ONYX composites

Innovative bicycle frame made of hemp and bambus

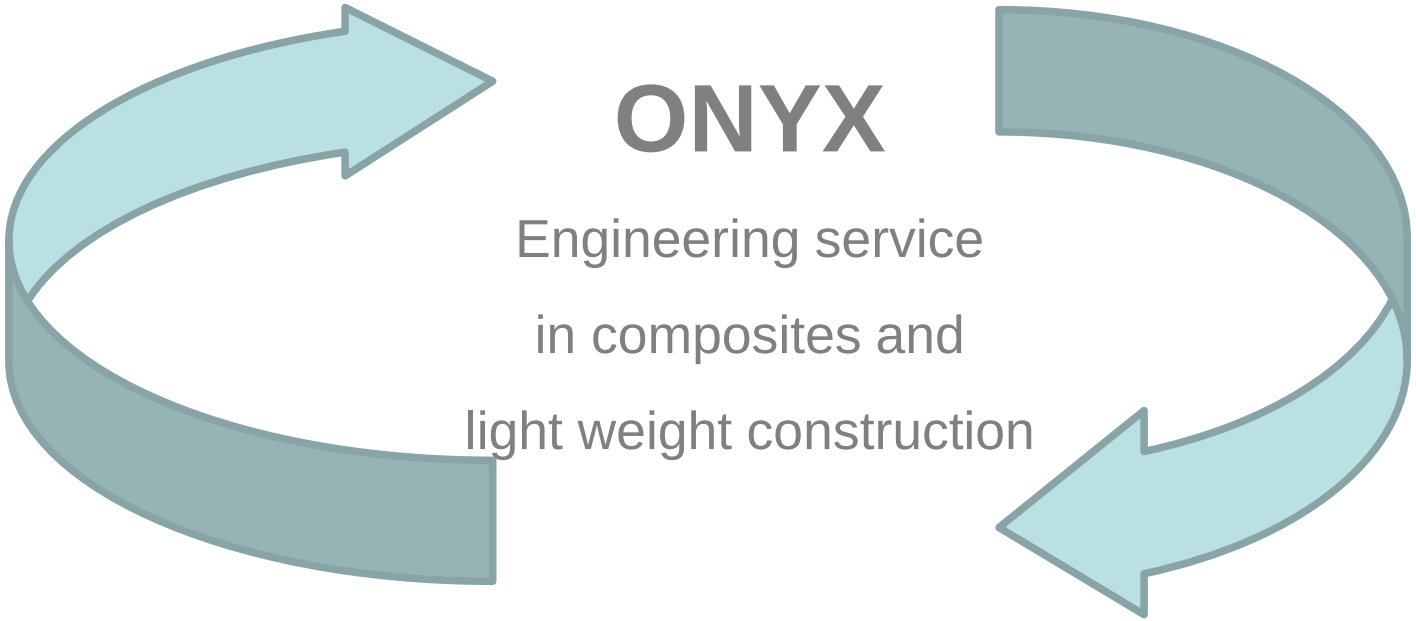
27.05.2010

by : Nicolas Meyer

- ONYX composites
- „hempbike“
- the next tasks

1. project work and prototyping

2. laboratory

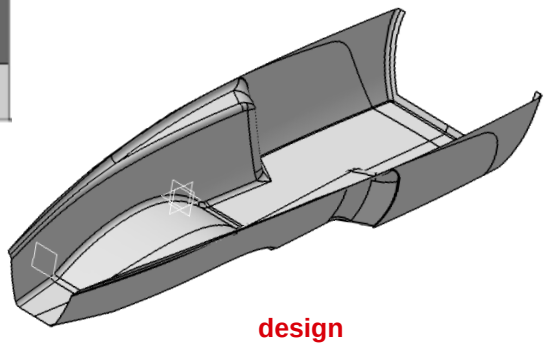


4. research and development

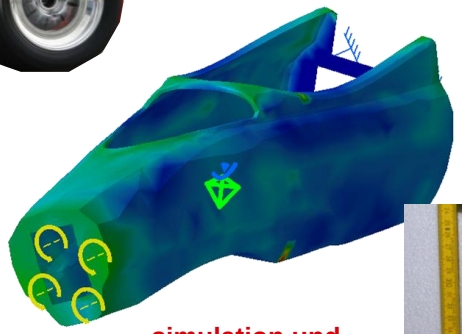
3. consulting and training

concept and calculating

laminat construktion



design



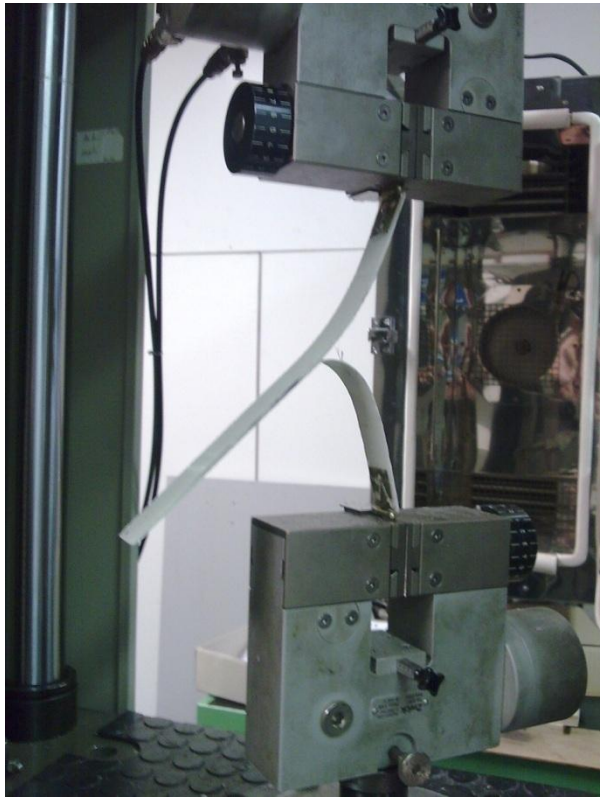
simulation und testing

assembly

manufacturing

Manufactoring of test coupons

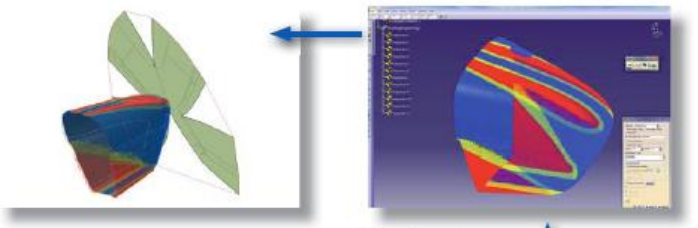
Fachhochschule Osnabrück
University of Applied Sciences



Testing at the FH Osnabrück

from theory….

Preliminary Design
- Composite Design Prozess
- Erstellen eines Materialkataloges
- Definition Zonen und Übergangszonen
- Erstellen des Lagenaufbaus
- Erstellen von Solids und Deckflächen
- Export und Weiterverarbeitung in Excel



Ausbildung an Komponenten aus dem Rennsport

….to praxis

Engineering Design (CPE)
- Manuelle Lagenerstellung
- Definitionen von Kernstrukturen
- Analysen hinsichtlich Materialstärke und Lagenaufbau

Manufacturing Design (CPM)
- Fertigungsgerechte Darstellung
- Lagen beschneiden
- Lagen abwickeln
- Drapieranalyse
- Plybook und Zeichnungserstellung

(linkes Bild)
Vorbereiten zur Infusion

(Bild unten)
CFK-Aramid "Nase" (520 g)

and without oil?

…but why hemdfibres?

Eigenschaften	
Faserlänge	Einzelfaser 5-55, durchschn. 25 mm; Faserbündel 1-3 m[1]
Faserdurchmesser	10-50 µm, durchschn. 25 µm[1]
density	1,48 g/cm³[1]
tensile strength	0,31-0,39 GPa[1]
Young`s modulus	69 GPa[1]
Bruchdehnung	1,6-2,7%[1]
Wasseraufnahme	8%[1] bzw. 8,5-10%[2]
Chemische Beständigkeit	beständig gegen Basen, unbeständig gegen starke Säuren[3]

