Le innovazioni dei Materiali Compositi Avanzati per il design di strutture leggere

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Martedì 14 Novembre 2017 ore 14.30

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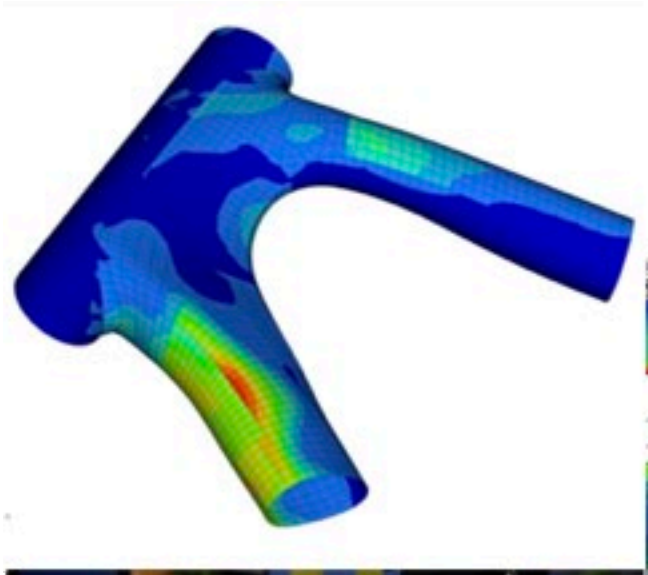
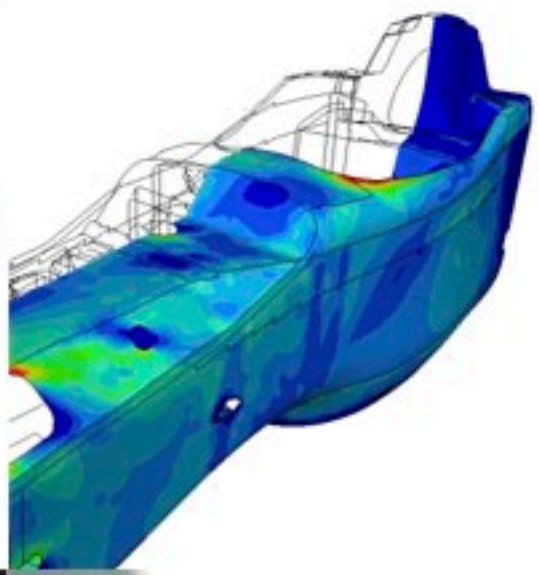
#Sharing3FVG

Webinar realizzato da IALFVG e parte degli 80 di #Sharing3FVG, progetto cofinanziato dal Fondo Sociale Europeo nell'ambito del Programma Operativo Regionale 2014/2020



