DESIGN OF

LHB SHELL

CAR BODY SHELL

DESIGN FEATURES

1. LIGHT WEIGHT
2. SPEED : OPERATIONAL SPEED = 160 KMPH

   TEST SPEED = 180 KMPH
3. DIMENSIONS :

TRACK GAUGE : 1676 mm

OVERALL MOVING DIMENSIONS AS PER RDSO DRAWING NO. EDO 590

DIMENSIONS RELATED TO S.O.D. – 1939

SHARPEST CURVE – 175 MTRS. RADIUS

SUPER ELEVATION - 165 mm

CLEARANCE ABOVE RAIL LEVEL – 102 mm

BODY SHELL

THE BODY SHELL BE OF INTEGRAL LIGHT WEIGHT
CONSTRUCTION CONSISTING OF SEPARATE ASSEMBLY GROUPS FOR U/F, SW, ROOF & END WALL.

WHOLE CAR BODY SHELL CONSISTS OF THREE TYPES OF STEEL.

THE INDIVIDUAL ASSEMBLIES ARE JOINED TO EACH OTHER BY WELDING

OVERALL DIMENSIONS OF THE COACH

A	LENGTH OVER BODY	23540 mm
B	BUFFER CENTRES	1956 mm
C	MAXIMUM WIDTH OVER BODY	3250 mm
D	HEIGHT OF CENTRES OF COUPLER FROM RAIL LEVEL	1105 mm
E	HEIGHT OF COMPT. FLOOR FROM RAIL LEVEL	1303 mm
F	MAX. DIST. BETWEEN INNER WHEELS	12345 mm
G	MAX. HEIGHT OF CENTRES OF BUFFERS ABOVE RAIL LEVEL	1105 mm

TYPES OF STEELS USED IN LHB SHELL

S. No.	TYPE OF STEEL	APPLICATION
1.	1.4301(Austenitic) 1.25 mm X5 Cr Ni 18 10	Trough floor & roof sheet
2.	1.4003(Ferritic) Carline –2mm. Roof beam -2mm. Side wall -2mm. Window Sill -2.5mm. Body Pillar -2.5mm. Cant Rail - 4mm.	Restructure including carlines, roofbeam, body pillar, end wall structure, side wall sheets, etc.
3.	Corten-A	All Parts of under frame except trough floor including Sole Bar.

SIDEWALL

- TIG WELDING OR LASER WELDING OF SIDEWALL SHEETS
  - LOW HEAT INPUT
  - LESS DISTORTION
  - NEGLIGIBLE SHRINKAGE

SIDE WALL

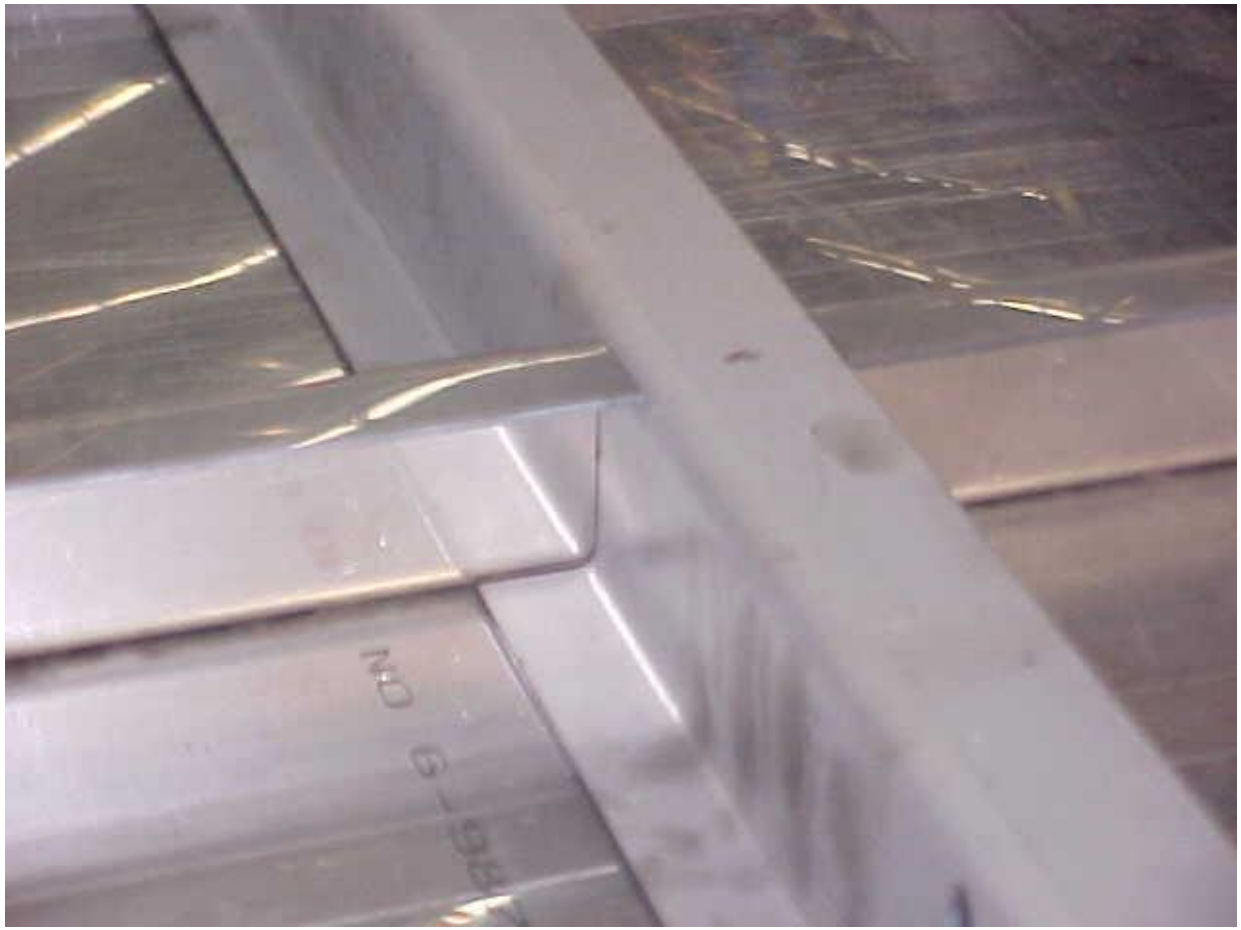
THICKNESS OF SIDE WALL : 2mm

LASER CUT, BUTT JOINT TIG WELDING OR LASER WELDING, SPOT WELDING

DOOR FRAMES IS A PART OF SUB ASSEMBLY OF SIDE WALL, BUT FABRICATED SEPERATELY

THICKNESS OF DOOR FRAME : 4mm

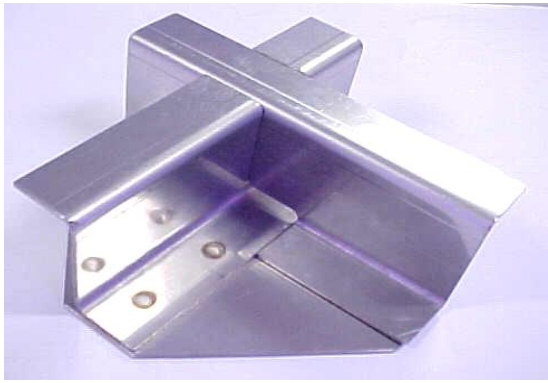
DOOR FRAMES ARE DESIGNED IN A MANNER TO ENABLE THE COMPENSATION OF TOLERANCES IN WHOLE SIDE WALL

