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1 Exercise with Granta

Overview: L'oggetto a noi assegnato è l'elmetto da bici (più precisamente il guscio esterno). Ecco riportato in ordine il processo di selezione dei due migliori materiali candidati:

- Selezione dei material indices dalla seguente *tabella*.
- Applicazione dei limiti
- Applicazione di un material index (costo)
- Selezione del materiale più cheap
- Rimozione del material index relativo al costo e selezione del material più expensive

Material indices: Prima di tutto scegliamo la geometria che meglio approssima l'oggetto finale che dobbiamo costruire. Successivamente ci siamo basati su Stiffness-limited-Design at minimum mass.

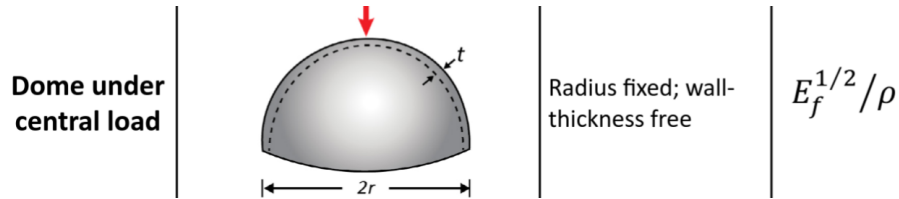


Figure 1: Function and Constraints and formula to maximize

Successivamente massimizziamo e Strength-limited-Design at minimum mass:

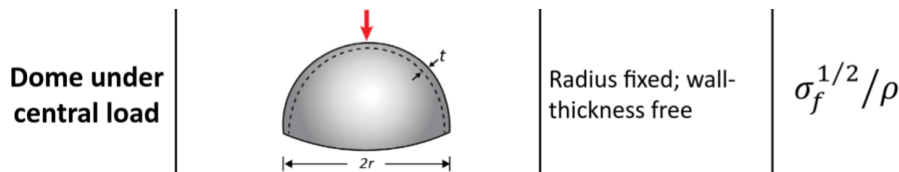


Figure 2: Function and Constraints and formula to maximize

I seguenti Ashby chart:

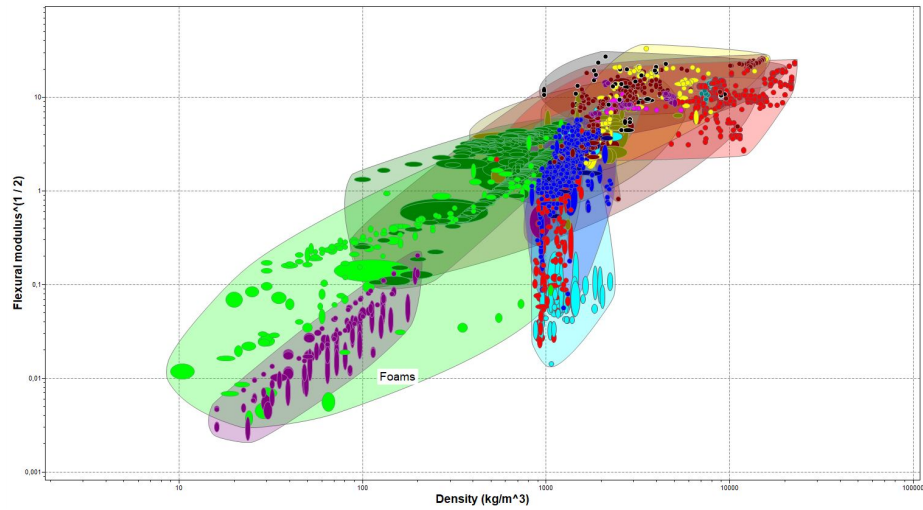


Figure 3: Stiffness-limited-Design at minimum mass

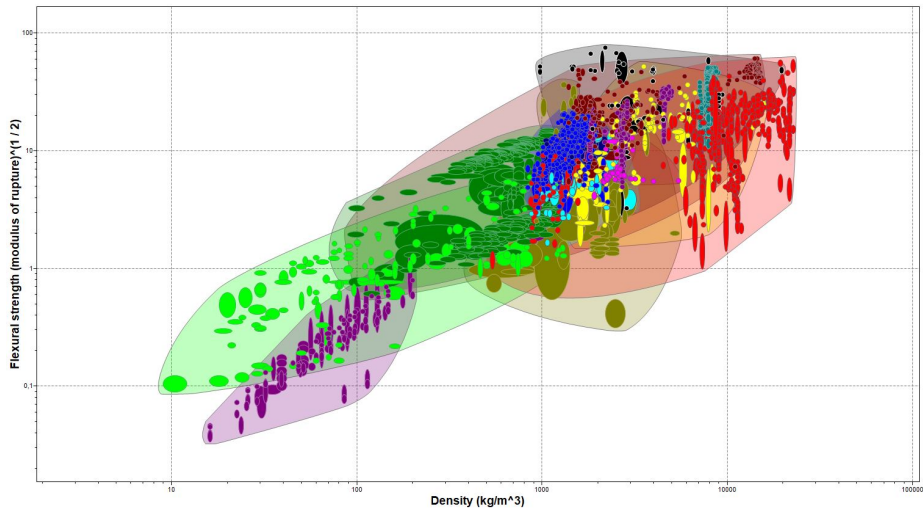


Figure 4: Strength-limited-Design at minimum mass

Applicando la formula dei material indices, per ogni grafico abbiamo posizionato una retta di pendenza 1 in modo da restringere il numero di candidates materials e massimizzare le proprietà.

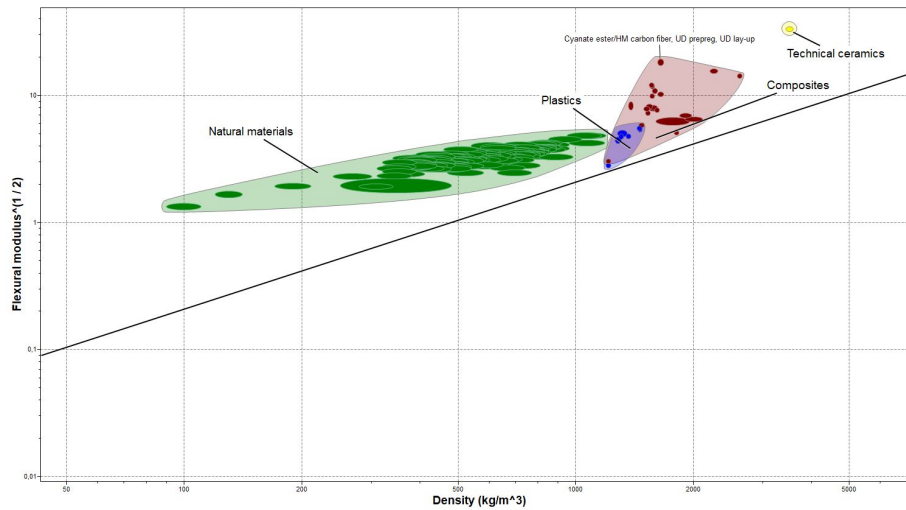


Figure 5: Maximizing Stiffness-limited-Design at minimum mass

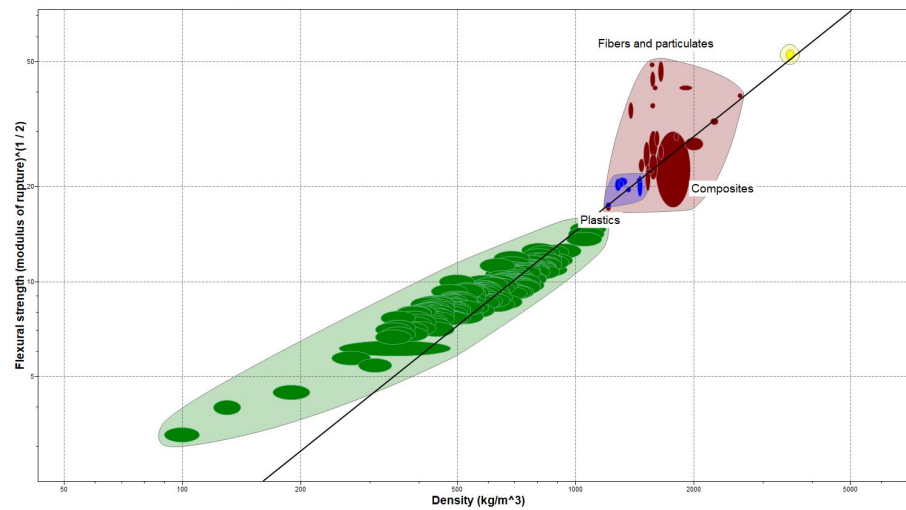


Figure 6: Maximizing Strength-limited-Design at minimum mass

Come si può vedere dai grafici le rette sono state posizionate in modo da mediare sulla selezione delle proprietà.

