FR Composites for Mass Transport Application

Webinar Organised by FRP Institute, India
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DELIVERING THE FUTURE OF COMPOSITE SOLUTIONS

Agenda

- **Indian Metro Rail Projects & Opportunities**
- **Gurit product offering for Metro Rail Industry**
-
- **Examples of Metro parts utilizing Gurit's technologies**
- **Indian Rail Projects & Opportunities**
- **Challenges in Indian Mass transfer composite Industry**
- **About Gurit**

1) Metro Rail Projects in INDIA

OPERATIONAL METRO	UNDER CONSTRUCTION METRO	UNDER PLANNING METRO
DELHI METRO	NAVI MUMBAI METRO	GUWAHATI METRO
NOIDA METRO	BHOPAL METRO	LUDHIANA METRO
MUMBAI METRO	INDORE METRO	KOZHIKODE METRO
CHENNAI METRO	KANPUR METRO	SURAT METRO
BANGALORE METRO	MEERUT METRO	SRINAGAR METRO
GURGAON METRO	PUNE METRO	VAJAYAWADA METRO
KOLKATA METRO	AGRA METRO	VARANASI METRO
AHMEDABAD METRO	PATNA METRO	VISAKHAPATNAM METRO
KOCHI METRO	MUMBAI METRO - 2 & 3	UTTARAKHAND METRO
HYDERABAD METRO	CHENNAI METRO - II	GWALIOR METRO
LUCKNOW METRO	DELHI METRO - IV	THIRUVANANTHAPURAM METRO
JAIPUR METRO		
NAGPUR METRO		

Opportunities In INDIA for Composite Parts in Metro Rail

Metro Rail Cars requirement till 2025

- Most of the under construction Metro will be in operation by 2025.
- The Total Metro Cars required for under construction Metros will be more than 1700.
- Most of them will be with FR Composite interiors.

Current Scenario for Metro Rail Car Manufacturing

- Metro Rail Car Manufactured in India using imported light weight composite parts.
- Under make India program currently Export quality light weight composite parts with EN45545 HL3 compliance, are being manufactured in India by composite part manufacturers.
- Aluminium interior parts are also being used in India.

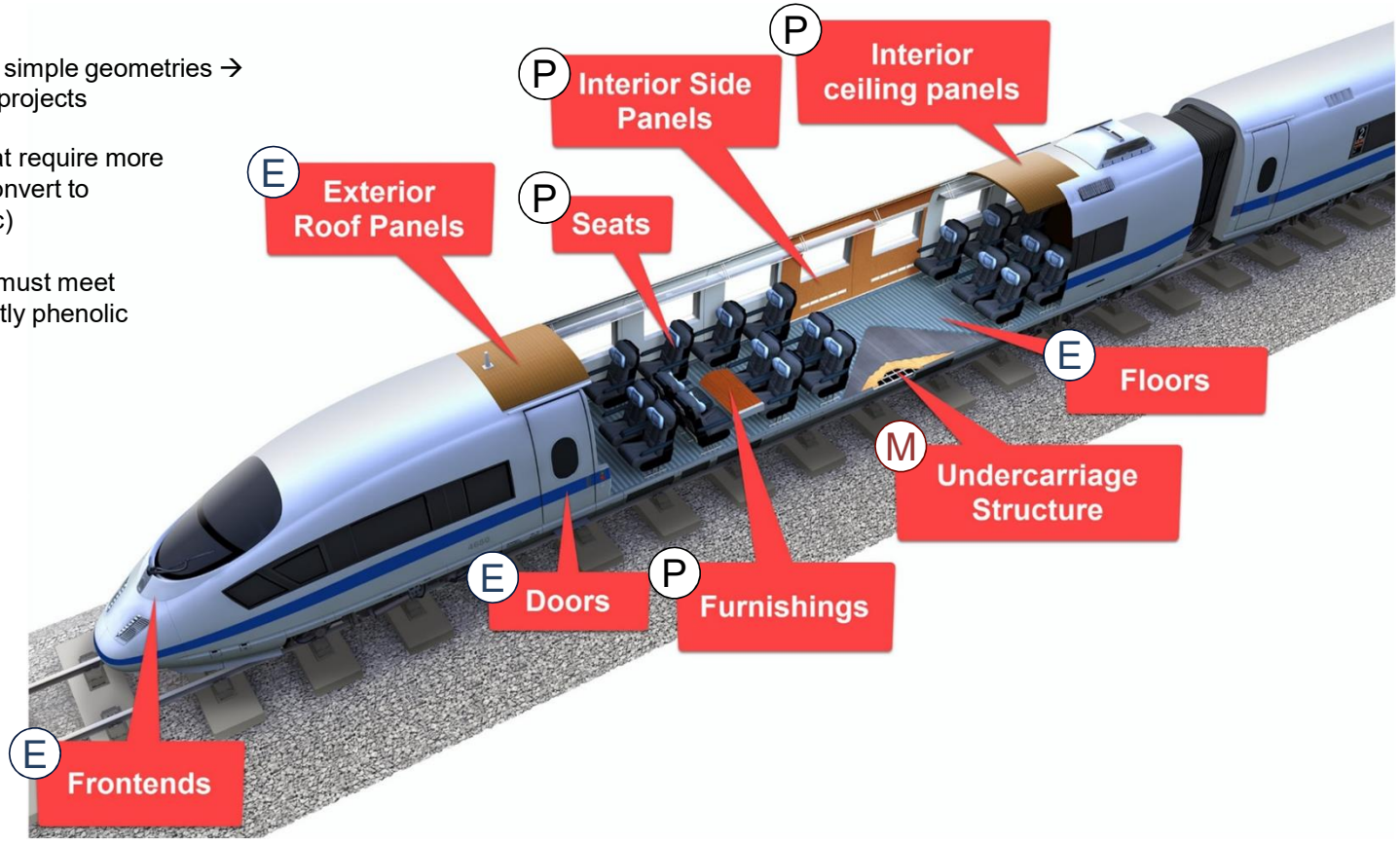
Rail applications

Time / Complexity

E External components with simple geometries → existing epoxy composite projects

M Structural components that require more complex engineering to convert to epoxy (cannot be phenolic)

P Internal components that must meet EN45545 HL2/3 → currently phenolic for HL3 & epoxy for HL2



