INTRODUCTION TO TRAIN 18

SILABHADRA DAS

PROFESSOR (TRAINSET)

IRIMEE

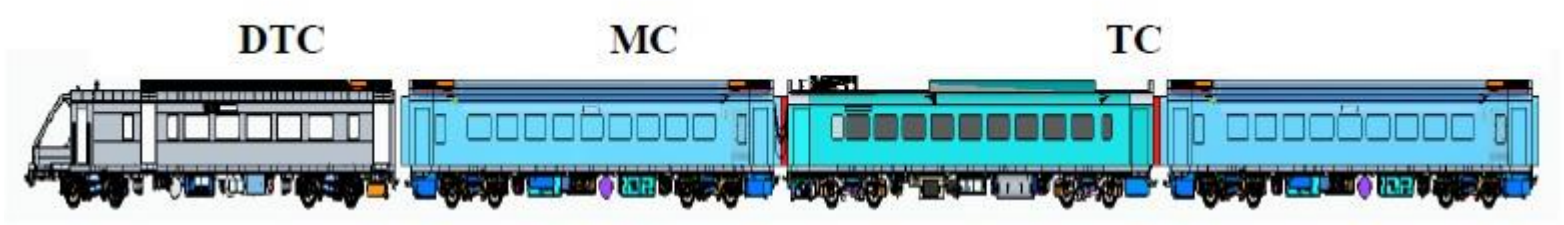
TRAIN 18 CONCEPT

Concept of TRAIN 18 (VANDHE BHARATH EXPRESS) was Semi High speed Multiple Unit Train set with quick acceleration and contemporary passenger amenities.

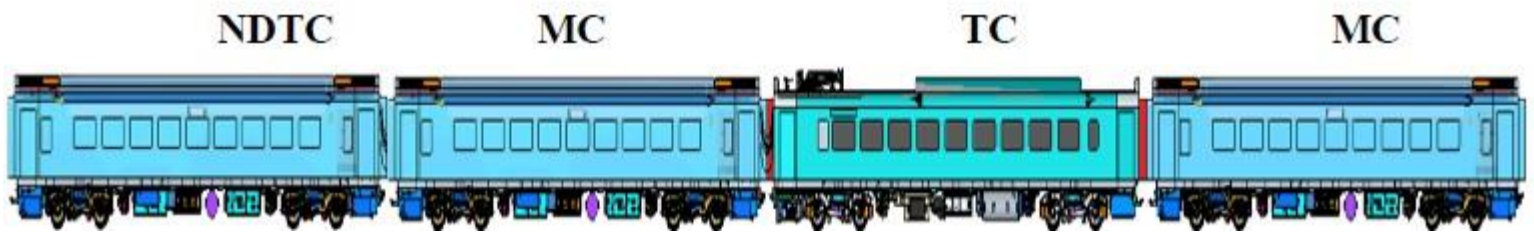
T-18

- **16 CAR DOUBLE HEADED TRAIN SET**
- **24X16 = 384 METRES LENGTH**
- **8 MOTOR CAR,**
- **4 TRAILER CAR**
- **2 Non DRIVING TRAILER CAR**
- **2 DRIVING TRAILER CAR**
- **ALL COACHES ARE CHAIR CARS**
- **Out of 16 coaches , 2 coaches are Executive Class**

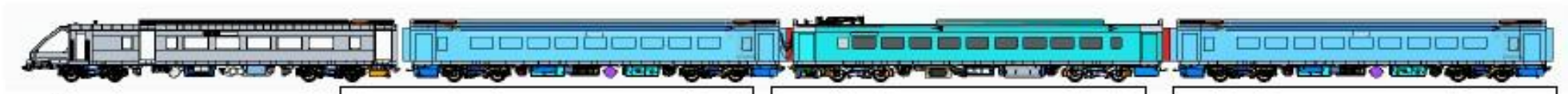
END BASIC UNIT



MIDDLE BASIC UNIT

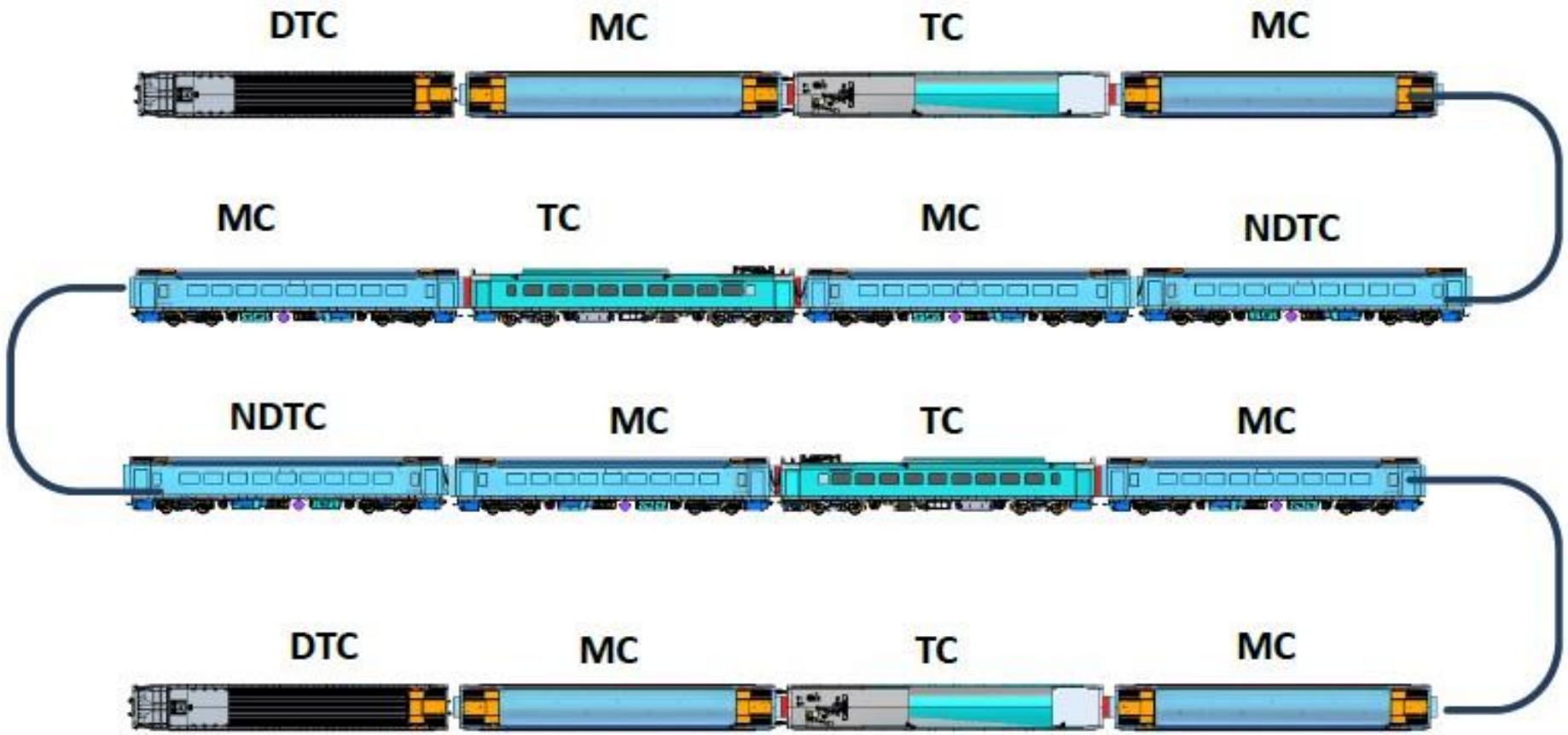


DTC – Driving trailer coach
MC – Motor Coach
TC – Trailer Coach
NDTC – Non-Driving trailer coach



DTC	MC	TC	MC
1. Battery 2. Battery charger	1. Traction Converter 2. Brake Chopper Resistor 3. Traction Motors	1. Transformer 2. Auxiliary Converter 3. Pantograph	1. Traction Converter 2. Brake Chopper Resistor 3. Traction Motors

Formation of Rake (16 coaches) : 4 X 4 Basic Units - Each Basic Unit with Four Cars



Major technical features of Train 18

- ✓ 160 km/h speed . Test speed- 180 km/h
- ✓ Maximum Design Axle Load – 17 T (Actual–16.5 T)
- ✓ Starting Acceleration – 0.8 m/sec^2
- ✓ Deceleration – 1 m/sec^2
- ✓ 50 % Powering
- ✓ 4 Car Basic Unit. One Pantograph per each BU
- ✓ Wheel Mounted Brake Disc
- ✓ Bogie Control for Brake System as well as Traction
- ✓ All Propulsion equipments are underslung
- ✓ Bolsterless bogie

FEATURES OF TRAIN SET

FEATURES:

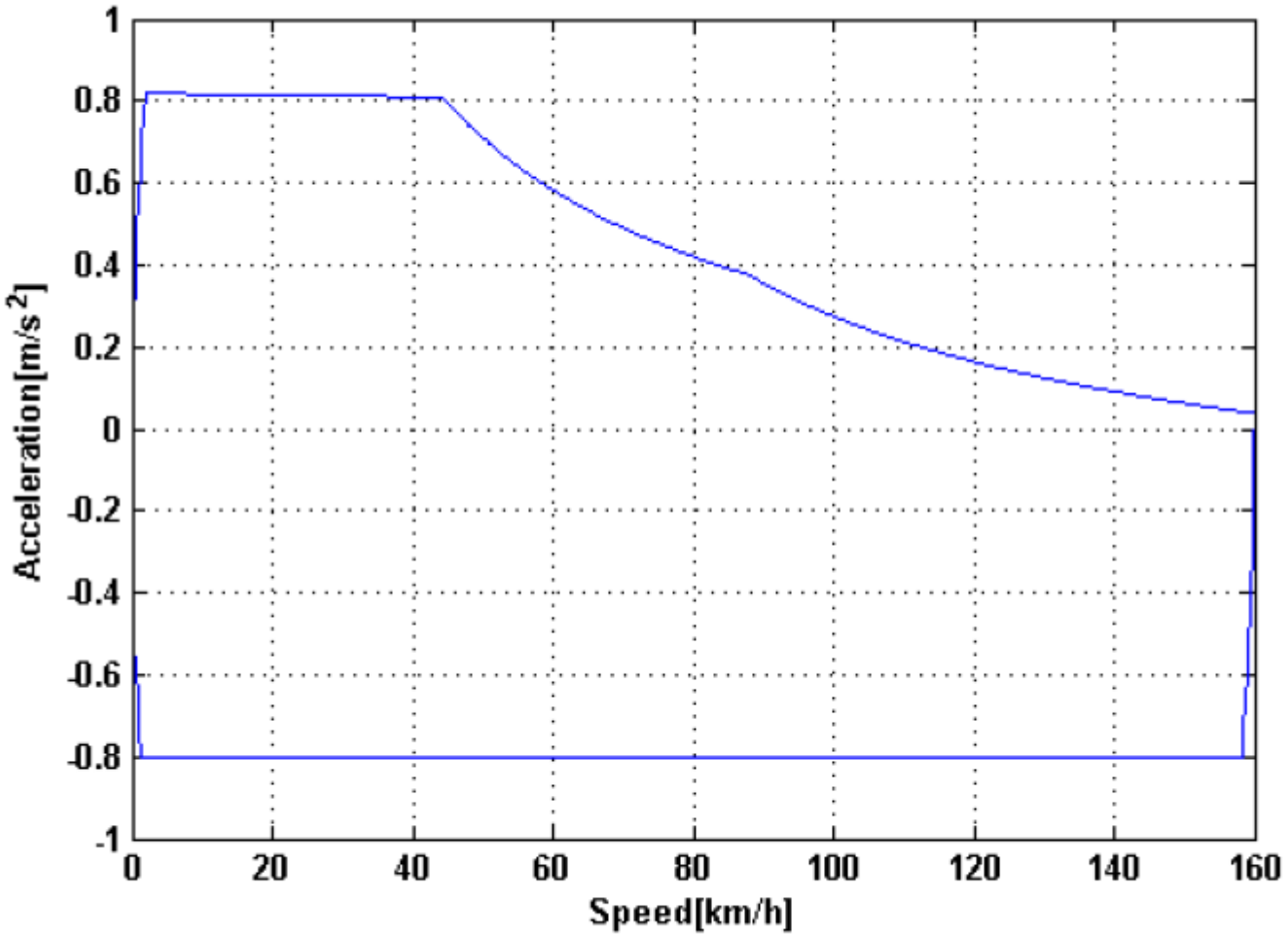
1. INTERIOR PANELING WITH CONCEALED SCREWS WITH STREAMLINED FINISH.
2. LED LIGHT FITTINGS (DIFFUSED LIGHTING) AND LED DESTINATION BOARD.
3. GPS BASED PASSENGER INFORMATION SYSTEM.
4. CCTV.
5. ANTI GRAFFITI EXTERIOR PAINTING.
6. AUTOMATIC GLASS PANEL TOUCH FREE IC SLIDING DOOR.
7. CENTRALISED AUTOMATIC PLUG DOOR FOR COACH ENTRY.
8. FRP MODULAR TOILET FOR PERSONS WITH MOBILITY RESTRICTIONS.
9. WIFI ROUTER.
10. VACUUM ASSISTED BIO TOILET.

FEATURES

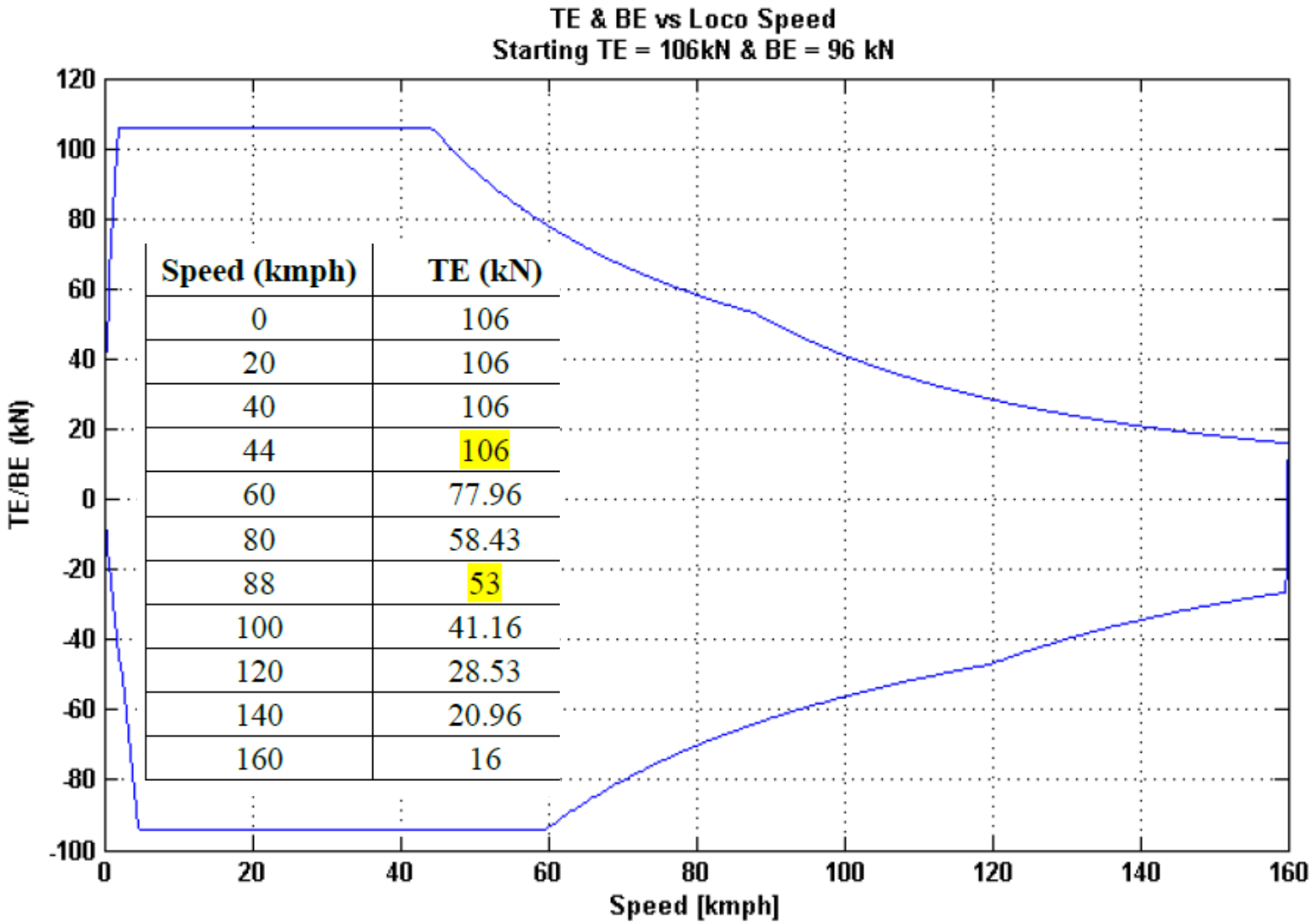
11. ON BOARD INFOTAINMENT SYSTEM (2 Nos. OF INFOTAINMENT MONITOR)
12. MAXIMUM SPEED UPTO 160 KMPH.
13. FULLY SUSPENDED TRACTION MOTOR & BOLSTERLESS BOGIE.
14. REGENERATIVE AND E.P. BRAKE SYSTEM. (BRAKE BLENDING)
15. PROVISION FOR TRAIN PROTECTION WARNING SYSTEM (TPWS)/ AUTOMATIC TRAIN PROTECTION (ATP)/ COMMUNICATIONS BASED TRAIN CONTROL (CBTC).
16. FITTED WITH AMBIENCE NOISE MEASUREMENT (ANM), EMERGENCY TALK BACK UNIT (ETBU), CENTRALIZED COACH MONITORING SYSTEM (CCMS).
17. SIGNAL EXCHANGE LIGHT.
18. DOOR INDICATION LAMPS.
19. CCMS AND TIP-UP SEATS FOR TECHNICAL CREW.
20. SEPERATE TIP-UP SEATS FOR PANTRY CREW.