hemp vs. other natural fibres

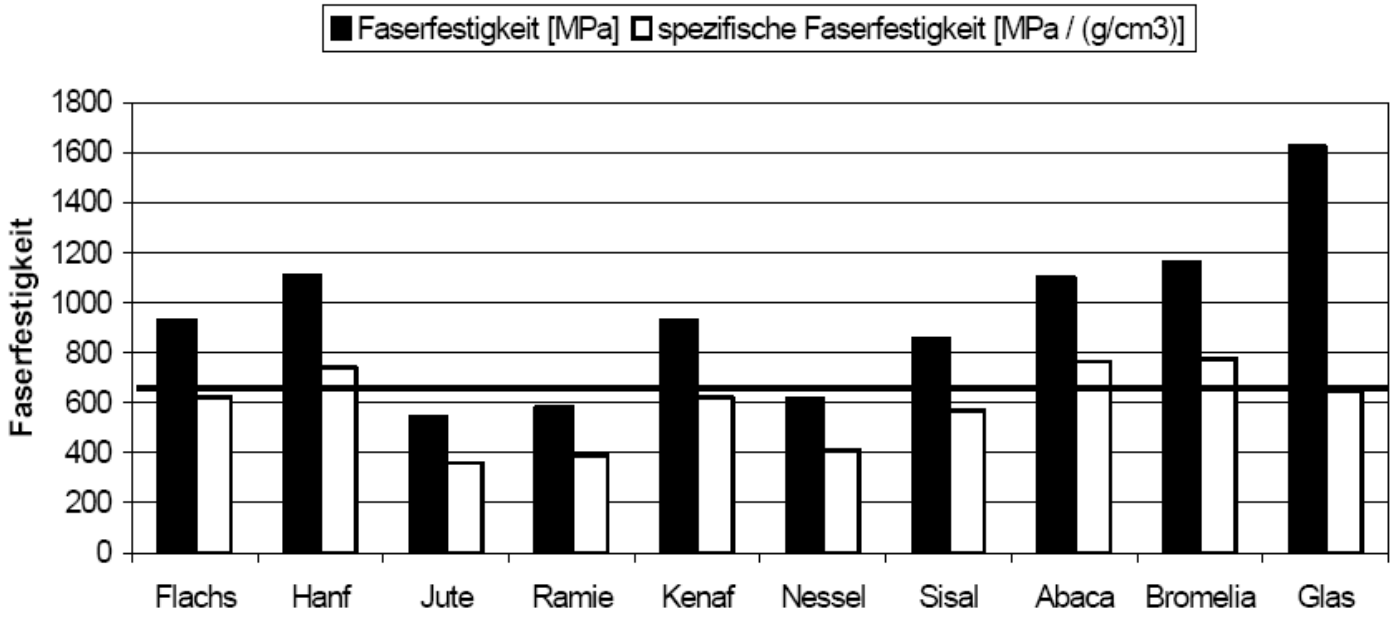
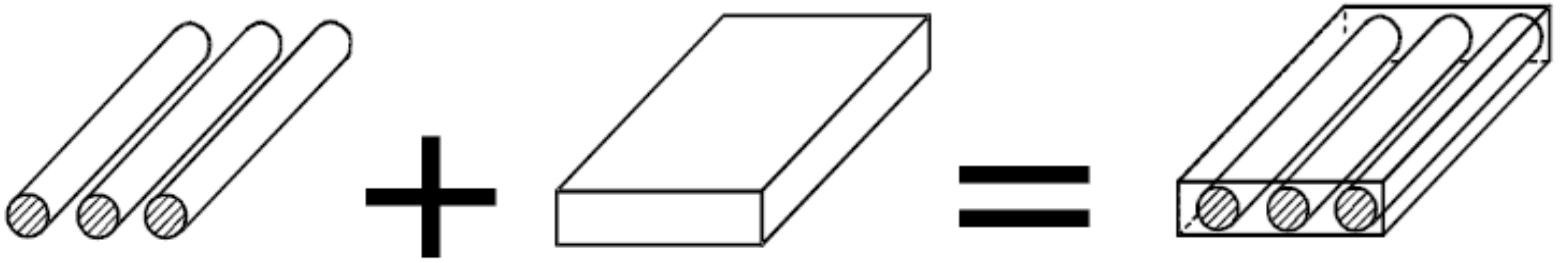


