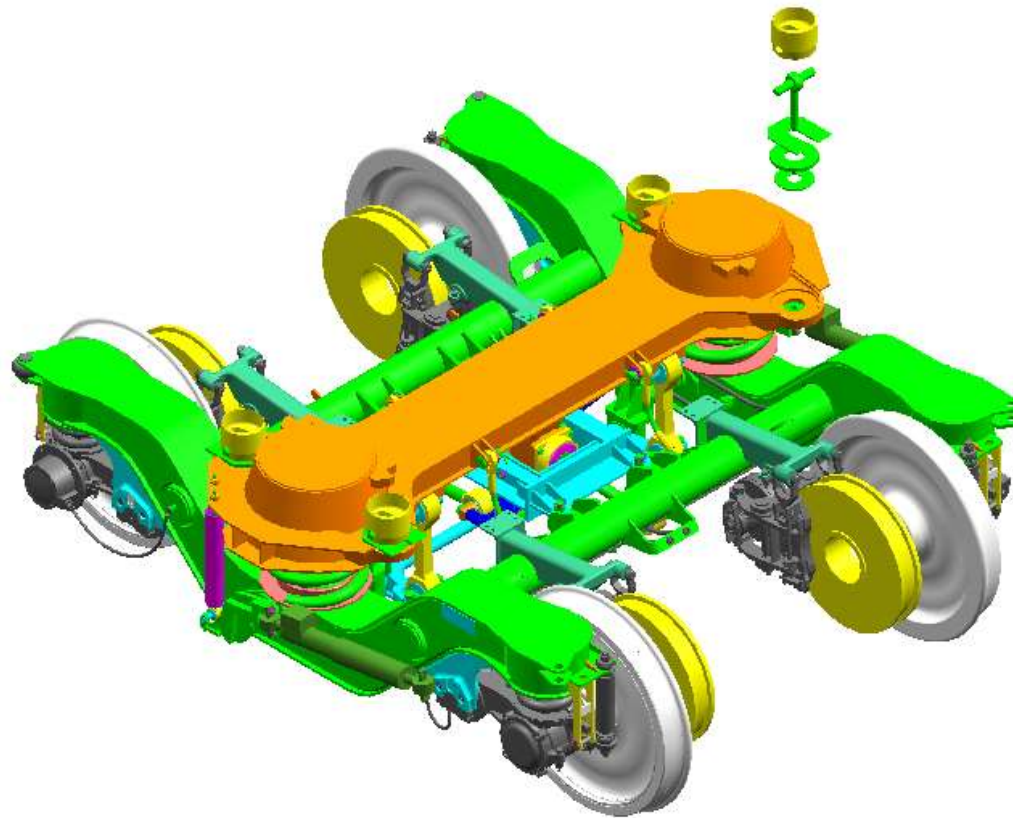
COUPLERS ARE AAR H-TYPE FEATURES BECAUSE OF VERTICAL

COUPLERS HAVE ADEQUATE STRENGTH FOR THE FOLLOWING:

- SATISFACTORY HAULING OF A TRAIN OF 26 COACHES AT 110 KMPH
- SATISFACTORY HAULING OF A TRAIN OF 18 COACHES AT 160 KMPH



FIAT BOGIE



TFR-ISO WORK

By : Balwant Singh - SME/Design/RCF



THANK YOU

Summary Of Steels Used In SS Coaches

MATERIAL	THICKNESS	WEIGHT in kg
Austenitic Steel	1.25 mm	1380
Total		1380
Ferritic Steel	2 mm	2800
-do-	3 mm	300
-do-	4 mm	60
Total		3160
Corten Steel	4 mm	725
-do-	6 mm	2000
-do-	8 mm	600
-do-	10 mm	200
Total		3525
Grand Total		8065

Stainless steel pipes: 10/12/15/18/22/28 mm - 385m
 (DIN2391-C- DIN17456 Grade 1.4301 X5CrNi 18 10)

Details of SS used in Stainless Steel coach

Main Assembly	Application area	Steels used	Thickness	Qty of finished product
Side wall	Side wall sheets	X2 CrNi 12 Ferritic Steel	2 mm	979 kg
	Vertical pillars	-do-	2 mm	425 kg
	Horizontal member	-do-	2 mm	288 kg
	Roof flange	-do-	2 mm	270 kg
Roof	Roof sheet	X5 CrNi 18 10 Austenitic Steel	1.25 mm	654 kg
	Carlines	X2 CrNi 12 Ferritic Steel	2 mm	160 kg
	End parts	-do-	2 mm	380 kg
	Final roof arch	-do-	4 mm	56 kg
End wall	End wall sheets	-do-	2/3 mm	98 kg
	End wall frames	-do-	2/2.5/3/4/6/10 mm	260 kg
U/frame	Trough floor	X5 CrNi 18 10 Austenitic Steel	1.25 mm	680 kg
	Sole bar	IRS M41 Corten steel	6 mm	645 kg
	Cross bearers	-do-	4 mm	645 kg
	Body bolster	-do-	6 mm	750 kg
	Head stock	-do-	4/6/8 mm	1280 kg
	Coupler carrier/Center sill	-do-	10 mm	200 kg
Vendor supplied items	Water tanks	SS 316 Ti	2 mm	300 kg
	Roof ventilators	X5 CrNi 18 10 Austenitic Steel	1.25 mm	49 kg

ACCZ

ACCW

FAC