- Indirect LED lights on Luggage Racks and AC Ducts
- Special air conditioning duct for silent and equal distribution of conditioned Air.
- Provision of entertainment and mobile charging at every seat.
- Revolving seats at Executive class
- Wifi
- Gps based passenger information system
- All coaches having ONE onboard MINI PANTRY

Acceleration Vs Speed



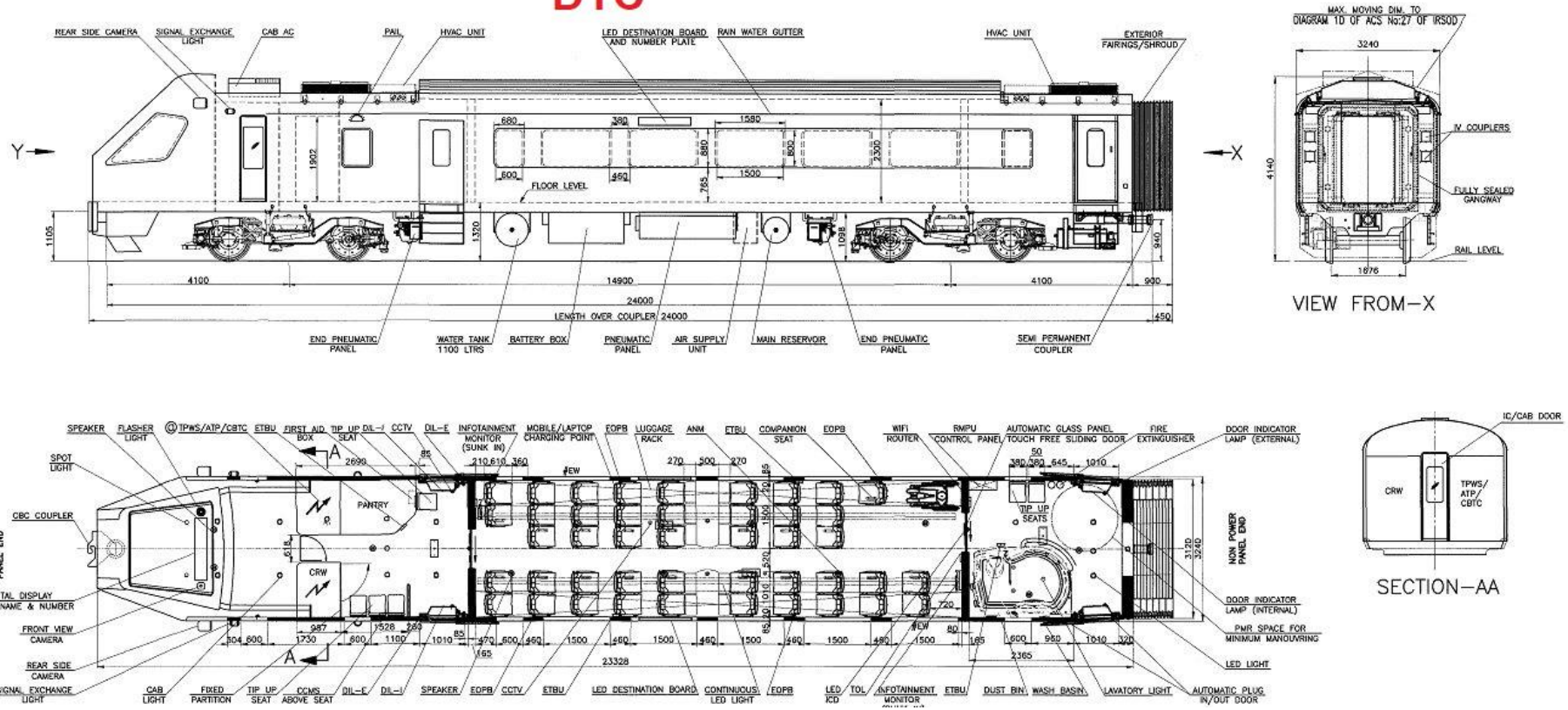
Regenerative Effort vs Speed per Motor Coach



Speed (kmph)	TE (kN)
0	106
20	106
40	106
44	106
60	77.96
80	58.43
88	53
100	41.16
120	28.53
140	20.96
160	16

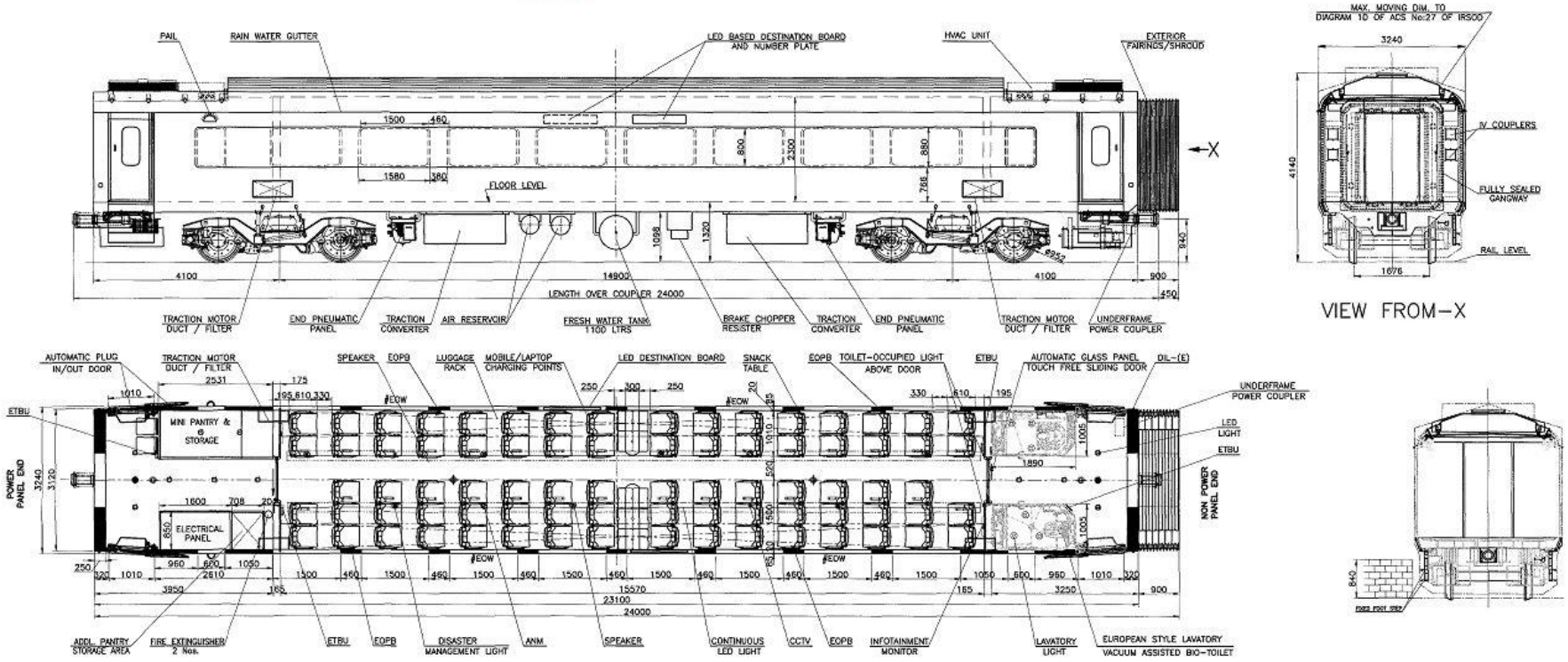
Electric Locomotive – 280 to 300 KN

DTC



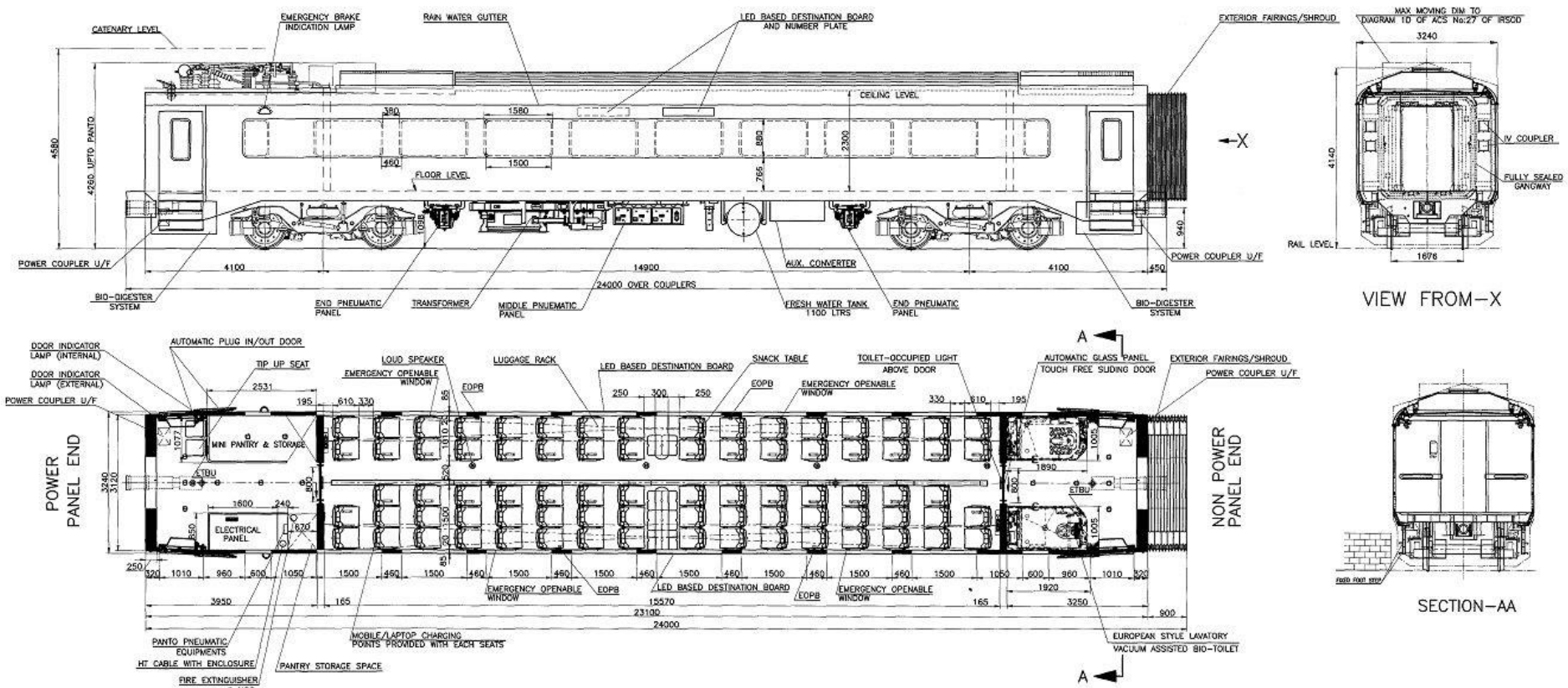
SEATING CAPACITY : 44

MC



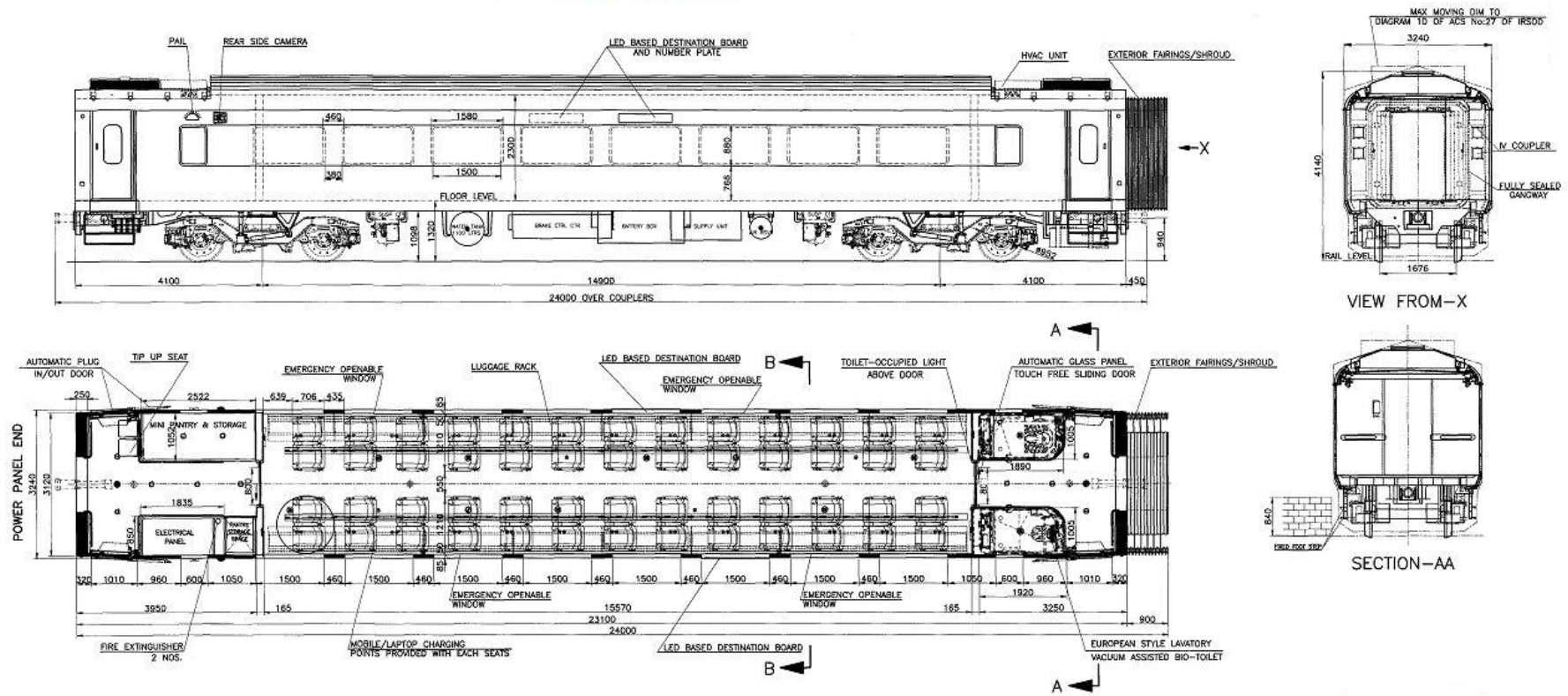
SEATING CAPACITY : 78

TC



SEATING CAPACITY : 78

NDTC/EC

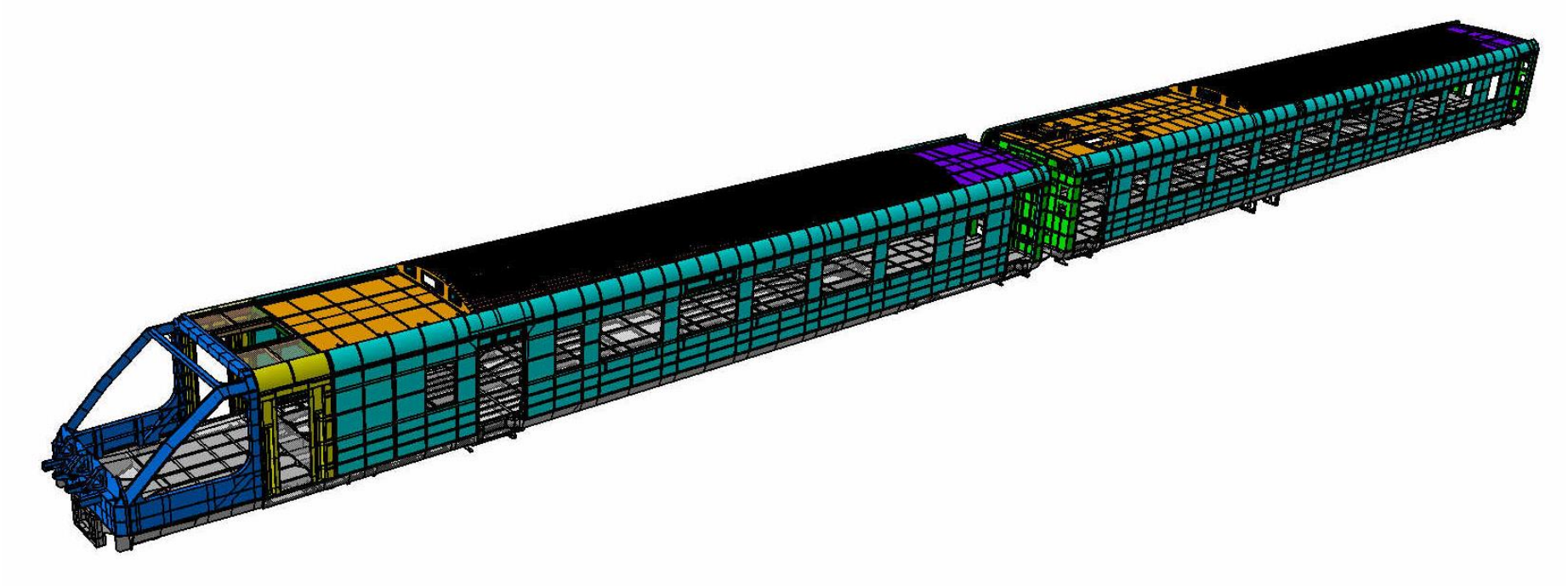


SEATING CAPACITY : 52

PASSENGER CAPACITY

TYPE OF COACH	PER COACH	NO.OF COACHES	TOTAL
DTC	44	2	88
NDTC/EC	52	2	104
MC	78	8	624
TC	78	4	312
		TOTAL	1128

SHELL



SHELL DESIGN – Tubular structure more or less similar to LHB shells

CONSULTANT FOR TRAIN 18: EC ENGINEERING POLAND,

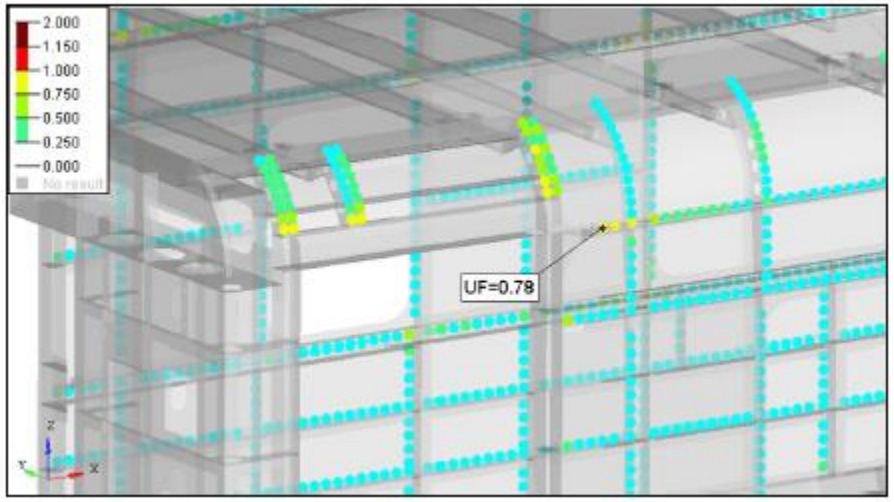
- IRSM 41 corten steel underframe with centre sill design
- No trough floor
- 2mm thick SS cover sheets on underframe instead of trough floor
- Side wall, Roof and End wall members of Ferritic Stainless steel 2 mm,2.5 mm, 3 mm & 4 mm thick
- Roof Sheets: Austenitic Steel 1.25 mm & 1.7 mm thick

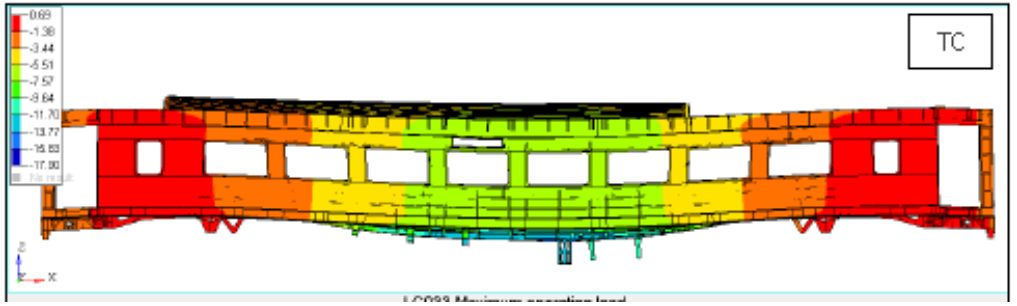
UNDERFRAME

- Material : up to 10mm thickness IRS M 41
- Material: above 10 mm thickness EN 10025
- Sole bar section same as that of LHB (6mm)
- Head stock with lowered location of semi permanent coupler (940 mm from Rail level)

Design Validation

- Car body Design meets the requirements of EN 12663-1:2010+A1:2014 and DVS1612:2014.
  - EN 12663-1:2010+A1:2014. Railway applications. Structural requirements of railway vehicle bodies. Part 1: Locomotives and passenger rolling stock
  - DVS 1612:2014. Design and endurance strength assessment of welded joints with steels in rail vehicle construction