Metro Rail Interior composite parts

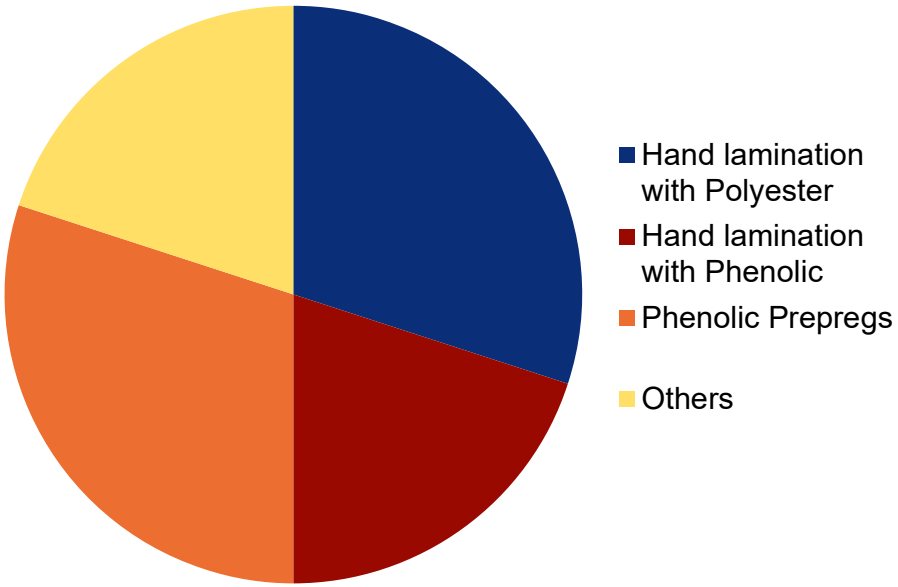
Interior Parts -

- Side walls
- Side ceiling panels
- Doors
- Front end
- Driver desk

Side wall panels

Front End

Metro Interior Composite Manufacturing Process



Phenolic Prepreg Manufacturing Details

- Approx Interior Surface area per car – 100 Sqr Mtr
- The composite sandwich panel should use Nomex Honeycomb core.
- The Avg. panel weight should be 4 Kg/m2.
- The panel should qualify for EN45545 HL3 fire specification.

Gurit Products for Metro Rail Applications

Core Materials

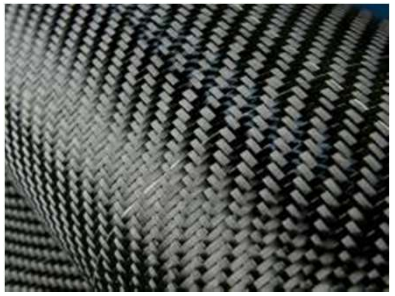
- Kerdyn Green FR™, a highly adaptable, recyclable foam from recycled PET (GREEN)
- Balsaflex™, a classic end-grain balsa wood core with good FST properties

Prepreg / SPRINT™

- PH840 → Phenolic
- 130FR → Epoxy
- PN900 & PN901 → Cyanate Ester

Adhesives

- Spabond™ range → Epoxy



Meeting FR Standards: Interior & Exterior applications

Prepreg / SPRINT™

- 130FR Epoxy → EN 45545 (R1/HL2 and R7/HL2-3)
- PH840 Phenolics → EN 45545 (R1/HL3)
- PN900 & PN901 Cyanate ester → EN 45545 (R1/HL3)

Either in monolithic application and in use with Kerdyn Green FR PET sandwich solution

Gurit‘s Phenolic Prepregs for Rail Applications

Features of Gurit PH 840 Prepregs

- Excellent Fire, smoke & toxicity (FST) behaviour
- Excellent mechanical properties
- Good Surface Finish
- Short Curing cycles, e.g. 15 minutes / 160°C
- Cost efficient Autoclave-free process possible
- Long shelf and shop life

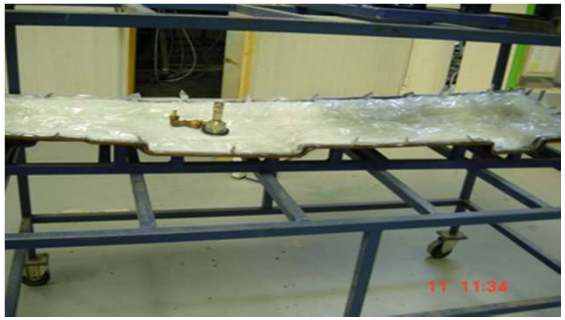
PH840 Prepreg Classification according to FST Standards

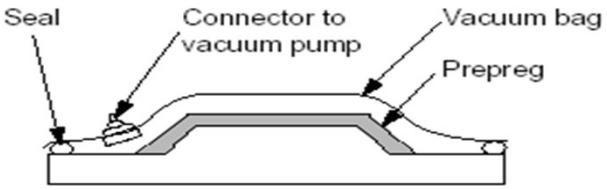
Standard	PH 840 Phenolic Prepreg with 60% by weight glass fabric
DIN 5510 Germany	S 4, SR 2, ST 2 (Sandwich with PVC foam)
NFF 16-101/102 France	M1, F1
UNE 23-721 Spain	M1
BS 6853 Great Britain	R. 025
DIN EN 45545-2 Europe	HL3 Smoke Toxicity/Density, Heat-Release, Flame Spread
BS 476-6 & 7	Class 1

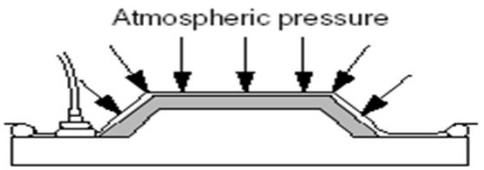
DIN EN 45545 HL3 Vs PH840

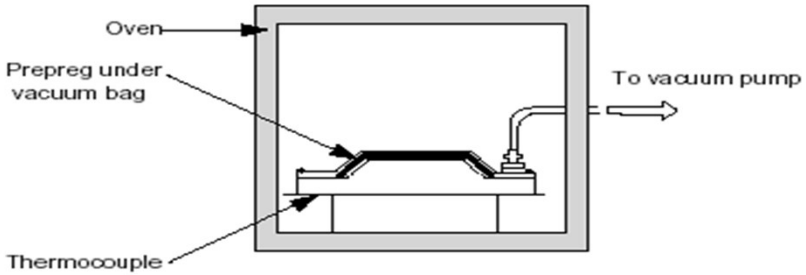
Standard	Unit	HL3	PH 840 Laminate	PH 840 Sandwich
			3 mm, 6 kg/m²	3 mm, 1,5 kg/m²
Flame spread T02 ISO 5658-2	CFE KW/m²	min. 20	> 50	35,7
Heat release T03.01 ISO 5660-1	Mahre KW/m²	max. 60	40,55	29,06
Smoke density T10.01 EN ISO 5659-2	Ds (4)	max. 150	16,84	68,25
Smoke density integral T10.02 EN ISO 5659-2	VOF4 min	max. 300	12,48	143,12
Toxicity T11.01 EN ISO 5659-2	CIT G	max. 0,75	0,0878	0,1481