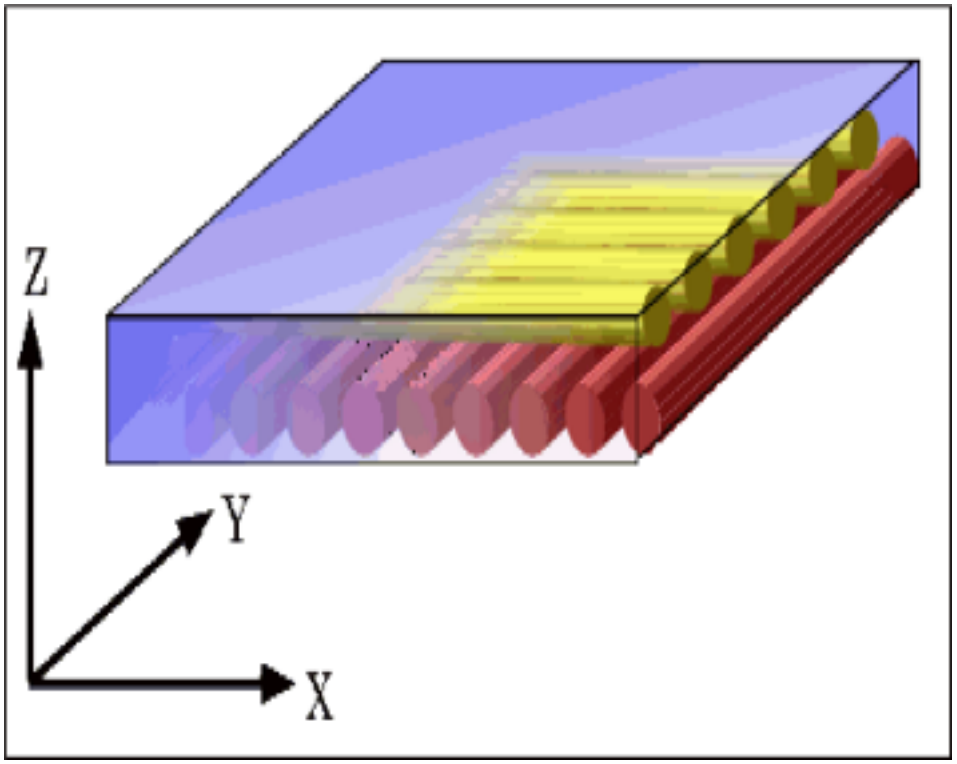



COLNAGO

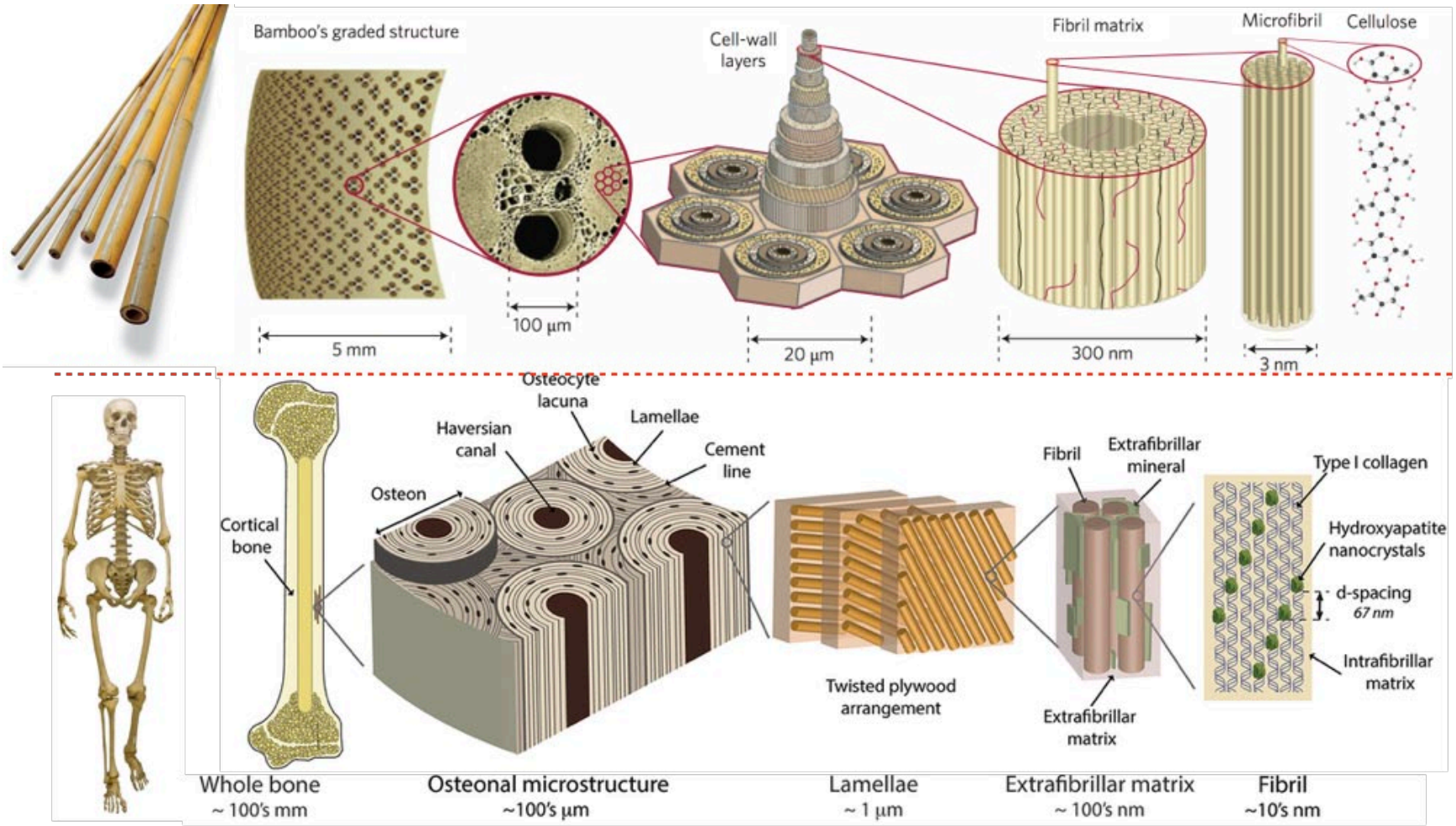

Virgin
Virgin

Materiali Compositi Avanzati

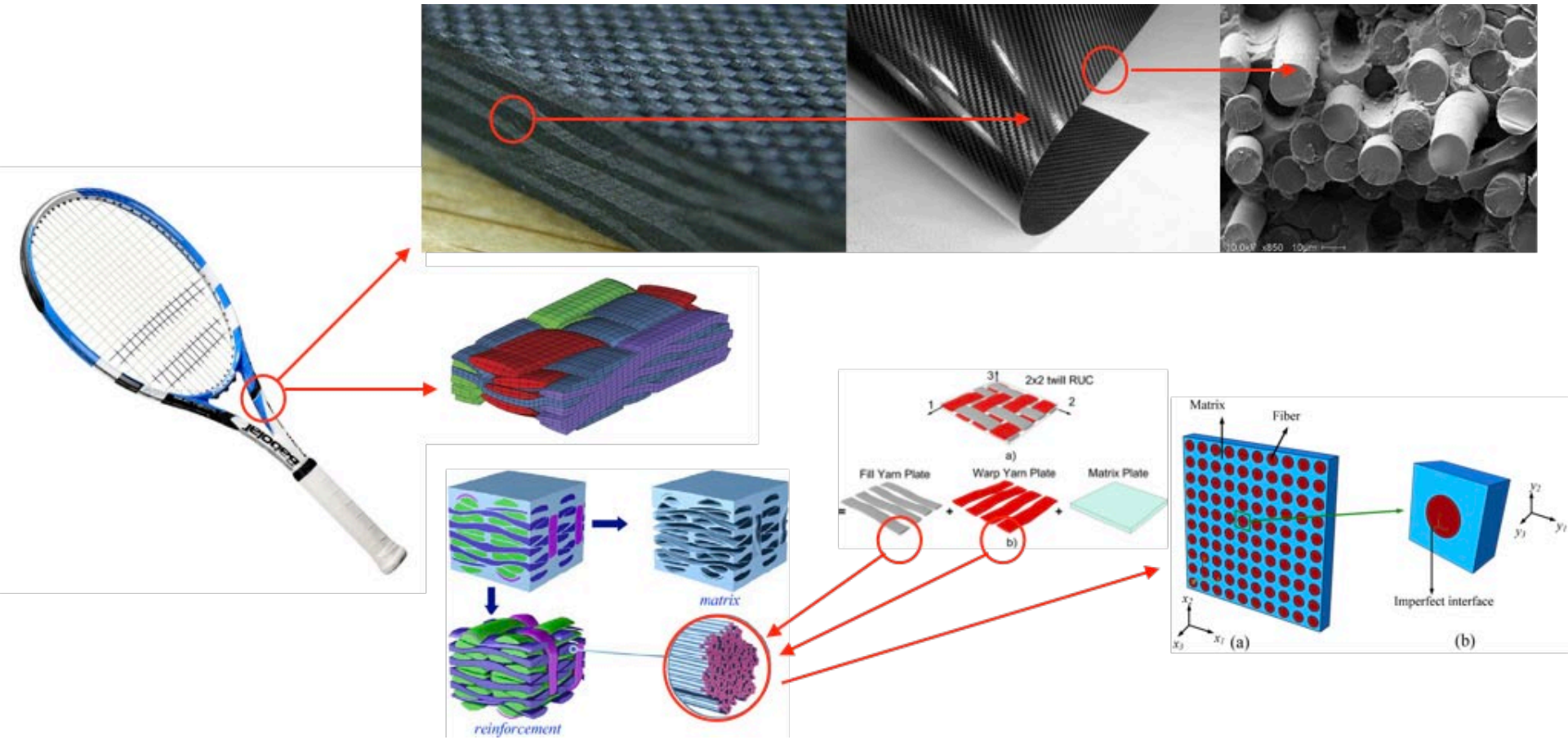
- In meccanica i **compositi avanzati** sono costituiti da fibre di varia struttura (vetro, carbonio, boro, fibra aramidica), inglobate in una matrice di resina (poliestere, vinilica, epossidica, fenolica).
- ***Le fibre*** conferiscono la resistenza meccanica,
- ***La matrice*** garantisce la coesione tra le fibre di uno stesso strato e tra gli strati adiacenti e svolge anche una funzione protettiva.



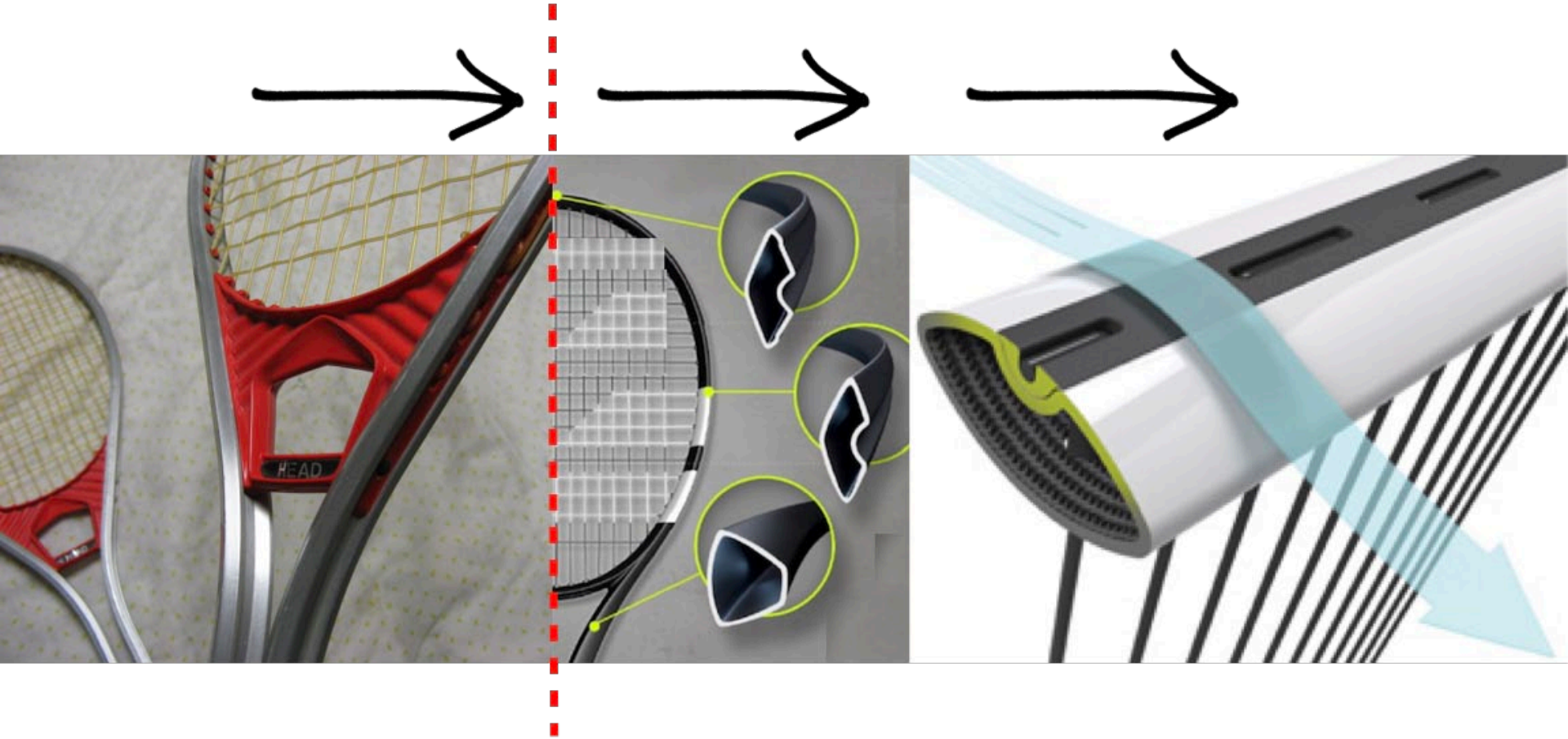
I materiali compositi non sono un'invenzione ma una scoperta