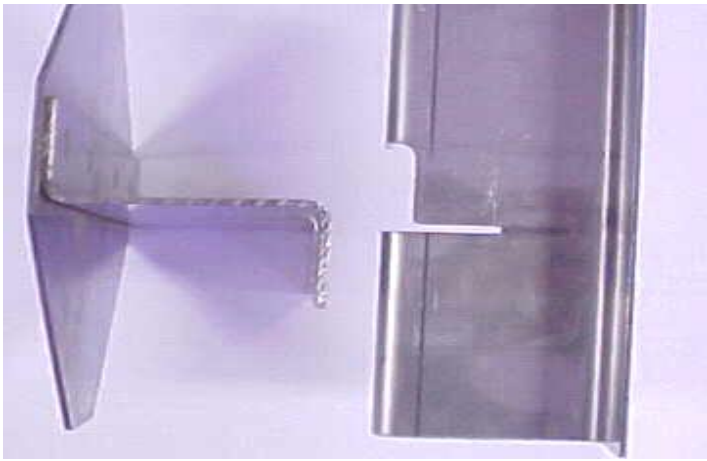


- POSITIVE INTERLOCKING BETWEEN ALL HORIZONTAL AND VERTICAL MEMBERS
  - •BETTER STRENGTH,
  - • REDUCTION OF SIDE WALL THICKNESS TO 60MM FROM 90 MM,
  - • BETTER GEOMETRICAL INTEGRITY

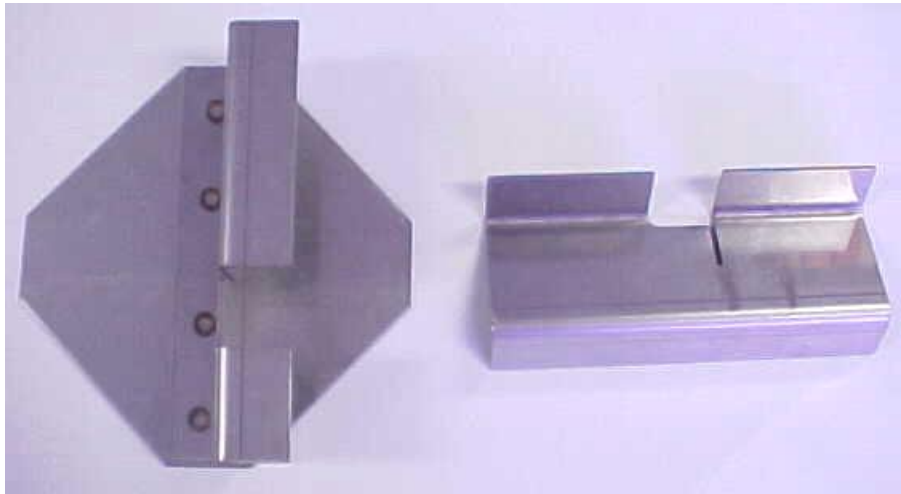
Sidewall-Interlocking

- Interlocking between the horizontal and vertical stiffening members of sub-assemblies like sidewall, endwall, underframe, etc.





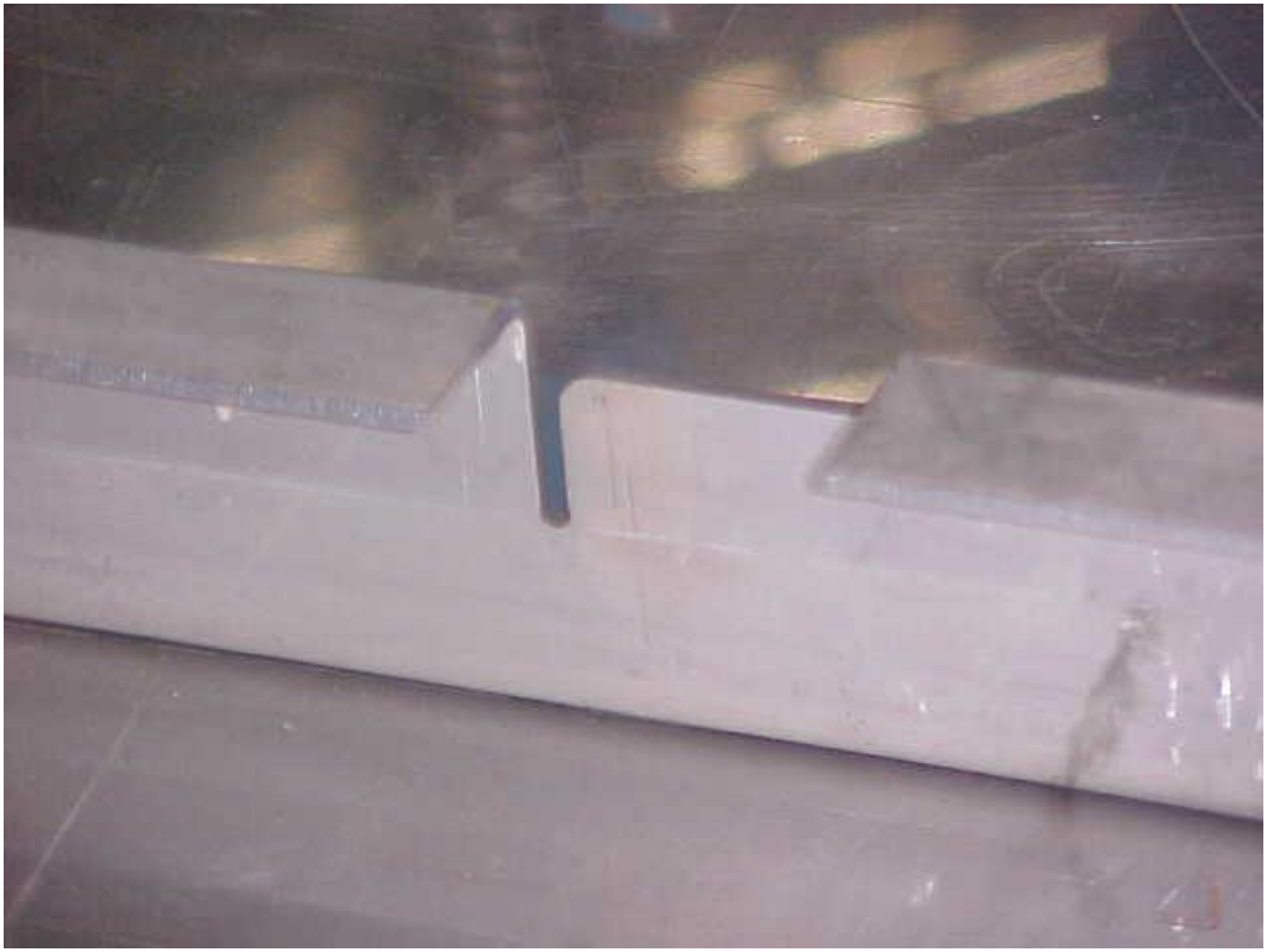
- Aligned stress flow
  - Better strength



- Reduction of side wall width from 90 mm to 60mm

SITUATION BEFORE INTERLOCKING TECHNIQUE

IN THE PAST, A LOT OF ROLLED PROFILES HAVE BEEN USED IN FRAME WORK OF SIDE WALL, END WALL AND UNDER FRAME, WHICH RESULTS A LOT OF WELD JOINTS, STRAIGHTENING AND REWORKING. THIS CAUSED A QUALITY REDUCTION AND INCREASE OF COST.