Out of Autoclave Vacuum Bagging process for PH840







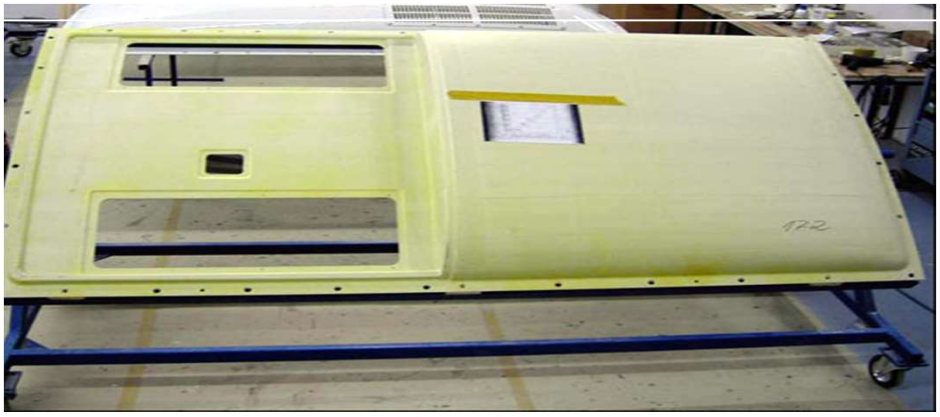


- Manufacturing of complex parts
- Option for economic tooling (e. g. composite-tools); low investment
- Excellent mechanical properties due to specific fibre placement and local reinforcement
- Direct use of different core materials

Parts Made with PH840 prepregs

Front end, Combino, Portugal

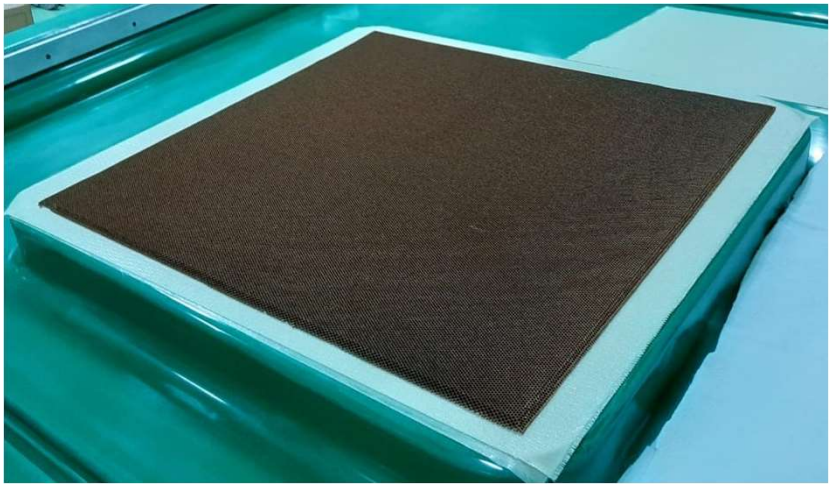
Manufacturing with PHG 840



Air Condition Fairing, Sandwich, ICE3

Cockpit DMU, UK

Parts Made with PH840 prepregs



Prototype parts by Indian composite parts manufacturer

Parts Made with PH840 prepregs

Ceiling Panel - PHG 840-300-42 Sandwich

CRH5 Train, Alstom & CRC, China

Parts manufactured with -

- PHG 840
- PF 807 Prepregs
- PN 900 Prepregs

Epoxy SPRINT™ - Industrial Production Method

SPRINT™- What is it?

"Composite sandwich"

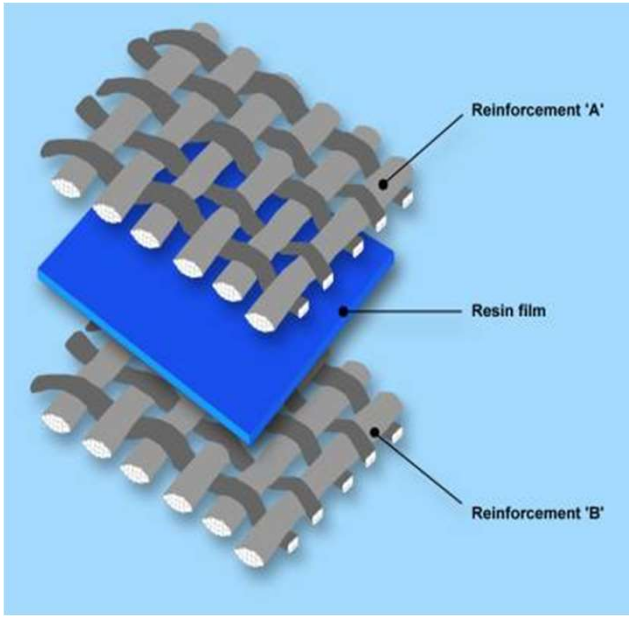
- Fabric = bread
- Resin = filling

How does it work?

- Uses ability of dry reinforcing fibers to transport air

What are the benefits?

- High conformability
- High deposition rates
- Autoclave quality from vacuum-bag processing
- No De-bulking required



ST130FR SPRINT™ - Cost Saving Solution

No gelcoat

- No gelcoat paint booth and equipment required
- Minimal to no movement of moulds in production
- Minimal mould occupation time

No Styrene chemistry

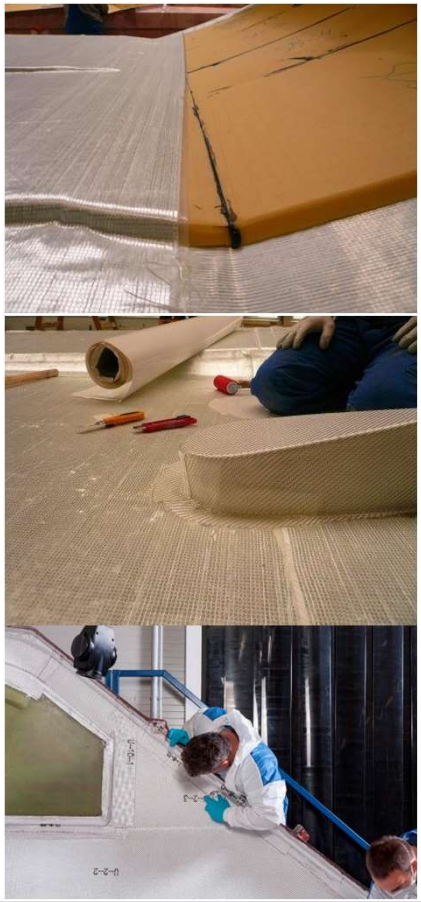
- No costly air extraction and cleaning

Ability to eliminate filling & fairing

- FR surface films in-situ provide basis for priming/painting -> low weight

Easy lay-up

- Heavy plies for high deposition rate, reducing labor cost
- “One-Hit” application (no debulking), cuts time and reduces weight