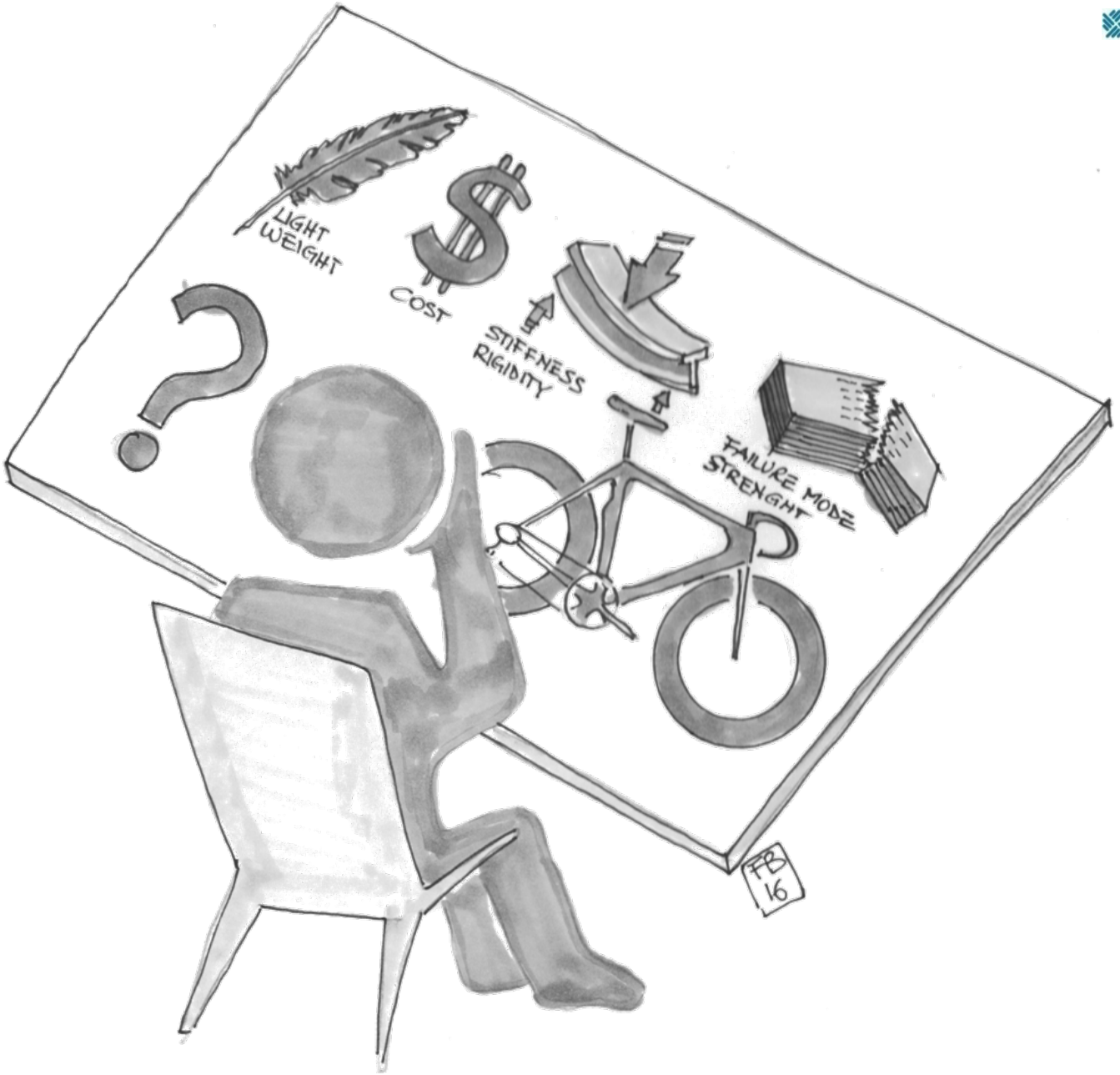


Un esempio reale



I materiali compositi permettono maggiore liberata' nel design




LIGHT WEIGHT
COST
STIFFNESS RIGIDITY
FAILURE MODE STRENGHT
FB 16

VIDEO

Santa Cruz Lab Danny M

Proprieta' meccaniche

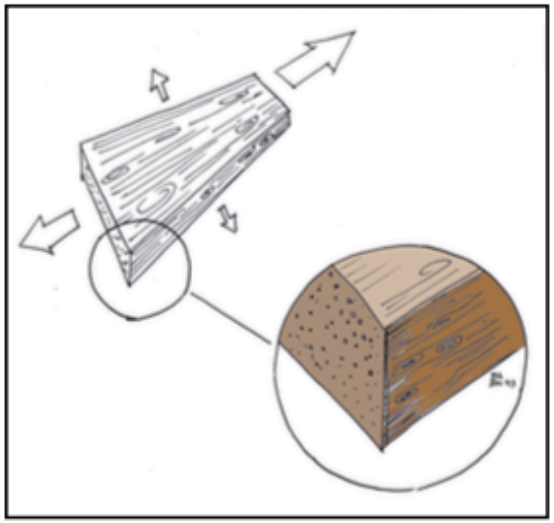
material properties

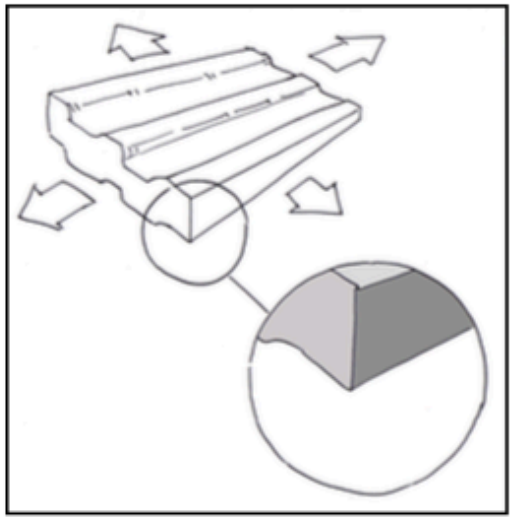
	Young's Modulus [GPa]	Strength [MPa]	Density [g/cm3]
Composite Carbon	100-260	500 - 2200	1.5 -1.6
Aluminum	71	200 - 600	2.8
Titanium	110	320 - 600	4.5
Steel	210	250 -1200	7.8

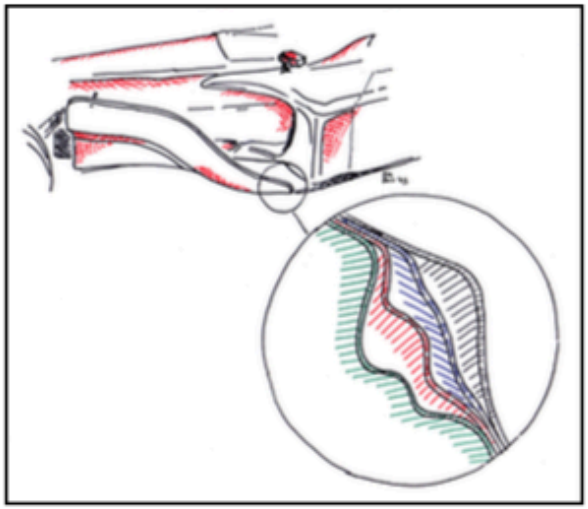
different weight but similar strength

L'evoluzione della progettazione

L'evoluzione della progettazione strutturale è molto spesso condizionata dalla scelta dei materiali: dal legno ai materiali omogenei come l'acciaio e leghe leggere, infine le nuove frontiere si oreinteranno sempre di più verso materiali compositi avanzati.