CUT PROVIDED IN S/W MEMBER FOR INTERLOCKING

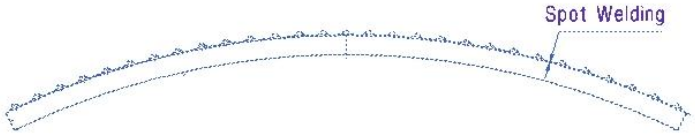
COMPLETE SIDEWALL

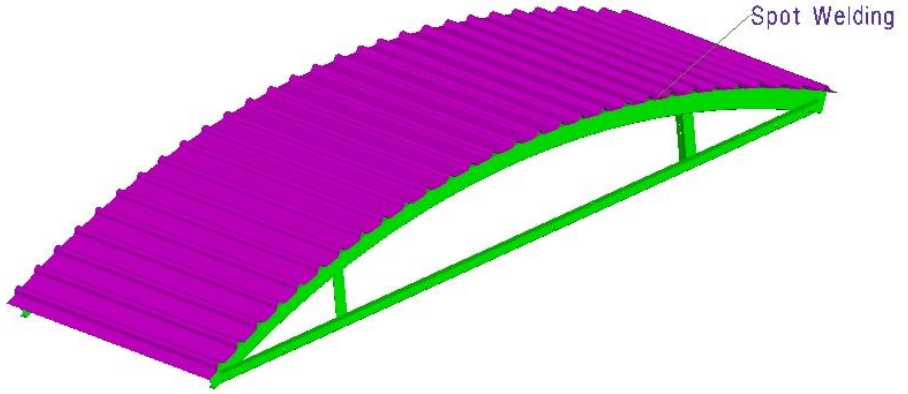
•CARLINE (CANT RAIL IN CONV. COACHES) IS PART OF THE SIDE WALL, UNLIKE CONV. COACHES WHERE IT IS A PART OF ROOF

- •BETTER RIGIDITY OF SIDE WALL
- •POSITIVE LOCATION OF ROOF

Roof

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



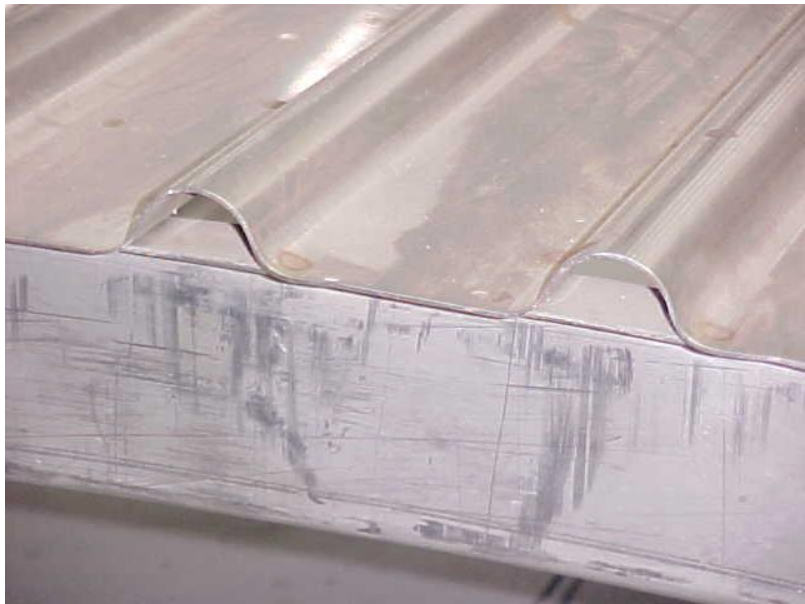


END WALL

HOLES PROVIDED IN ALL STIFFENERS OF END WALL TO REDUCE WEIGHT

ROOF

- CORRUGATED ROOF SHEET SPOT WELDED TO Z-SECTION ROOF ARCHES
- UNIFORM HEIGHT OF ARCHES ALONG IT'S LENGTH
- ROOF WEIGHS ONLY ABOUT 1000KG



ROOF

- **MIDDLE PART:**
- CORRUGATED SHEET 1.25 mm THICK AUSTENITIC STAINLESS STEEL
- # ROOF ARCHES : Z SECTION 30x80x30x2
- # HORIZONTAL CROSS BRACES : Z SECTION 30x50x30x2
- **END PARTS :** THESE ARE PREPARED FOR MATCHING THE TAPERING AT ENDS

UNDERFRAME

UNDERFRAME FRONT PART IS MADE BY JOINING TOGETHER HEAD STOCK…

…AND BODY BOLSTER

UNDER FRAME

MAIN COMPONENTS OF UNDER FRAME

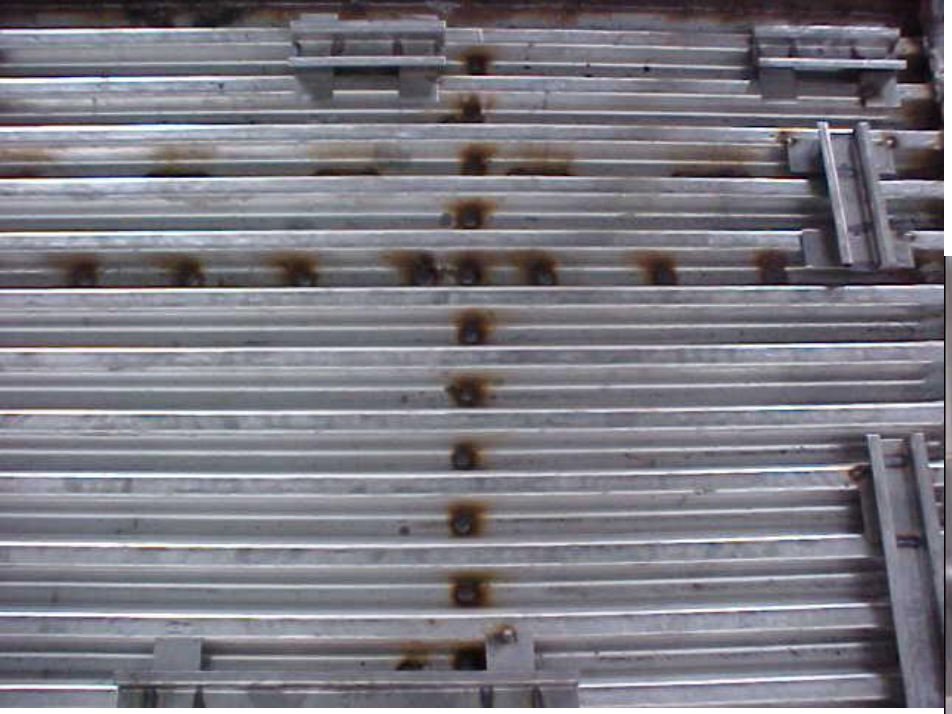
TWO SIDE SILS (SOLE BAR) W SECTION 220x65x8