ST130FR SPRINT™ - Cost Saving Solution

Self-adhesive to foam cores

- Removal of additional adhesive film layers

Forgiving processing

- Resin travels fractions of mm, not x meters
- As convenient as dry fabric (drape)
- Cure temperature down to 85° C/6hrs

Simple vacuum process

- Classic peel ply / perf. film / breather / vacuum bag application
- No “flow strategy” required

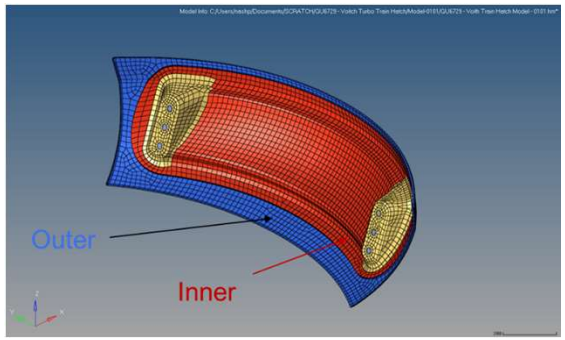
Out-of-autoclave

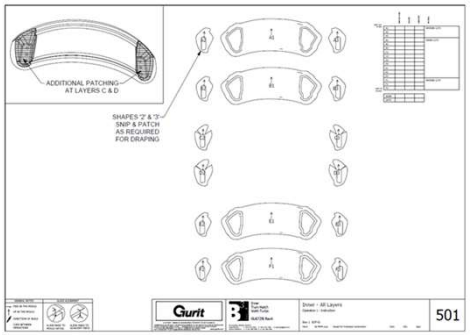
- Only temperature cure
- Permanent or mobile oven
- Simple monolithic moulds
- High laminate quality, air void content ≤ 1,5%
- High TG, stable paint surfaces

130FR : Voith Turbo – Front Hatch Redesign

CONFIDENTIAL

- Voith were impressed with SPRINT™ system
- Potential opportunity to make 2.5 x 1.5m side hatches for bogie power plant





- Inner 3.5kg
- Outer 4.4kg
- **SPRINT 130FR Total 7.9kgs**
- **Infused version 12.7kg**
- **Wet Lam version 22kg**

The Hatch Project – Benchmarking Technologies

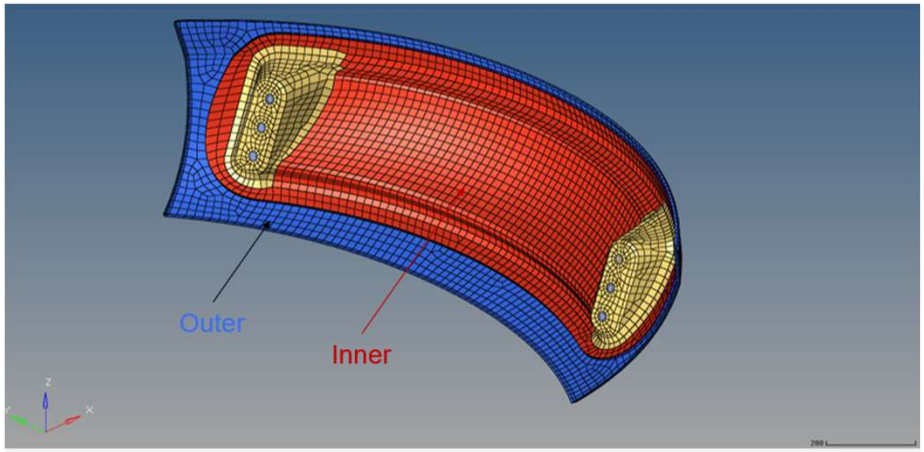
Gurit Products used

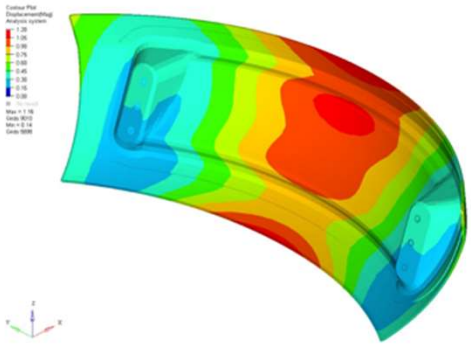
130FR Glass SPRINT™
Kerdyn™ Green FR
Spabond™ 545 Adhesive
SP4832 mono component paste

Gurit Services used

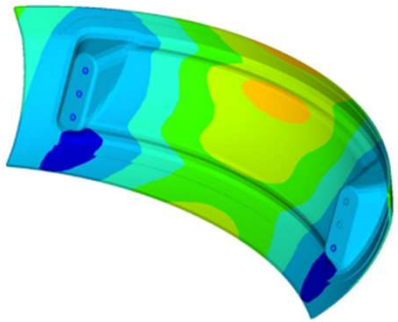
Gurit Engineering
Smartpac kitting
On-site Technical Support

Engineered to be:
Lighter (22kg → 7.5kg)
Stiffer (29% less displacement)





Current Wet lam component

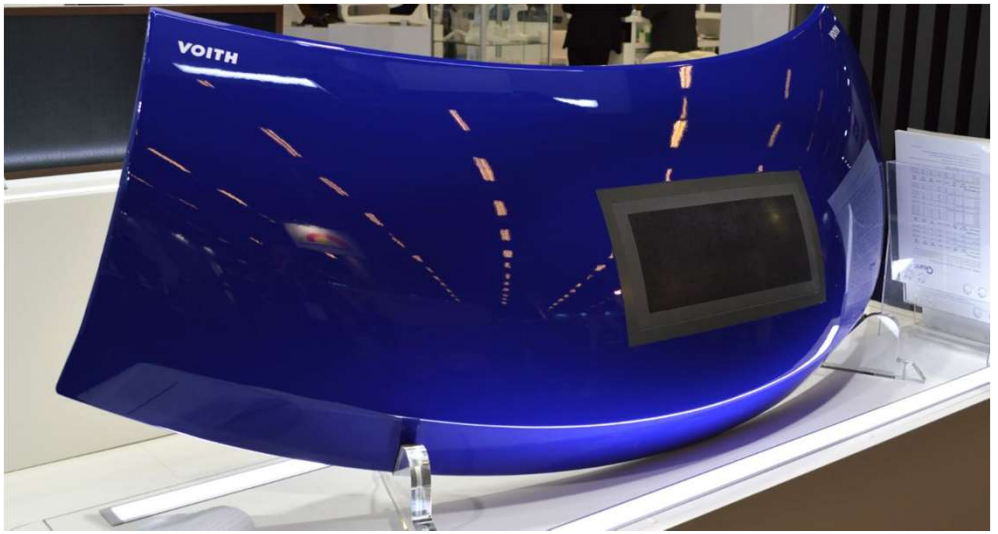


Gurit Engineered SPRINT Component

The Hatch Project – 130FR SPRINT™

The Hatch Project – 130FR SPRINT™

The Hatch Project – 130FR SPRINT™



2) Indian Rail Projects in India

Indian Rail is manufacturing their different type of coaches in three manufacturing units in India.