Costi: Abbiamo impostato un limite sulla geometria del nostro materiale in modo da avere una geometria il più simile ad un casco da bici, come riportato in Fig. 7. Questo limite permette al programma di selezionare tutti i materiale che possono ottenere la forma da noi desiderata tramite vari processi industriali.

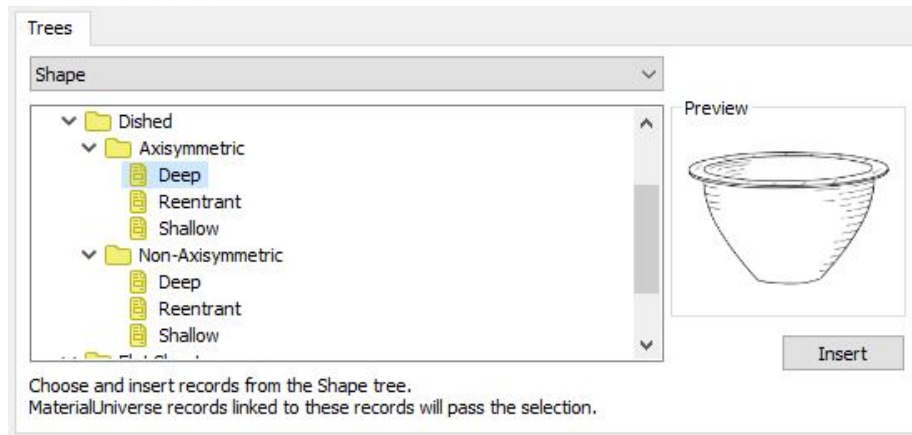


Figure 7: Selection of the closest resembling geometrical shape

Limits: Abbiamo impostato il material index basato sul costo (vedi Fig. 8):

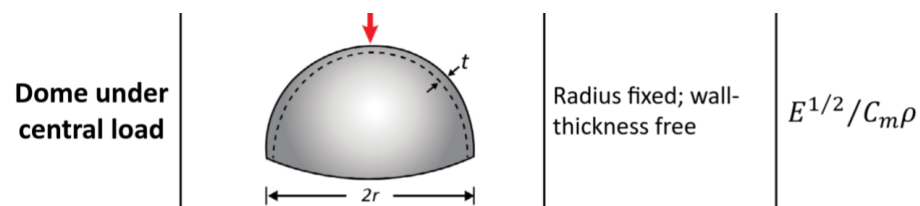


Figure 8: fra non ha voglia....

Il seguenti Ashby chart:

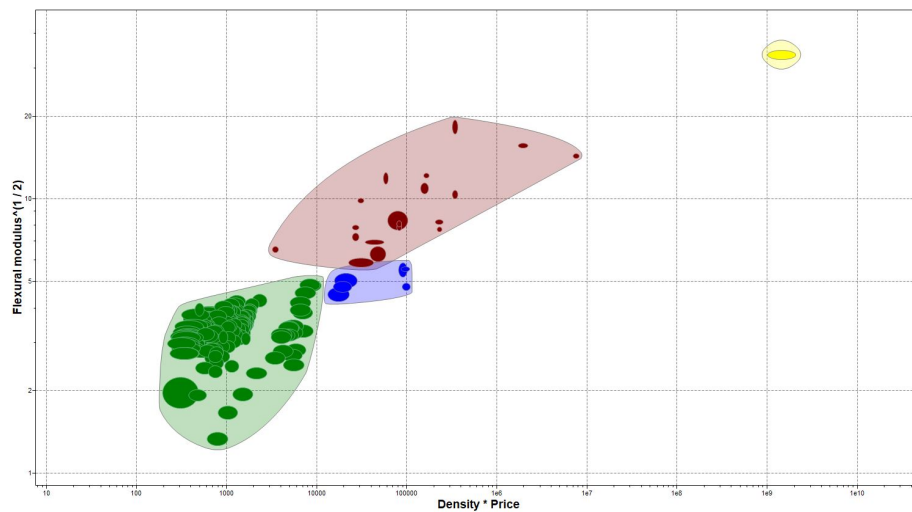


Figure 9: fra non ha voglia....

