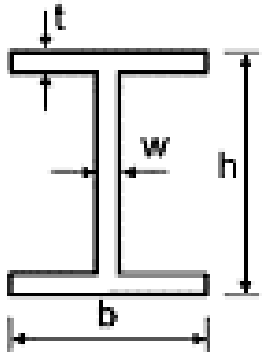
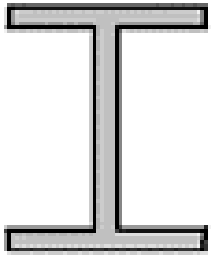
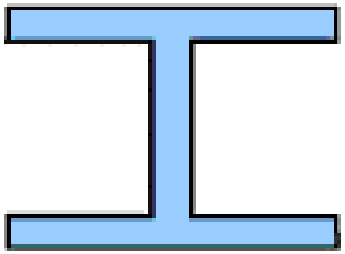
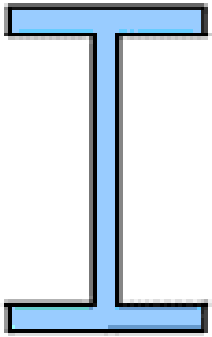
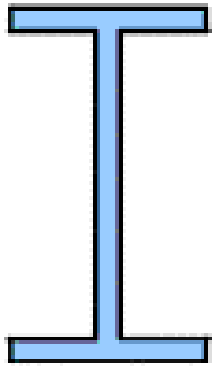
Aluminium

	Steel	Aluminium Alloy	Aluminium Alloy	Aluminium Alloy
				
Moment of inertia I (mm^4)	$38,9 \cdot 10^6$	$116,7 \cdot 10^6$	$116,7 \cdot 10^6$	$116,7 \cdot 10^6$
Elast. Modulus E (N/mm^2)	210.000	70.000	70.000	70.000
Stiffness E x I (Nmm^2)	$8,17 \cdot 10^{12}$	$8,17 \cdot 10^{12}$	$8,17 \cdot 10^{12}$	$8,17 \cdot 10^{12}$
h (mm)	240	240	300	330
b (mm)	120	240,2	193,5	189,1
t (mm)	9,8	18,3	12,9	10
w (mm)	6,2	12	8	8
Weight (kg/m)	**30,7**	**30,3**	**19,4**	**16,9**

Aluminium

- In practice, the section-height of weight-optimised aluminium beams used will increase 30% compared to weight-optimised steel beams, while offering about 50% weight savings
- Aluminium specific fabrication techniques, such as complex, multi-hollow extrusions or thin-walled, high-strength, vacuum die castings, enable new design solutions.

Aluminium Matrix Composites

- It can be utilized for high strength, higher stiffness at higher temperature
- Examples of actual and possible applications are:
- parts of combustion engines
- Radiator fans
- brake systems
- stiff beams
- load transfer elements in vehicles