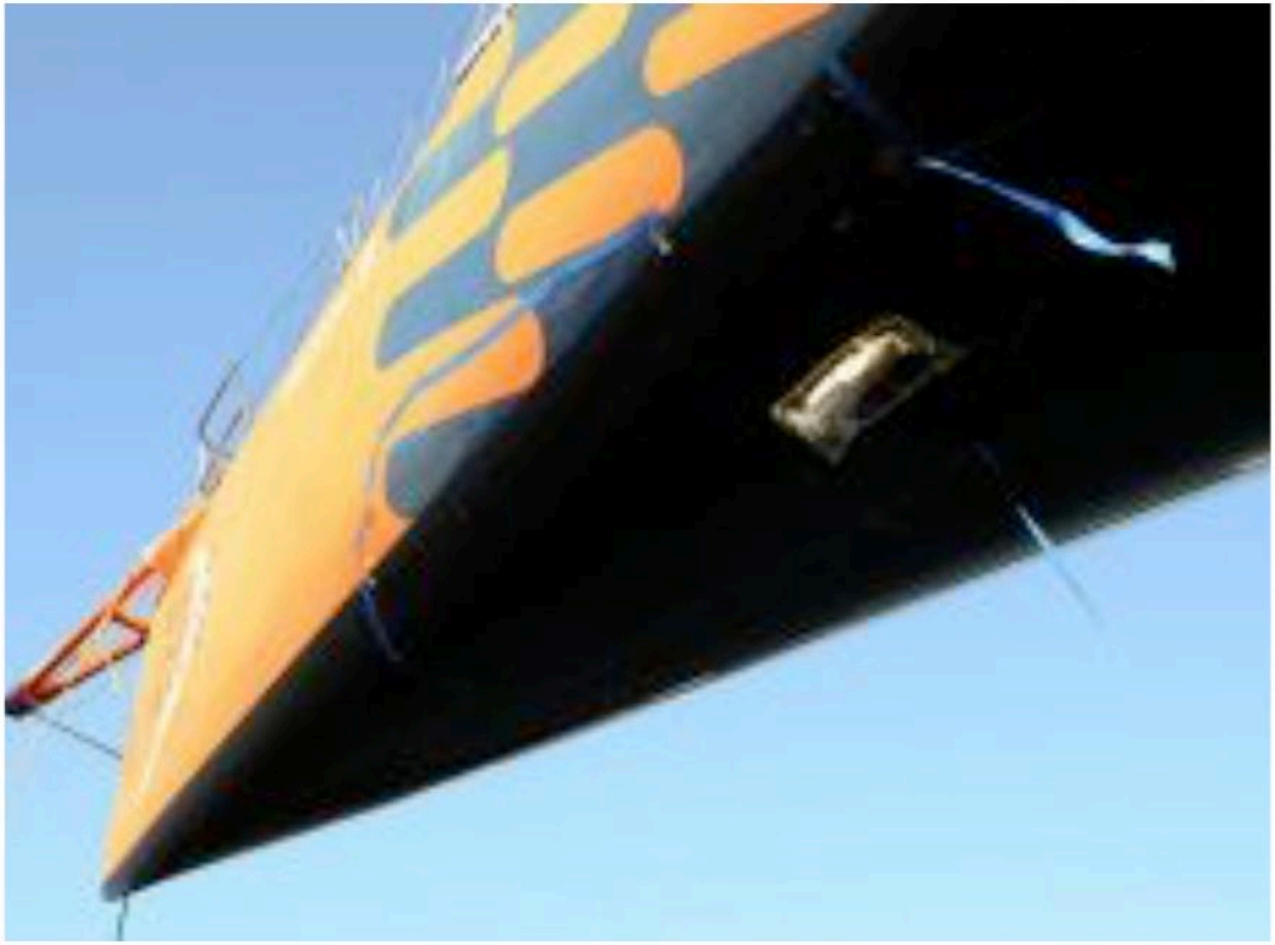


I materiali compositi naturali e quelli "avanzati" sono materiali ottimizzati per natura e i concetti che guidano la progettazione del legno sono analoghi a quelli utilizzati per la fibra di carbonio.


ERICSSON
TAKING YOU FORWARD
www.VolvoOceanRace.org
4

Ericsson 4 covered the 42,500 miles (68,400 km) of the race in a time of 127 days, 7 hours, 46 minutes, 21 seconds

black swan

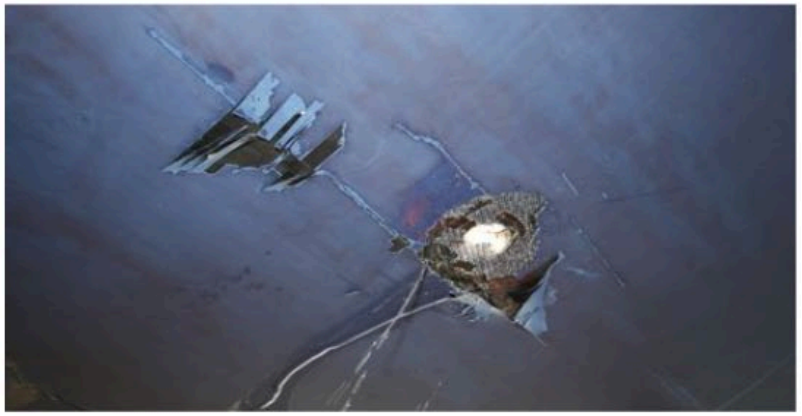


Hualien, Taiwan, (Jan. 27, 2009) E3 is making way for Taiwan after discovering cracks in the forward port side of the hull.

Area of damage

Area 4m x 1.5m

local impact



removing the failure panel

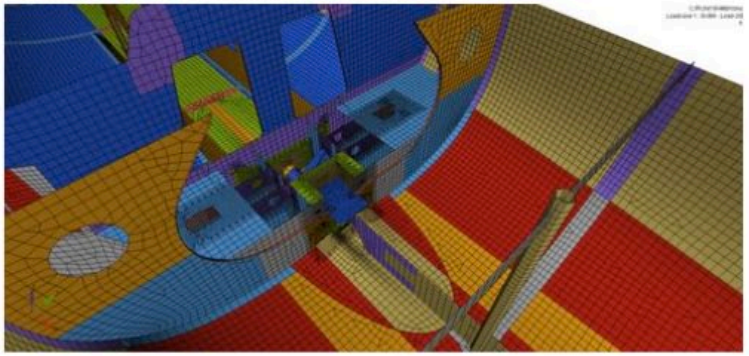
Analysis of the repair options

Application of the new panel

Bonding and final result

working loads
or
running loads

example of *Pull Down Test*
(limit service load)