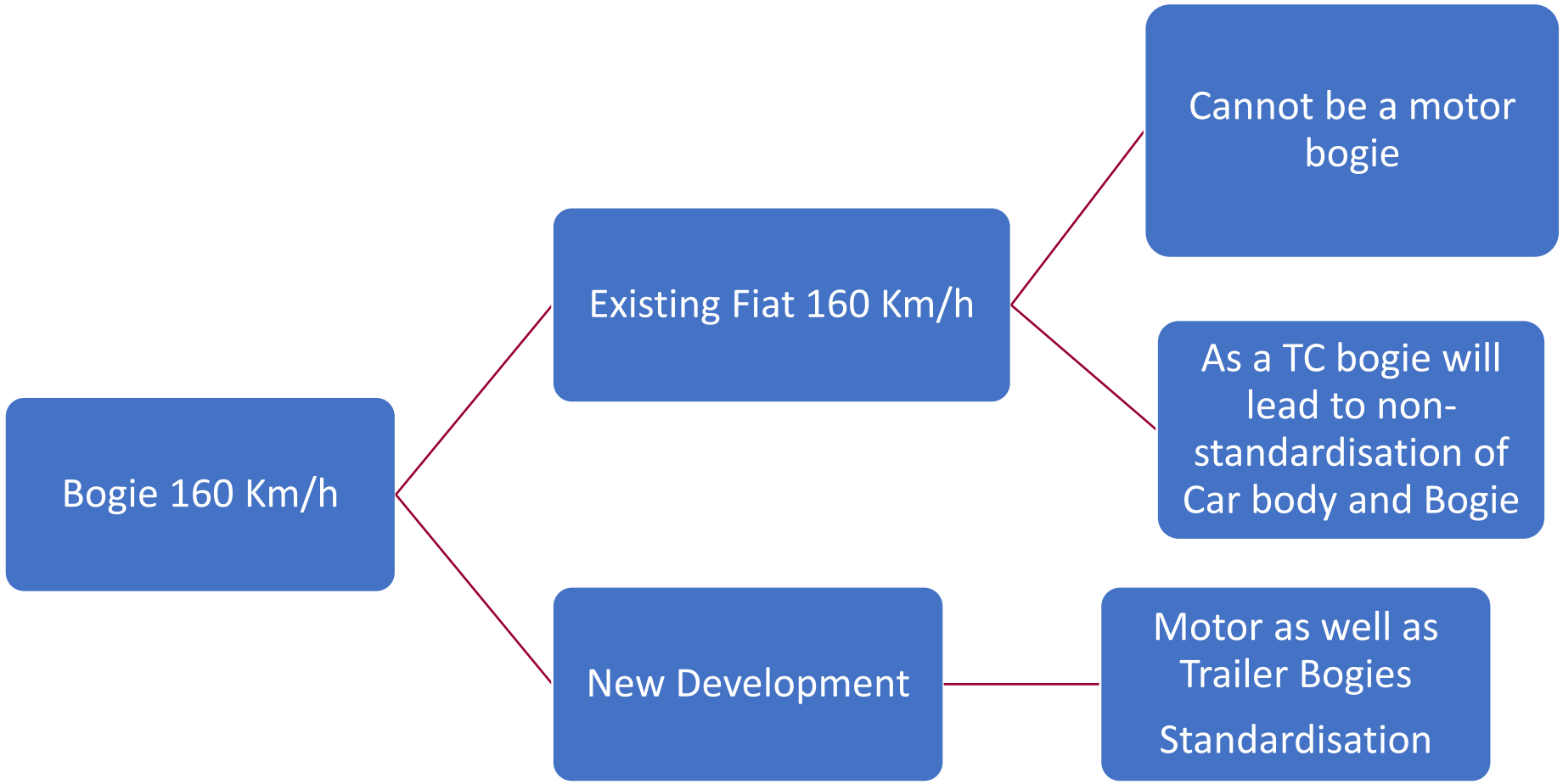




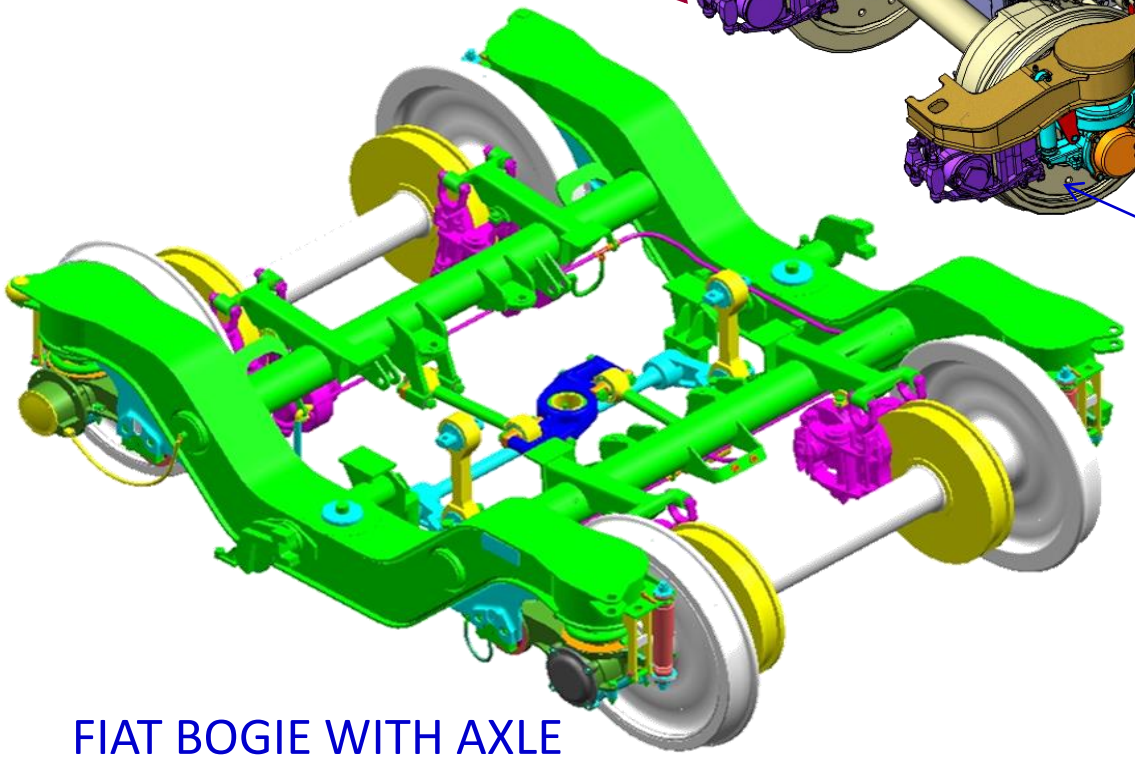
BOGIE

- BOLSTERLESS DESIGN
- FULLY SUSPENDED TRACTION MOTOR
- DISC BRAKE WITH BRAKE DISC ON WHEEL
- AIR SPRING ON SECONDARY SUSPENSION
- SPEED POTENTIAL CAN BE ENHANCED TO 200 Kmph

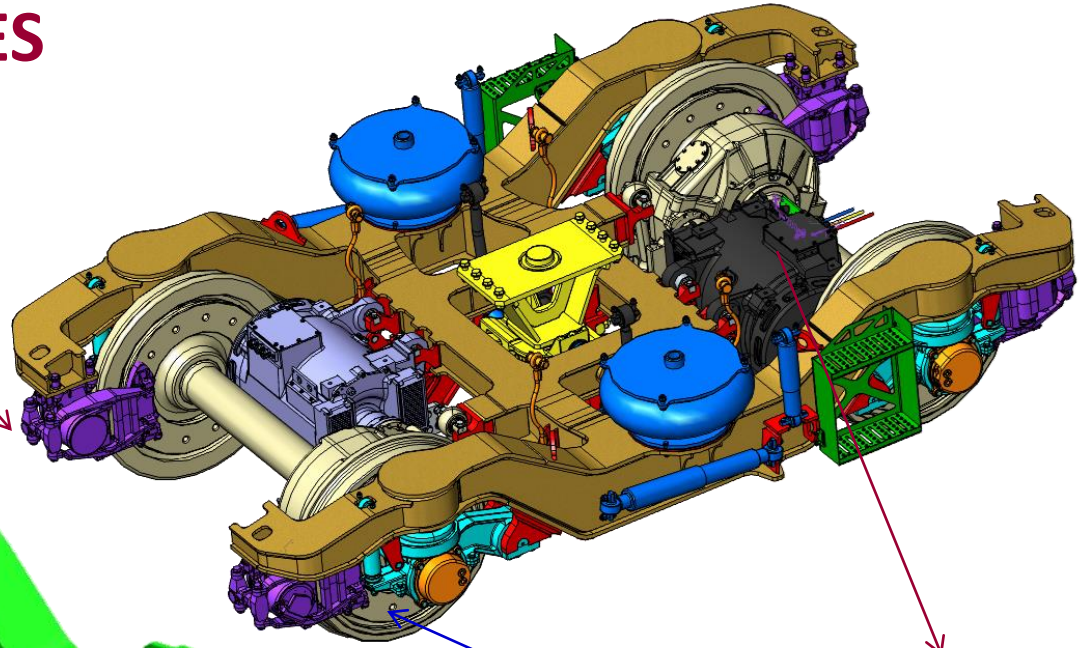
Development of Bogies



WHEEL MOUNTED BRAKE DISC ON MOTOR AS WELL AS TRAILER COACHES



FIAT BOGIE WITH AXLE MOUNTED DISC BRAKES



BRAKE CALLIPERS

FULLY SUSPENDED TRACTION MOTOR

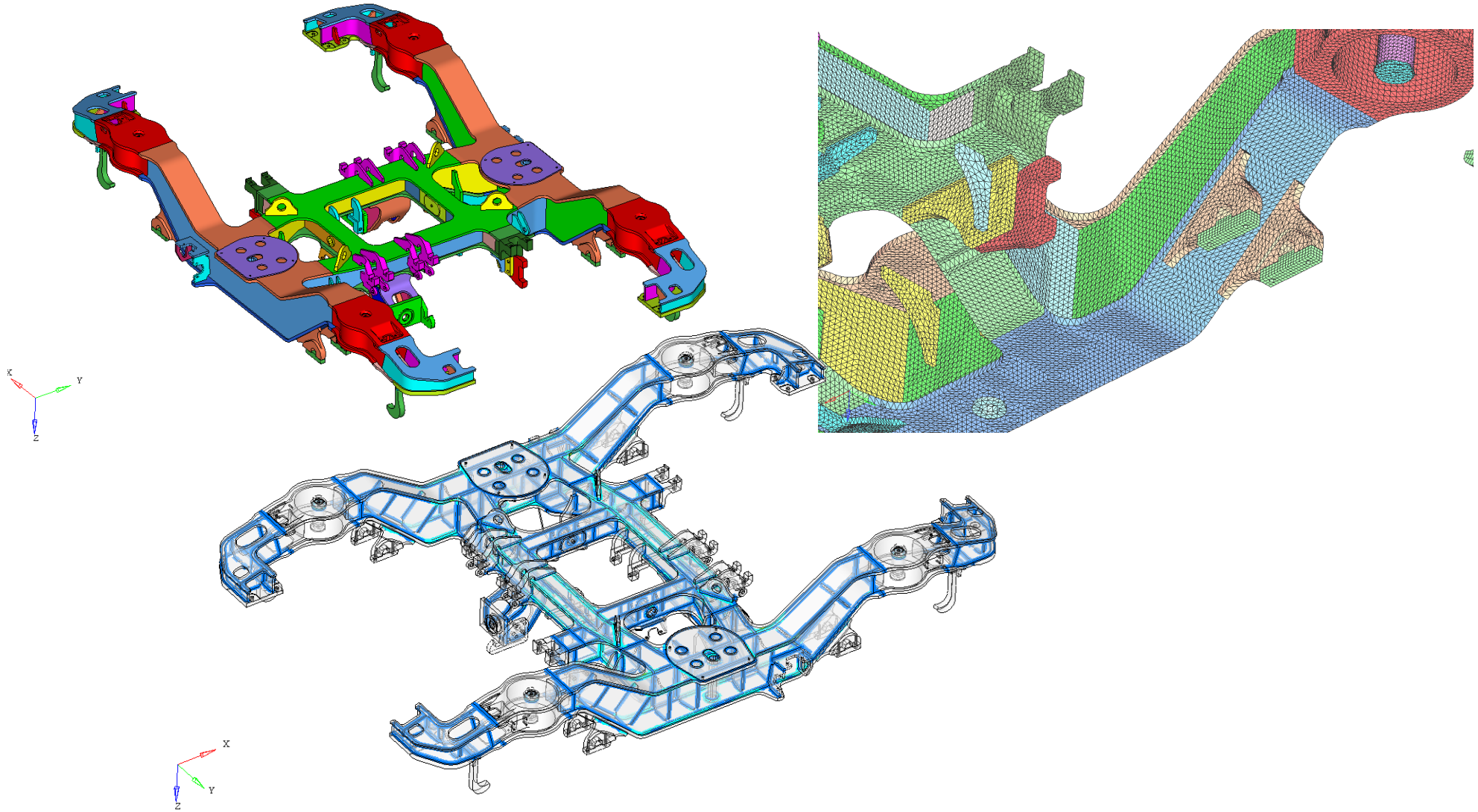
WHEEL MOUNTED BRAKE DISC

Bolster Less Bogie with Fully Suspended Traction Motors

- ✓ Reduced weight (Reduced Unsprung Mass)
- ✓ Better Ride Comfort
- ✓ Reduced number of Wearing Parts
- ✓ Greater Stability at higher speeds (Because of Yaw dampers and rigidity of rubber items)
- ✓ Better performance on curves

Train-18 Bogie

Structural analysis of bogie frame according to EN 13749:2011



Bogies – Design Validation

- Dynamic Multi Body analysis shown stable behaviour upto 180 kmph according to EN 14363 and RDSO's Third Criteria Committee
- Simulation for the acceptance of running characteristics according to EN 14363:2016 - running behavior and stationary tests.
- The Simulation results matched the values of RDSO Trials

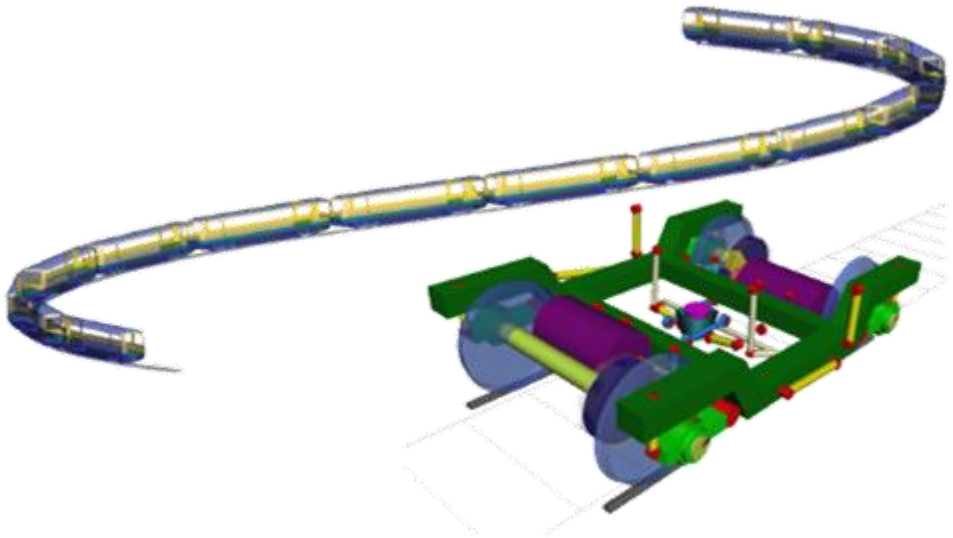
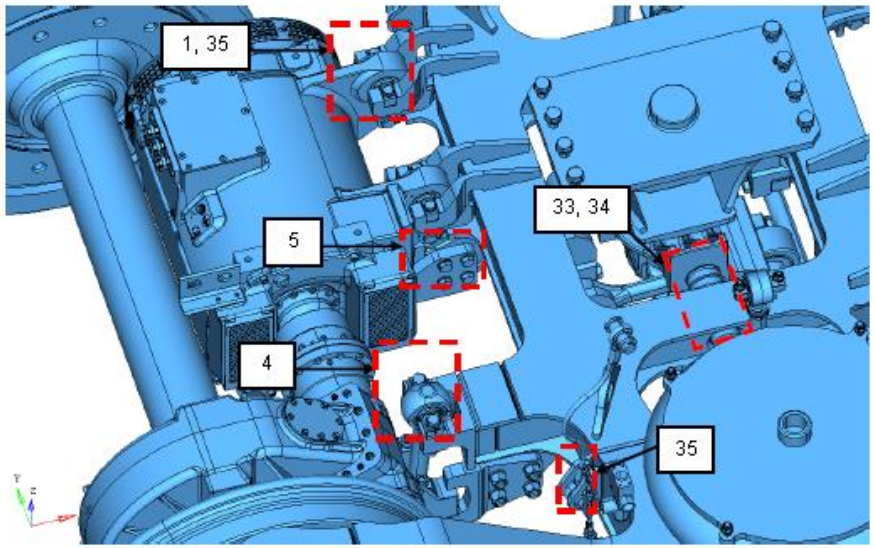
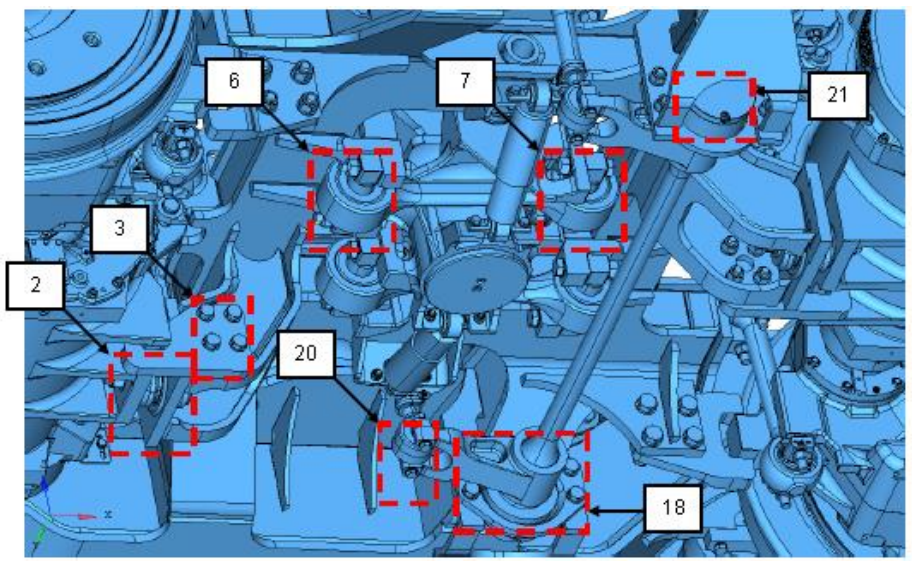


Fig. 31. Multibody model of vehicle.

