

# AIREX<sup>®</sup> BALTEK<sup>®</sup>



The case for lightweight in railway applications

What's the weight of a train – in € please

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## Who is Airex AG?

- Airex AG belongs to 3A Composites, Sins (CH)
- We are leading producers and suppliers of AIREX® and BALTEK® core materials for use in sandwich constructions in Marine, Wind, Transport and industrial applications
- Our service offering comprises:
  - Sandwich design and calculations
  - Sandwich production support
  - Testing and certifications
- Rail-specific portfolio:
  - AIREX® T90 (PET based foam core material)
  - AIREX® R82 (PEI based foam core material)
  - BALTEK® SB (Balsa core material)
  - AIREX® C70 (PVC based foam core material)



**AIREX® BALTEK®**



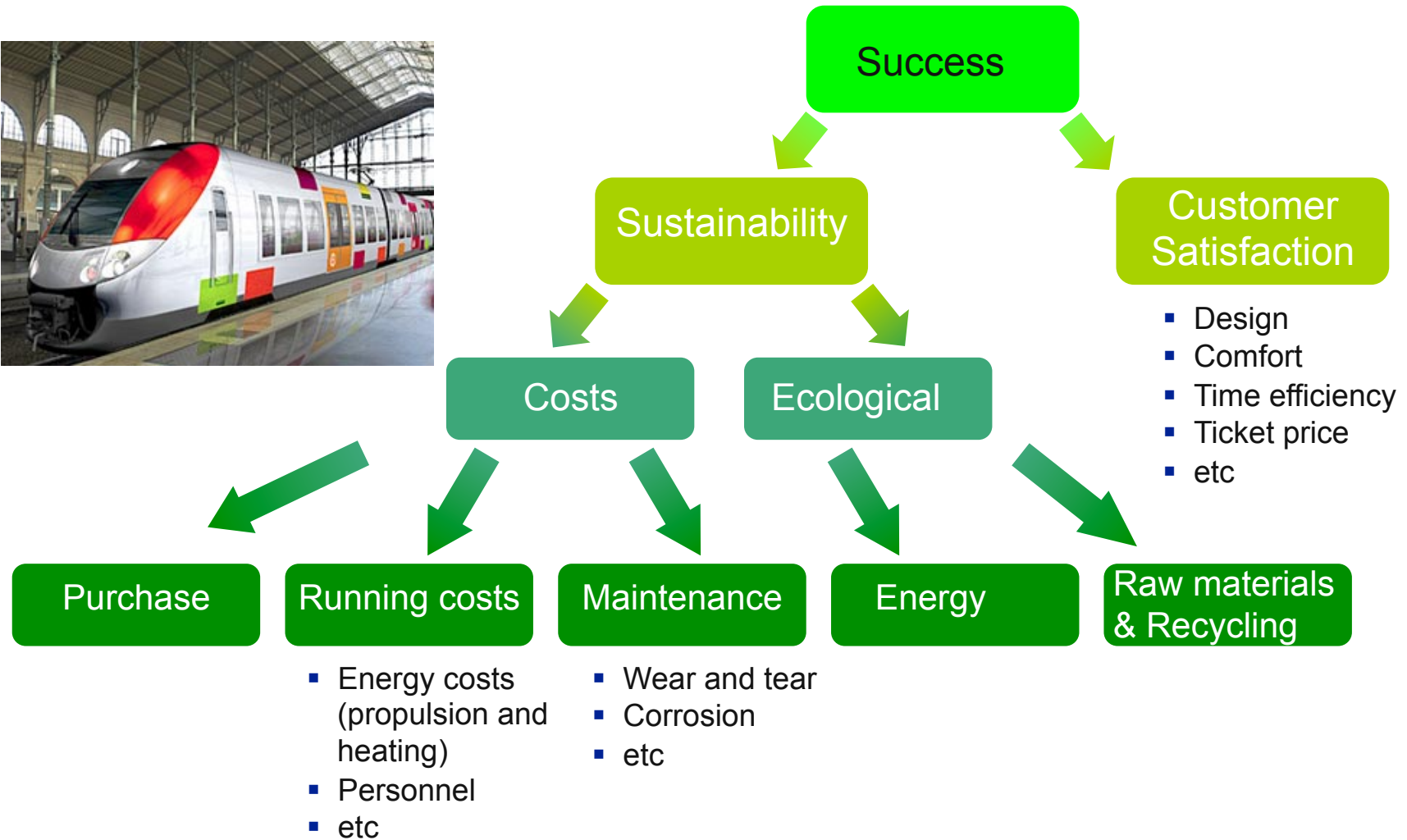
A personal experience for introduction



**Designed for success?**

**AIREX® BALTEK®**

## What does it take for a successful train





## What are sandwiches good for?

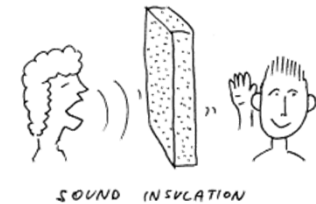
### ■ Weight reduction

Sandwich design can reduce a part's weight by up to 50%



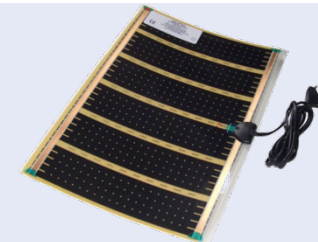
### ■ Insulation

A sandwich efficiently insulates – heat, noise and vibration



### ■ Functional integration

Heating and other subsystems can easily be integrated



### ■ Cost reduction

- Reduced weight → propulsion energy costs
- Improved insulation → heating/clima costs
- Reduced maintenance (especially with FRP skins)

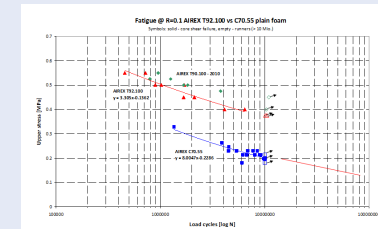


## Special requirements in railway applications

### ■ Longevity

Composites & sandwiches have very high fatigue resistance