Abb. 2: Zugeigenschaften von Naturfasern im Vergleich mit Glasfasern [7,8,15]; Bündelprüfung nach DIN EN ISO 5079: Einspannlänge 0 mm, Vorschubgeschwindigkeit 30 mm/min

hemp vs. conventional fibres

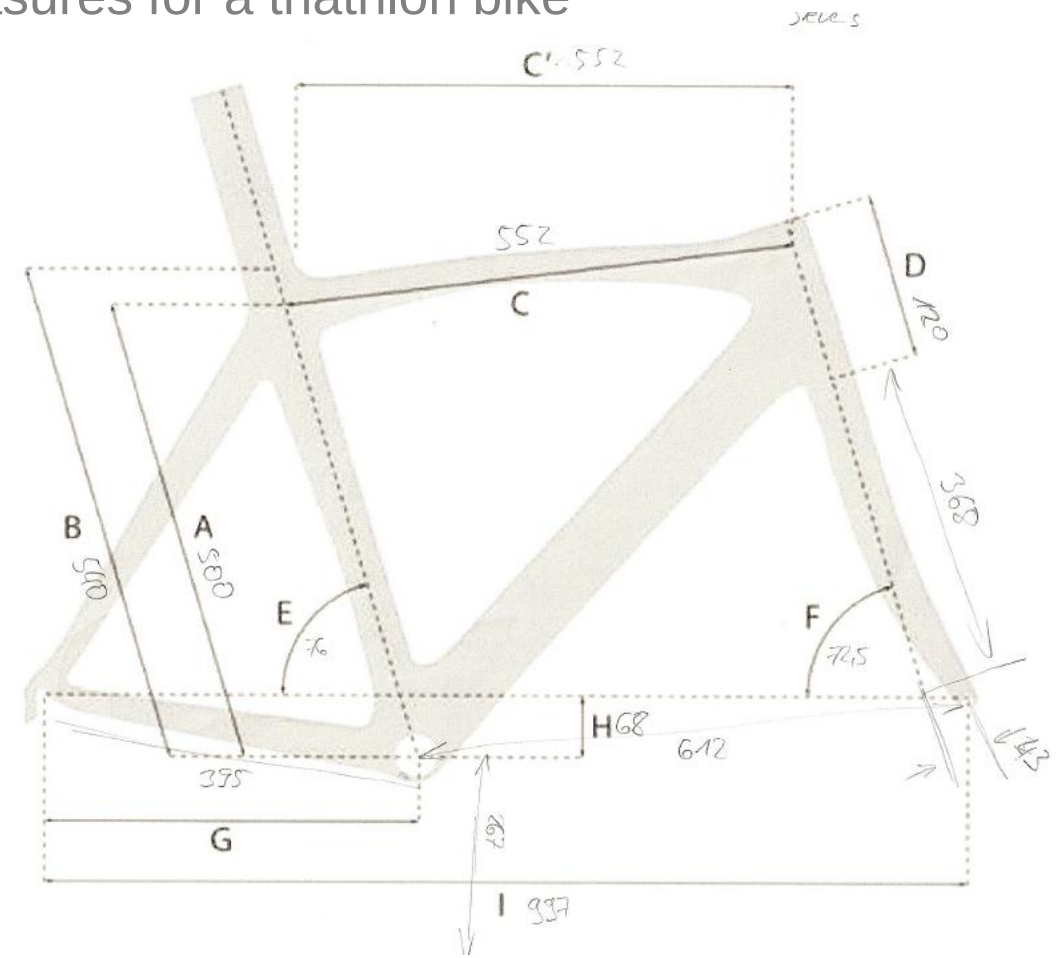
Vergleich verschiedener Materialien und deren Eigenschaften					
	Physikalischen Eigenschaften				
Material	**Zugfestigkeit [R_m]N/mm²**	**Elastizitätsmodul N/mm²**	**Dichte [ρ]=kg/dm³**	**Wärmeleitfähigkeit [λ]=W/K*m**	**Wärmeausdehnungskoeffizient [α]=10^{-6} K^{-1}**
Aluminium (AU 4G)	350 - 390	74000	2,8	140	23
Aluguss	70 - 420	65000 - 83000	2,75	140 - 210	20 - 24
Stahl (St52, heute S355)	510	210000	7,8	20 - 100	13
E-Glasfaser	1650 - 4500	55000 - 86000	2,1 - 2,6	1	4,1 - 5,6
Laminat E- Glass/ Epoxy	variabel	variabel	variabel	0,3 - 0,8	variabel
Aramidfaser	2800	Längs der Faser = 67000 - 130000 Quer zur Faser = 5400	1,45	0.03	Längs der Faser = -2,0 Quer zur Faser = 12,5 - 17
Hanffaser	310 -390	69000	1,48		
Carbonfaser	2150 - 4510	Längs der Faser = 230000 - 450000 Quer zur Faser = 15200 - 28000	1,7 - 1,9	200	Längs der Faser = (-0,5) - (-1,1) Quer zur Faser = 12,5 - 31