Structural analysis of bolted Joints - VDI2230:2014





Structural analysis of monoblock wheel according to EN 13979-1+A1 (2011)

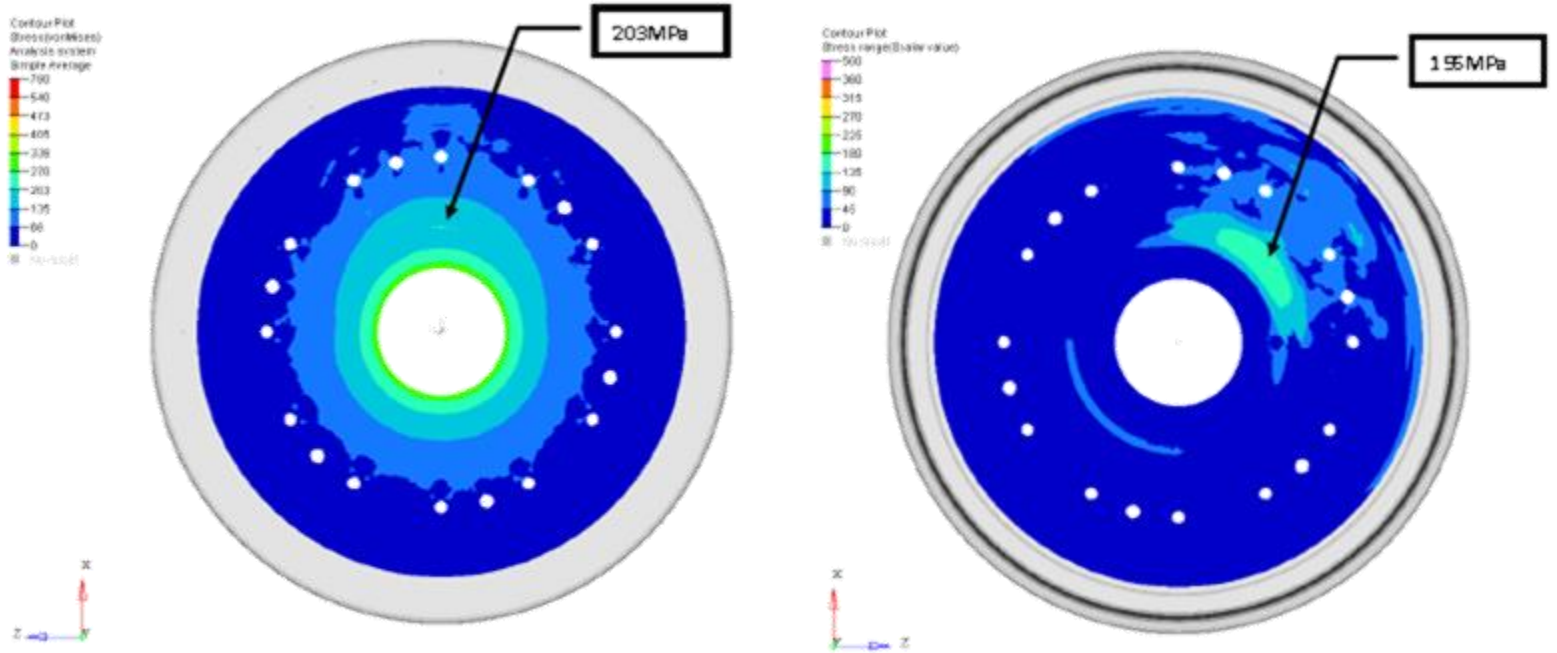


Fig. 9. Von Mises stresses for a new wheel, A-A section.

Furnishing

- **World class furnishing , consultancy by Global players**
- Entrance door with Retractable foot step (for first two rakes only)and Plug in - plug out door- **Knor Bremse**
- **Brake and controls – Knor Bremse and Faively**
- Continuous Window which seems like a single window from out side – supply UNIVERSAL ENGINEERS.

  (**FLATCH GLASS** & **SCHALBU** FOR TRAIN 18)
- Panels and interiors by **BFG and Hindustan Fibre Glass (HFG)**
- **IC DOORS by Prag Polymers**
- Fully sealed gangway and exterior shroud by

  Dellner**, Avadh Rail Infra and Pioneer Fil-Med**

Vacuum assisted Bio Toilets by **Evac**

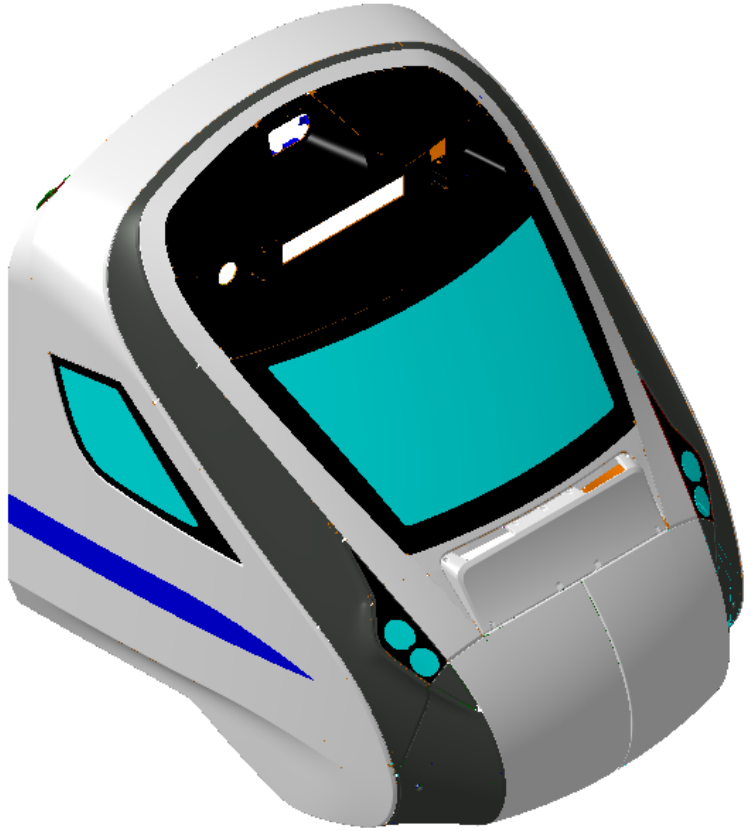
Seats by STER (POLLAND)

Flooring - IMPORTED PVC BASED FLOKED FLOOR COVERING by FLOTEX

Ducting by EC, HANSPAL and Universal Engineers

ELECTRICS,PROPULSION SYSTEM AND CONTROLS BY MEDHA

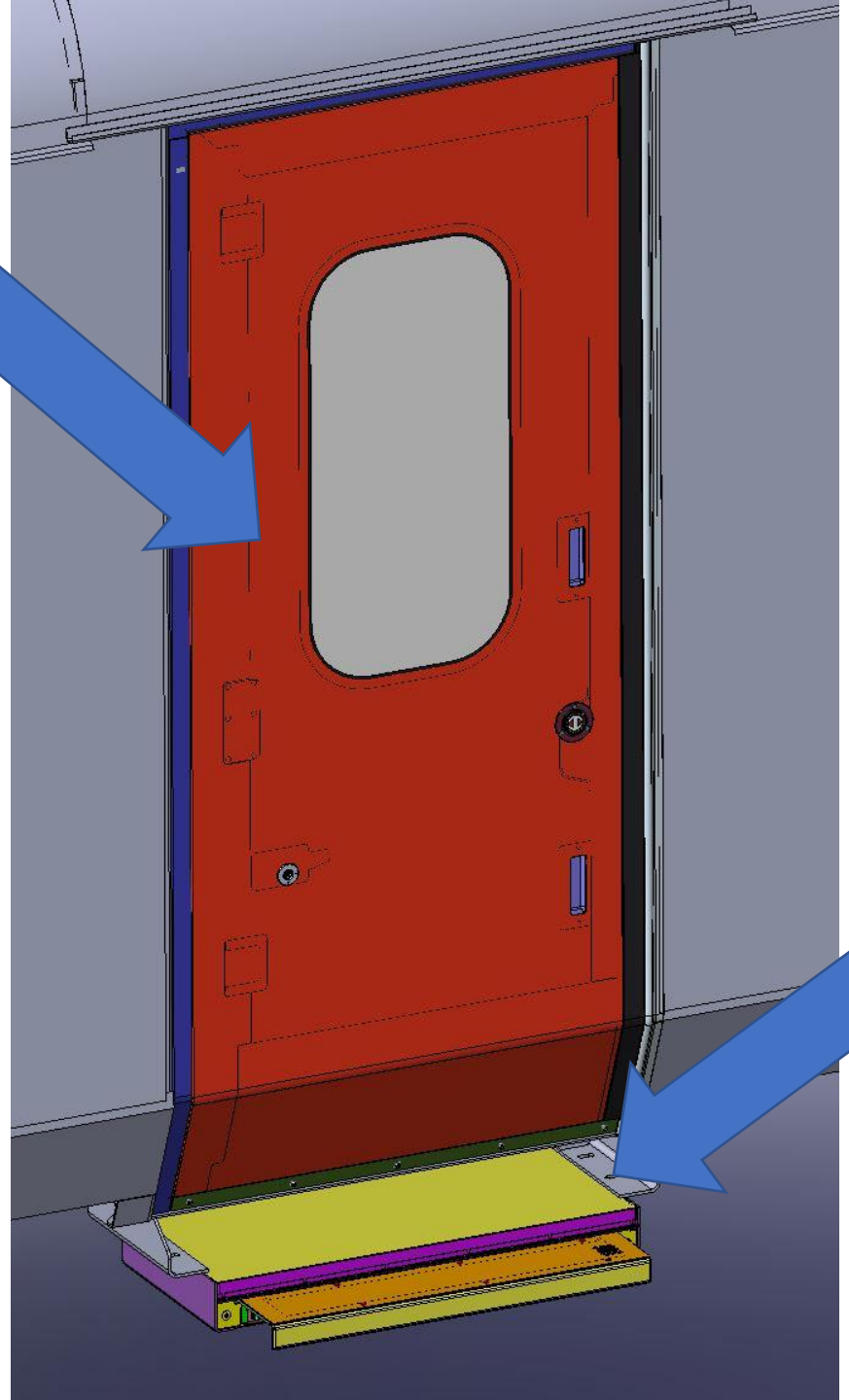
FRP SKIN NOSE CONE



SUPPLY BY BFG

PLUG DOOR

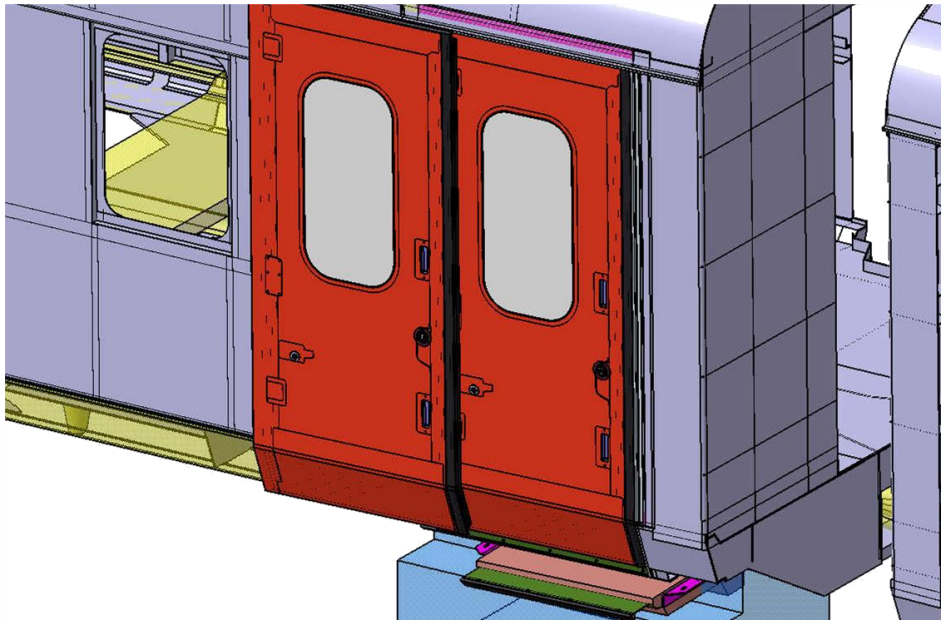
Automatic Single Leaf Plug Door System with Retractable Sliding FootStep



RETRACTABLE FOOT STEP

Automatic Plug Doors with Sliding Foot Steps

- ✓ Provision of Sliding Step Required shifting of door way to the end – to avoid infringement with Bogie
- ✓ Door closing and opening switch is on ALP side in driver cabin and with guard
- ✓ Door closes after time delay of 3 seconds.
- ✓ Door opening causes traction cutoff

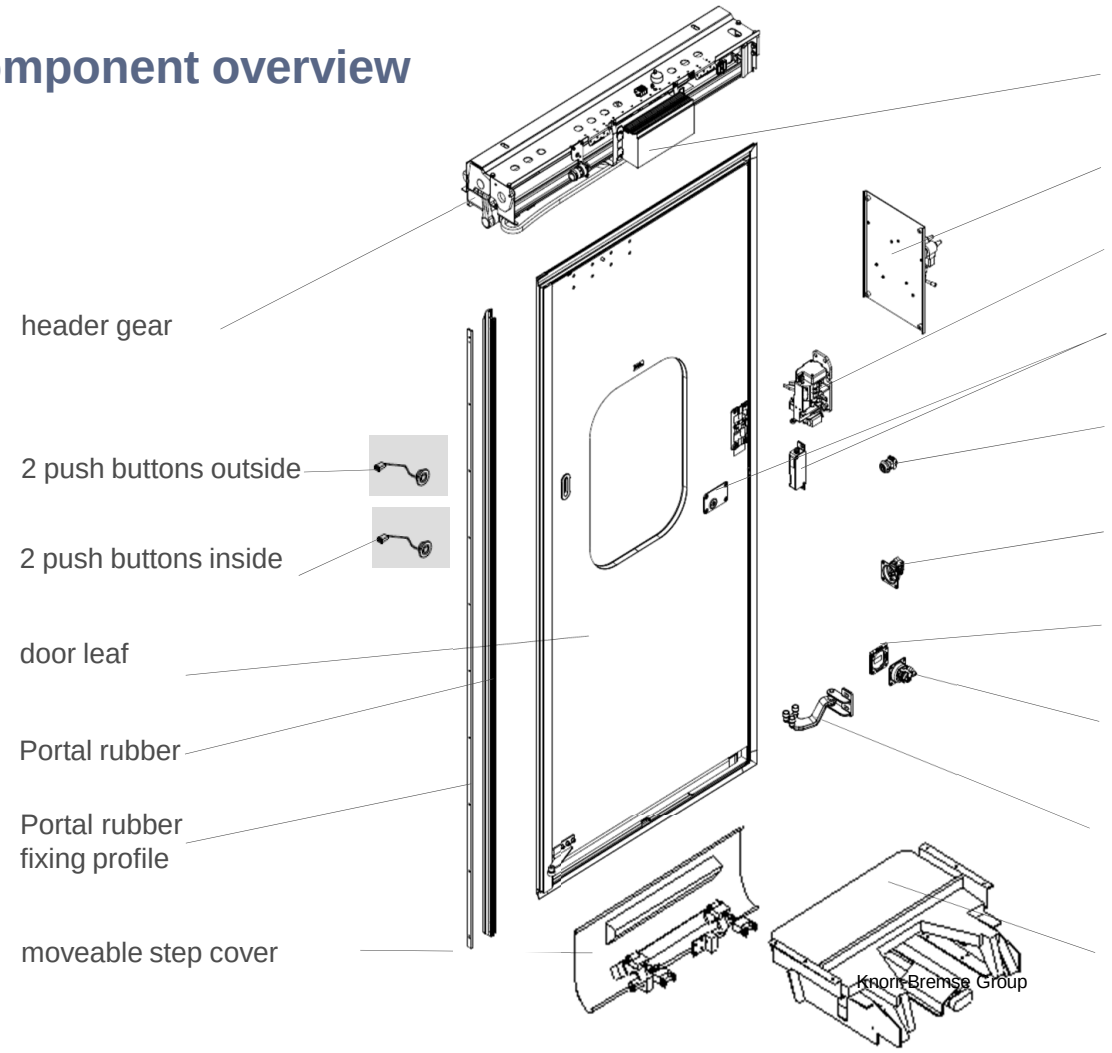


Overview of door system

Technical System Data:

• Voltage supply:	110VDC +25/-30%
• Pressure supply:	5 – 9bar (IFE pressure regulator is pre-set at 6bar)
• Door opening time:	4 ± 1 seconds
• Door closing time:	4 ± 1 seconds
• Step opening time:	2 ± 1 seconds
• Step closing time:	2 ± 1 seconds
• Average power consumption of the door	140 W (opening and closing sequence)
• Maximum power consumption of the door:	500 W (for a time of 500 ms) during locking, unlocking, reopening.
• Free opening width door:	800 +5/-0 mm
• Free opening width step :	150 +5/-0 mm
• Squeezing force: (according to EN 14752)	< 150 N effective for the first closing sequence < 200 N effective for the following closing sequences < 300 N peak

Component overview



Door control unit

- Pneumatic control unit
- Locking device
- Mechanical door isolation device
- Crew key switch
- emergency egress device
- Cover of emergency access device
- emergency access device
- lower door leaf guiding (roller swing arm)
- moveable step

Brake System

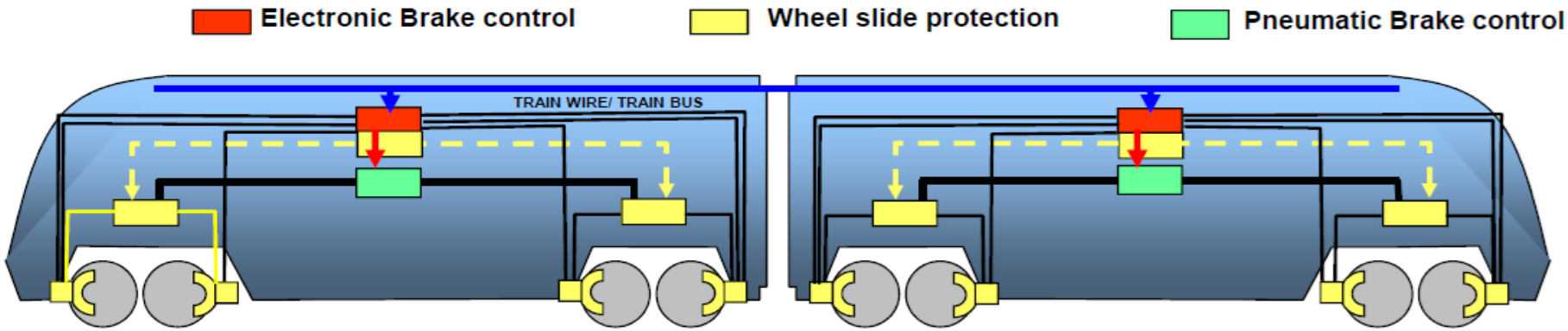
EP Brake System with Latest Gen Electronic Platform

- ✓ Bogie level control of Brakes and Two Tier Redundancy of Mechanical and Electronic equipment
- ✓ Braking is a combination of Electro Pneumatic and Electro Dynamic braking (Blended braking)
- ✓ Electro dynamic brake preferred over electro pneumatic brake
- ✓ Maximum ED Brake force of 376 KN is possible. Balance braking force provided by EP brakes.
- ✓ Service Brake application on the basis of passenger load detected at secondary air spring level (Load corrected Braking)
- ✓ Wheel Slide Control and Jerk Control
- ✓ Quicker application and release (Lesser Brake distances)
- ✓ Oil free Compressors

Brake System

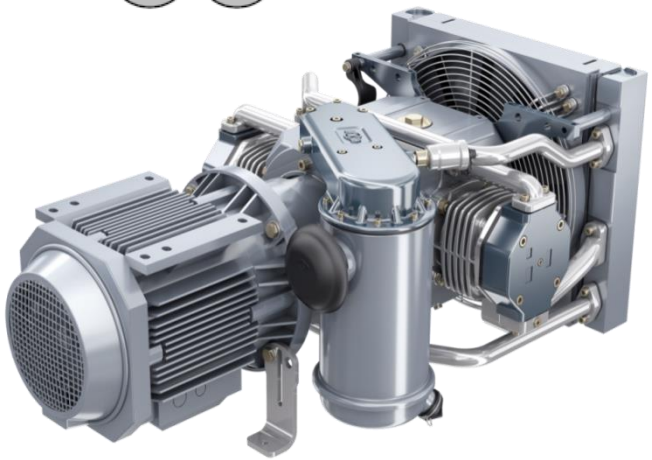
Latest Generation Electronic Pneumatic Brake System