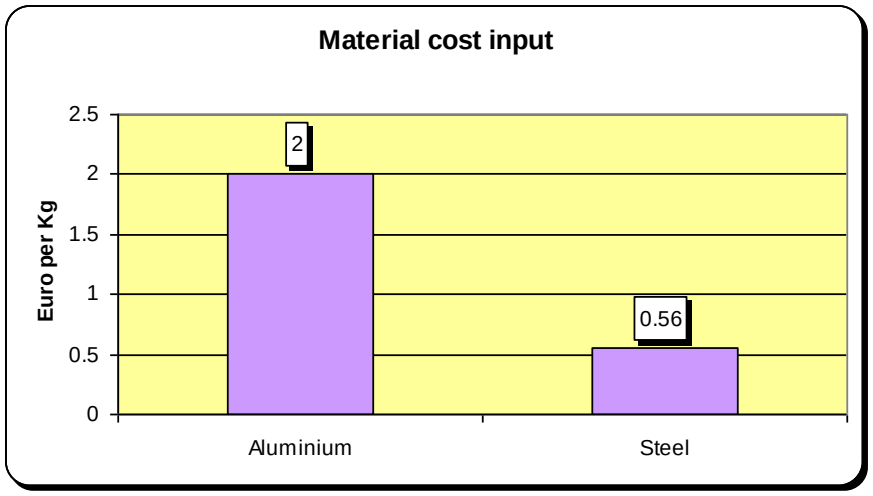
Aluminium Matrix Composites

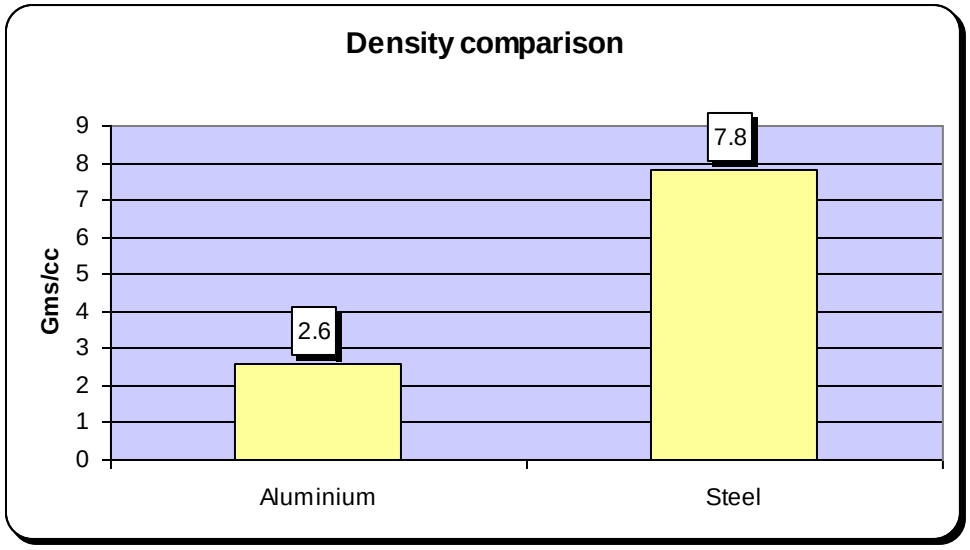
- Disadvantages are
- Cannot be fabricated, forged , extruded or rolled
- Can be cast
- Expensive
- Expertise is limited