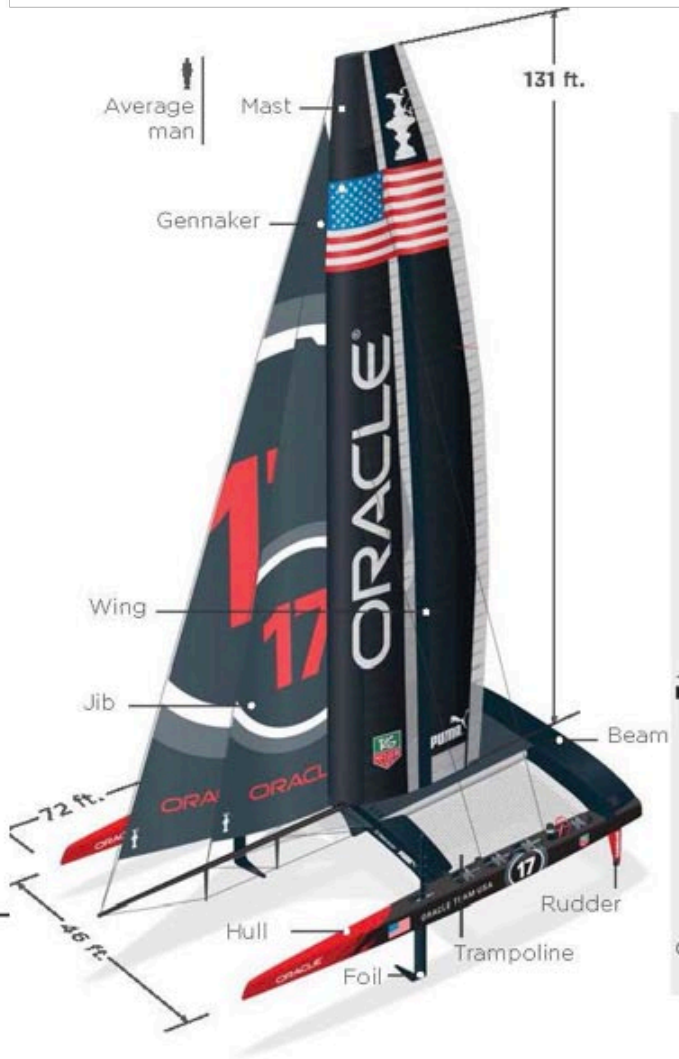


VIDEO

Volvo Ocean Race 2008

34th America's Cup (San Francisco)

ARTEMIS 2 AC72
Boat number 2



AC72
131' 2" Mast Height

Boeing 747 Wing
105' 9" Long

VIDEO

America’s Cup

black swan

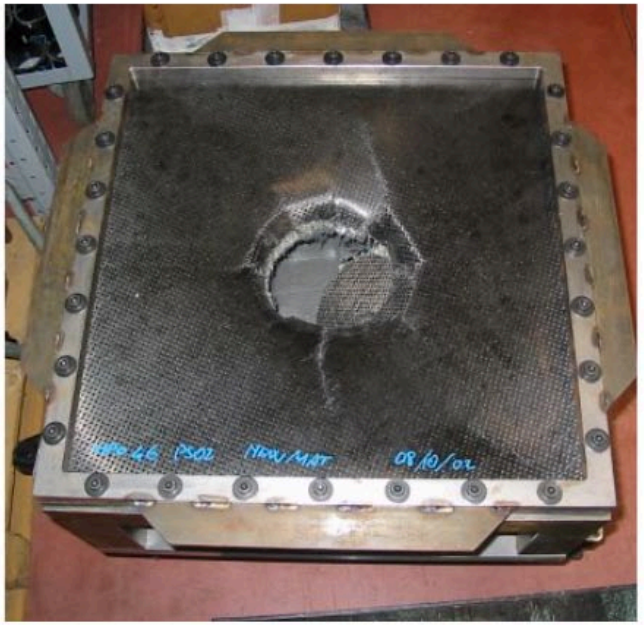
F3000 side penetration accident - Barcelona 2000 qualifying (Haberfeld)