Epoxi

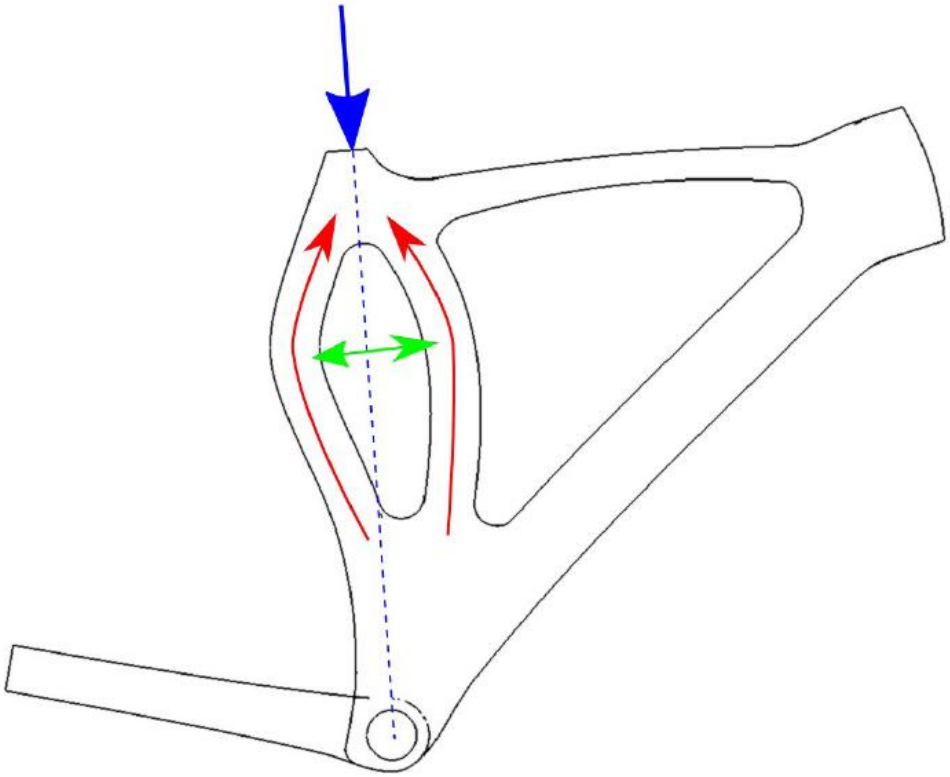


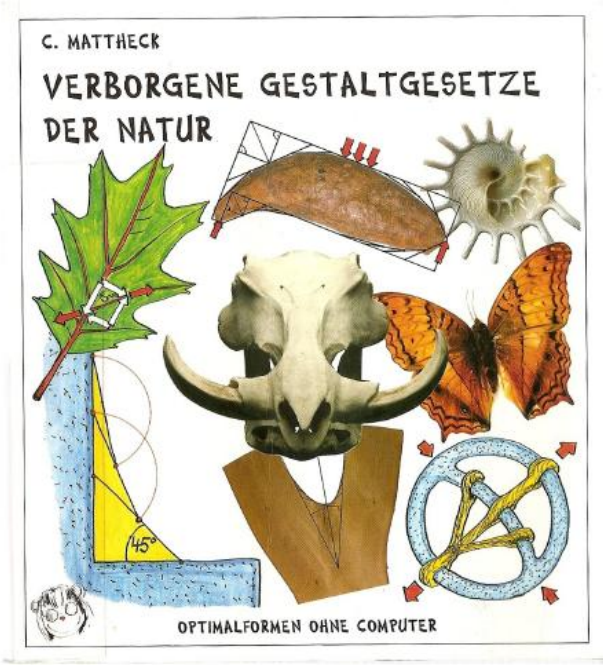
fibre + matrix = composite