- ✓ For redundancy in WSP and BC pressure control.
- ✓ Latest electronic platform
- ✓ Quicker braking



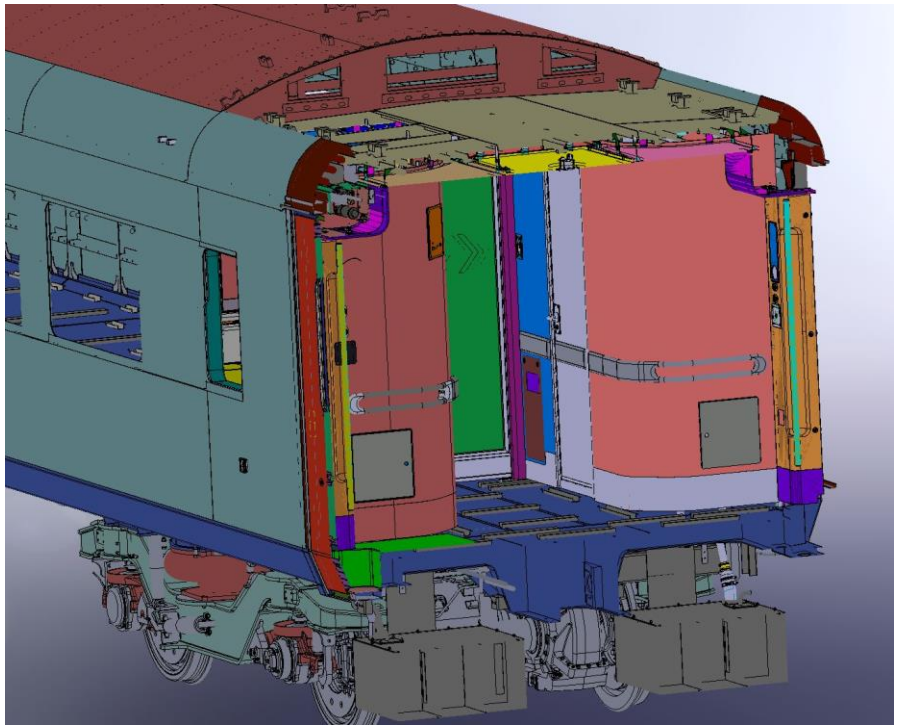
- ✓ CENTRALIZED EP BRAKE SYSTEM WITH BOGIE CONTROL

- ✓ Oil free Compressor



Bio-Vacuum toilet System

- ✓ Unique Design
- ✓ Zero Discharge and Clean Toilets



TRAINSET INTERIOR FEATURES

TRAINSET INTERIOR FEATURES

- ✓ Flooring.
- ✓ FRP-Interior panelling.
- ✓ Partitions with electrically operated touch free sliding doors.
- ✓ Endwall with Electrical inspection doors.
- ✓ Continuous window glass design with provision for emergency exit.
- ✓ AC-Ducting arrangement.
- ✓ Corrugated FRP roof panel design to improve aesthetics.
- ✓ Sunk in type Tip-up seat arrangement.
- ✓ On board infotainment system.
- ✓ Centralised coach monitoring system.
- ✓ Mini pantry and it’s storage area.
- ✓ Emergency alarm push buttons inside the compartment.
- ✓ Talk back unit inside and out side the compartment.

Properties of FRP panel

FRP Panel Description

i. Non-Crimp Fabrics (NCF) made of glass fibre of appropriate construction. The glass fibre content by weight shall not be less than 30%.
ii. The process shall be Vacuum Infusion process/VARTM.
iii. The thickness of the finished FRP panel shall not be less than 3 mm (without gel coating).
iv. All internal panel surfaces shall be smooth finished with modern low flammability, low smoke emission, and low toxicity materials. All internal panels shall be resistant to graffiti, scuffing, vandalism, and cleaning agents. Rounded corners or covings shall be provided wherever mutually perpendicular flat plane surfaces abut.
v. FRP panels shall be gel coated to a thickness of 0.6 to 0.8 mm and gloss value shall be between 60 to 70 measured at 60°.

Resin

a) The resin shall be fire retardant grade isophthalic based polyester resin. Necessary additive may be used for obtaining fire retardant property in the resin system.

The isophthalic FR resin shall be procured from a reputed manufacturer in sealed containers along with the test certificates. Traceability of resin should be demonstrated if called for by ICF.

b) The manufacturer should provide details of the catalyst used along with the FR resin and as called for by ICF and demonstrate the test there of.

Flooring

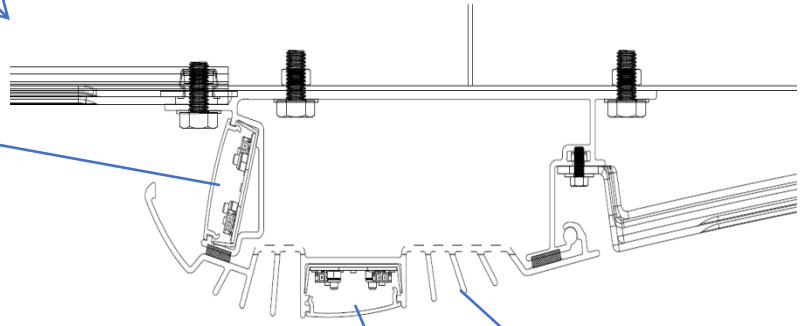
- **Decoupling type floor board fixing arrangement similar to LHB coaches.**
- **PVC based Flocked floor covering.**

Partition with touch free automatic sliding door

- Aluminium honey comb or FRP foam with HPL sheet exterior doorway partitions.
- Electrically operated inter communication sliding door with emergency stop provision.
- Concealed type infotainment partition displays.
- Provision for Passenger information system at top partition.

Roof panelling with Air diffuser

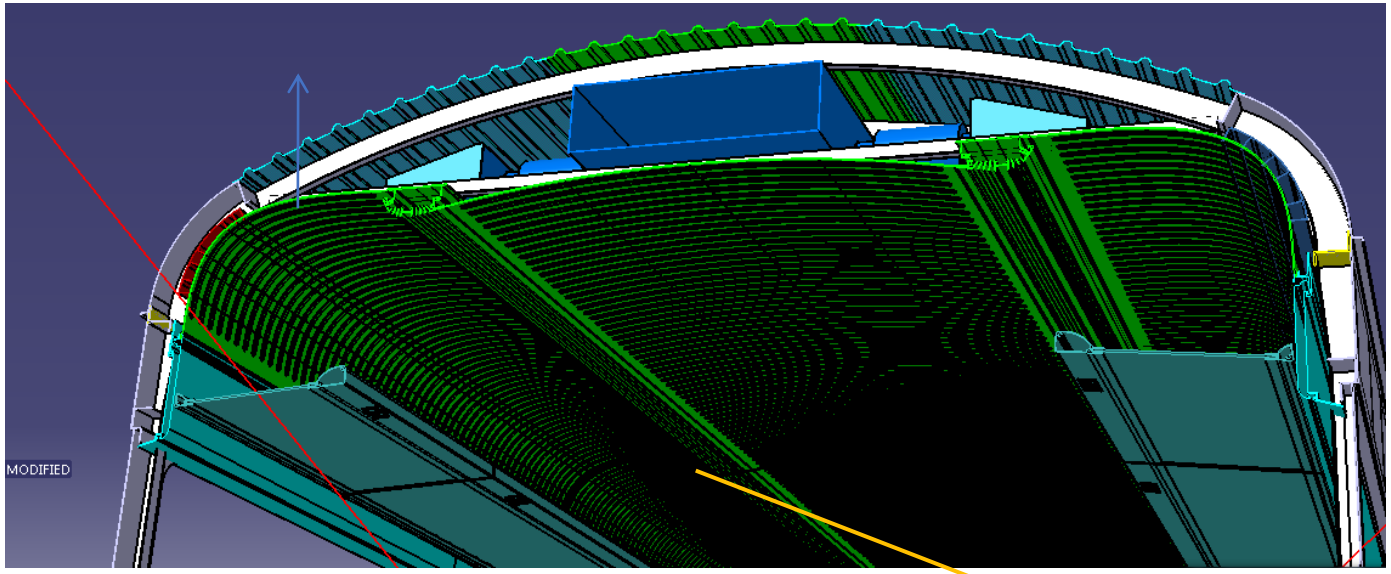
LED Indirect Lighting



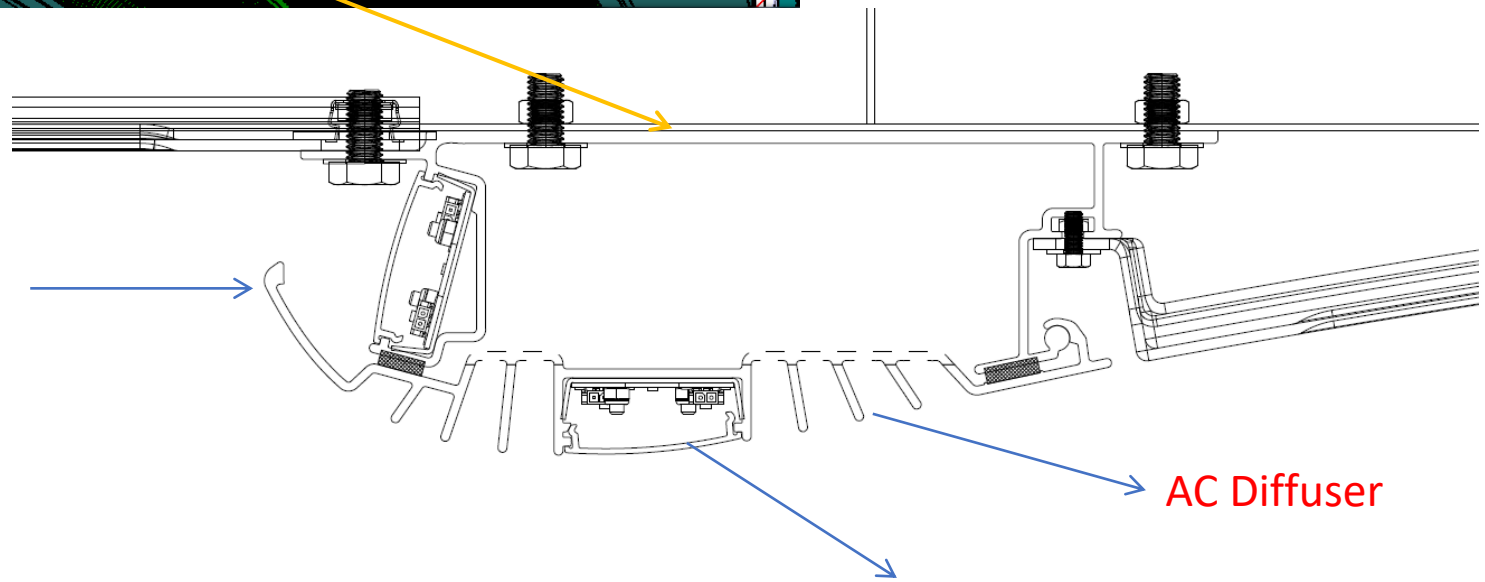
- ✓ Corrugated FRP roof panelling design.
- ✓ Wider AC Ducting for improvised Flow.
- ✓ Continuous air diffuser with Direct and Indirect Lighting.

AC Diffuser

LED Direct Lighting



- ✓ Interior Furnishing
- ✓ Design built up

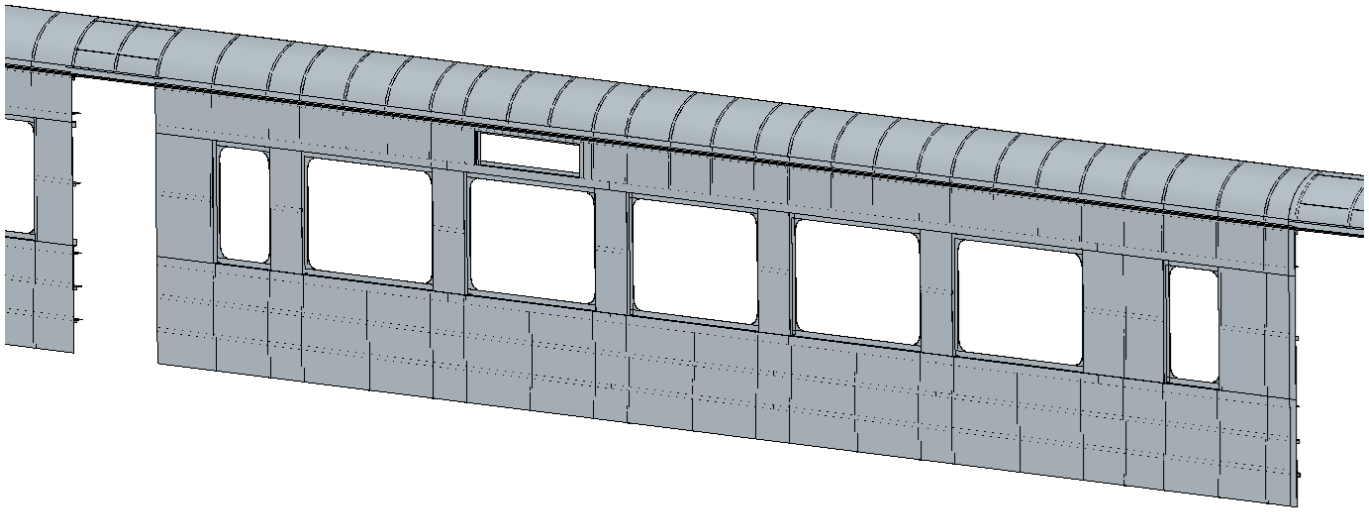


LED Diffused Lighting

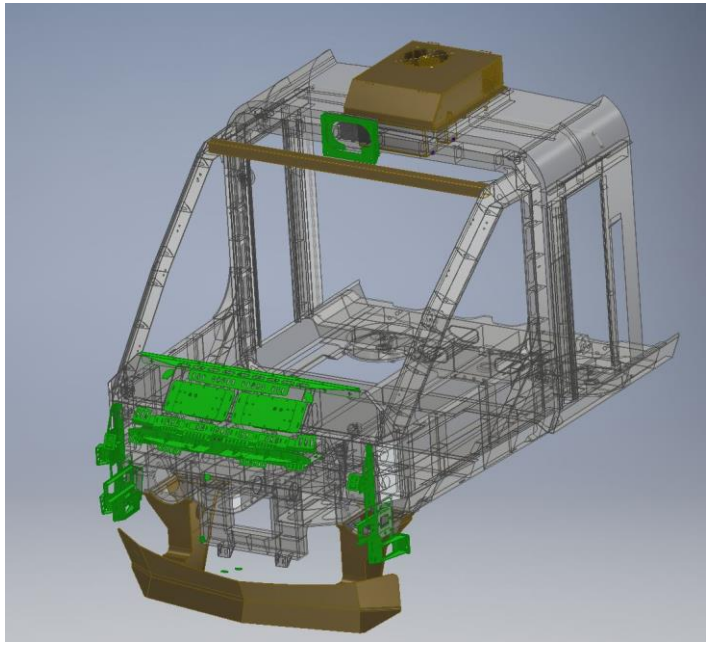
AC Diffuser

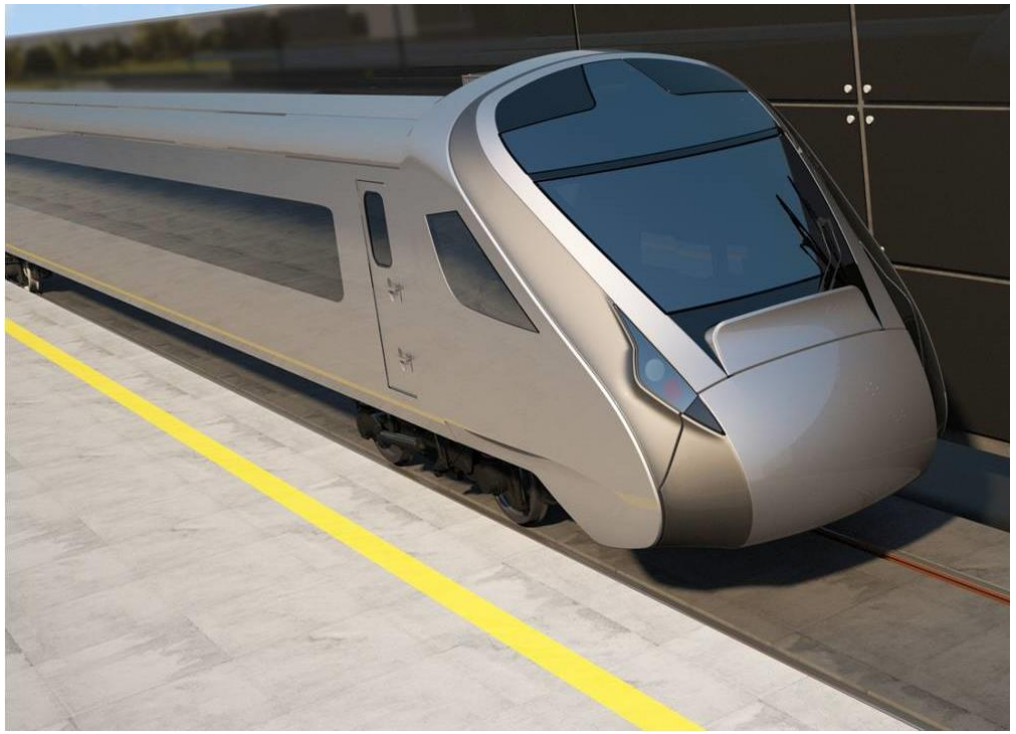
LED Direct Lighting

- ✓ Direct and Diffused Lighting



Continuous
Windows





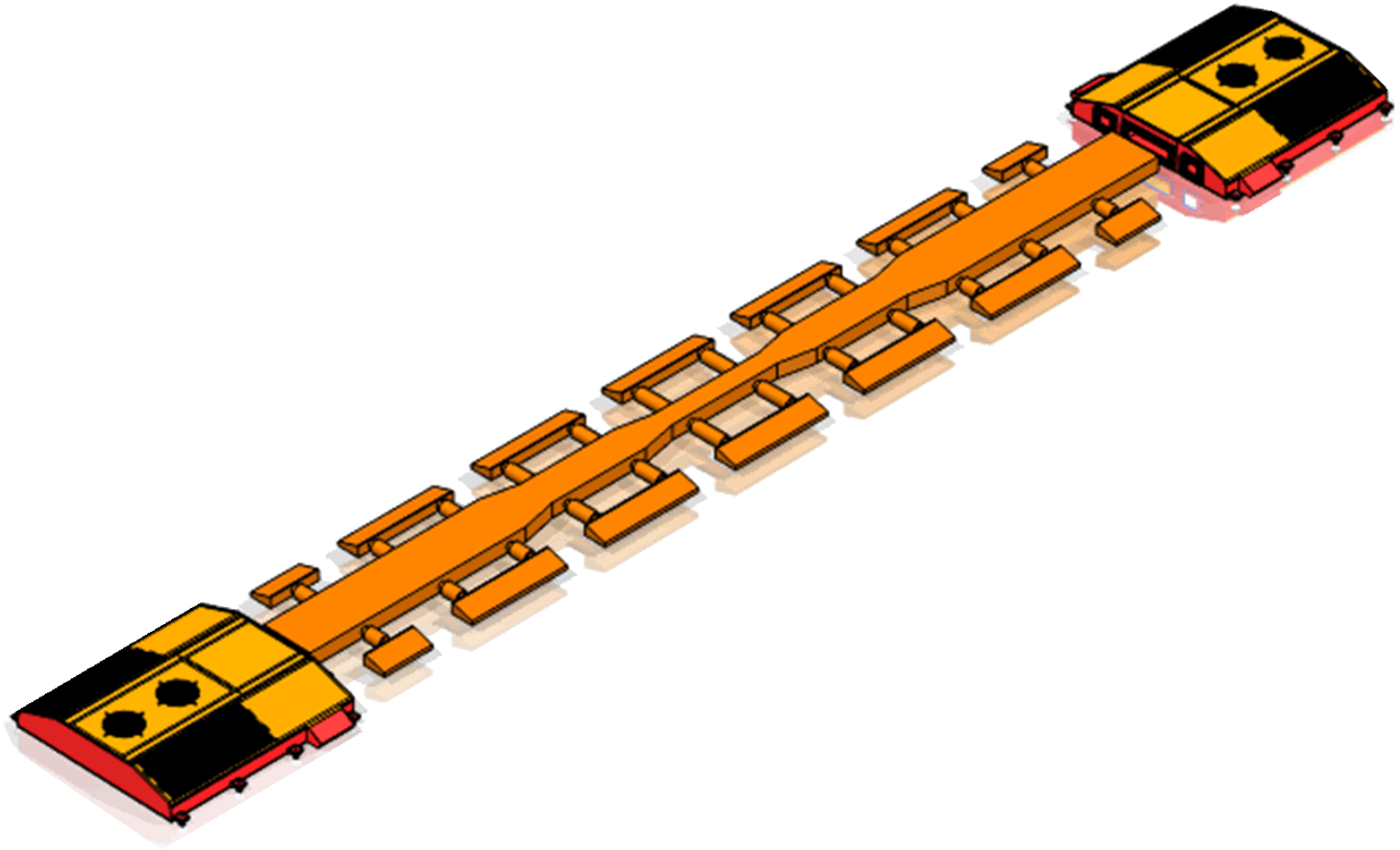
Continuous window glass design with

- Continuous window glass design contains sealed glass unite and pillar glass.
- Provision of emergency window glass unite to use in emergency with glass barker/hammer.