TWO MAIN CROSS MEMBERS - BOX TYPE 6 mm THICK SITUATED IN A REGION OF BOGIES

FRAME WORK – CROSS MEMBERS MADE OF FOLDED CHANNEL SECTIONS 140x50x4 FORM THE MAIN PART OF THE FRAME WORK OF U/F

FRONT PART – IT IS HEAD STOCKS CONSISTS OF SHEETS WITH THICKNESS OF 10mm, 6mm & 4mm

FLOOR – IT CONSISTS OF CORRUGATED SHEETS OF 1.25 mm THICK



•UNDER FRAME CORRUGATED TROUGH FLOOR IS PLUG WELDED FROM TOP WITH THE CROSS MEMBERS

•ALUMINIUM BASED WELDABLE PRIMER USED FOR WELDING CORTEN STEEL TO SS TO PREVENT BI-METALLIC CORROSION

PROVISION FOR CBC AS WELL A SIDE BUFFER MOUNTING IN HEAD STOCK

FLOORING SUPPORT MEMBERS ON UNDERFRAME

WATER TANK MOUNTING BRACKETS WELDED ON THE UNDER FRAME

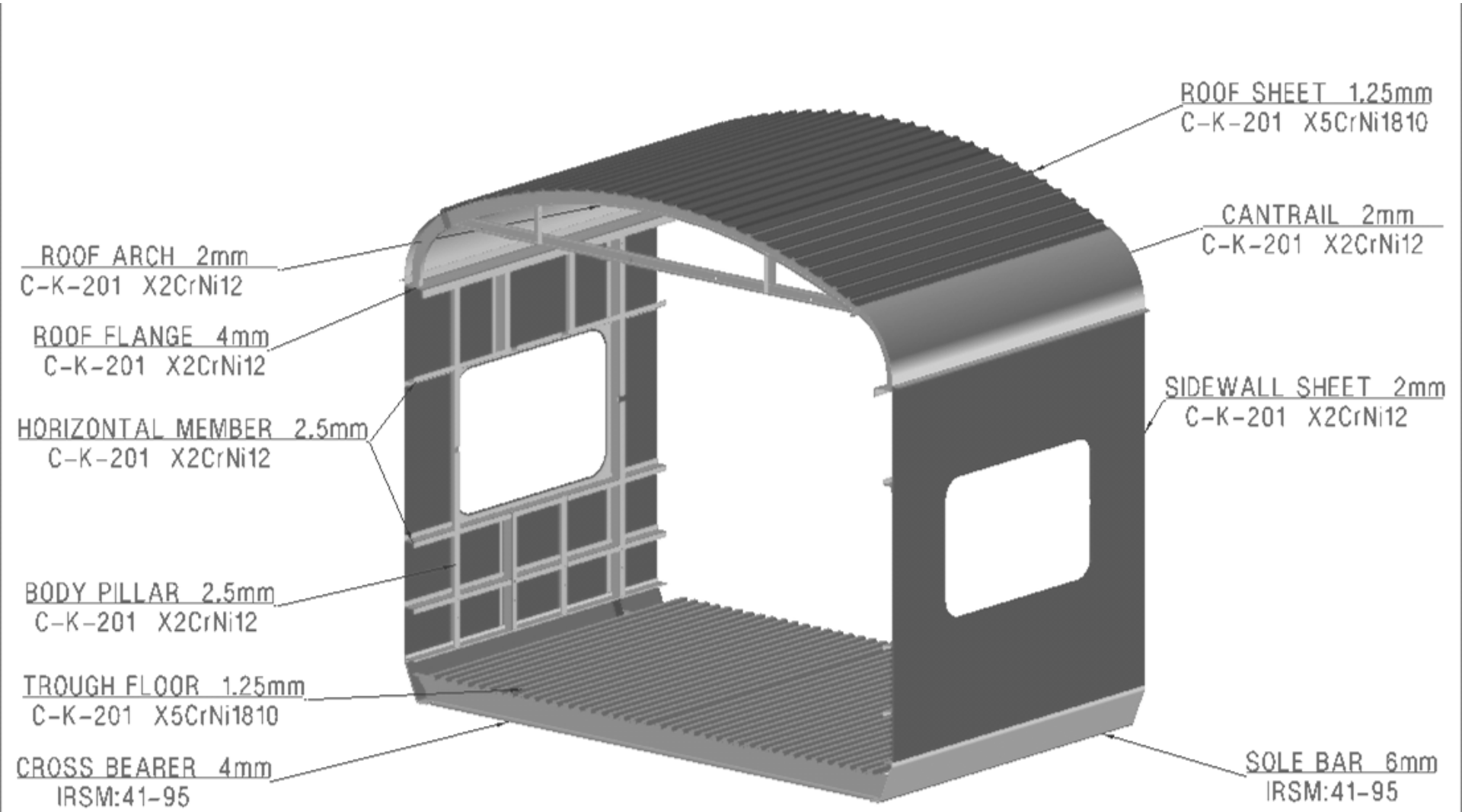
YAW DAMPER (CONNECTED BETWEEN UNDERFRAME AND BOGIE FRAME) BRACKETS WELDED ON THE UNDERFRAME

Steels used in LHB Coach Shell

Shell Assemblies	Steels used and their %age compositions	UTS N/mm^2	Yield Stress N/mm^2
Side wall, End wall and Roof structure	X2 Cr8 Ferritic Steel (SS 409M) (C < .03%, Cr 10-12%, Si 1%, Mn 1.5%)	450-600	320
Roof sheet and Trough floor	X5 CrNi 18 10 Austenitic Steel (SS 304) (C < .07%, Cr 18%, Ni 10 % Si 1%, Mn 2%)	700-850	235
Underframe	IRS M-41 / CortenSteel (C < .01%, Cr .35 -.6%, Ni .2 - .4% Cu .3 - .6% Si .3 - .7%, Mn .25%)	440-480	320

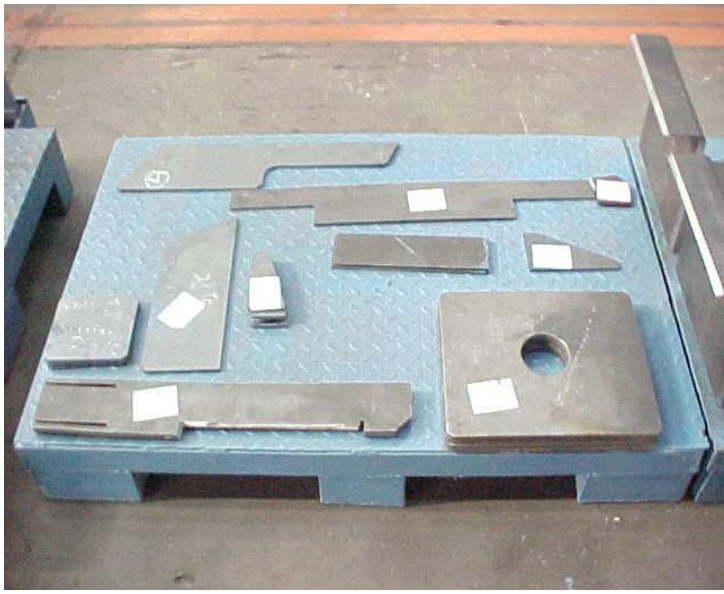
SS 409M is a modified version of SS 409 offering higher strength abrassion resistance and weldability

Shell structure



Manufacturing Techniques

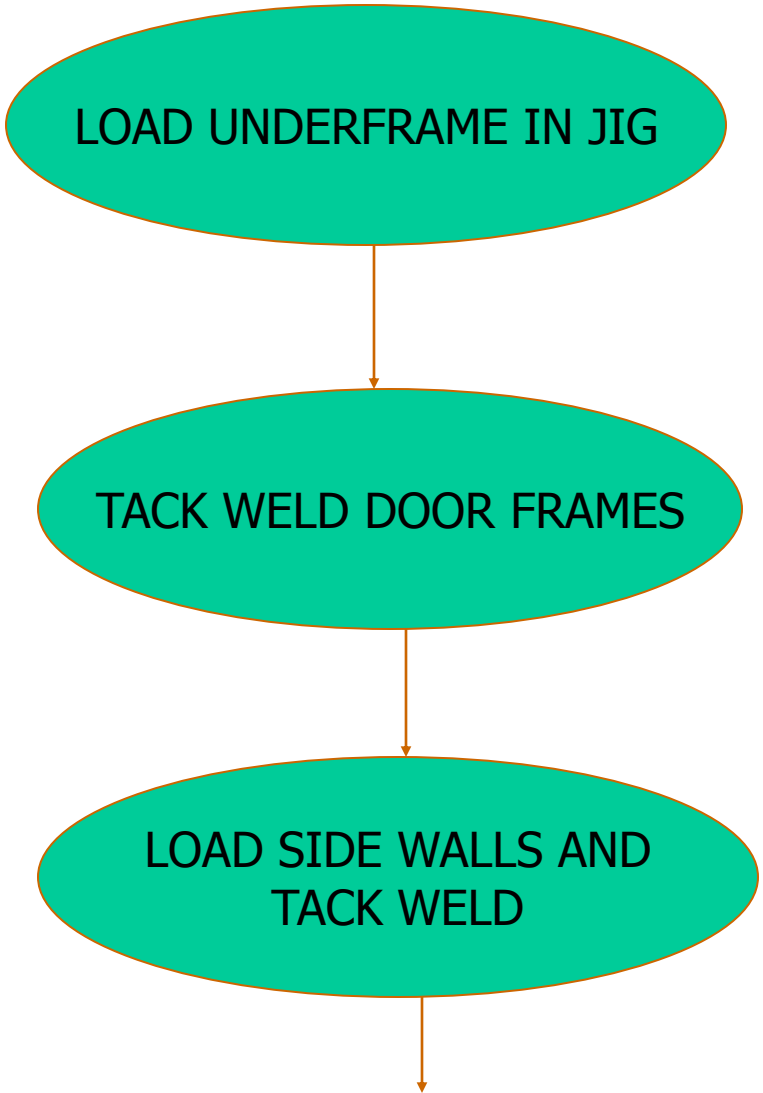
- Laser Profile Cutting Of Components
- Sidewall/Roof Spot Welding
- Magnetic Skin Tensioning Of Shell