Longevity has been successfully proven in thousands of marine and wind applications



### ■ Fire resistance / passenger safety

Composites und sandwiches meet the respective fire regulations  
DIN 5510, NF 16-101, EN 45'545



### ■ Modular construction

The pre-assembly of integrated subsystems allows an efficient and highly modular production process

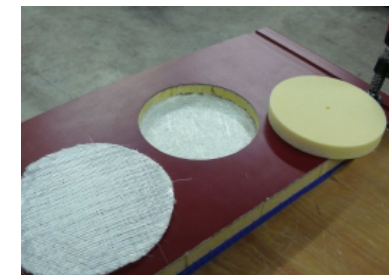


### ■ Service-friendly, reparable

Lower weight reduces wear and tear  
→ reduced maintenance and repair on rails and bogies

Excellent corrosion resistance

Composites und Sandwiches are easy to repair



## Case Study Stadler “KISS”; double-deck regional train

Train examples	<ul style="list-style-type: none"> <li>- S-Bahn Zürich, Bern</li> <li>- Westbahn Austria</li> </ul>
Mileage (life time)	4 Mio. km
Specific energy saving	1.75 MJ / 100km / 100kg
Total life time energy saving	19.5 MWh / 100kg = 8.3t CO <sub>2</sub> / 100kg = € 1'170 / 100kg



## Example of a lightweight floor construction

Application example	Floors of double-decker regional train
Standard weight	10kg / m <sup>2</sup> → 1400kg per waggon
Weight reduction (sandwich)	15% → 210kg per waggon
Total cost saving (weight)	€ 2'500 per waggon (€ 1'170 / 100kg)

Not included:

- Other weight saving potentials (roof, front-ends, skirts, claddings compartment walls)
- Reduced heating/cooling due to improved insulation of sandwich
- Reduced maintenance due to lower weight on bogie and rails
- Any possible system integration e.g. floor heating, offering further considerable weight savings (elimination of radiators, reduction of air circulation system etc)