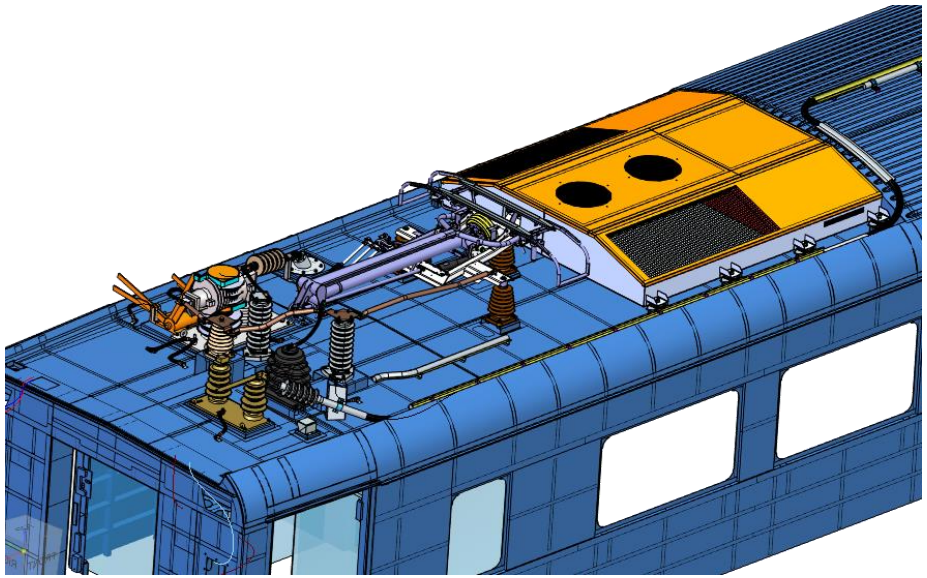
Emergency Passenger communication system

- **Emergency talk back unit for passenger emergency communication.**

AC ducting arrangement

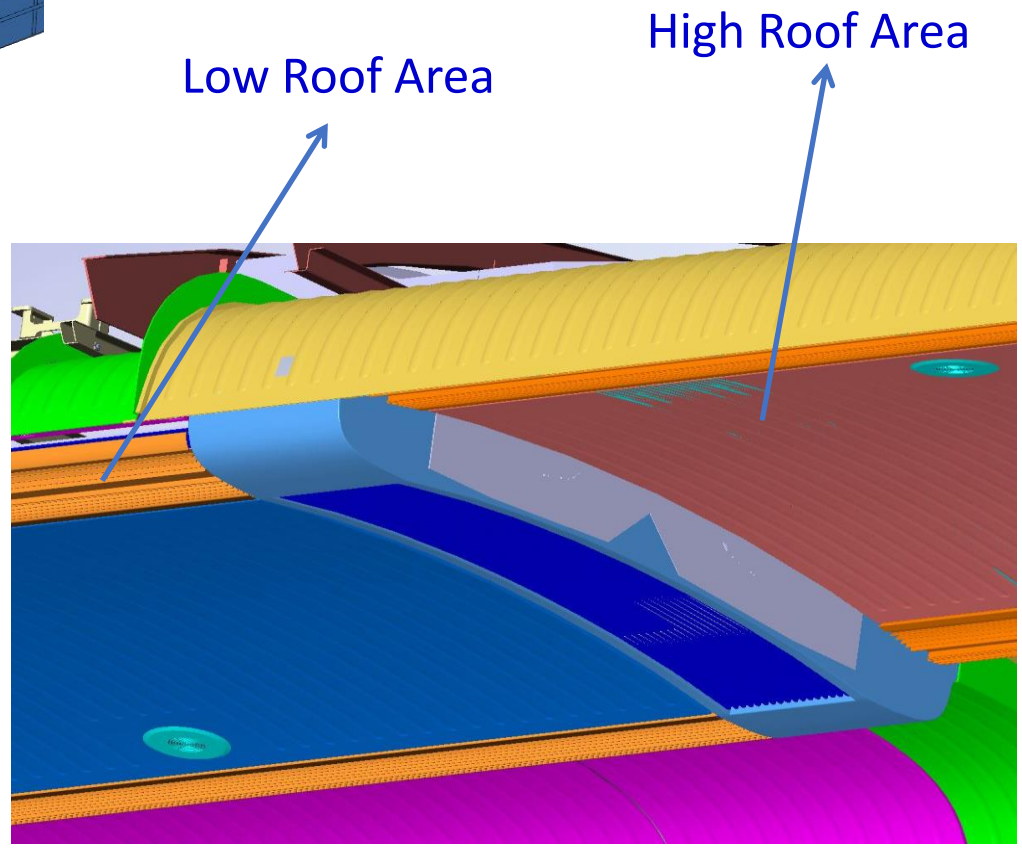


➢**Aluminium AC ducting arrangement with thermal and sound insulation with return air provision.**

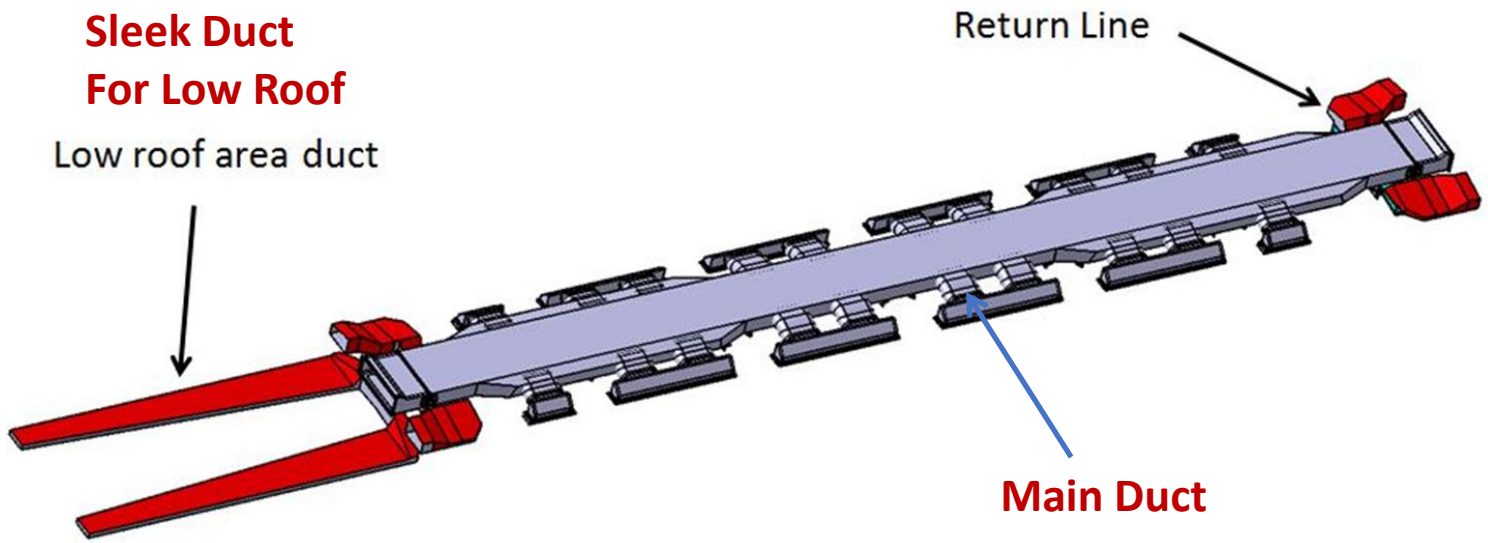


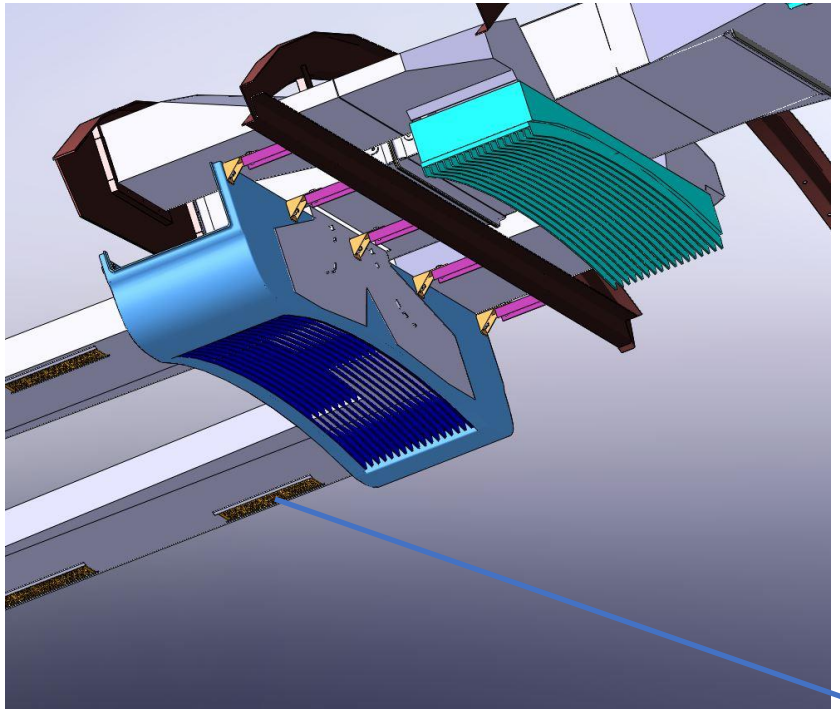
Air Conditioning In Pantograph Coach

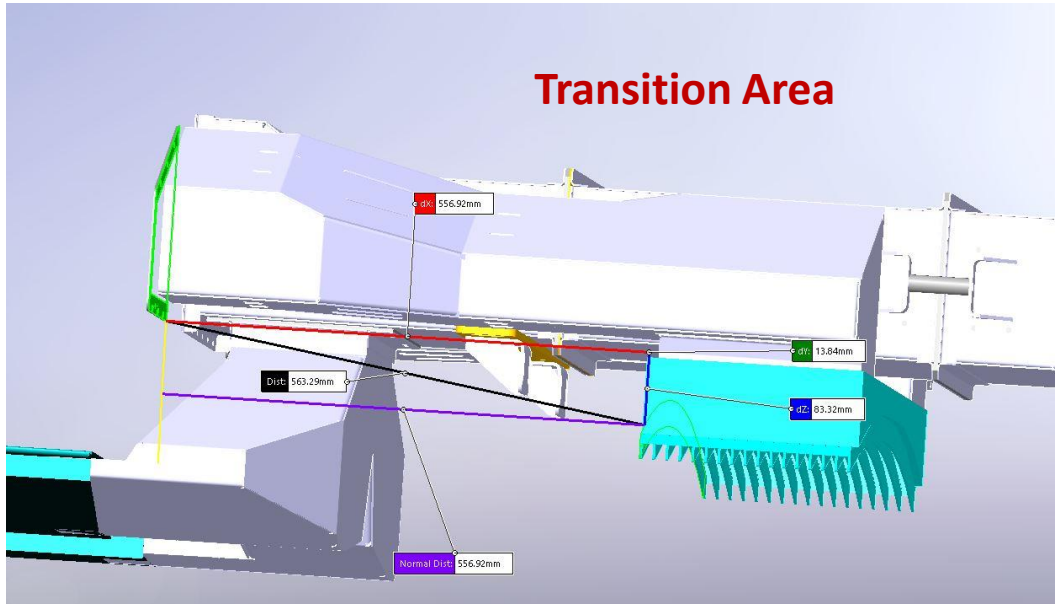
- ✓ Low Head Room Below Pantograph
- ✓ Not feasible to extend the AC duct and also the diffuser element will be not sufficient to provide conditioned Air to low roof area



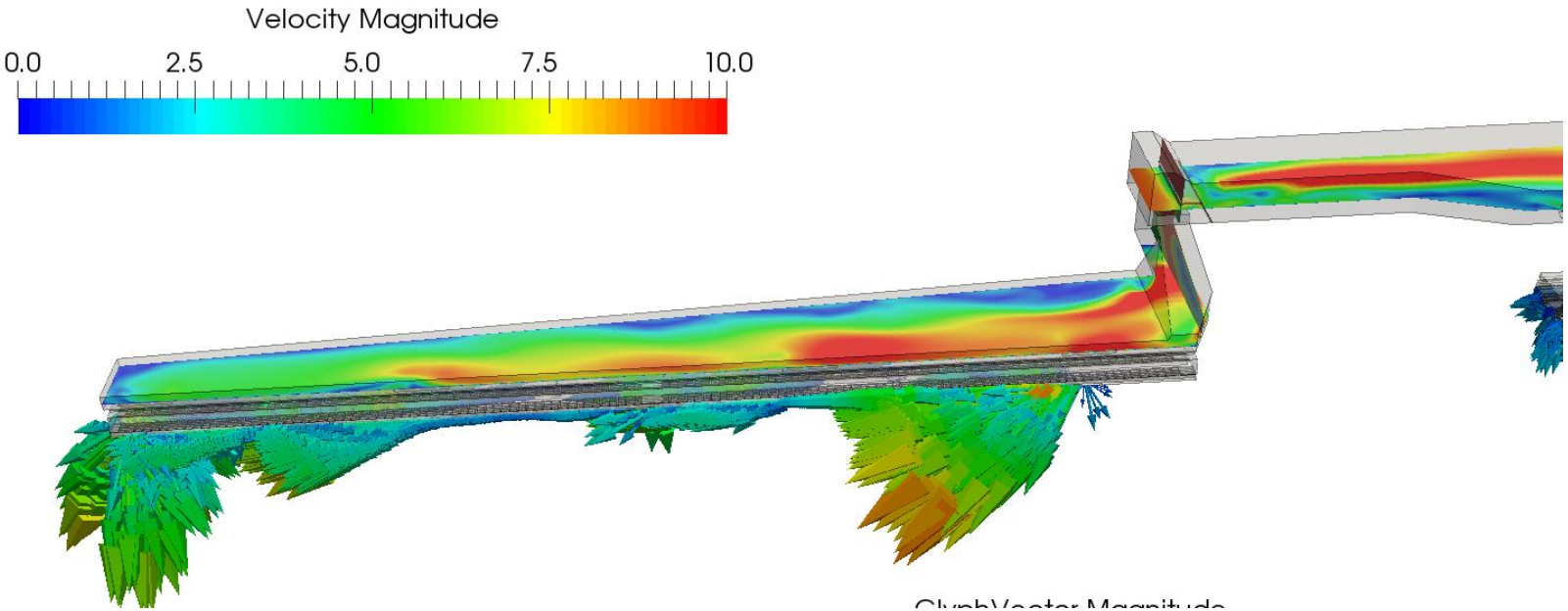
Sleek Duct
For Low Roof





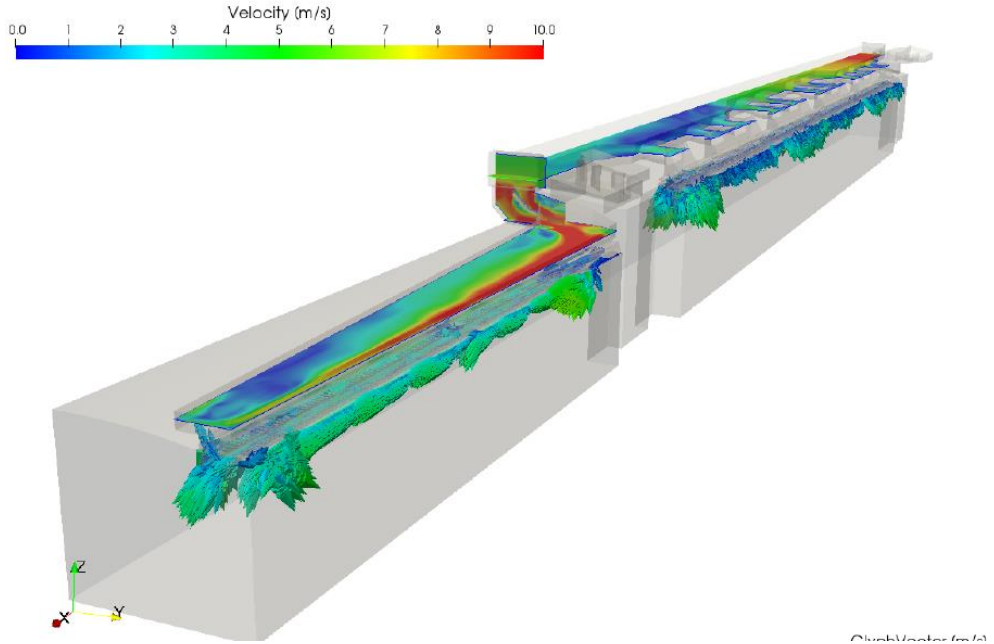


Low Roof Area



CFD Analysis

Final result Noise – Free Air-conditioning



Concealed roller blind

- **Concealed roller blind arrangement for all windows.**

Trainset-Safety features

➢ FRP roof panels with provision of camera, speaker, disaster management light and fire detection system.