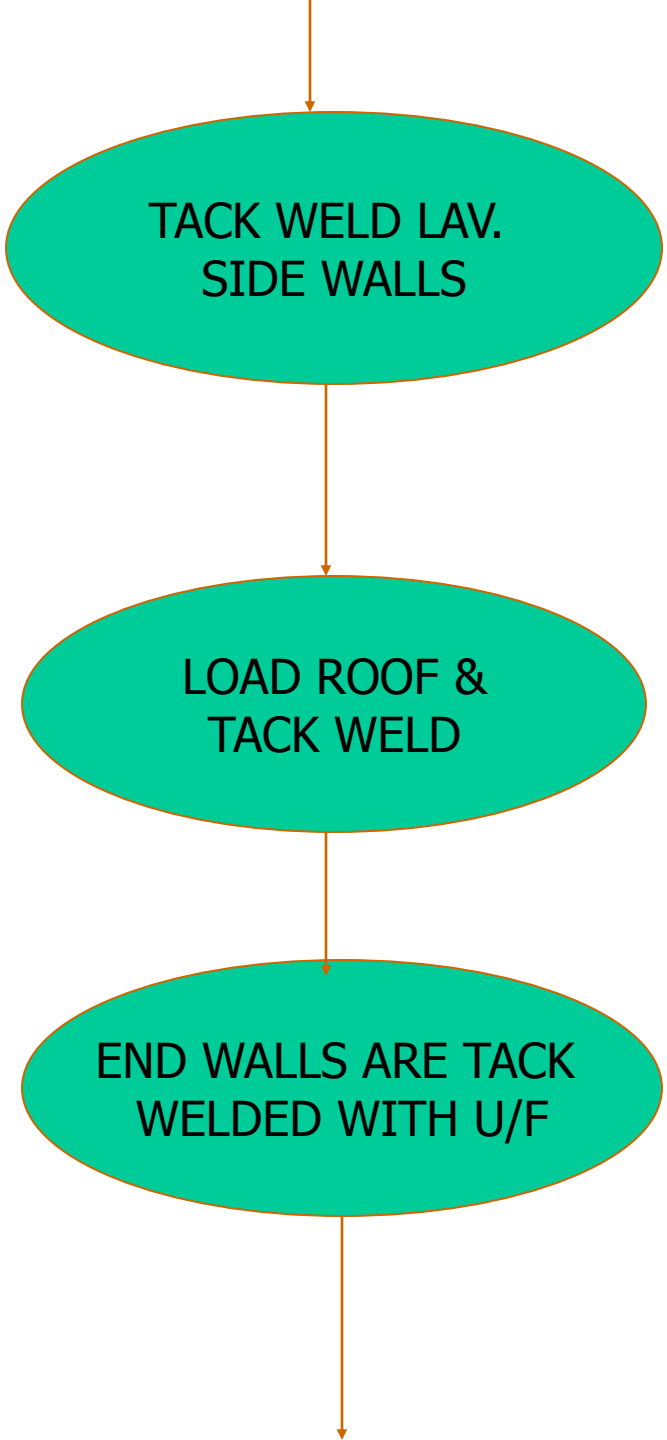


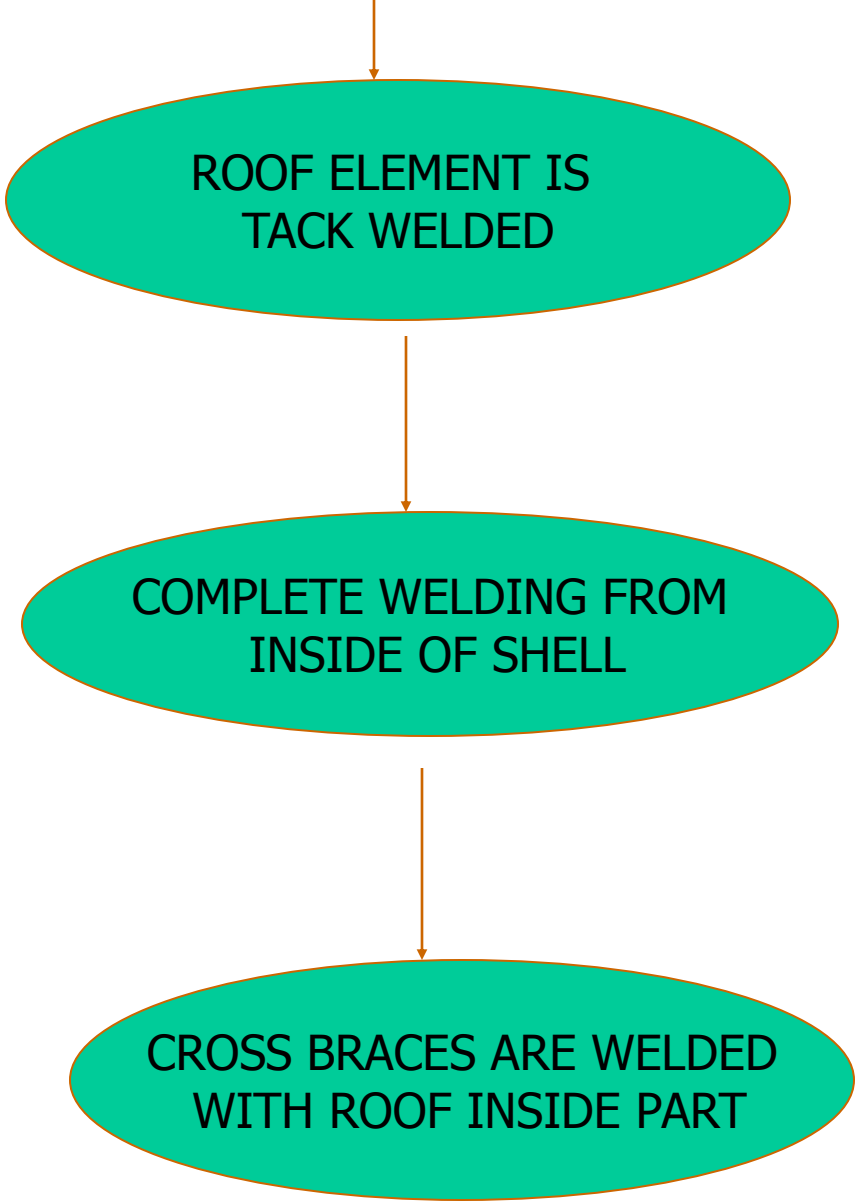
JIGS & FIXTURES

S.NO.	*DESCRIPTION*
1.	*BODY SHELL ASSEMBLY JIG*

PROCESS CHART
STAGE 1




TACK WELD LAV.
SIDE WALLS
LOAD ROOF &
TACK WELD
END WALLS ARE TACK
WELDED WITH U/F

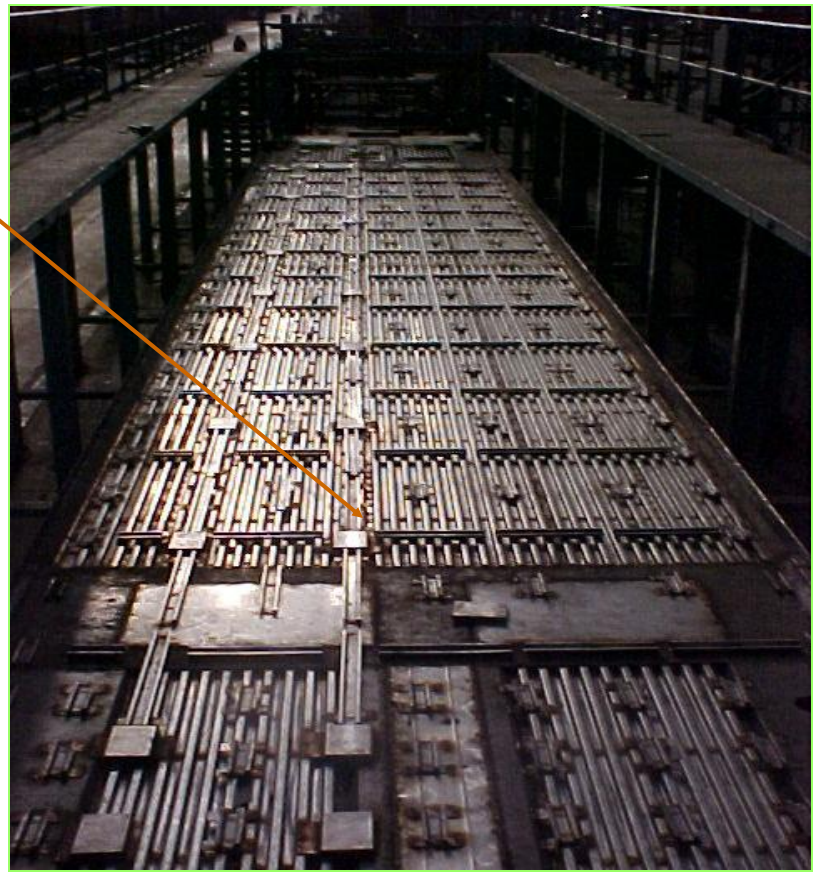

ROOF ELEMENT IS
TACK WELDED
COMPLETE WELDING FROM
INSIDE OF SHELL
CROSS BRACES ARE WELDED
WITH ROOF INSIDE PART

PROCESS

STAGE -1

CONTD…

1. *CLEAN THE JIG FROM SPATTERS AND LOAD UNDER FRAME ON IT. CENTRE THE UNDERFRAME AND CLAMP IT.*



CONTD…

2. DOOR FRAMES ON ONE SIDE ARE LOADED AND TACK WELDED.

CONTD…

3. SIDE WALLS ARE LOADED IN THE JIG ON BOTH SIDES AND TACK WELDED. INTERNAL DIMENSIONS ARE MAINTAINED.

CONTD…

4. AGAIN DOOR FRAMES ARE LOADED ON THE OTHER END OF UNDERFRAME. TIE RODS ARE USED TO MAINTAIN THE INTERNAL DIMENSIONS.

CONTD…

5. *LAVATORY SIDE WALLS ARE LOADED AND TACK WELDED WITH UNDERFRAME AND DOOR FRAMES.*

CONTD…