the right measures for a triathlon bike

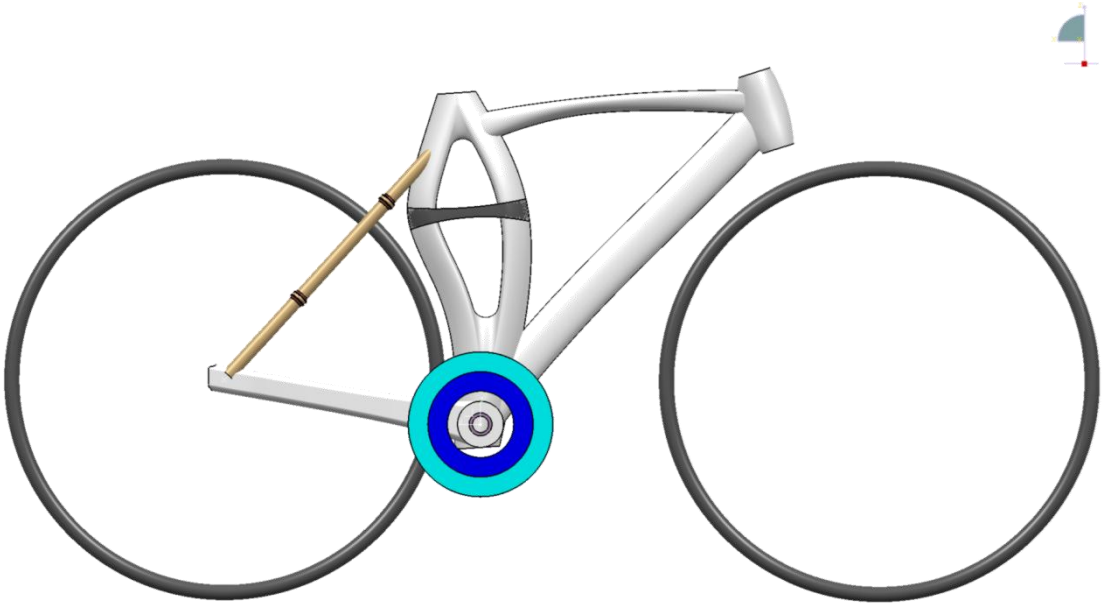


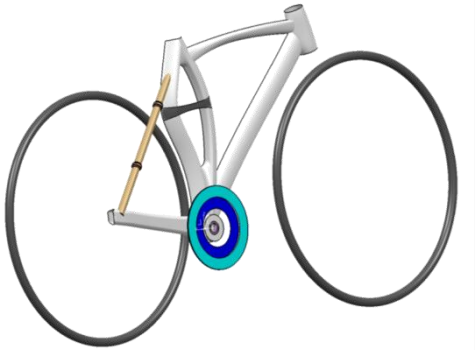
the right composite design