Plug door pelmet with entrance camera
Textured doors
Foot step Emergency device


Electrical cubicle doors
Plug door controllers

1st Class

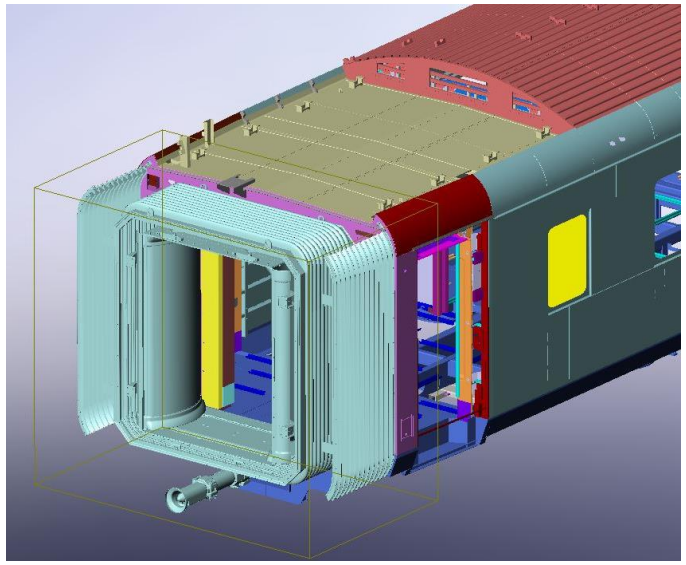
2nd Class

GANGWAYS

SEALED GANGWAYS

Relative movements.	Non-articulated Vehicle connections.
Construction type.	Monobloc Gangway.
Fixation System.	Bolted to Car body shell at one end. Quick Latched at another end via Plate.
Vertical throughway.	1954 mm
Horizontal throughway.	1150 mm
Curve radius at track	R175m
Curve radius in depot	R152.4m

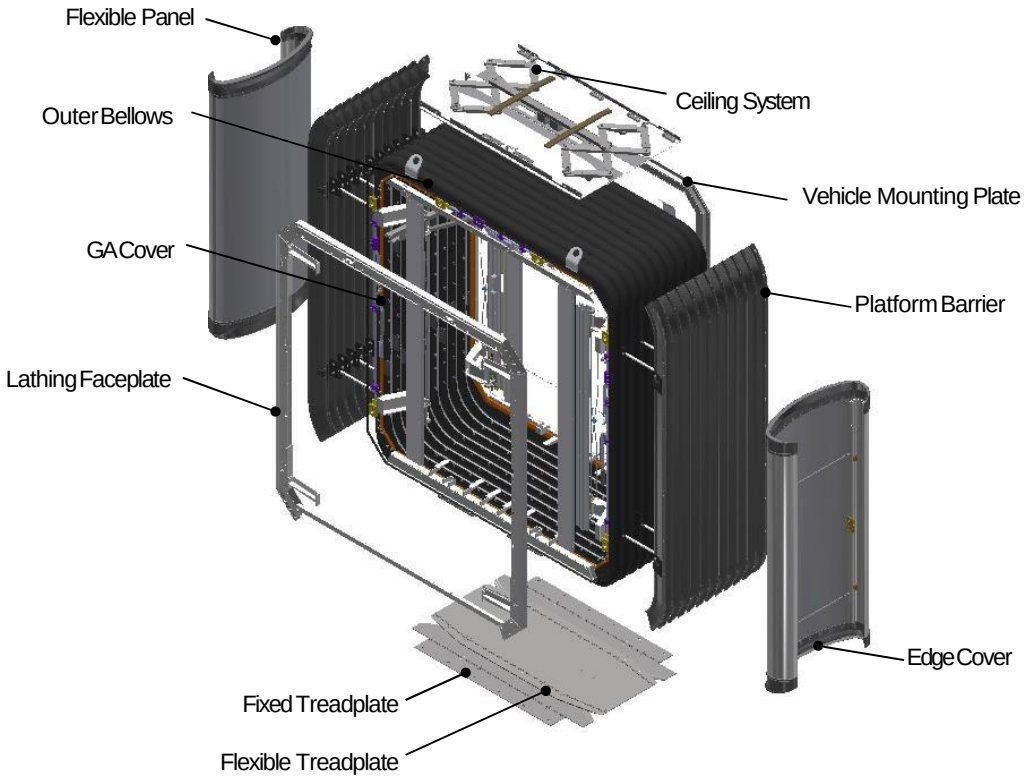
Choice Of Gangway



- ✓ Simple Fully Sealed Gangway Vs Fully Sealed Gangways with Inner and Exterior Fairings
- ✓ For contemporary exterior look as well as for free passenger movement – Gangway with exterior and interior fairings was chosen
- ✓ Mounting of exterior fairing required iterations of changes in Inter Vehicular Electrical Couplers and Roof HT Cable

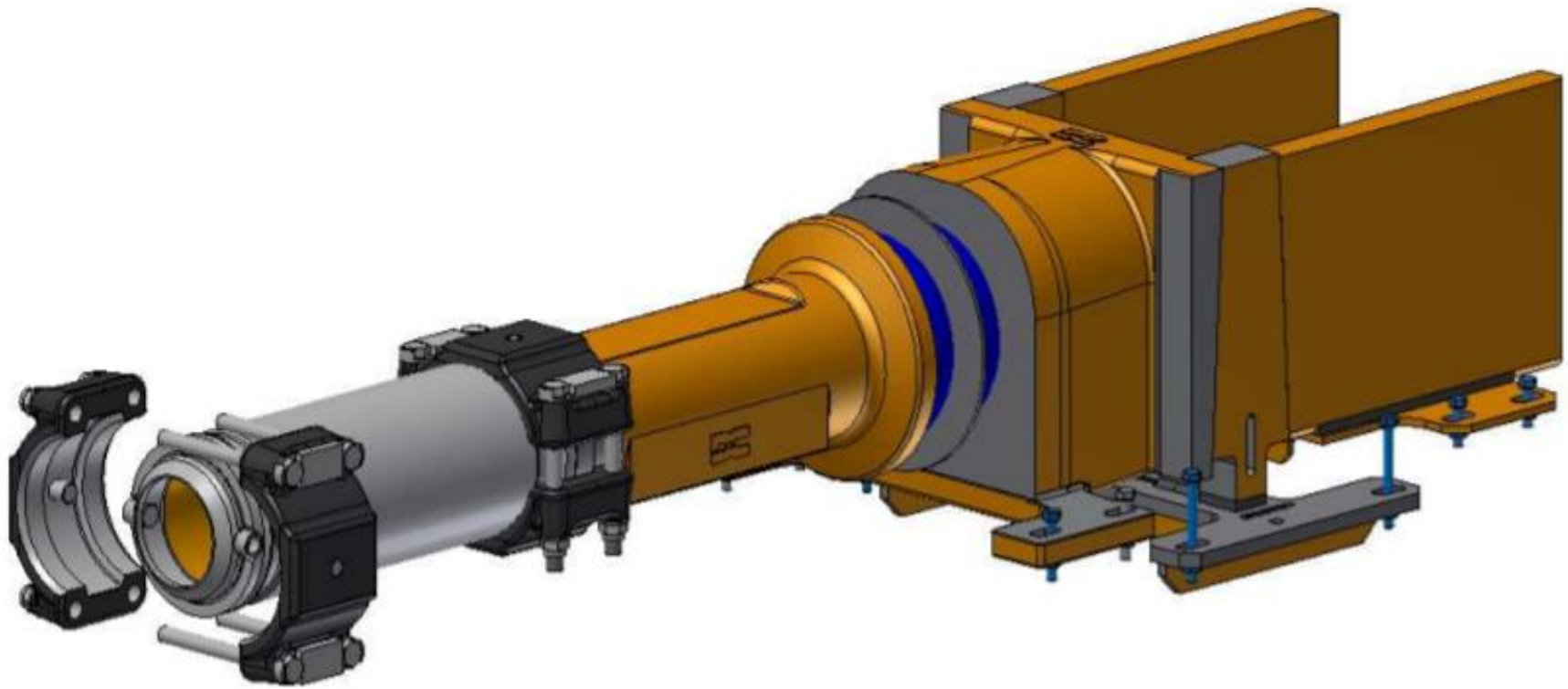
SEALED GANGWAYS

TRAIN18 Gangway Exploded View

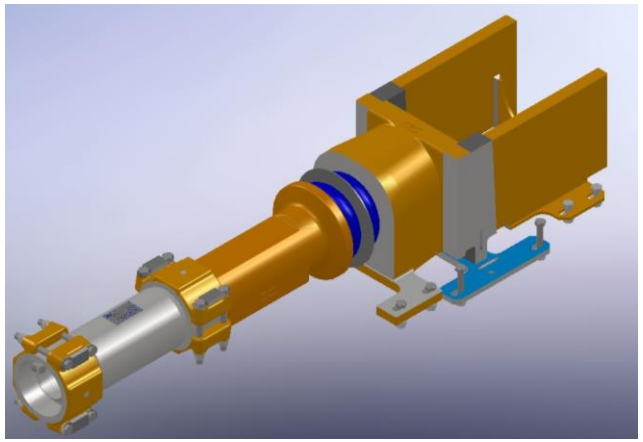


COUPLERS

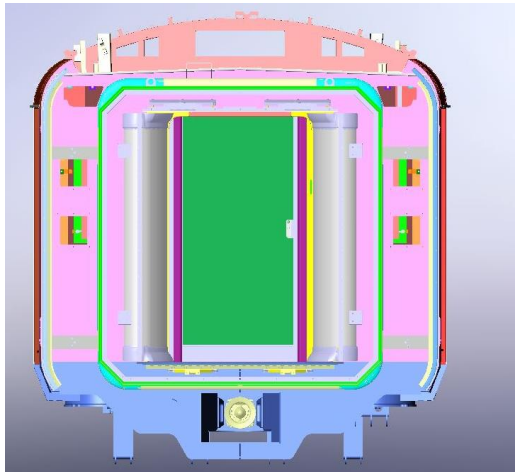
Semi-Permanent Coupler (SPC)

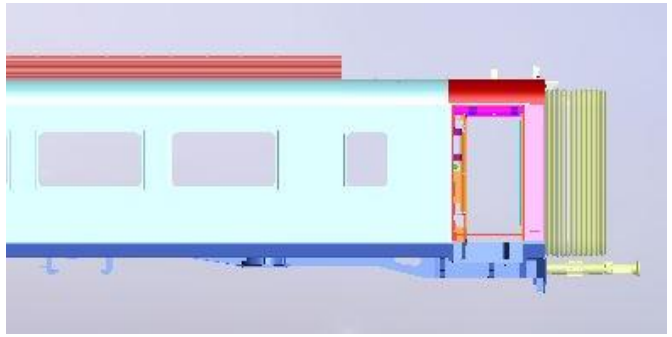


Choice Of Coupler



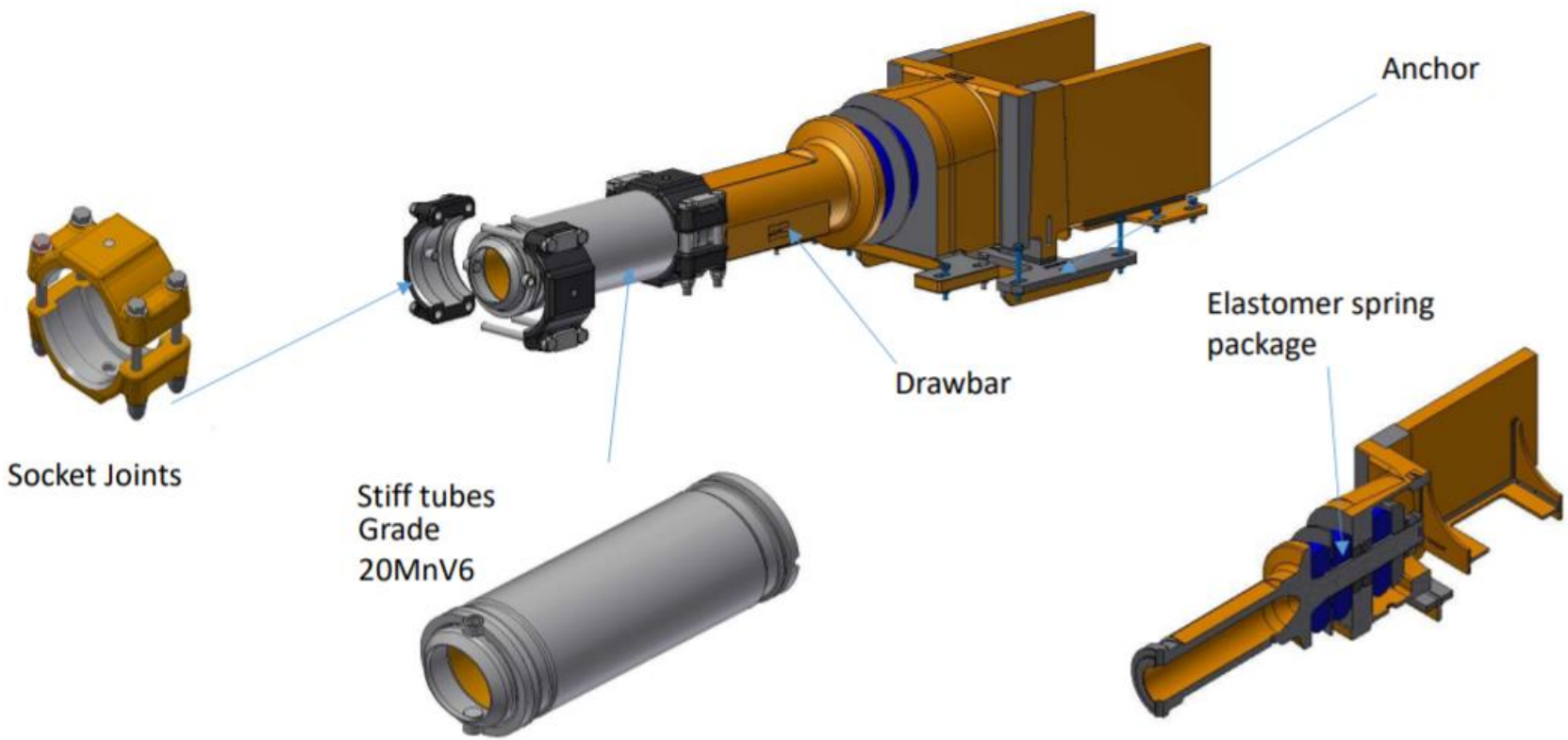
CBC Draft Gear with Semi Permanent Head





- Tight Lock CBC couplers on Passenger Coaches – where jerks are experienced
- Semi Permanent Couplers between Coaches
- In search for Semi Permanent coupler to haul 24 Coaches, ICF zeroed on CBC draft gear with Semi Permanent Head
- The Coupler is developed by M/s Dellner
- To Mount the Fully sealed gangway at the same height of the coach floor (at 1320 mm from rail level), the coupler height has been reduced to 940mm from 1105 mm.
- This required modification of Coupler pocket on the coach

SUB ASSEMBLIES



TCMS – Train Control and Management System

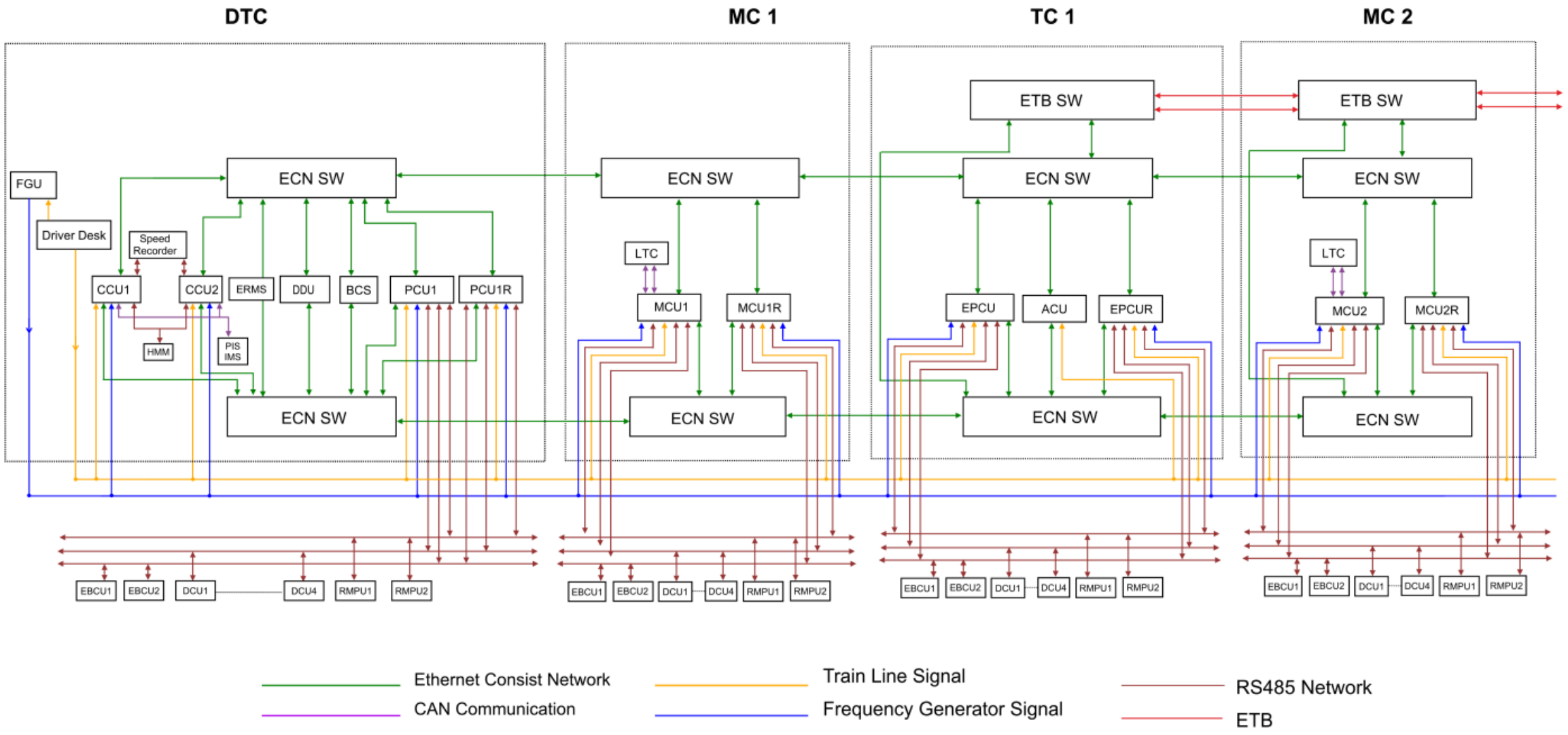
Major Function done by TCMS

- ✓ Interface with Driver Desk
- ✓ Pantograph Control
- ✓ VCB Control
- ✓ Traction Control
- ✓ Regenerative Brake Control and total brake calculation
- ✓ Brake Blending
- ✓ Interface with RMPU control
- ✓ Interface with Door control
- ✓ Interface with Brake control
- ✓ Compressor control
- ✓ Parking Brake control
- ✓ Light Control.