6. *ROOF IS MOUNTED OVER SIDE WALLS AND TACK WELDED.*

CONTD…

7. *END WALL ASSEMBLIES ARE LOADED ON THE HEAD STOCK OF THE UNDER FRAME AND TACK WELDED.*

CONTD…

8. *ROOF ELEMENT IS LOADED OVER LAV. SIDE WALLS ON BOTH SIDES AND TACK WELDED. IT IS USED FOR FITTING OF AIR CONDITIONER ASSEMBLY.*

CONTD…

9. COMPLETE WELDING OF FOLLOWING PARTS IS DONE FROM INSIDE.

(i) ROOF WITH SIDE WALL.

(ii) SIDE WALL WITH UNDERFRAME.

(iii) SIDE WALL WITH DOOR FRAME.

(iv) LAV. SIDE WALL WITH END WALL.

(v) ROOF ELEMENT WITH DOOR FRAME.

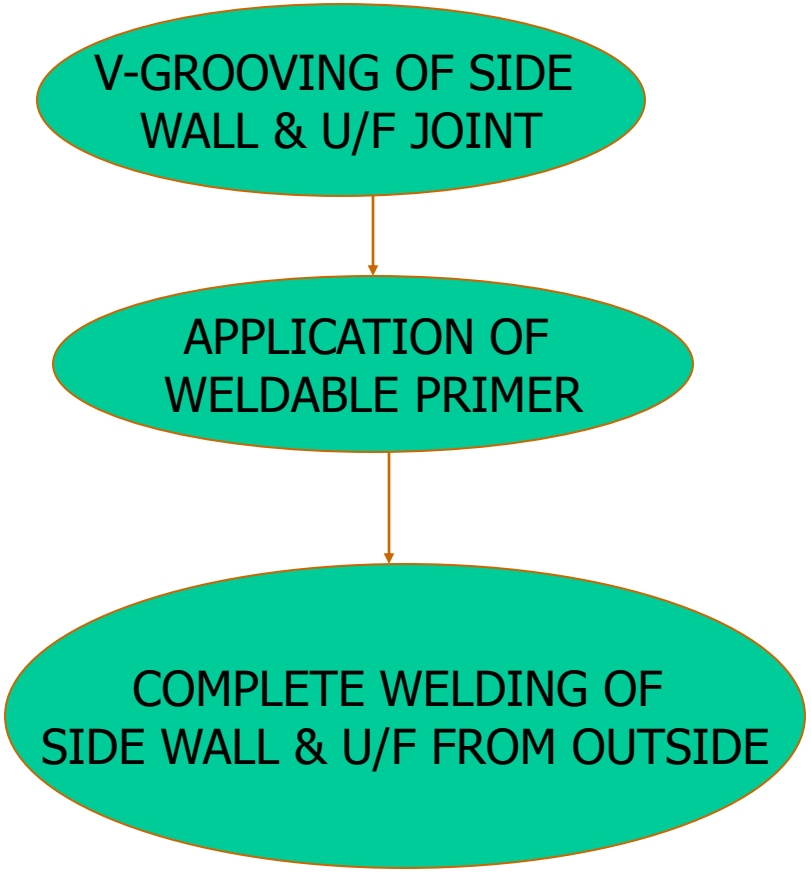
(vi) UNDERFRAME WITH END WALL.

CONTD…

10. CROSS BRACES ARE WELDED WITH ROOF INSIDE SHELL FOR AIR CONDITIONER'S DUCT. THEN THE SHELL IS MOVED TO STAGE 2.


STAGE II

PROCESS CHART
STAGE 2



1. *V- GROOVING OF UNDERFRAME SOLE BAR WITH SIDE WALL JOINT IS DONE FROM OUTSIDE THE SHELL BY USING ANGLE GRINDER ON BOTH SIDES OF SHELL.*
2. *'META COT 'SILVER GREY WELDABLE PRIMER IS APPLIED TO AVOID BIMETALLIC CORROSION.*

CONTD….