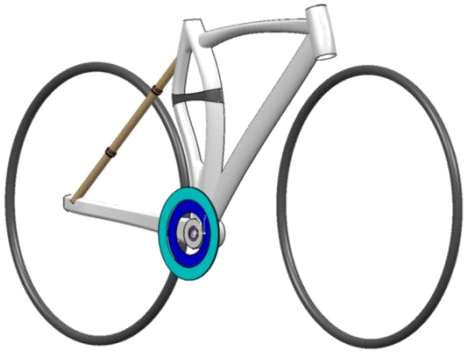




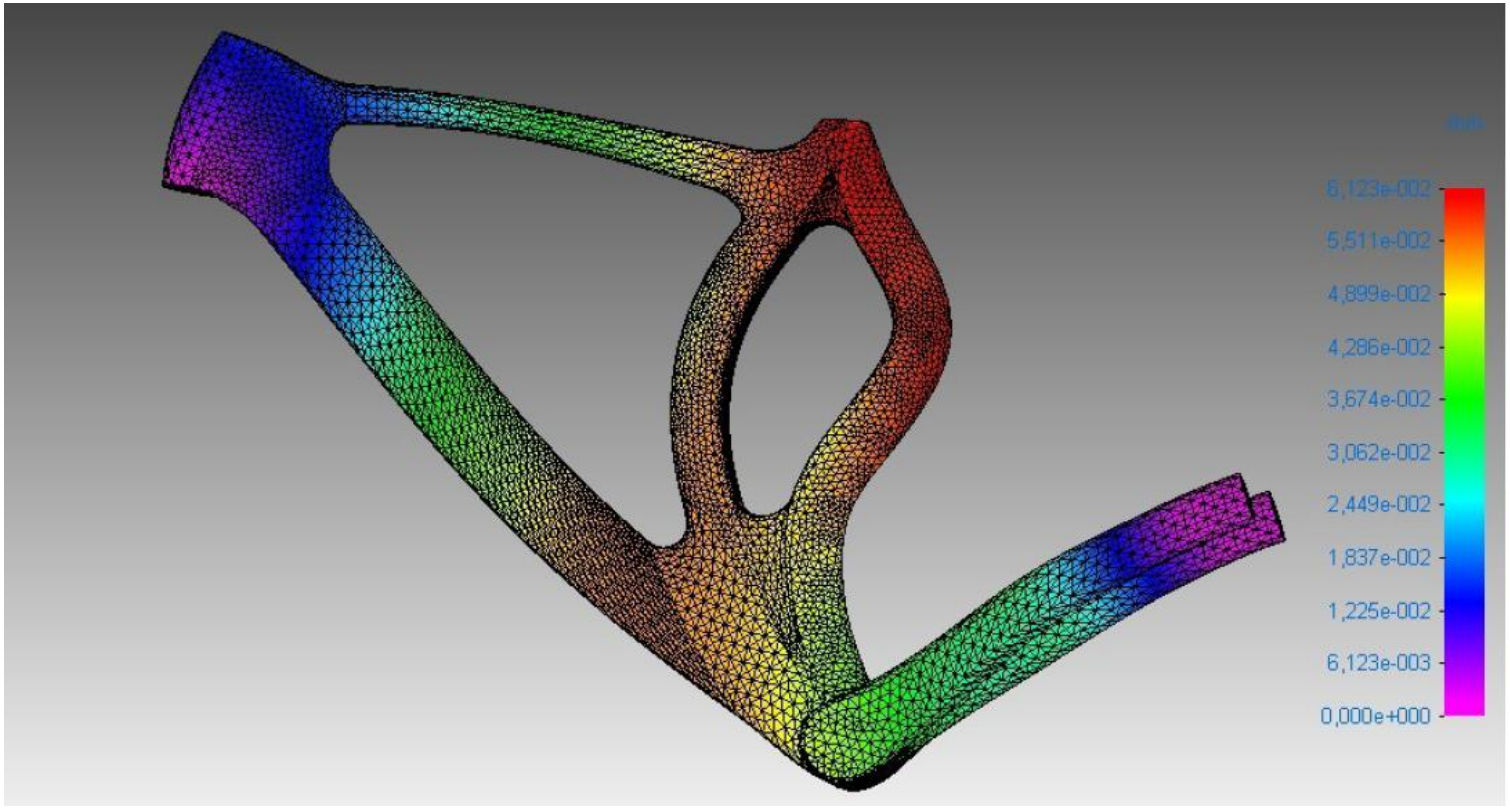
the first cad design for simulating the frame