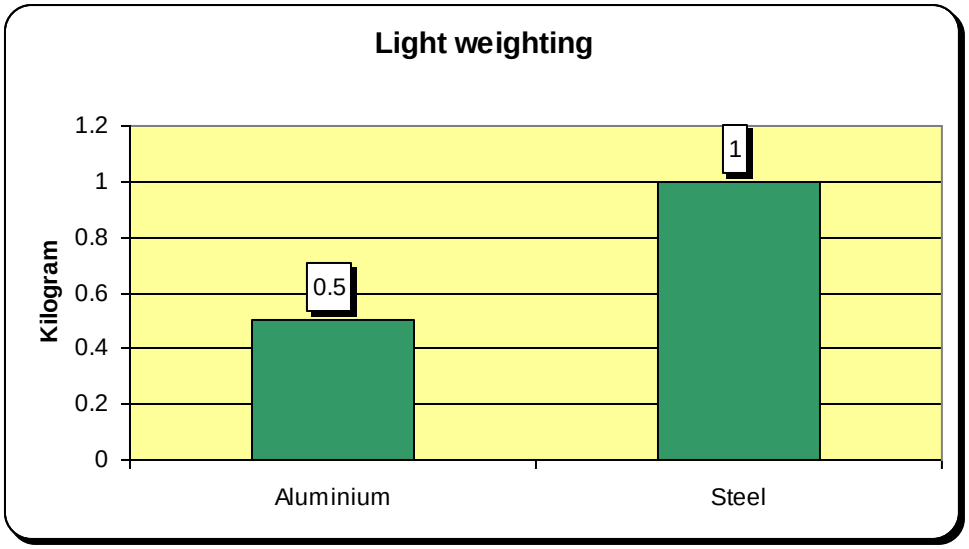
Aluminium

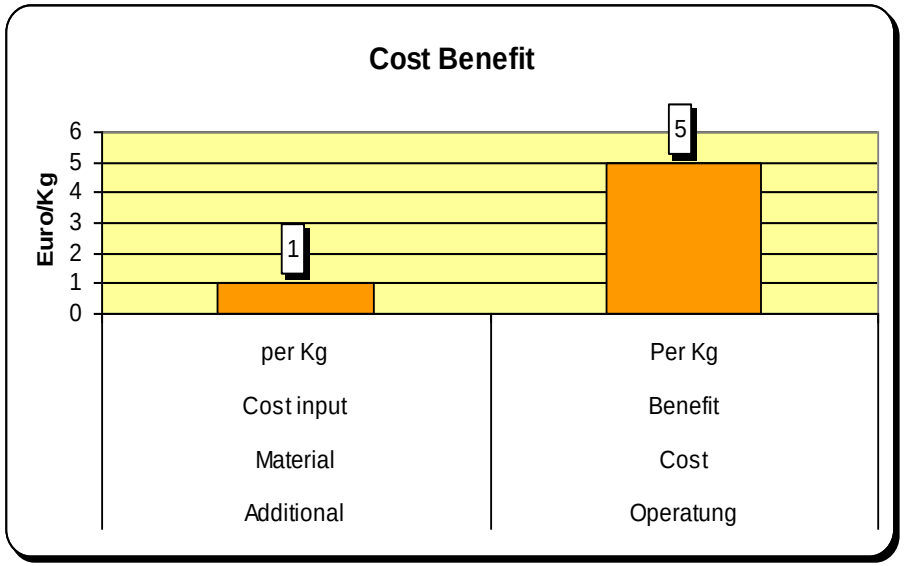
- As a general indicator, 1 kg of automotive aluminium substituted for a heavier material in a vehicle typically avoids 20 kg of greenhouse gas emissions during its operating life.
- A vehicle's life cycle covers three discrete parts: production; use; and end-of-life. With the ability of aluminium to be recycled, this process is better described as "cradle to cradle" rather than "cradle to grave".
- Recycled aluminium can be utilised for almost all applications & Scrap value of Aluminium is high
- It is corrosion resistant

Vehicle type	Electricity consumption per 100 kg Weight **MJ/100 km**	Electricity savings per 100 kg Weight Savings **MJ/100 km**	Lifetime Distance **km**	Lifetime electricity savings per 100 kg Weight Savings **kWh**	Lifetime Greenhouse Gas savings per 1 kg Weight Savings **kg CO2eq**
Subway/urban train – per wagon	2.5	2.00	3 000 000	167	71
Short distance train – per wagon	2.5	1.75	4 000 000	194	83
Normal Passenger train - per wagon	1.0	0.40	8 000 000	89	38
High-speed Passenger Train – per wagon	1.0	0.32	15 000 000	133	57
Freight train - per wagon	0.8	0.40	8 000 000	89	38


Material cost input
Euro per Kg
2.5
2
1.5
1
0.5
0
2
0.56
Aluminium
Steel


Density comparison
Gms/cc
9
8
7
6
5
4
3
2
1
0
2.6
7.8
Aluminium
Steel


Light weighting
Kilogram
1.2
1
0.8
0.6
0.4
0.2
0
0.5
1
Aluminium
Steel


Cost Benefit
Euro/Kg
6
5
4
3
2
1
0
1
5
per Kg
Cost input
Material
Additional
Per Kg
Benefit
Cost
Operatung