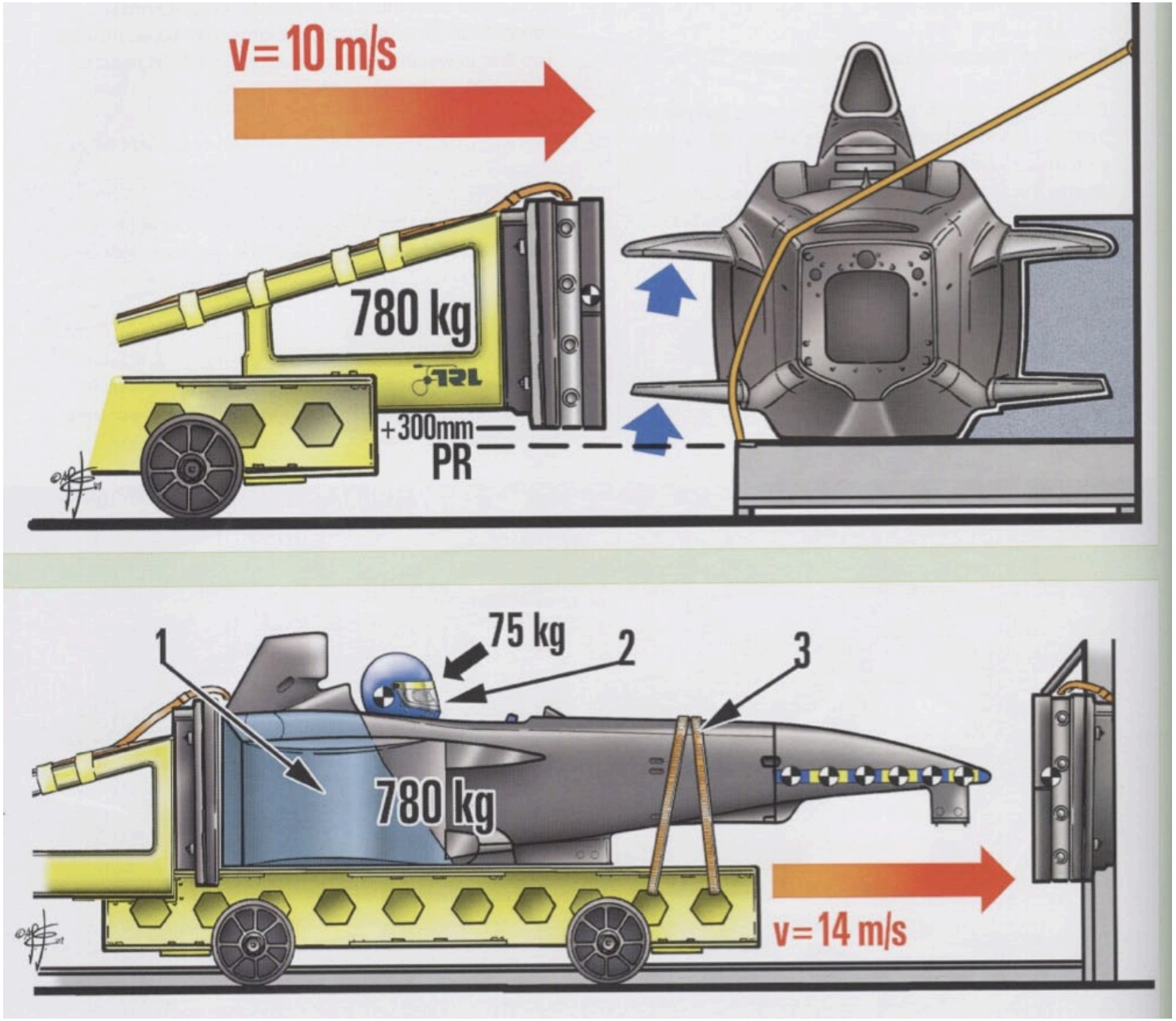
Flat Test panel

displacement of 150 mm

max reaction force 200 kN

max energy 6000 J

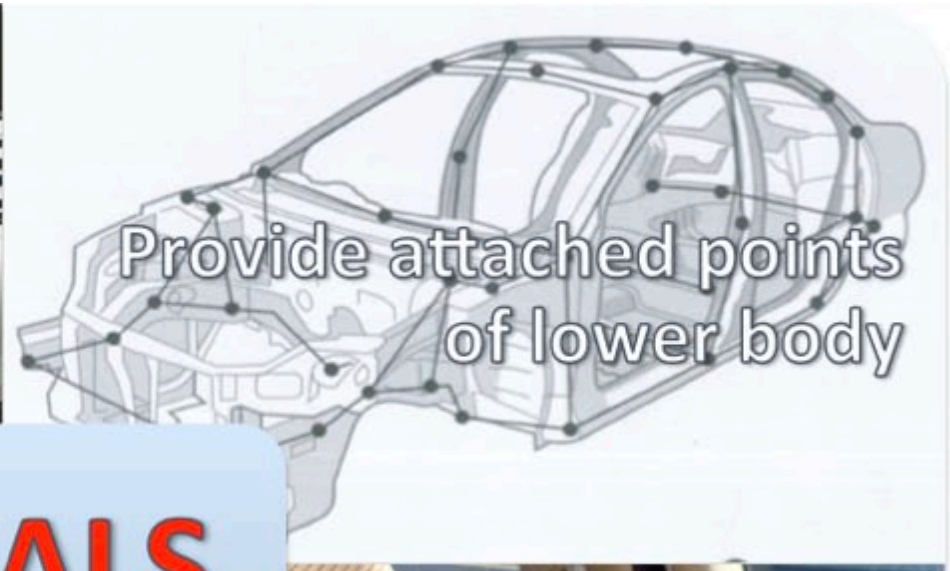



v=10 m/s
780 kg
TRL
+300mm
PR
75 kg
1
2
3
780 kg
v=14 m/s

VIDEO

F1 Crash test


Protect occupants


Provide attached points
of lower body

GOALS

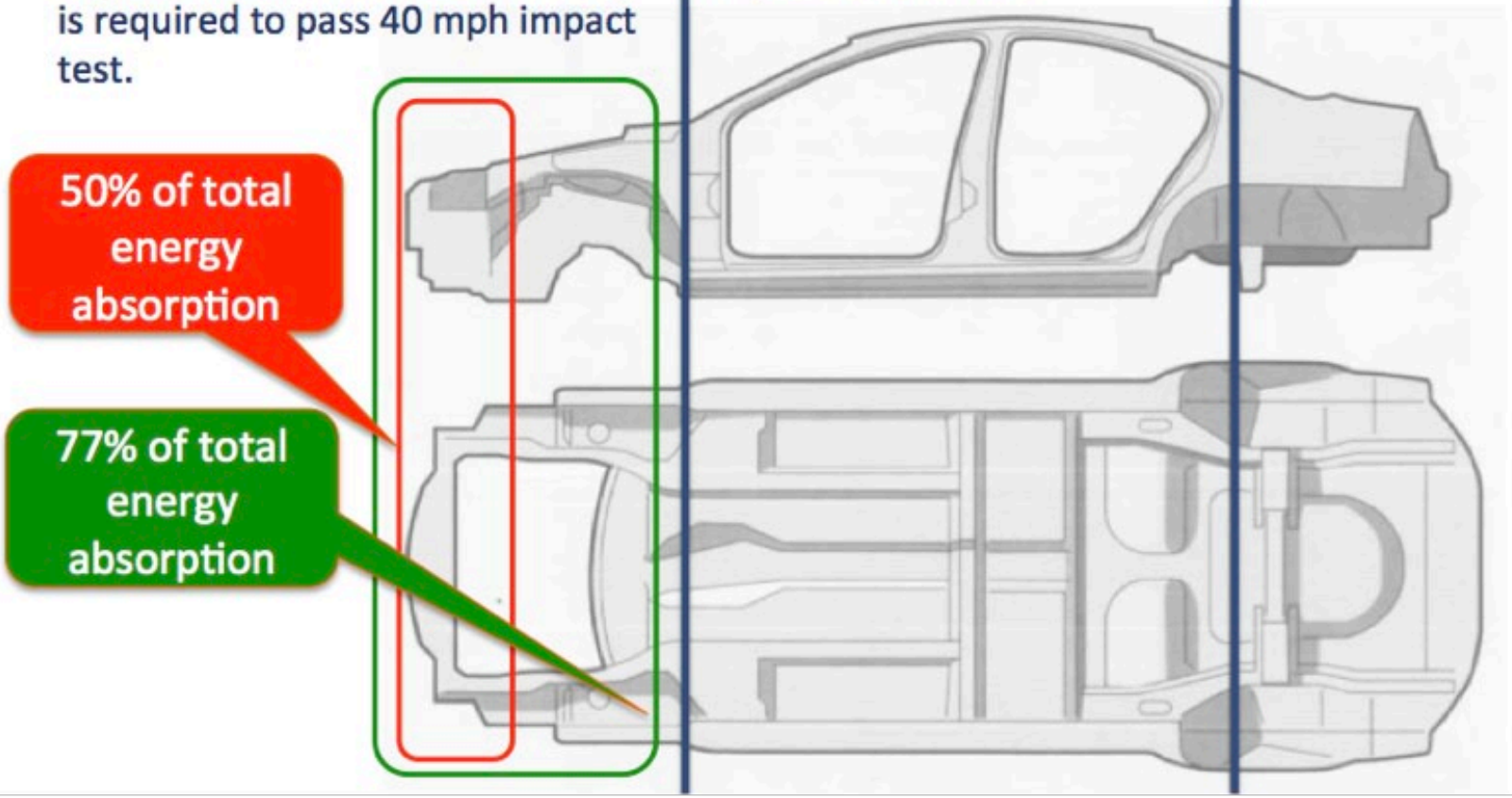

Weight reduction


Reduce noise

Front End: Energy absorption
The front end structure is designed to crush at a specific rate to absorb energy. Clear crush space around any solid components such as the engine, transmission and steering is required to pass 40 mph impact test.

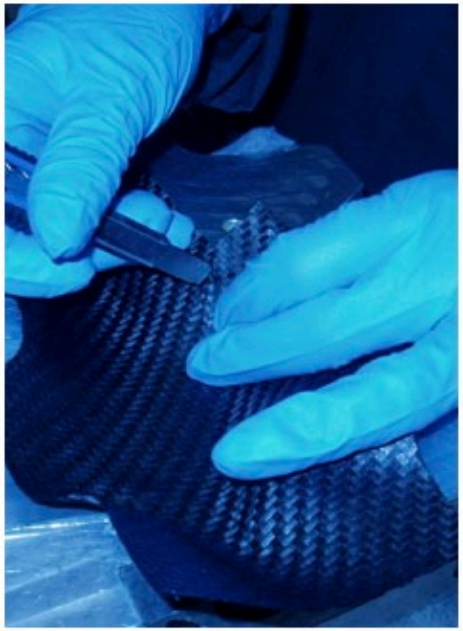
High structural integrity
The passenger compartment is very rigid to protect the occupants form being crushed during a high-speed impact or rollover.

Rear End: Energy absorption
The rear-end structure is designed to crush in a similar way to the front.