simulation


6,123e-002
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2,449e-002
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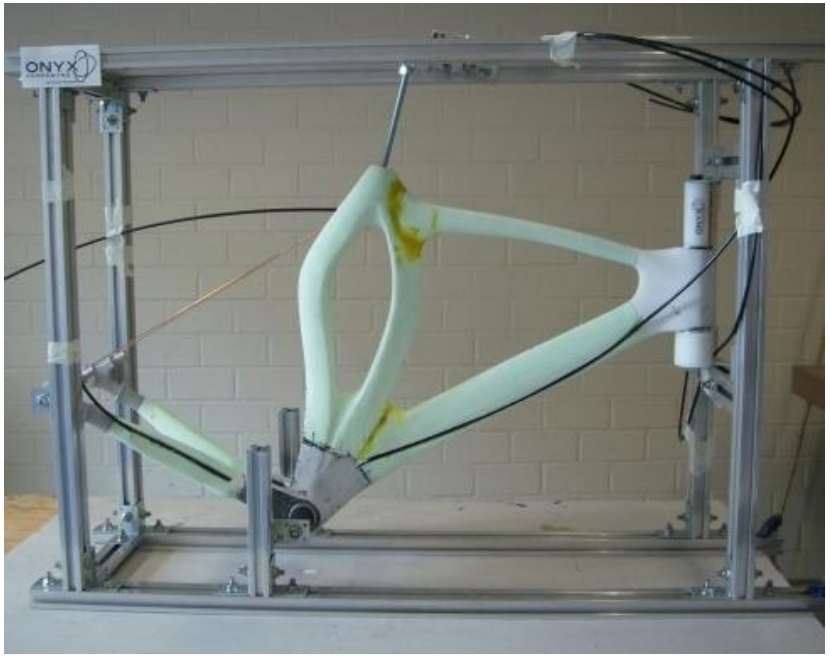
6,123e-003
0,000e+000

wheels an positiv mould of the frame

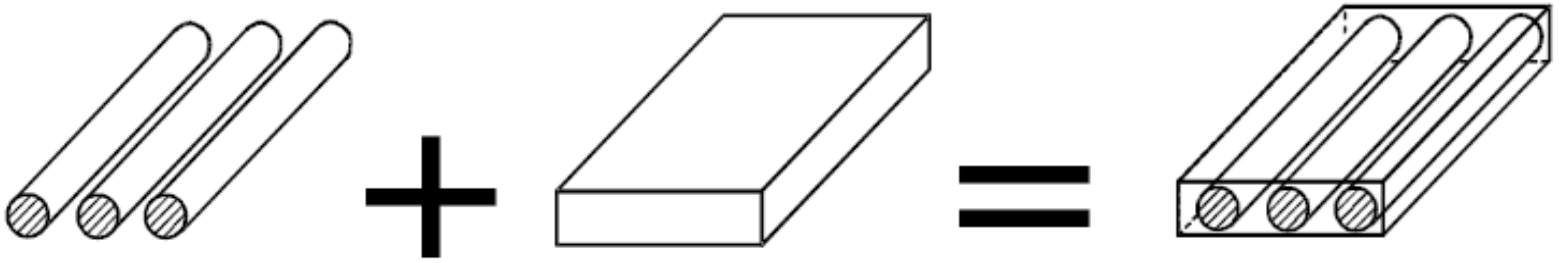


The production widget

Laminating by hand with epoxiresin


www.Bluschke.com

Epoxi



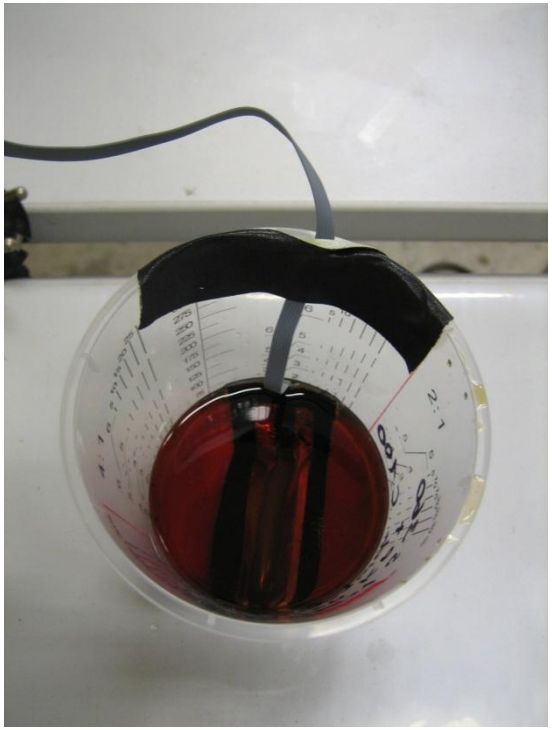
fibre + matrix = composite

Bio-Resin Tribest from Cognis

Tribest is a Matrix that is used for composite- prts like the body from the KTH Team by the Shell Eco- marathon. It is based on renewable raw materials (acrylatmodified Sojaöl).

Shell Eco-marathon

testing of the Tribest resin



Laminating hempfibres with Tribest resin