- Rail Coach Factory, Kapurthala (RCF)
- Modern Coach Factory, Raebareli (MCF)
- Integrated Coach Factory, Chennai (ICF)

Indian Rail done technology transfer collaboration with Linke Hofmann & Busch (LHB) in 2000 & then started manufacturing light weight coaches in India. The current manufacturing of LHB coaches across all three factories are –

Sr No	Coach Factory	LHB Coaches produced		
		2017-18	2018-19	2019-20
1	RCF	659	782	1000
2	MCF	711	1425	1930
3	ICF	2277	3200	4300

Composites Parts for Indian Rail

Interior Parts -

- Side wall
- Roof / Ceiling
- Modular Toilets
- Window shutters
- Partition walls
- Door cover

Side Walls

Modular Toilets

Manufacturing Process –

- UPR hand lamination – monolithic
- RTM with UPR – monolithic

Fire Specification –

Resistance to spread of flame – Class A or B – UIC 564-2
Critical Oxygen Index – 28% min – ASTM D – 2863
Toxicity – 1.25 max – NCD-1409
Smoke Density – Class A or B – UIC 564-2

FRP Part Details

Modular Toilets -

Composite weight of one Modular Toilet is 150 ± 10 Kgs

Number of modular Toilets / Coach = Avg 3 nos (some coaches need 2 toilets, some 3 & some 4 nos)

Manufacturing Process – Hand lamination with UPR

Glass Content by weight – 35% (min)

Side Walls –

Composite weight of one set of Side walls – 400 Kg (approx 60 to 80 Sqr Mtr per coach)

Manufacturing Process – Hand lamination with UPR

Glass Content by weight – 35% (min)

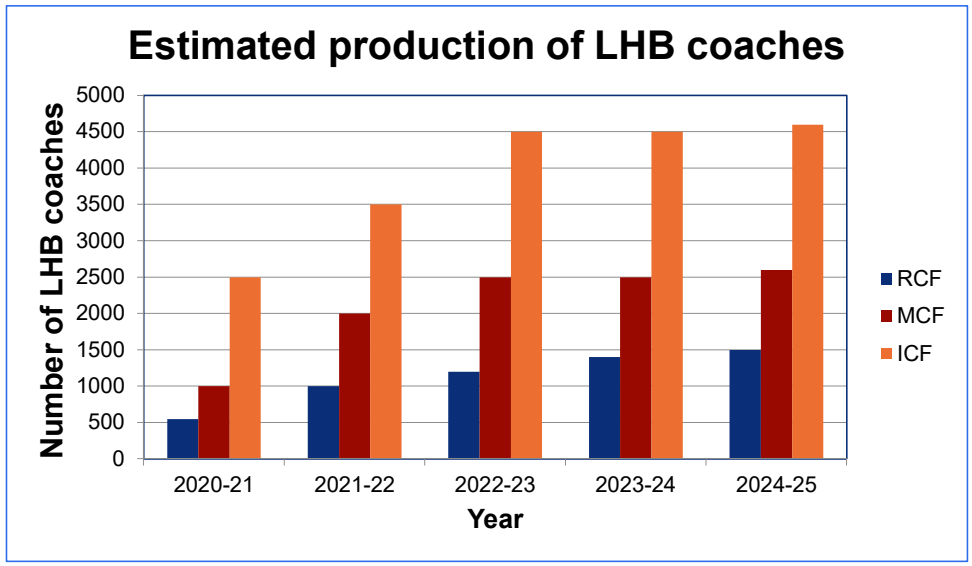
Ceiling Panels –

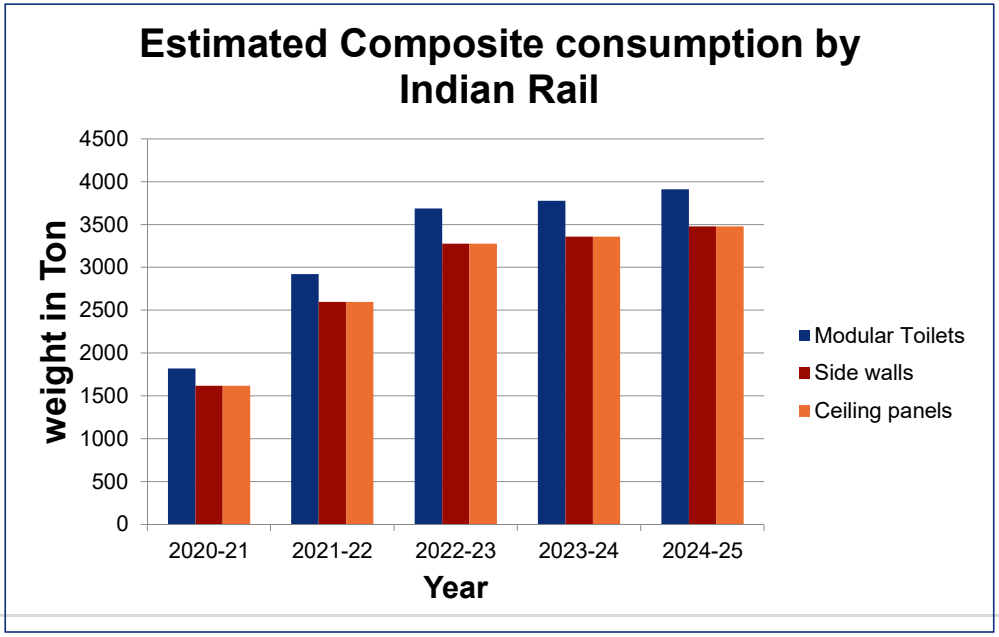
Composite weight of one set of Side walls – 400 Kg (approx 60 to 80 Sqr Mtr per coach)

Manufacturing Process – Hand lamination with UPR

Glass Content by weight – 35% (min)

Estimated Composite Requirement for LHB Coach





The Future Of Composites In Rail

Mature industry demands lightweight components and cost-effective industrialized production with the aim of automisation

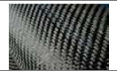
▪ Increasing traffic volumes	→	Lightweight solutions
▪ Increasing energy efficiency	→	Lightweight solutions
▪ High attractiveness of carriers	→	Futuristic design freedom
▪ Fast and punctual service	→	Robust products with long life and minimal maintenance
▪ High safety and security	→	Materials meeting highest standards (EN45545)

Challenges in Composite Mass Transport Industry

- The Future of Composites Indian Rail Industry is very Bright in coming years.
- Unavailability of International Standard equivalent Fire Testing labs at economical charges in India.
- Composite parts manufacturers need to invest in advance composite manufacturing processes.
- Indian Rail ministry should promote to use advanced fiberglass manufacturing processes to improve light weighting & product quality.
- Metro Rail coach manufacturers should encourage Indian composite part manufacturers to qualify & produce the International standard composite parts in India.
- Processes for the recycling of composites waste need to be improved.
- R&D activities need to be increased to drive new composites products and applications.
- Covid-19 has impacted the market dynamics, competition, and supply chains. The revenues have gone down in 2020 and may resume an uptrend gradually from 2021.