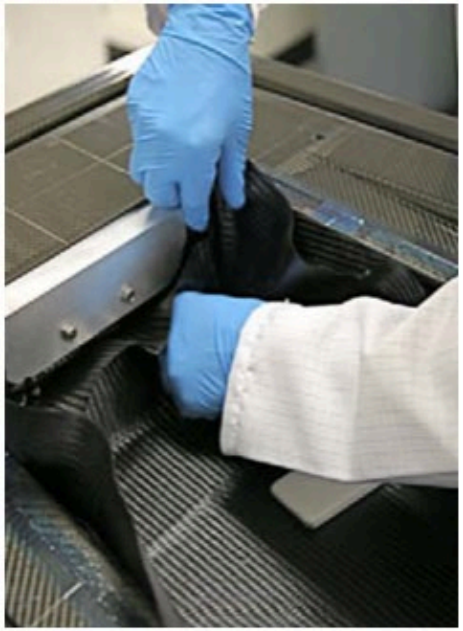


VIDEO

Automotive Crash



real world

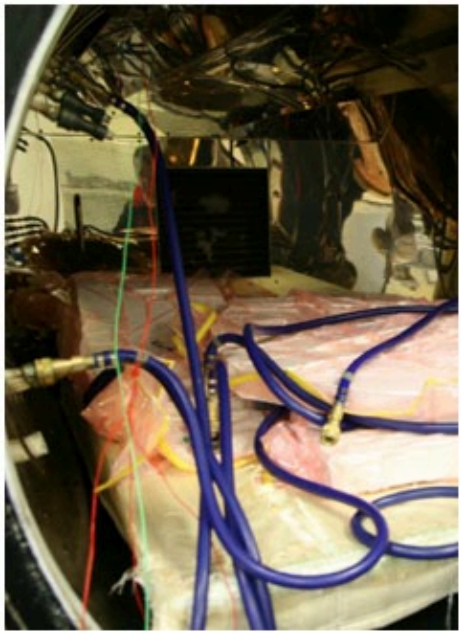


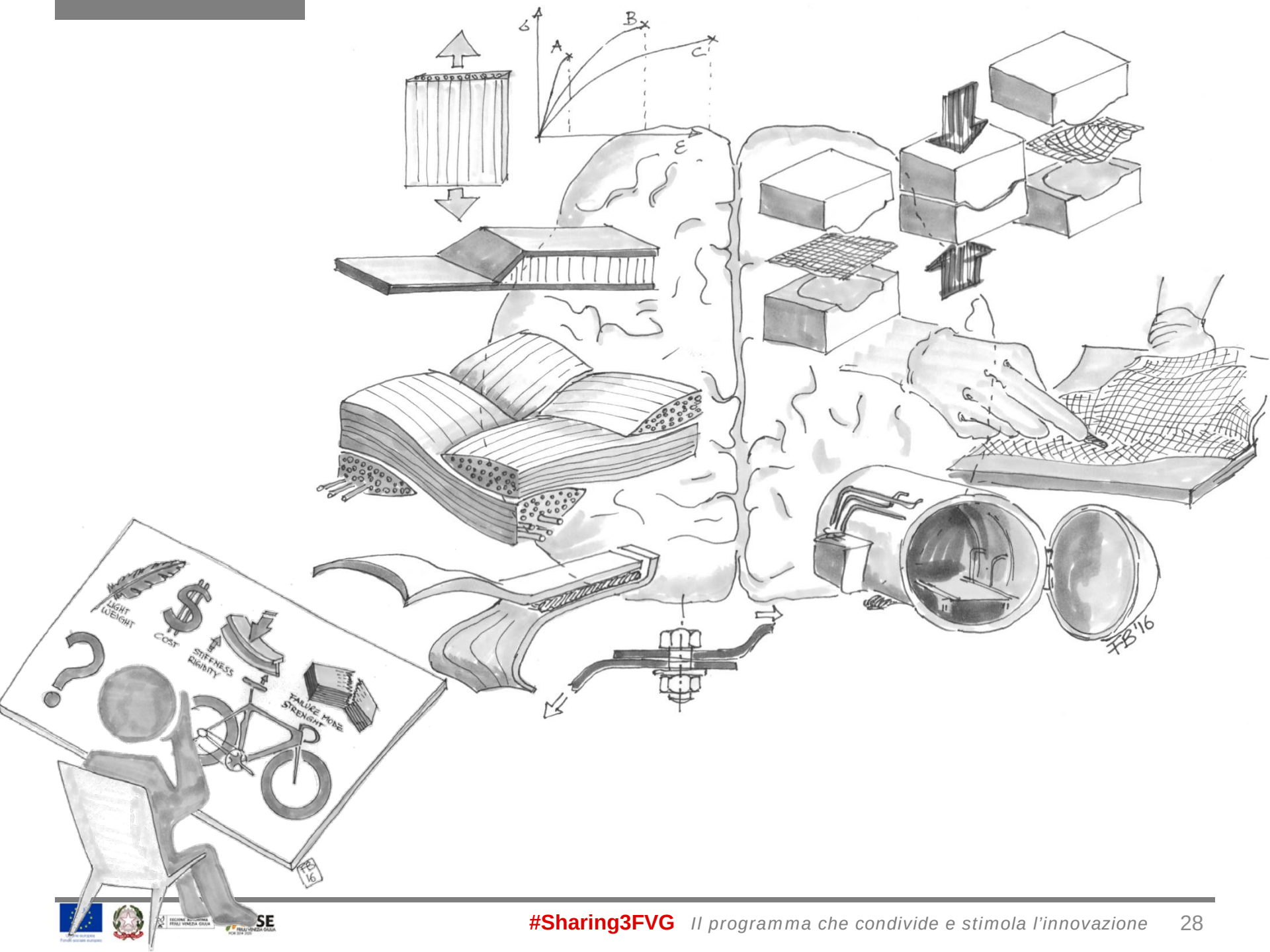
manual process :

lamination

and autoclave

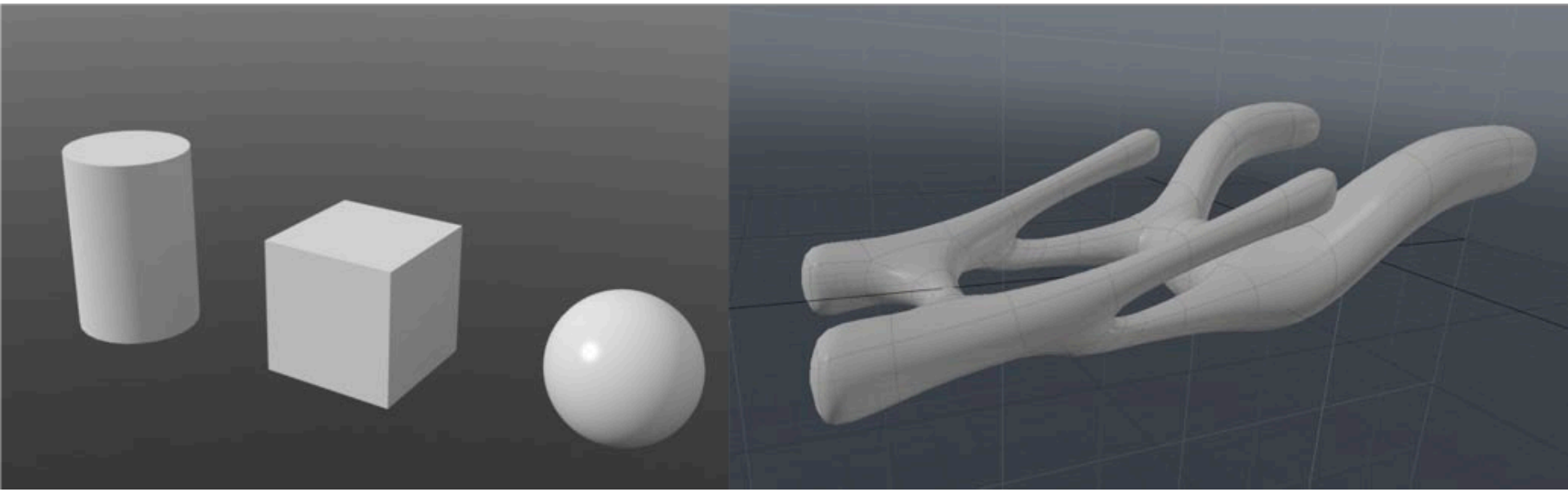
What is the difference between design and real construction?