3. SOLE BAR AND SIDE WALL ARE WELDED FROM EXTERIOR OF SHELL USING MAGNETIC TRACK WELDING MACHINE.

4. GRINDING OF WELDED JOINTS OF SOLE BAR AND SIDE WALL IS DONE.

WELDING JOINT

WELDING PARAMETER FOR MAG CO2 WELDING

MAT. THICKN-ESS	NO. OF LAYERS	WIRE DIA mm	WELDING CURRENT (AMP)	ARC VOLTAGE	WIRE FEED M/MIN	TRAVEL SPEED CM/MIN	THROAT THICKN-ESS (a mm)
1.6*1.6	1	0.8	100-120	22-24	5.0	50	1.2
2.0*2.0	1	0.8	100-120	22-24	5.0	45	1.6
2.0*5.0	1	1.2	100-120	22-24	5.0	45	2.5
5.0*5.0	1	1.2	200-220	26-27	6.5	40	3.2

STAGEWISE ACTIVITIES OF SHELL ASSEMBLY

SAS-I

ACTIVITIES :- CLAMPING OF U/F BY CLAMPS.

ALIGN WITH PIANO WIRE AT THREE LOCATIONS

LOADING OF 5 INTERNAL JIGGING FRAME

DOOR FRAME FITMENT

MIDDLE SIDE WALL FITMENT

TACKING OF SIDE WALL SHEET TO U/F FLANGE

STRAIGHTNESS IS CHECKED WITH PIANO WIRE

PLACEMENT OF ROOF

ROOF CROSS BRACES FITMENT

PLACEMENT OF FINAL ROOF ELEMENT

END WALL FITTING

STAGES OF SHELL ASSEMBLY

SAS-II

WELDING OF SIDE WALL WITH SOLEBAR BOTH SIDES FROM OUTSIDE WITH TRACTOR WELDING. GRINDING OF ALL THE HORIZONTAL & VERTICAL WELDING JOINTS FOR PROPER OUTER FINISH

STAGES OF SHELL ASSEMBLY

- **SAS-III**
- SENDER GRINDING TO REMOVE HIGH SPOTS
- COLD STRAIGHTENING THE SIDE WALL & END WALL
- SKIN TENSIONING BY HEATING OF SIDE WALL FROM INSIDE THROUGH PERFORATED PLATE HOLES WITH MULTI HEAD TORCH BY USING OXY ACETYLENE SET.
- CHECK THE SURFACE FINISH BEFORE & AFTER SKIN TENSIONING.
- PIN WELDING ON ROOF (660 Nos) BY PIN WELDING MACHINE TO HOLD GLASS WOOL.

STAGES OF SHELL ASSEMBLY

SAS-IV

FITTING OF PARTITION FRAME WHERE REQUIRED

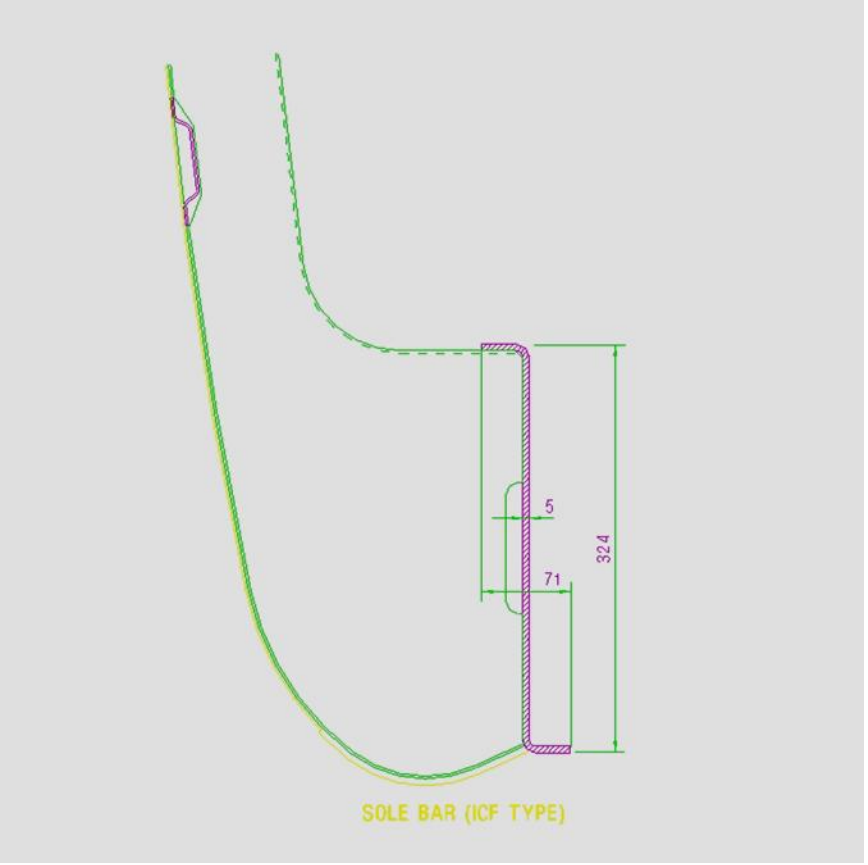
WELDING PARTS CAR BODY SHELL PP END & NPP END

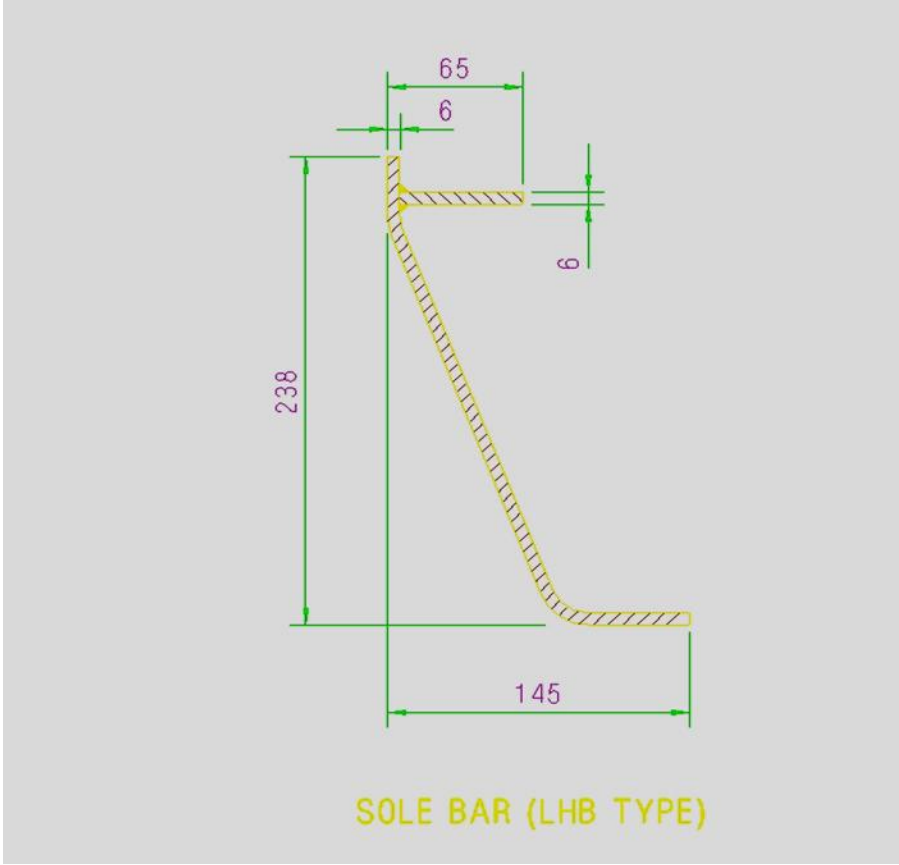
CBC FITMENT

STAGES OF SHELL ASSEMBLY

- CHECKING & INSPECTION
- # ALL DIMENSIONAL INSPECTION OF THE SHELL
- # DPT TEST FOR SIDE WALL JOINTS
- # TWIST CHECK
- # PLACING ON DIPLORY FOR SHIFTING TO NEXT STAGE