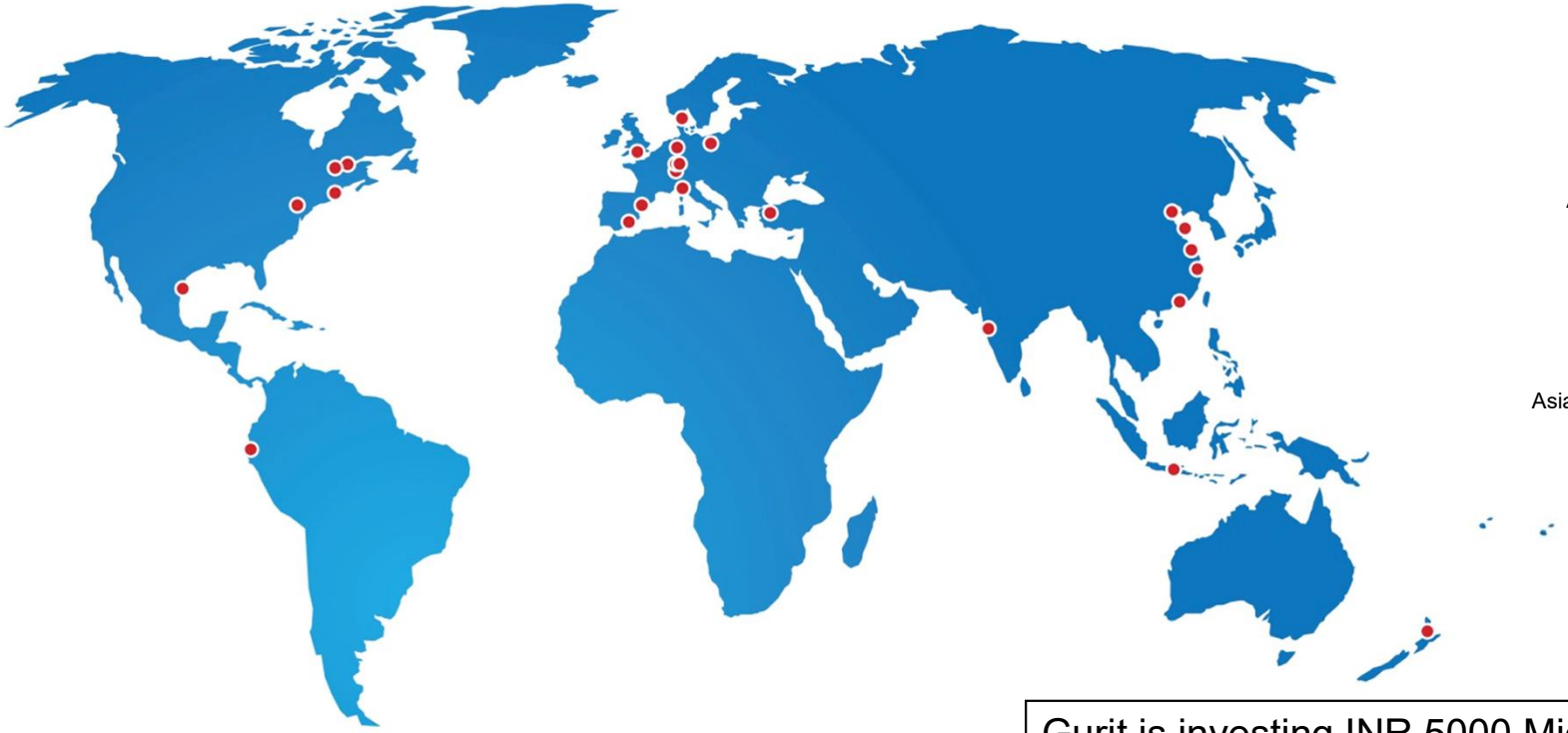

Gurit
Our vision
Our mission
With passion
for a sustainable future
Our mission is in wind energy and lightweighting.
We are a system partner for wind energy customers globally, with focus on the wind turbine blade. With our unique offerings and in-depth understanding of the value chain we help to increase wind energy competitiveness and promote its sustainable growth. For lightweighting applications we use our knowledge and expertise to provide high-performance materials and engineering.

Our offering

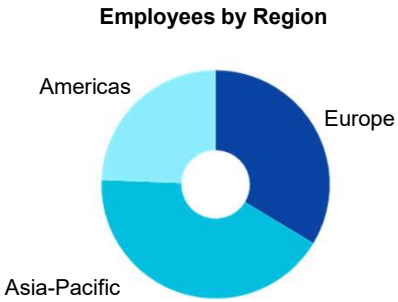
Market / Offering	Wind Energy	Lightweighting		
		Aero 	Marine 	Industrial 
Composite Materials:				
▪ Core materials 	✓		✓	✓
▪ Prepreg 	✓	✓	✓	✓
▪ Formulated 	✓		✓	✓
Tooling 	✓			
Kitting 	✓			
Structural Engineering			✓	✓

GURIT AROUND THE WORLD

Global presence



- Gurit production sites and sales offices

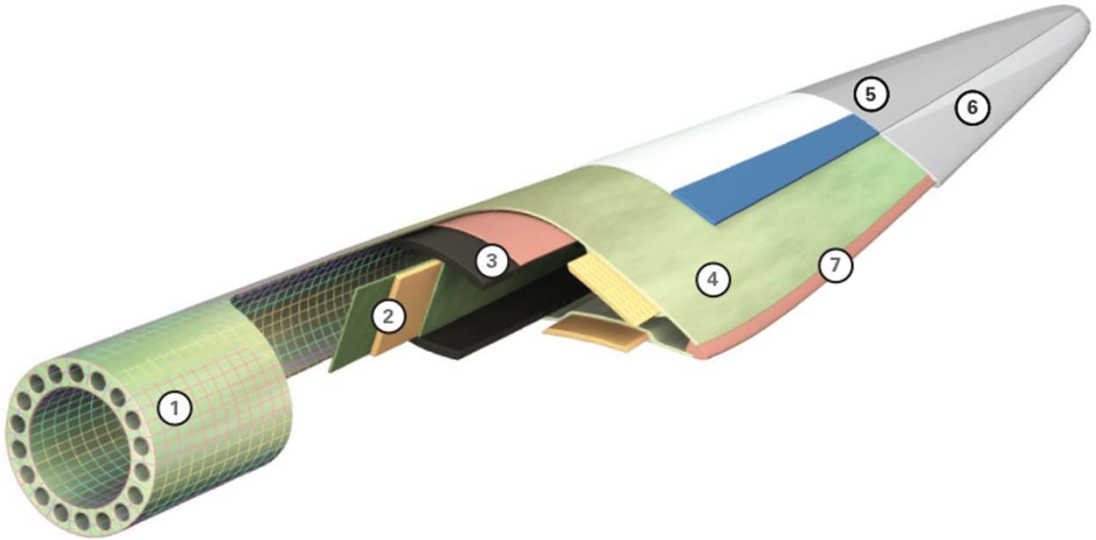


Gurit is investing INR 5000 Mio in India to set up two manufacturing plants at Chennai and Ahmedabad