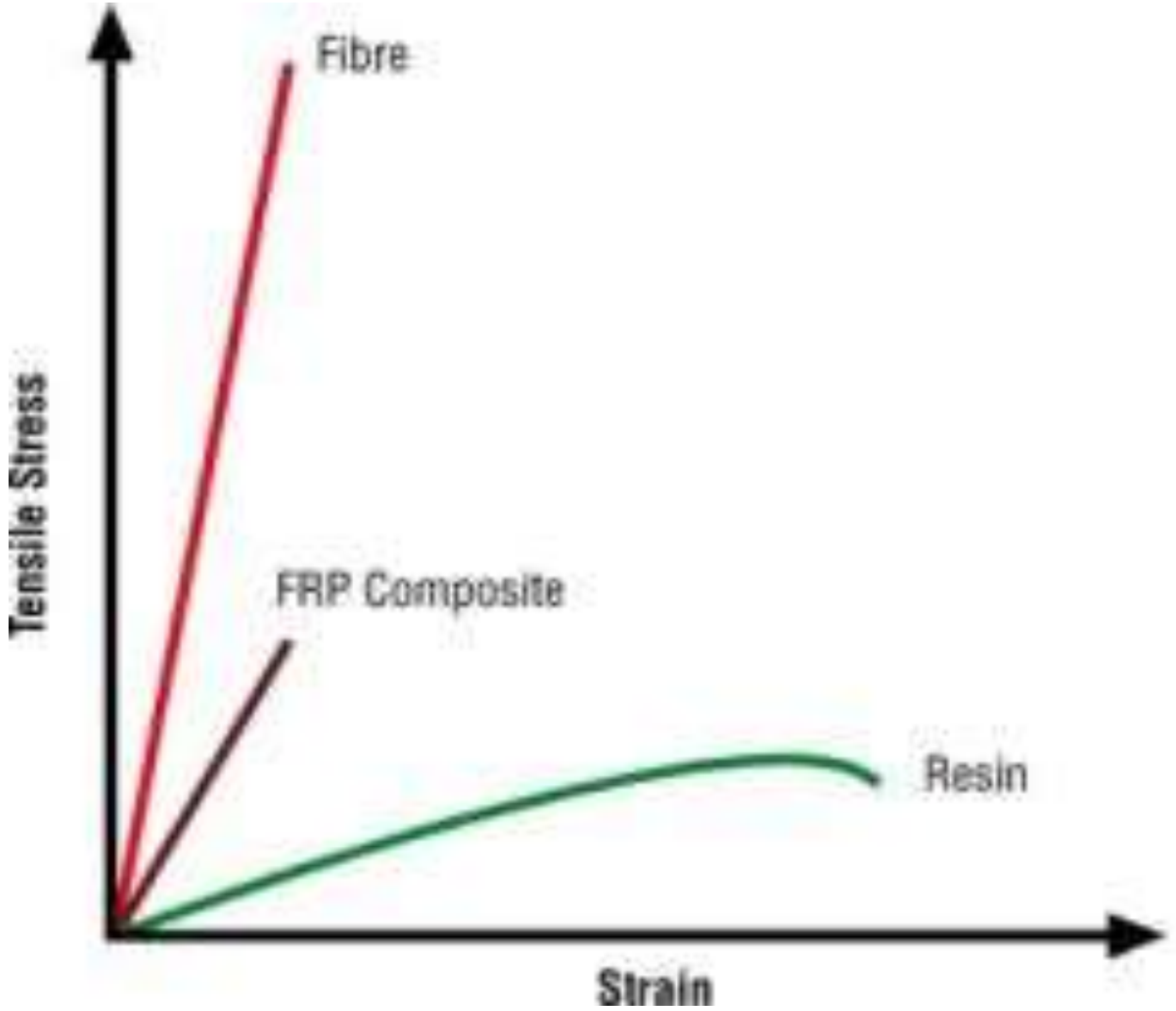
POLYMER COMPOSITE

Polymer Composites in Transport sector

- Composites are engineering materials, which are lighter, stiffer, flexible, corrosion resistant and readily mouldable to shape
- Transport is a major sector, where composite has entered with a great impact

Composite in Aerospace

- Due to the opportunities they present for weight saving, their share has reached more than 15 % of the structural weight of civil aircraft, and more than 50% of the structural weight of helicopters and fighter aircraft over the last 40 years.
- Composites are, besides aluminium, the most important materials for aerospace applications


Fibre
FRP Composite
Resin
Tensile Stress
Strain

FRP

- **Density of FRP is 1.6 to 2.3 gm/cc, It is lighter than Al**
- **Young's Modulus 12,000psi to 20,000psi**
- **Tensile strength can be matched with Al or steel**
- **Different proportion of fiber and resin can be manipulated to get the properties.**
- **Cost may vary from 0.18 Euro to 10 Euro per Kg**
- **The fibers are usually fiberglass, carbon, or aramid, while the polymer is usually an epoxy, vinylester or polyester thermosetting plastic**

Composites for Indian Railways –

- **FRP Gear-Case for Diesel & Electric Locomotives**
- **Features:**
- **Reduced dead weight**
- **staggered fibre lay-up with rounded edges so as to reduce stress concentration and thus preventing edge cracking due to ballast hit**
- **No damage on ballast hits & leakage of lubricants**
- **longer life compared to 3 years for steel gear-case**