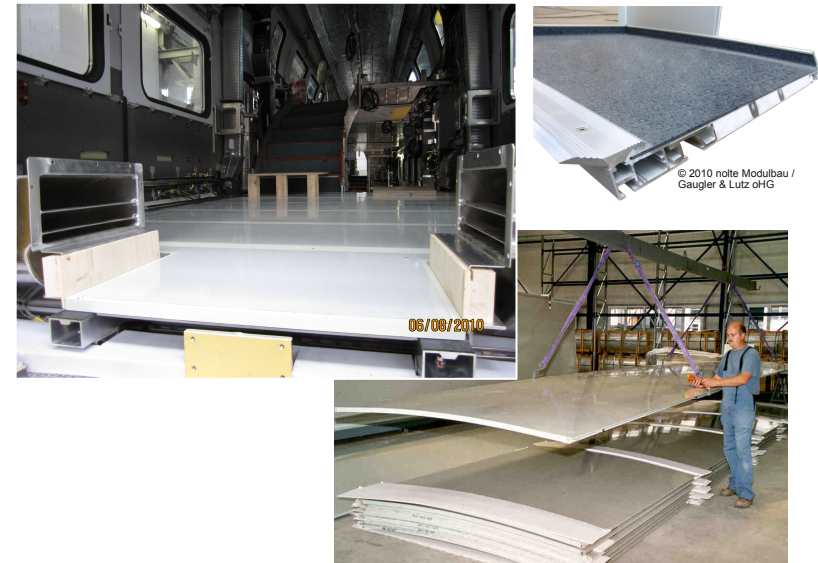
## Skins of fibre-reinforced plastic or metal?

### FRP skin sandwich



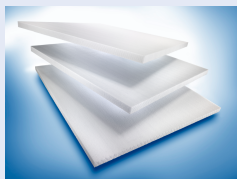
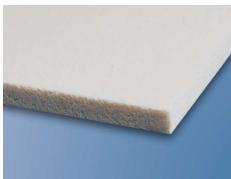

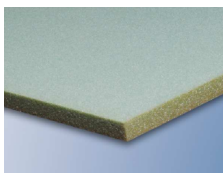
- Design freedom (free-forms possible)
  - Fire resistance primarily through resin system
  - Maintenance-free
- For front-ends, covers, claddings etc.

### Metal skin sandwich



- 2-D to 2 ½-D
  - Fire resistance through metal skin
  - Simple processing (bonding)
- For floors, roofs, wall elements, doors etc.

## Suitable AIREX® und BALTEK® core materials

	<b>AIREX® T90</b>	<b>AIREX® R82</b>	<b>BALTEK® SB</b>	<b>AIREX® C70</b>
<b>Base-Polymer</b>	PET	PEI	Balsa	PVC
<b>Mech. Properties</b>	Good	Good	Very good	Good
<b>FST Properties</b>	Very good	Very good	Good	OK
				
<b>NF 16-101</b> <b>DIN 5510</b> <b>EN 45'545</b>	M1 / F1 S4 SR2 ST2 K1 Acc. to design	M1 / F1 S4 SR2 ST2 K1 Acc. to design	M4 / F2 S5 SR2 ST2 (Alu) Acc. to design	M2 / F4 S4 SR2 ST2 Acc. to design



- Floor
- Roof
- Side walls
- Front-ends

## RAIL

## AIREX® R82 High Performance Structural Foam

Application:	Transrapid International, China;  Roof, side panels, floors and front cabin of the Transrapid with AIREX® R82.80
Processing:	Cold bonded (aluminium skins) / vacuum infusion
Benefits:	<ul style="list-style-type: none"> <li>• Cost reduction</li> <li>• Weight saving</li> <li>• Excellent FST properties</li> <li>• Very good strength and stiffness</li> </ul>