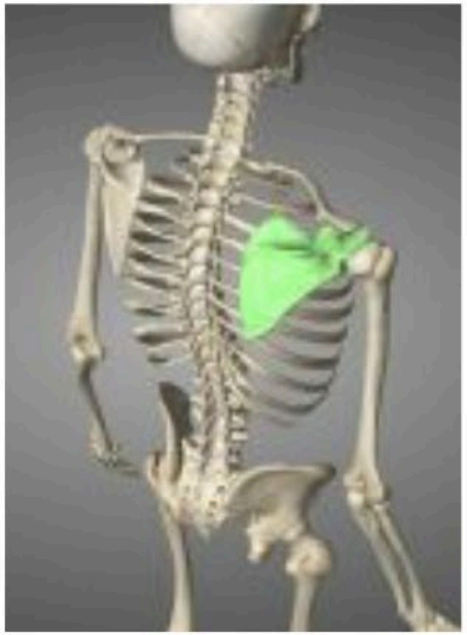



σ
A
B
C
ε
LIGHT WEIGHT
COST
STIFFNESS RIGIDITY
FAILURE MORE STRENGHT
FB '16

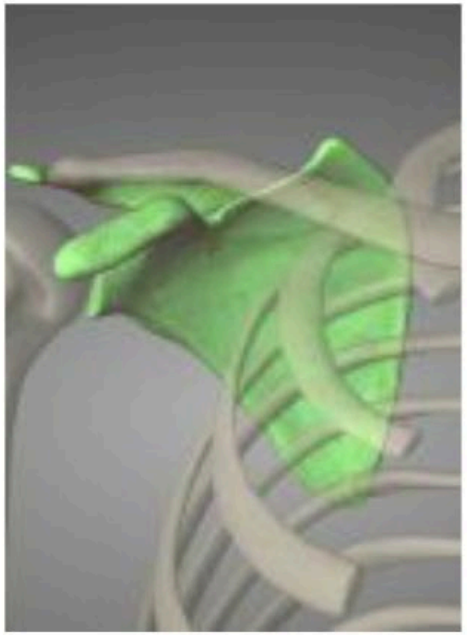
Autonomous Vehicle Safety

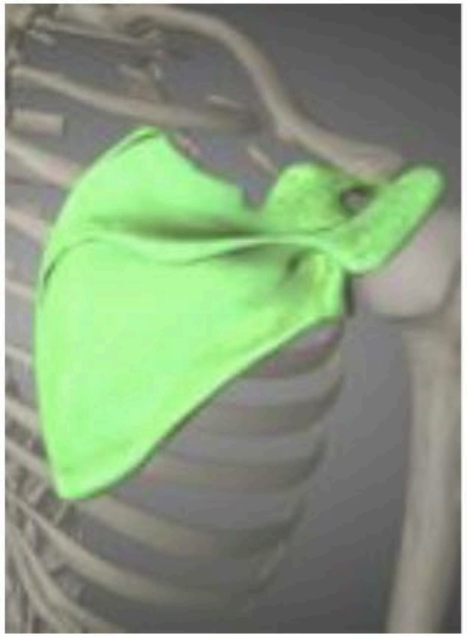
Organic design





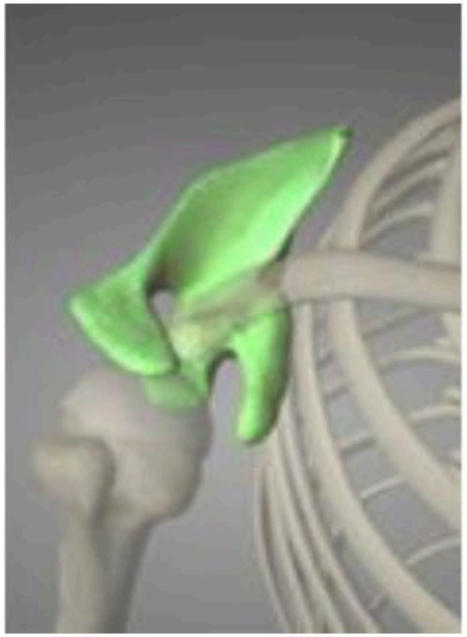
scapula right



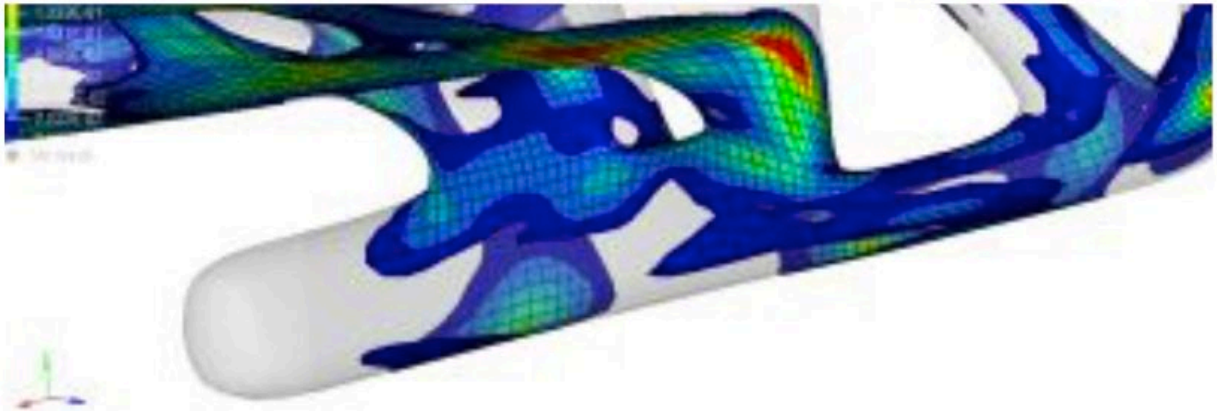


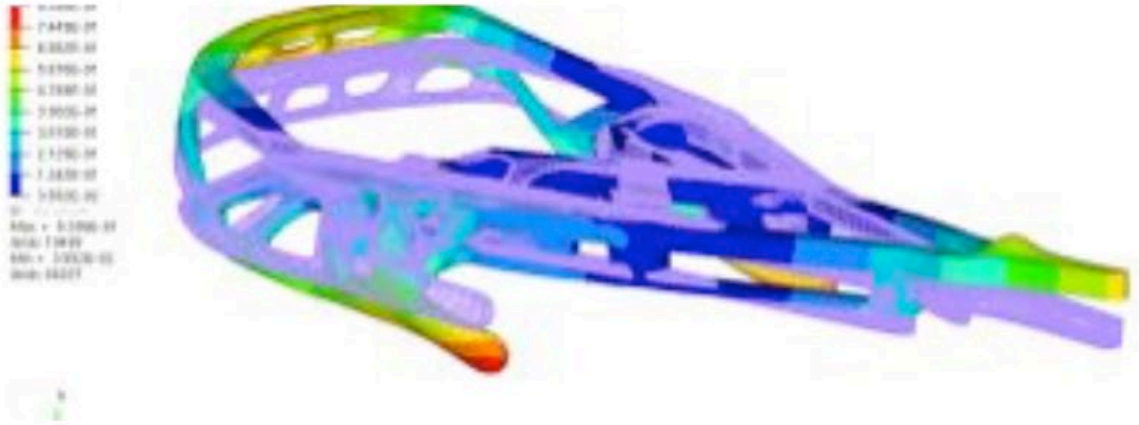
Scapula is a flat, triangular bone that is also know as the shoulder blade. This bone is usually resistant to fracture.

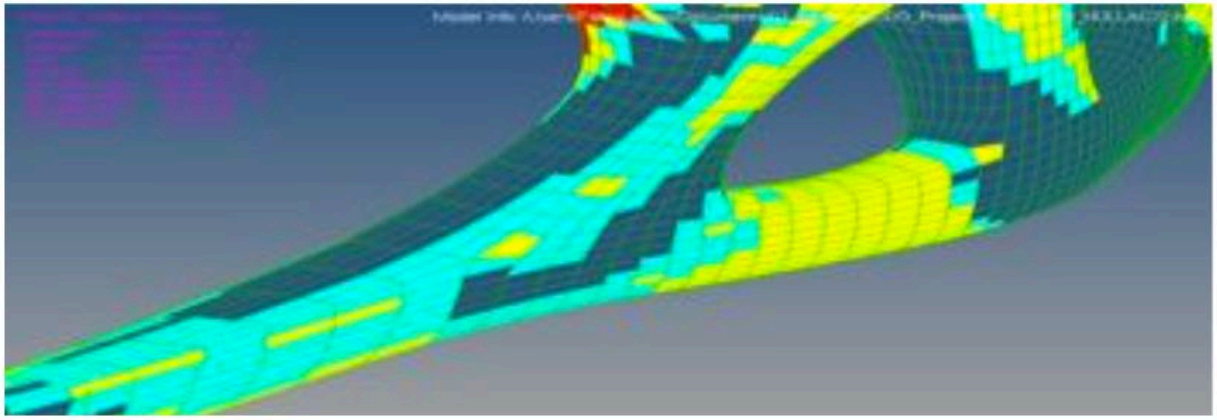
This is a great example of incredible light design with hight performance.



Shapes
for humans
not
humans for
shapes







Thanks

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FSE FRIULI VENEZIA GIULIA POR 2014 2020

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