WIND TURBINE BLADE

Typical applications of Gurit products

- Structural core materials
- Prepregs
- Adhesives, Laminating, Coatings, Fill/fair



1. Root
2. Shear web
3. Sparcap
4. Shell
5. Blade coating
6. Over-lamination
7. Bonding

TOOLING

Wind turbine blade moulds

Moulds for any **wind turbine blade** production process.

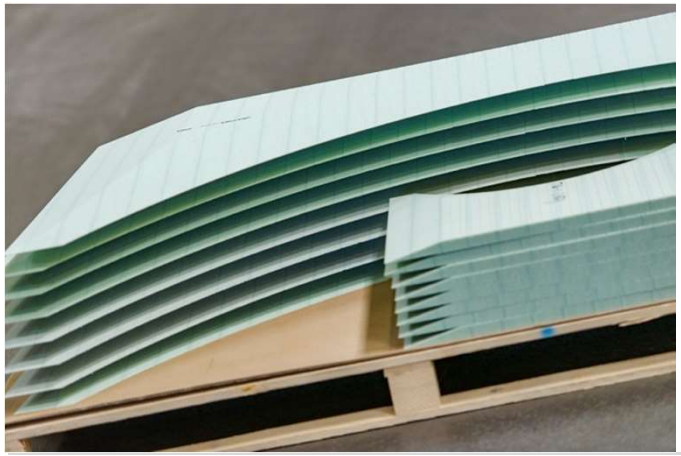
The moulds enable excellent **geometry** dimensional control, blade curing **heating**, blade shell **turning & clamping** and **vacuum processing**.

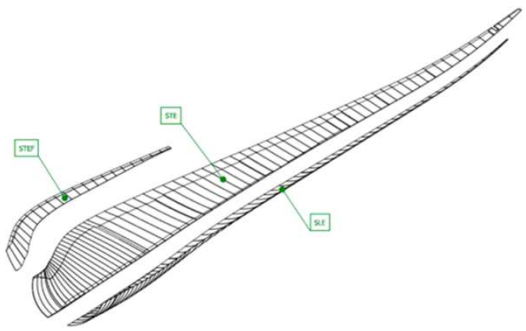
KITTING

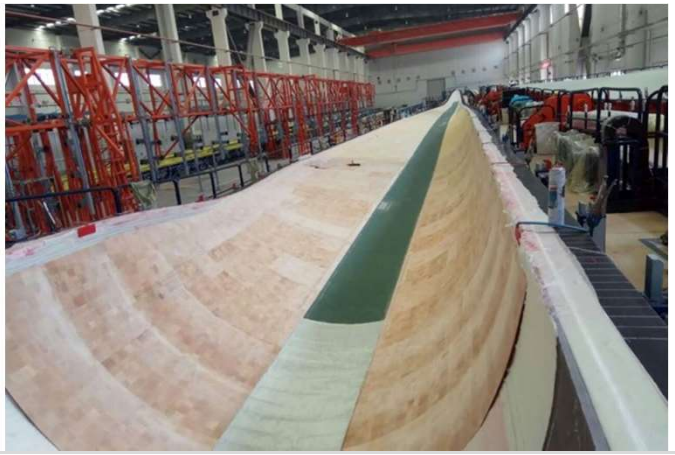
Core material kitting services

Serving the **wind turbine industry with strategic development of innovative kits:**