- Floors
- Front-ends



*Assembly of the floor*

## RAIL

## AIREX® T90 Easy Processing Structural FST Foam

Application:	Stadler Rail Group, Switzerland;  Front end and floors of ‚KISS‘ double-decker train with AIREX® T90
Processing:	Resin infusion and adhesive bonding
Benefits:	<ul style="list-style-type: none"> <li>• Lightweight and energy saving</li> <li>• Excellent fire resistance and outstanding price / performance ratio</li> </ul>





## ■ Front-ends

RAIL

AIREX® T90

Easy Processing Structural FST Foam

Application:

Alstom Deutschland AG, Germany;

Front end car of X60 Coradia Lirex with  
AIREX® T90.100

Processing:

Contact moulding

Benefits:

- Excellent fire, smoke, toxicity properties
- High mechanical properties
- Weight saving



- Side walls
- Front-ends
- Toilet modules

## RAIL

## AIREX® T90 Easy Processing Structural FST Foam

Application:	Qingdao Kangping Railway GRP Company Ltd, China;  Front end, sidewall and wash-room modules of the Chinese high speed train ,EMU' with AIREX® T90.100
Processing:	Hand lay-up
Benefits:	<ul style="list-style-type: none"> <li>• Lightweight</li> <li>• Superior FST properties (DIN5510; NF16.101; FAR25.853)</li> <li>• Excellent fatigue strength</li> <li>• Easy processability with all types of resins and lamination processes</li> </ul>



■ Front-ends

## RAIL

### AIREX® T90 Easy Processing Structural FST Foam

Application: Qingdao Kangping Railway GRP Company Ltd, China;

Front ends of Shanghai, Beijing and Nanjing metro with  
AIREX® T90.100

Processing: Hand lay-up

Benefits:

- Lightweight
- Superior FST properties (DIN5510; NF16.101; FAR25.853)
- Excellent fatigue strength
- Easy processability with all types of resins and lamination processes



## Foam / balsa vs. Honeycomb core

	<b>Foam / Balsa</b>	<b>Honeycomb</b>
▪ Lightweight	light (from 40 kg/m <sup>3</sup> )	Extremely light (from 17 kg/m <sup>3</sup> )
▪ Insulation	Thermal, accoustic, vibration	Little
▪ FST	Good	Very good depending on material
▪ Edge close-out	Simple and easy	Special solutions necessary
▪ Fixation / load introduction	Relatively simple	More complicated
▪ Processing / production	Practically all common processes	No infusion, RTM etc. (skin adhesion, surface quality )
▪ Costs	depending on choice of material	





- Floors
- Front-ends

## RAIL

## AIREX® T90 Easy Processing Structural FST Foam

Application: Stadler Rail Group, Switzerland;  
Front end and floors of the 'FLIRT Intercity' train with  
AIREX® T90

Processing: Resin infusion and adhesive bonding

Benefits:

- Meets the demanding requirements of the new CEN/TS 45545
- Energy efficiency and environmental impact
- Weight saving as well as thermal and accoustic insulation

- Front-ends



## RAIL

## AIREX® T90 Easy Processing Structural FST Foam

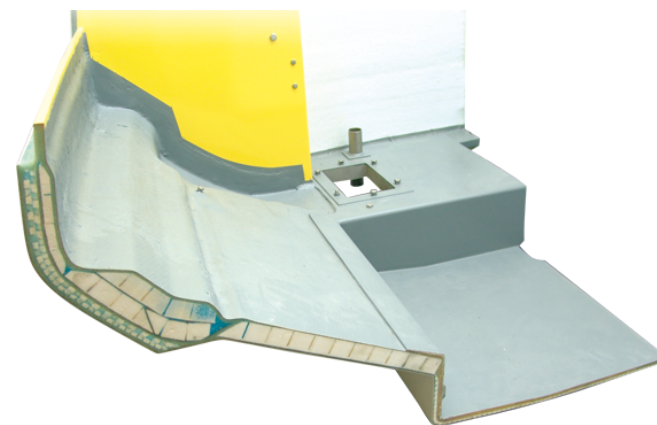
Application:	NSPS Composites, The Netherlands  Nose plate of Dutch intercity train ,Koploper' with AIREX® T90.100
Processing:	RTM - vacuum moulding
Benefits:	<ul style="list-style-type: none"> <li>• Thermoformability of AIREX® T90</li> <li>• Good FST properties</li> <li>• Recyclability</li> <li>• Considerable saving of weight and energy</li> </ul>