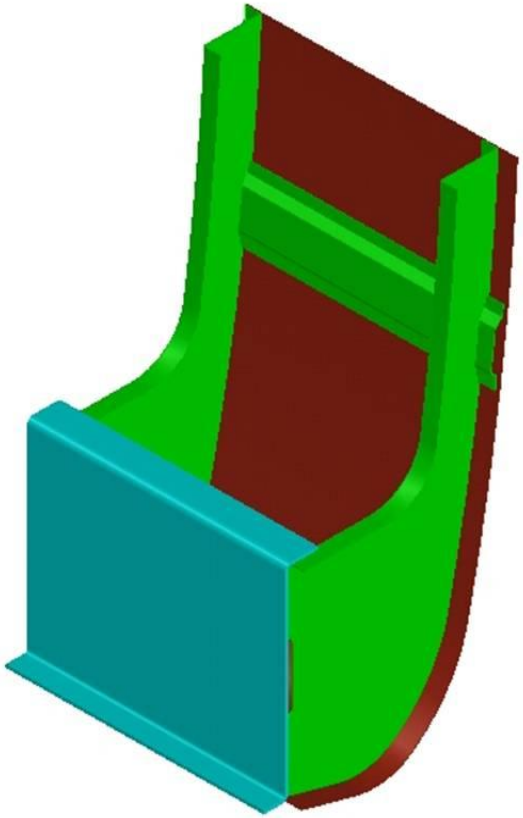

COMPARISION

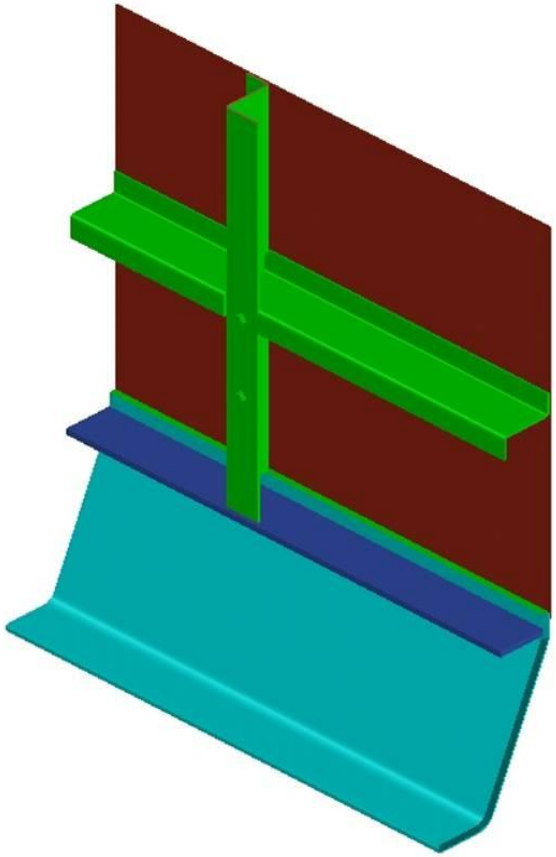




- TURN UNDER HAS BEEN ELIMINATED
- CLEAR APPROACH FOR SAND BLASTING AND PAINTING
- NO ACCUMULATION OF WATER AND MUCK
- PILLAR RESTS ON SOLEBAR AS COMPARED TO LOAD TRANSFER THROUGH A VERTICAL WELDED JOINT IN CONV. COACHES

SIDEWALL TO UNDERFRAME JOINT, CONV. VS.LHB





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

SEPARATE DOOR FRAME FITTED BEFORE SIDEWALLS IN LHB, NO PROBLEM OF DOOR SIZE/SQUARENESS ETC.

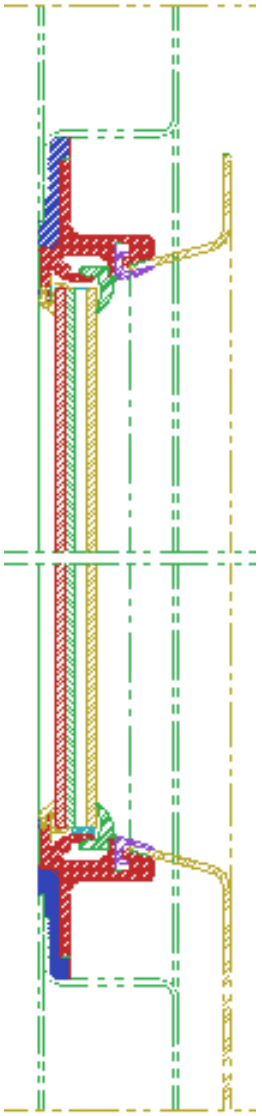
NO DOOR FRAME, DOOR OPENING SQUARENESS MAINTAINED BY FITTING ONE SIDE'S DOOR CORNER SHEET AFTER SIDE WALL

- **WEIGHT PER METER LENGTH OF LHB COACHES IS APPROXIMATELY 10% LESS THAN THE CONVENTIONAL COACHES. BETTER PAYLOAD TO TARE WT RATIO.**
- **NO CHANGE REQUIRED IN SHELL DESIGN FOR SPEEDS OF 200KMPH**

DIMENSIONAL COMPARISON	**ICF**	**LHB**
LENGTH OVER BODY	**21770**	**23540**
LENGTH OVER BUFFER	**22280**	**24700**
WIDTH OVER BODY	**3245**	**3240**
INNER WIDTH	**3065**	**3120**
WINDOW OPENING (ac sleeper)	**1220x610**	**1180x760**

WINDOWS

Sealed window Glass Units



- The window glass unit characteristics are:
  - K value not lass than 1.6 W/M^2K
  - Transparency > 39 %
  - Reflection > 40
  - Total energy absorption < 21%
- The sealed window units consists of 8.4 mm outer laminated and 4 mm tempered inner glass with 6 mm Krypton/Argon gas filling
- Window glass is secured to Al extrusions by rubber profiles
- The Al frame is glued to the car body with the help of PU, elastic gap filling structural adhesive (Sikaflex-264 T & eq.). Capable of withstanding high dynamic stresses

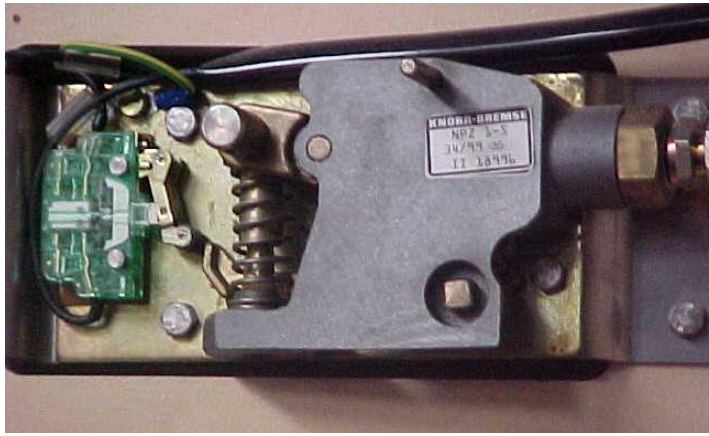
Emergency openable window

- It is similar to the fixed unit
- 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

Passenger Emergency Alarm

- 5 passenger emergency alarms per coach in chair car have been provided at following locations:
  - 2 in passenger compartment
  - 3 in lavatories
- There is no mechanical linkage like a chain and these handles directly operate a valve venting the brake pipe
- Designed to stop the train not just warn the driver



THANK YOU