- Consulting and design
- Prototyping
- Production
- Delivery



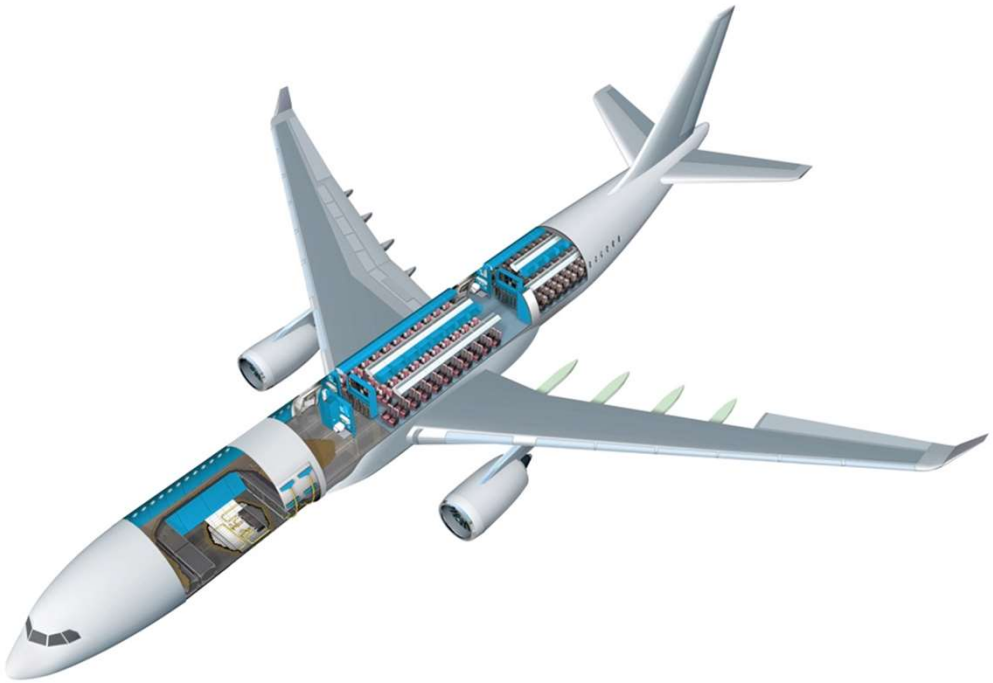




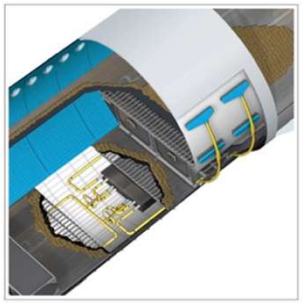
Lightweighting markets

AEROSPACE

Materials for cabin interiors and secondary structures



Sidewalls, flooring

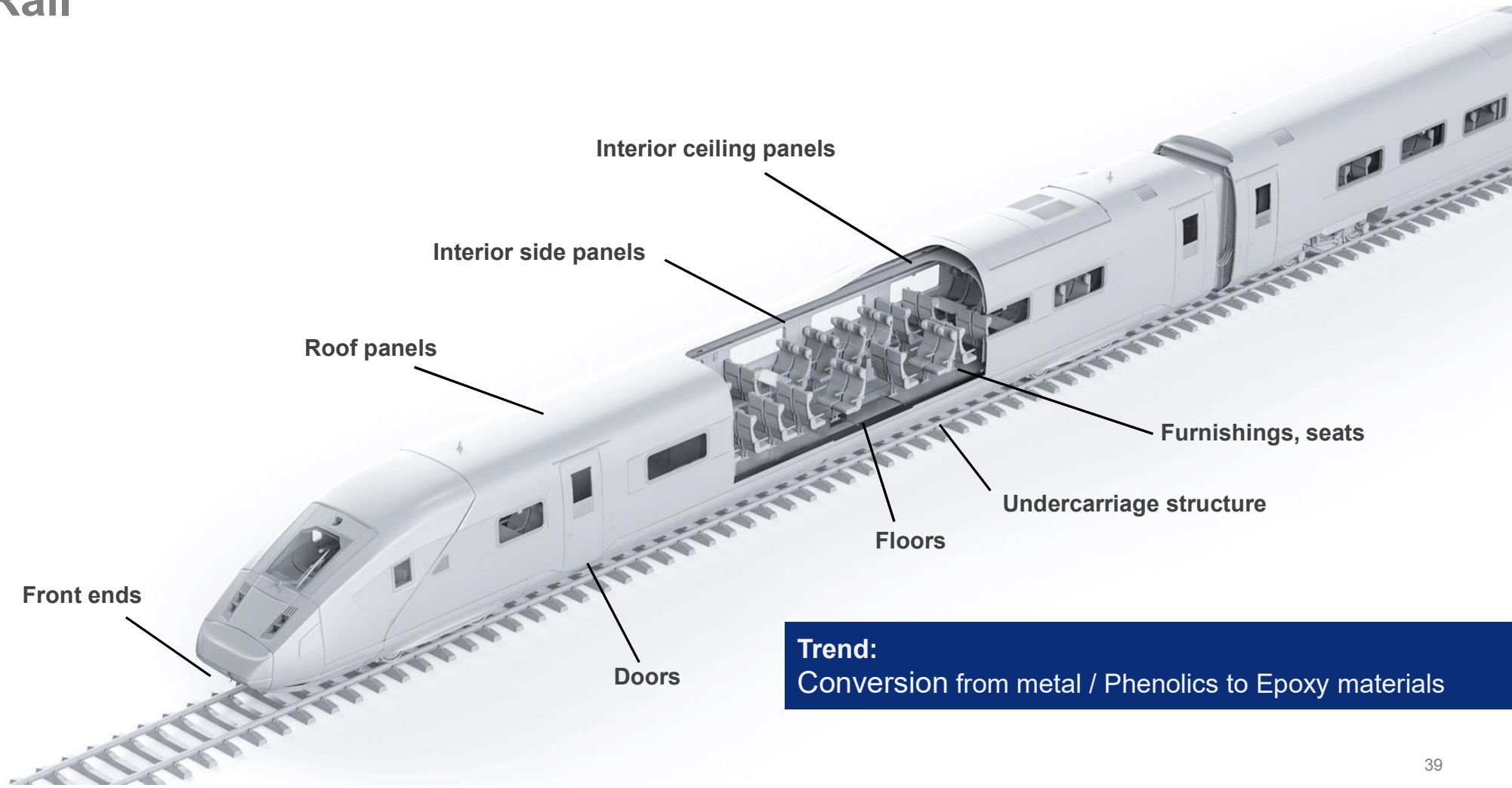


Ducting

Interiors, seating

Gurit is a leading supplier for qualified cabin interior materials and secondary structures

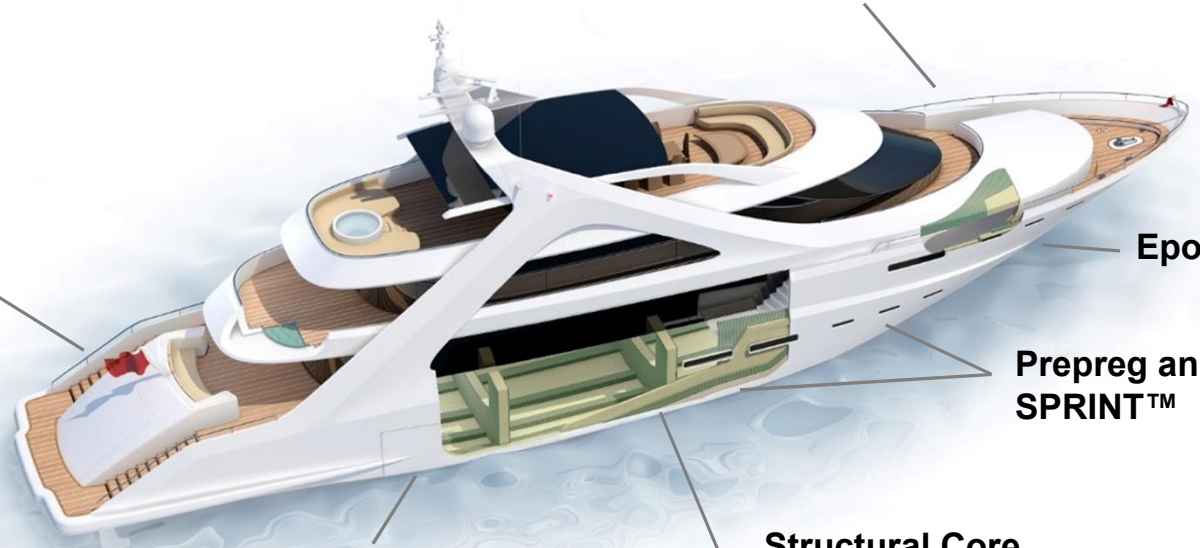
Rail



Trend:
Conversion from metal / Phenolics to Epoxy materials

TYPICAL APPLICATIONS

Marine



Epoxy coating & In- mould process coat

Adhesives

Epoxy filling & fairing

Prepreg and SPRINT™

Epoxy multi-purpose systems

Epoxy wet laminating & Infusion systems

Structural Core materials; Corecell™, Kerdyn, PVC & Balsa

Successful together

Gurit

Any questions?

Thank you
for your attention

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DELIVERING THE FUTURE OF COMPOSITE SOLUTIONS

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