## Front-end in FRP sandwiched with AIREX® T90



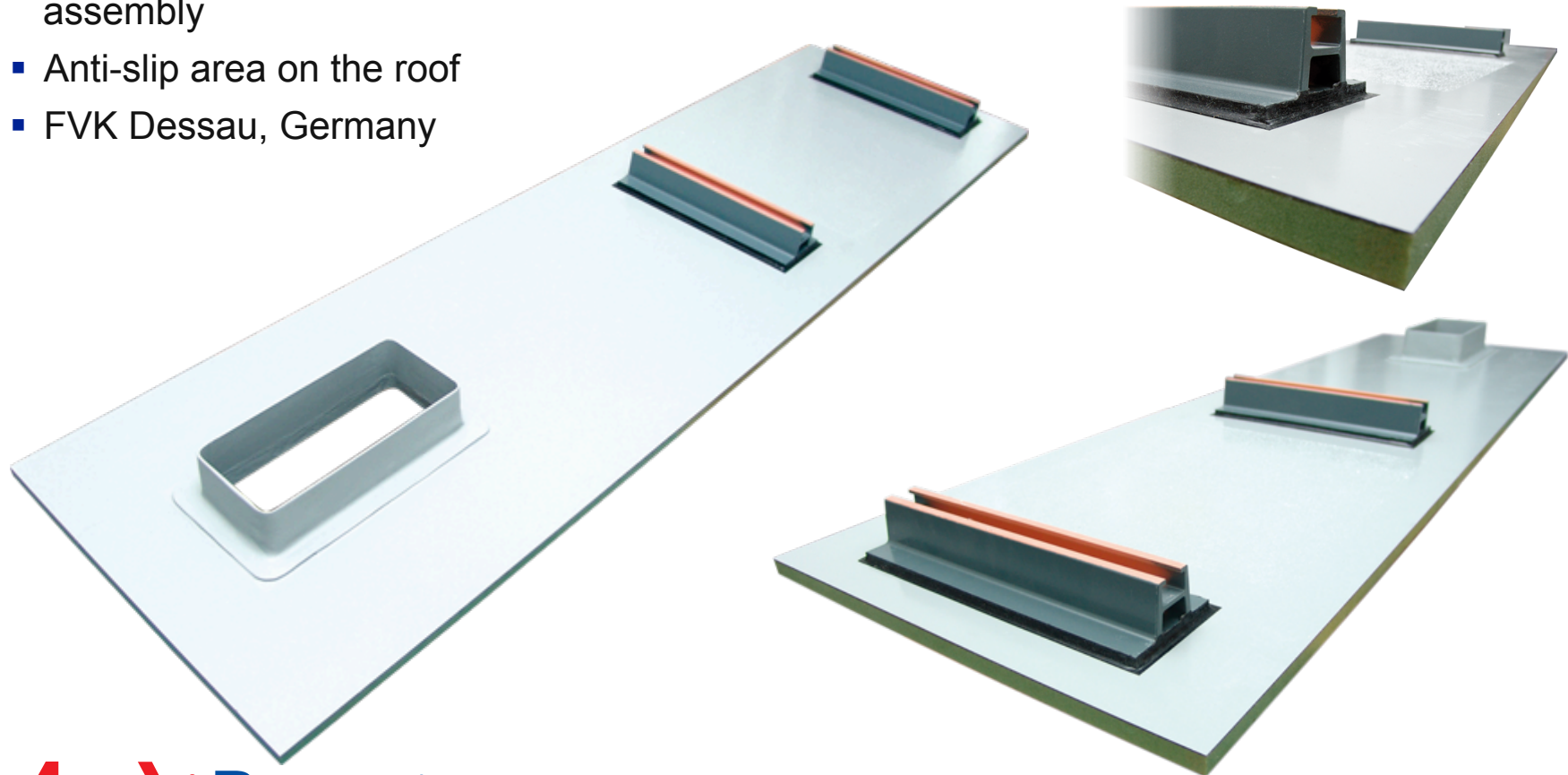
- Very light
- High collision strength
- Nice 3-D shapes
- Fire resistant (M2 / F1; S4/SR2/ST2)
- RCS GmbH, Germany