Questa volta abbiamo posizionato la retta in modo da selezionare un solo materiale candidato, che corrisponde all'opzione più economica del casco, come riportato in Fig. 10

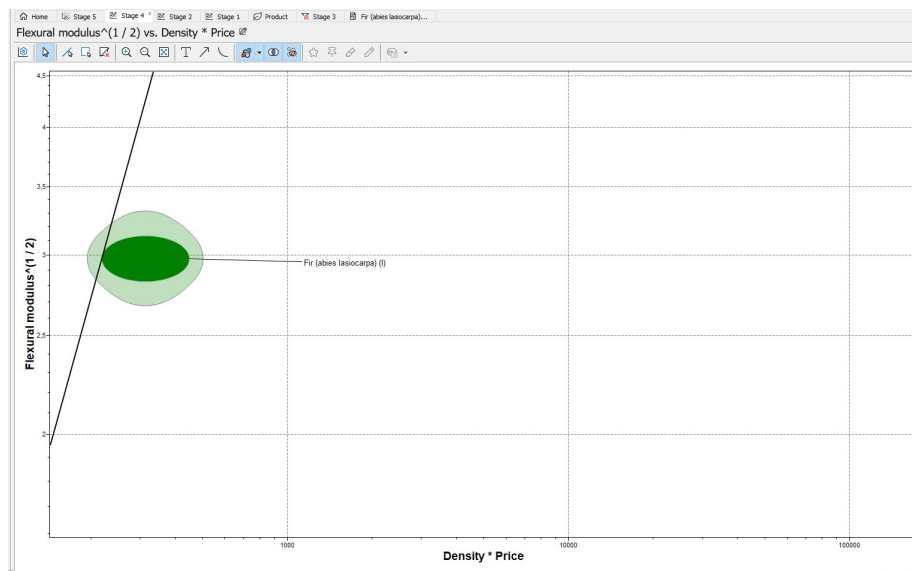


Figure 10: Cheap chop

Il materiale trovato è Fir (abies lasiocarpa) (longitudinal)

Fir (abies lasiocarpa) (l)			
Datasheet view: All attributes ⌵ Show/Hide Find Similar			
2005: 6.68 MJ/kg (Pustmann, Wagner and Johnson, 2010); 6.7 MJ/kg (Gomes, 2005); 7.1 MJ/kg (Gomes, 2005); 7.37 MJ/kg (Athens Sustainable Materials Institute, 2009 (5)); 7.72 MJ/kg (Pustmann, Begeman, Hubbert, Johnson, Lippie, Ornel and Wagner, 2010); 8.17 MJ/kg (Begeman and Bove, 2010); 8.6 MJ/kg (Gomes, 2005); 9.05 MJ/kg (Pustmann, Begeman, Hubbert, Johnson, Lippie, Ornel and Wagner, 2010); 9.19 MJ/kg (Joseph and Tezakova-Matally, 2010); 9.95 MJ/kg (Pustmann, Begeman, Hubbert, Johnson, Lippie, Ornel and Wagner, 2010); 13.3 MJ/kg (Gomes, 2005); 15.4 MJ/kg (Larson and Tisdale, 2002); 14 MJ/kg (Gomes, 2005); 17.5 MJ/kg (Gomes, 2005); 19.3 MJ/kg (Gomes, 2005); 25.9 MJ/kg (Gomes, 2005); 40.1 MJ/kg (assimint v3.9.1); 41.4 MJ/kg (assimint v3.9.1); 41.1 MJ/kg (assimint v3.9.1); 39.8 MJ/kg (assimint v3.9.1); 40.7 MJ/kg (assimint v3.9.1); 39.5 MJ/kg (assimint v3.9.1)			
Embodied energy, primary production (typical grade)	⓪	* 15.9	- 17.5 MJ/kg
CO2 footprint, primary production (virgin grade)	⓪	0.229	- 0.253 kg/kg
Sources 6.174 kg/kg (Joseph and Tezakova-Matally, 2010); 0.271 kg/kg (Athens Sustainable Materials Institute, 2009 (5)); 0.296 kg/kg (Pustmann, Wagner and Johnson, 2010); 0.304 kg/kg (Begeman and Bove, 2010); 0.213 kg/kg (assimint v3.9.1); 0.229 kg/kg (assimint v3.9.1); 0.187 kg/kg (assimint v3.9.1); 0.177 kg/kg (assimint v3.9.1); 0.15 kg/kg (assimint v3.9.1); 0.146 kg/kg (assimint v3.9.1)			
CO2 footprint, primary production (typical grade)	⓪	* 0.229	- 0.253 kg/kg
Water usage	⓪	* 665	- 735 l/kg
Processing energy, CO2 footprint & water			
Coarse machining energy (per unit wt removed)	⓪	* 1.37	- 1.52 MJ/kg
Coarse machining CO2 (per unit wt removed)	⓪	* 0.103	- 0.114 kg/kg
Fine machining energy (per unit wt removed)	⓪	* 9.45	- 10.4 MJ/kg
Fine machining CO2 (per unit wt removed)	⓪	* 0.709	- 0.784 kg/kg
Ginding energy (per unit wt removed)	⓪	* 18.4	- 20.4 MJ/kg
Ginding CO2 (per unit wt removed)	⓪	* 1.30	- 1.53 kg/kg
Recycling and end of life			
Recycle	⓪	✗	
Downcycle	⓪	✓	
Combust for energy recovery	⓪	✓	
Heat of combustion (net)	⓪	* 20.7	- 22.1 MJ/kg
Combustion CO2	⓪	* 1.76	- 1.85 kg/kg
Landfill	⓪	✓	
Biodegrade	⓪	✓	
Notes			
Warning ⓘ All woods have properties which show variation; they depend principally on growth conditions and moisture content.			
Links			
ProcessUniverse		☑	
Reference		☑	
Shape		☑	