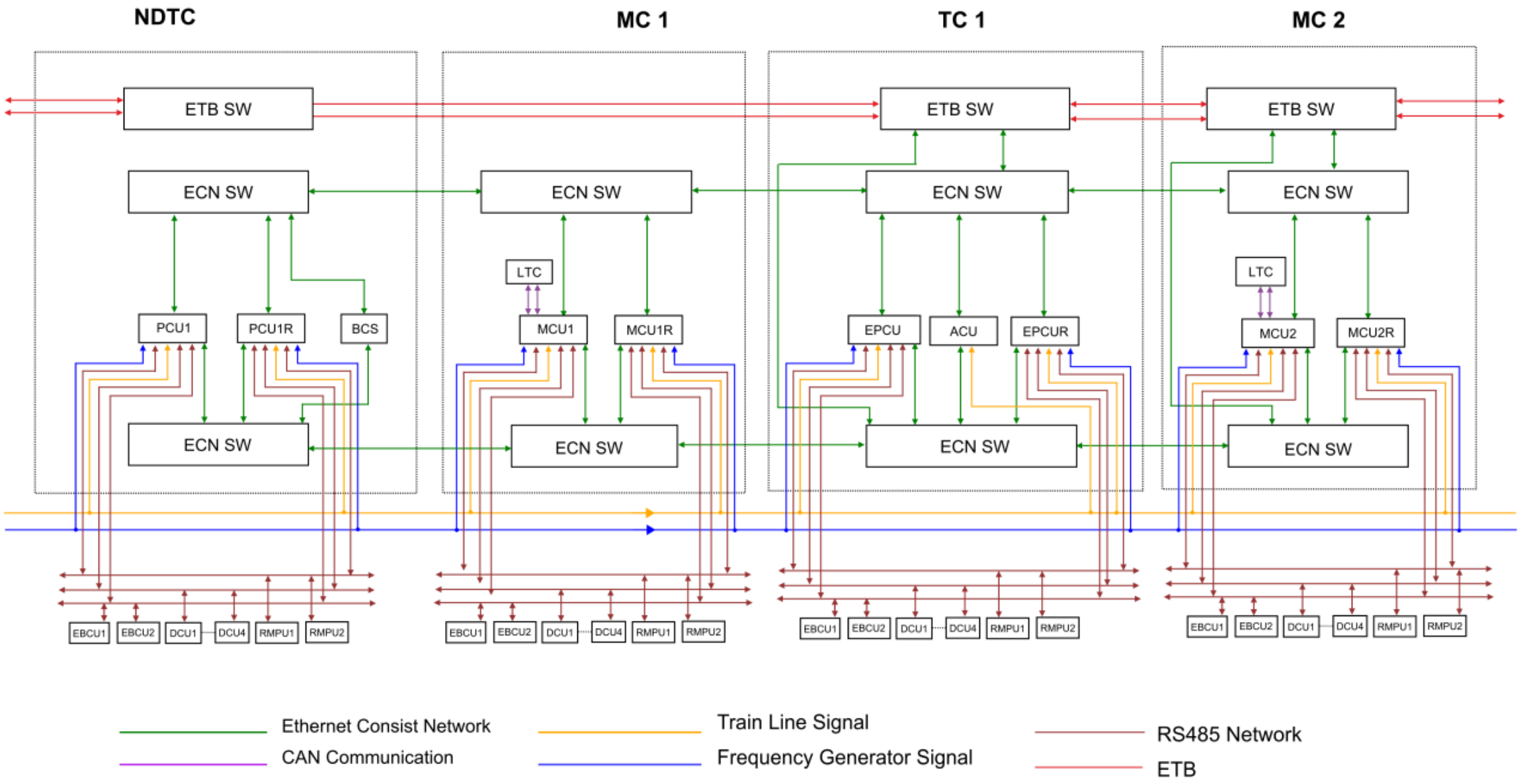
Major Function done by TCMS

- ✓ Rollback Detection
- ✓ Vigilance control
- ✓ Cruise Control
- ✓ Neutral Section Control
- ✓ Test Modes
- ✓ Settings through DDU
- ✓ Event Recording
- ✓ Centralized coach RMPU monitoring system
- ✓ All train level protection (Ex: EOL, EBL, Cab Occupy).

TCMS – End Basic Unit



TCMS – Middle Basic Unit



ECN – Ethernet Consist Network
Utilized for communication within a Basic Unit

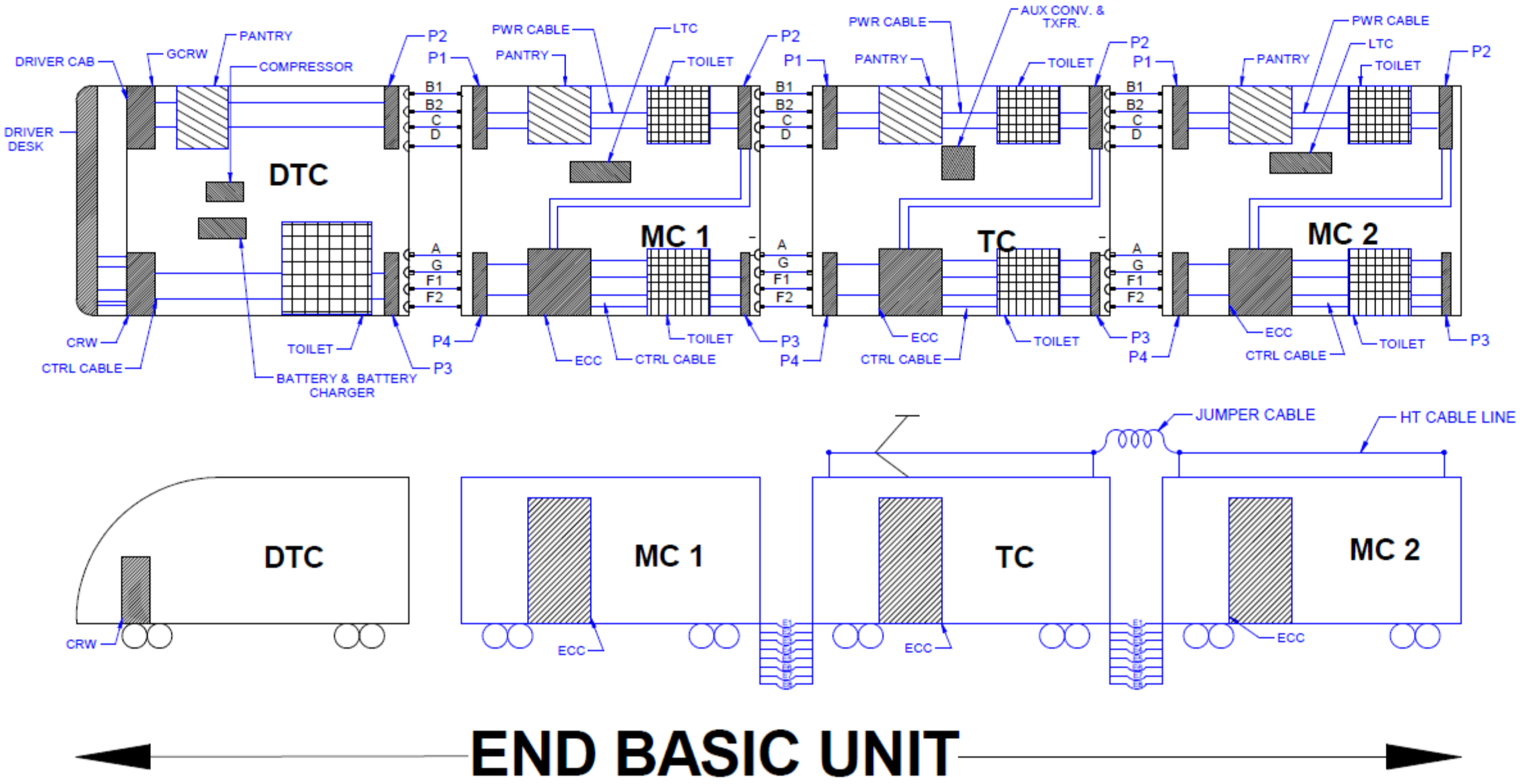
ETB – Ethernet Train Backbone (available in TC1 and MC2)
For inter basic unit communication

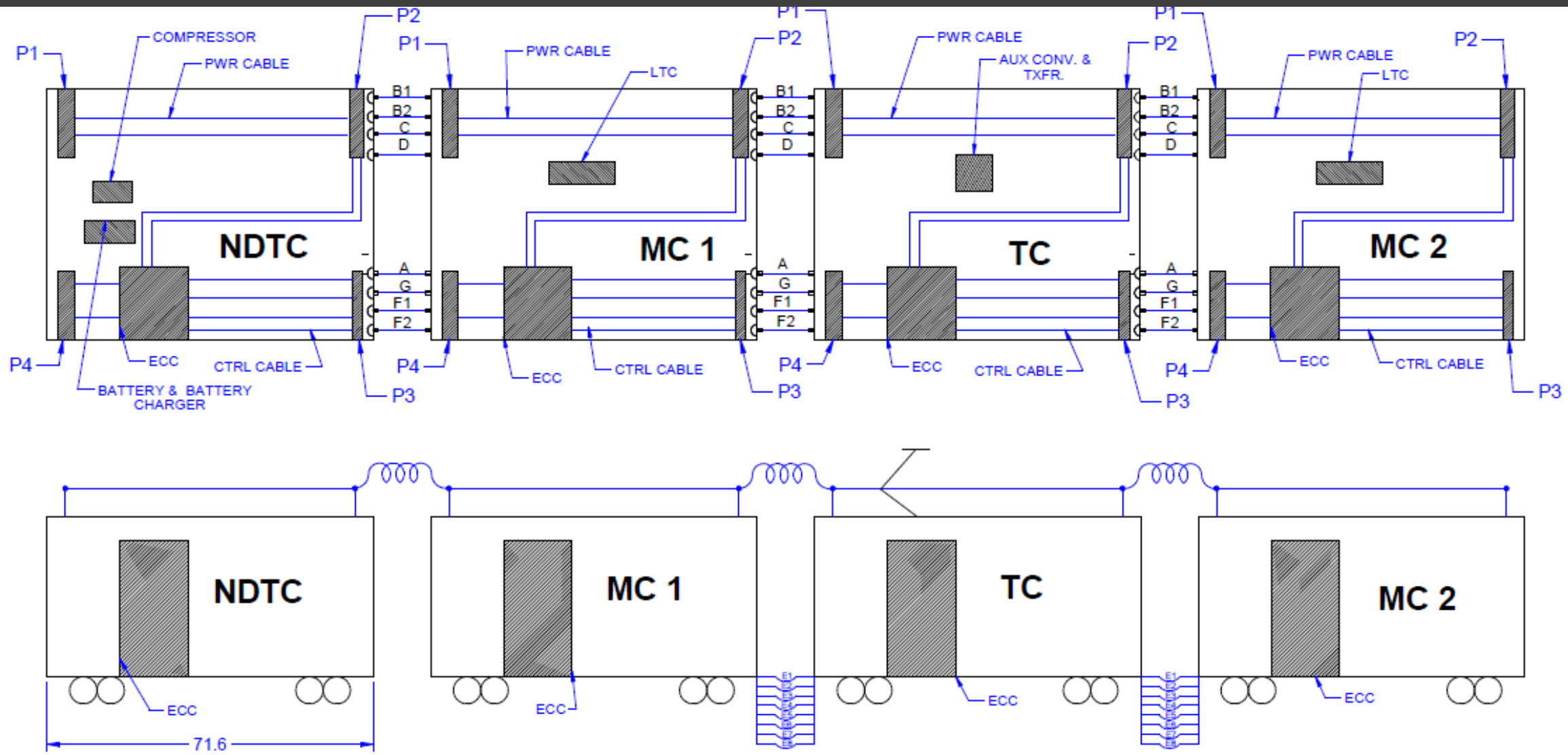
Train Line Signal – Communication network loop which originates from Front DTC and goes to rear end DTC and returns to front DTC. It is connected CCU1, CC2, MCU, ACU.
It enables and indicates connectivity and continuity between Driver desk and all coaches of trainset

FGU – Frequency Generator Unit
If Train Line Signal fails, FGU gets turned on and ensures connectivity between DTC computers and coach computers. In this case Vmax reduces to 100 Kmph. Special Rescue Drive mode.

CAN – Control Area Network
If Both FGU and Train line signal fails, CAN ensures communication
Rescue Drive Mode, Vmax reduces to 60 Kmph

INTER VEHICULAR CONNECTIONS


DRIVER CAB
GCRW
PANTRY
COMPRESSOR
P2
P1
PWR CABLE
PANTRY
LTC
TOILET
P2
P1
PWR CABLE
PANTRY
AUX CONV. & TXFR.
TOILET
P2
P1
PANTRY
PWR CABLE
LTC
TOILET
P2
DRIVER DESK
DTC
MC 1
TC
MC 2
B1
B2
C
D
A
G
F1
F2
CRW
CTRL CABLE
TOILET
BATTERY & BATTERY CHARGER
P4
P3
ECC
CTRL CABLE
TOILET
P3
P4
ECC
CTRL CABLE
TOILET
P3
P4
ECC
CTRL CABLE
TOILET
P3
JUMPER CABLE
HT CABLE LINE
DTC
MC 1
TC
MC 2
CRW
ECC
ECC
ECC
END BASIC UNIT


P1
COMPRESSOR
PWR CABLE
P2
B1
B2
C
D
A
G
F1
F2
NDTC
P4
ECC
CTRL CABLE
BATTERY & BATTERY CHARGER
P3
LTC
MC 1
AUX CONV. & TXFR.
TC
MC 2
71.6
MIDDLE BASIC UNIT

F1 COUPLER	PIN NO.		Cable Sqmm
Description			
PANTO UP TL	ab	1	2.5Sqmm
PANTO DOWN TL	ab	2	2.5Sqmm
MC ON TL	ab	3	2.5Sqmm
MC OFF TL	ab	4	2.5Sqmm
PANTO STATUS TL	ab	5	2.5Sqmm
STATE OF MC TL	ab	6	2.5Sqmm
PANTO/VCB 110V TL	ab	7	2.5Sqmm
CAB OCCUPY REG 110V	ab	8	2.5Sqmm
CAB OCCUPY REG 0V	ab	9	2.5Sqmm
DRIVE CONTROL TL	ab	10	2.5Sqmm
BRAKE CONTROL TL	ab	11	2.5Sqmm
COAST TL	ab	12	2.5Sqmm
FWD TL	cd	1	2.5Sqmm
REV TL	cd	2	2.5Sqmm
CAB OCCPY CAB 1 TL	cd	3	2.5Sqmm
CAB OCCPY CAB 2 TL	cd	4	2.5Sqmm
FREQEUNCY SIGNAL	cd	5	2.5Sqmm
NEUTRAL SECTION TL	cd	6	2.5Sqmm
RDM TL	cd	7	2.5Sqmm
EOL1_110V	cd	8	2.5Sqmm
EOL1_STATUS	cd	9	2.5Sqmm
EOL1_0V	cd	10	2.5Sqmm
EBL 1(1) TL	cd	11	2.5Sqmm
EBL 1(2) TL	cd	12	2.5Sqmm
EBL 1 0V TL	cd	13	2.5Sqmm
EBL BYPASS TL	cd	14	2.5Sqmm
EBL BYPASS 0V TL	ef	1	2.5Sqmm
BAL 110V TL	ef	2	2.5Sqmm
BAL STATUS TL	ef	3	2.5Sqmm
BAL 0V TL	ef	4	2.5Sqmm
SB 2(1) 110V TL	ef	5	2.5Sqmm
SB 2(2) TL	ef	6	2.5Sqmm
SB 2 0V TL	ef	7	2.5Sqmm
V>5KMPH	ef	8	2.5Sqmm
DOOR CLOSE	ef	9	2.5Sqmm
DOOR OPEN RIGHT	ef	10	2.5Sqmm
DOOR OPEN LEFT	ef	11	2.5Sqmm
DOOR WARNING BELL	ef	12	2.5Sqmm
NO MOTION	ef	13	2.5Sqmm
PIS SYN	ef	14	2.5Sqmm
PIS RESET	ef	15	2.5Sqmm
SPARE	ef	16	2.5Sqmm
SPARE	ef	17	2.5Sqmm
SPARE/VCB_TRIP_I/P MC1	ef	18	2.5Sqmm
SPARE/HVPT OP +VE	ef	19	2.5Sqmm
SPARE/HVPT OP -VE	ef	20	2.5Sqmm

F2 COUPLER	PIN NO		Cable Sqmm
Description			
CAB OCCUPY HPT 110V	ab	1	2.5Sqmm
CAB OCCUPY HPT 0V	ab	2	2.5Sqmm
EOL2_110V	ab	3	2.5Sqmm
EOL2_STATUS	ab	4	2.5Sqmm
EOL2-0V	ab	5	2.5Sqmm
EBL 2(1) TL	ab	6	2.5Sqmm
EBL 2(2) TL	ab	7	2.5Sqmm
EBL 2 0V TL	ab	8	2.5Sqmm
DPR 110VDC	ab	9	2.5Sqmm
DPR STATUS	ab	10	2.5Sqmm
PB RELEASE TL	ab	11	2.5Sqmm
PB APPLY TL	ab	12	2.5Sqmm
PB TL 110VDC	cd	1	2.5Sqmm
PB STATUS TL	cd	2	2.5Sqmm
BATTERY MAIN SW ON	cd	3	2.5Sqmm
BATTERY MAIN SW 0V	cd	4	2.5Sqmm
BATTERY MAIN SW OFF	cd	5	2.5Sqmm
PANTO 1&4	cd	6	2.5Sqmm
PANTO 2&3	cd	7	2.5Sqmm
AC OFF	cd	8	2.5Sqmm
AC ON	cd	9	2.5Sqmm
AC 110VDC	cd	10	2.5Sqmm
AC STATUS	cd	11	2.5Sqmm
PAS 110V DC	cd	12	2.5Sqmm
PAS STATUS	cd	13	2.5Sqmm
SM TL	cd	14	2.5Sqmm
SPARE	ef	1	2.5Sqmm
SPARE	ef	2	2.5Sqmm
SPARE	ef	3	2.5Sqmm
SPARE	ef	4	2.5Sqmm

A COUPLER	PIN NO		Cable Sqmm
Description			
ETB MAIN	ab1	1	Cat 5E
	ab1	2	
	ab1	3	
	ab1	4	
ECN MAIN	ab2	1	Cat 5E
	ab2	2	
	ab2	3	
	ab2	4	
AUDIO	C	3	2*0.5Sqmm SCR
	C	4	
PECU	C	5	4X0.5 SQMM
	C	6	
	C	7	
	C	8	
BRAKE(KBI KSN)	C	9	4x0.5 sqmm 120 Ohm Data cable
	C	10	
Ethernet Cable (Spare)	ef1	1	Cat 5E
	ef1	2	
	ef1	3	
	ef1	4	
Main-PIS CAN	ef2	1	2*0.75 DATA CABLE 120OHM
	ef2	2	
G COUPLER	**PIN NO**		**Cable Sqmm**
Description			
ETN REDUNDANT	ab1	1	Cat 5E
	ab1	2	
	ab1	3	
	ab1	4	
ECN REDUNDANT	ab2	1	Cat 5E
	ab2	2	
	ab2	3	
	ab2	4	
AUDIO	C	3	2*0.5Sqmm SCR
	C	4	
PECU	C	5	4X0.5 SQMM
	C	6	
	C	7	
	C	8	
BRAKE(KBI KSN)	C	9	4x0.5 sqmm 120 Ohm Data cable
	C	10	
CCTV NETWORK	ef1	1	Cat 5E
	ef1	2	
	ef1	3	
	ef1	4	
Redundant-PIS CAN	ef2	1	2*0.75 DATA CABLE 120OHM
	ef2	2	

B1 COUPLER	PIN NO		Cable Sqmm
Description			
415 VAC R phase	ab	1	50Sqmm
415 VAC Y phase	cd	1	
415 VAC B phase	ef	1	
B2 COUPLER	**PIN NO**		**Cable Sqmm**
Description			
415 VAC R phase	ab	1	50Sqmm
415 VAC Y phase	cd	1	
415 VAC B phase	ef	1	
D COUPLER	**PIN NO**		**Cable Sqmm**
Description			
110DC BN	cd1	1	35Sqmm
110DC BN	cd2	1	
110DC BN GND	ef1	1	
110DC BN GND	ef2	1	
C COUPLER	**PIN NO**		**Cable Sqmm**
Description			
110 V DC BD	ef1	1	25Sqmm
110 V DC BD GND	ef2	1	
P1 COUPLER	**PIN NO**		**Cable Sqmm**
Description			
1200VAC Txfr. Sec	ab	1	120Sqmm
1200VAC Txfr. Sec	cd	1	
P2 COUPLER	**PIN NO**		**Cable Sqmm**
Description			
1200VAC Txfr. Sec	ab	1	120Sqmm
1200VAC Txfr. Sec	cd	1	
P3 COUPLER	**PIN NO**		**Cable Sqmm**
Description			
1200VAC Txfr. Sec	ab	1	120Sqmm
1200VAC Txfr. Sec	cd	1	
P4 COUPLER	**PIN NO**		**Cable Sqmm**
Description			
1200VAC Txfr. Sec	ab	1	120Sqmm
1200VAC Txfr. Sec	cd	1	

THANK YOU