## Roof modul for tramway cored with AIREX® C70

- Light and very high stiffness
- System integration; ready for final assembly
- Anti-slip area on the roof
- FVK Dessau, Germany



**AIREX® BALTEK®**

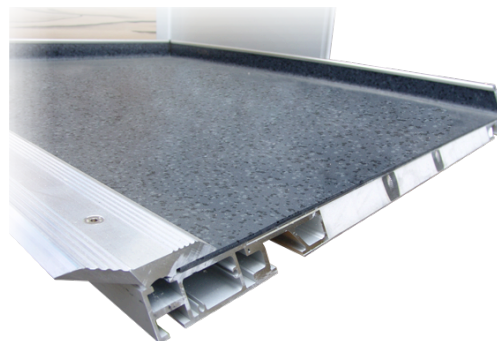
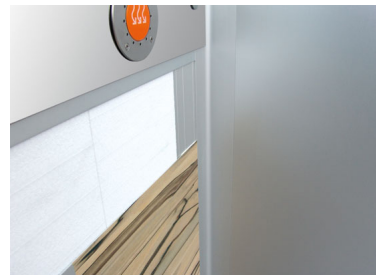
Pictures: © 2010 FVK Dessau / Gaugler & Lutz oHG





## Toilet module in alu with AIREX® T90

- Floor, walls, roof, door
- Light, but stiff and strong
- Fixation elements:
  - Alu profiles for edge close-out
  - Blind rivets
  - Nut inserts
- Modulbau Nolte GmbH, Germany



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Pictures: © 2010 nolte Modulbau / Gaugler & Lutz oHG

## Railways are no ships...

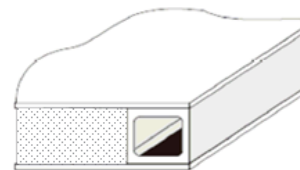
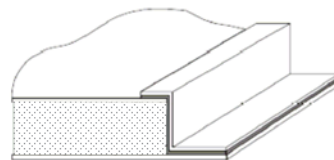
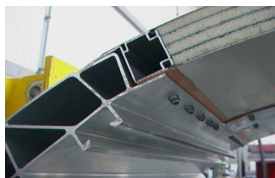



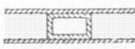
- Highly integrated, complex design
- Mainly straight design lines
- Modular design (customer specific)
- Complex fixations



- Rel. small number of parts
- Many 3-D free-forms
- Larger, identical series
- Highest surface quality

➤ Railway will never be built predominantly in FRP



	Solid block of foam, metal or plastic bonded in place.
	Extruded shapes for continuous ribs. Very strong. Edge bond core.

Yes, sandwich technology can help a lot

■ **Compelling advantages of sandwiches**

- Sandwich technology offers considerable weight savings
- Lightweight saves money (energy / maintenance)
- Integrated insulation (comfort)
- Proven technology (many industries)

■ **Wide field of application**

- Metro, Tramway, Trains (regional IC, ICE)
- Floors, front-ends, roofs, interiors, claddings etc
- worldwide

➤ **Barriers to be overcome**

- Convince train operators of cost benefits of weight reduction
- Convince OEM's and their engineers and purchasers of availability and proof record of this technology
- Train and coach part producers



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Thank you for your interest!

Philipp Angst  
Product Manager Core Materials  
[www.airex.ch](http://www.airex.ch)