Figure 11: Fir footprint

Selezione del materiale più expensive: Abbiamo rimosso il material index relativo al costo in modo da poter selezionare un materiale che massimizzi lo Stiffness index. Inoltre abbiamo applicato dei limiti per migliorare la durability: resistenza all'acqua, alla luce solare e infiammabilità.

Durability	
Water (fresh)	Limited use; Acceptable; Excellent
Water (salt)	
Weak acids	
Strong acids	
Weak alkalis	
Strong alkalis	
Organic solvents	
Oxidation at 500C	
UV radiation (sunlight)	Fair; Good; Excellent
Galling resistance (adhesive wear)	
Flammability	Self-extinguishing; Non-flammable

Figure 12: Selection of the closest resembling geometrical shape

TODO add best material Ashby map

Home | Stage 1 | Stage 2 | Stage 3 | Stage 4 | Stage 5 | Fir abies lasiocarpa | Cyanate ester/HM carbon fiber | Fir (abies lasiocarpa)... | Links

Eco Audit Project

Product definition | Report

New | Open | Save | Compare with...

Product information

Name: Cyanate ester/HM carbon fiber

Material, manufacture and end of life

How do I use my own materials or processes?

Qty	Component name	Material	Recycled content	Mass (kg)	Primary process	End of life
1000		Cyanate ester/HM carbon fiber	Virgin (0%)	0.15	Filament winding	Downcycle
0			0			None

Transport

Name	Transport type	Distance (km)
	Truck 16-32t, EURO 5	2000

Use

Product life: 10 Years

Country of use: Europe

Static mode

☐ Product uses the following energy:

Energy input and output: Electric to thermal

Power ratings: 0 W

Usage: 0 days per year

Usage: 0 hours per day

Mobile mode

☐ Product is part of or carried in a vehicle:

Fuel and mobility type: Diesel - ocean shipping

Usage: 0 days per year

Distance: 0 km per day

Report

Summary chart | Detailed report

Image: Note:

Browse... Clear

Figure 13: Eco audit carbon fiber

Home | Stage 1 | Stage 2 | Stage 3 | Stage 4 | Stage 5 | Fir abies lasiocarpa | Cyanate ester/HM carbon fiber | Fir (abies lasiocarpa)... | Links

Eco Audit Project

Product definition | Report

New | Open | Save | Compare with...

Product information

Name: Cyanate ester/HM carbon fiber

Material, manufacture and end of life

How do I use my own materials or processes?

Qty	Component name	Material	Recycled content	Mass (kg)	Primary process	End of life
1000		Fir abies lasiocarpa (B)	Virgin (0%)	0.15		Downcycle

Transport

Name	Transport type	Distance (km)
	Truck 16-32t, EURO 5	2000

Use

Product life: 5 Years

Country of use: Europe

Static mode

☐ Product uses the following energy:

Energy input and output: Electric to thermal

Power ratings: 0 W

Usage: 0 days per year

Usage: 0 hours per day

Mobile mode

☐ Product is part of or carried in a vehicle:

Fuel and mobility type: Diesel - ocean shipping

Usage: 0 days per year

Distance: 0 km per day

Report

Summary chart | Detailed report

Image: Note:

Browse... Clear

Figure 14: Eco audit fir

Ecoaudit