Task 1_1

Design requirements for wind turbine blade

Function	Wind turbine blade – Light stiff blade
Constraints	Bending stiffness S specified Length L specified
Objectives	Minimize the mass Needs to survive in high wind speeds
Free variables	Choice of material Blade shape -> Area A

To form the performance met

The objective to minimize mass gives the equation:

$$m = AL\rho$$

The bending stiffness has the equation:

$$S = \frac{C_2 EI}{L^3} \geq S^*$$

Second moment of area has the equation:

$$I = C_1 A$$

Now to combine these equations gives the following equation:

$$m = \left(\frac{S^* L^3}{C_1 C_2 E}\right)^{0.5} * L * \left(\frac{\rho}{E^{0.5}}\right)$$

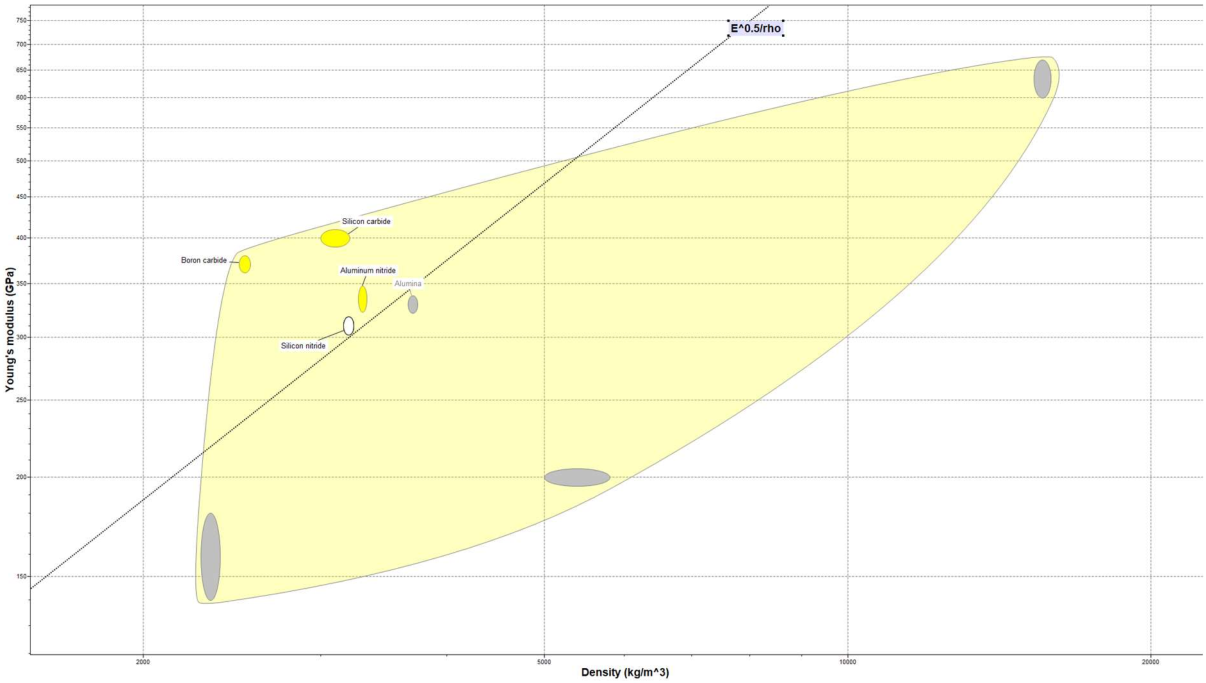
From this can we form the material index M, since S^, L, C_1 and C_2 will be constants or specified the $\frac{\rho}{E^{0.5}}$ will define the performance of the material. As it should be minimized we can try to maximize and define M as:

$$M = \frac{E^{0.5}}{\rho}$$

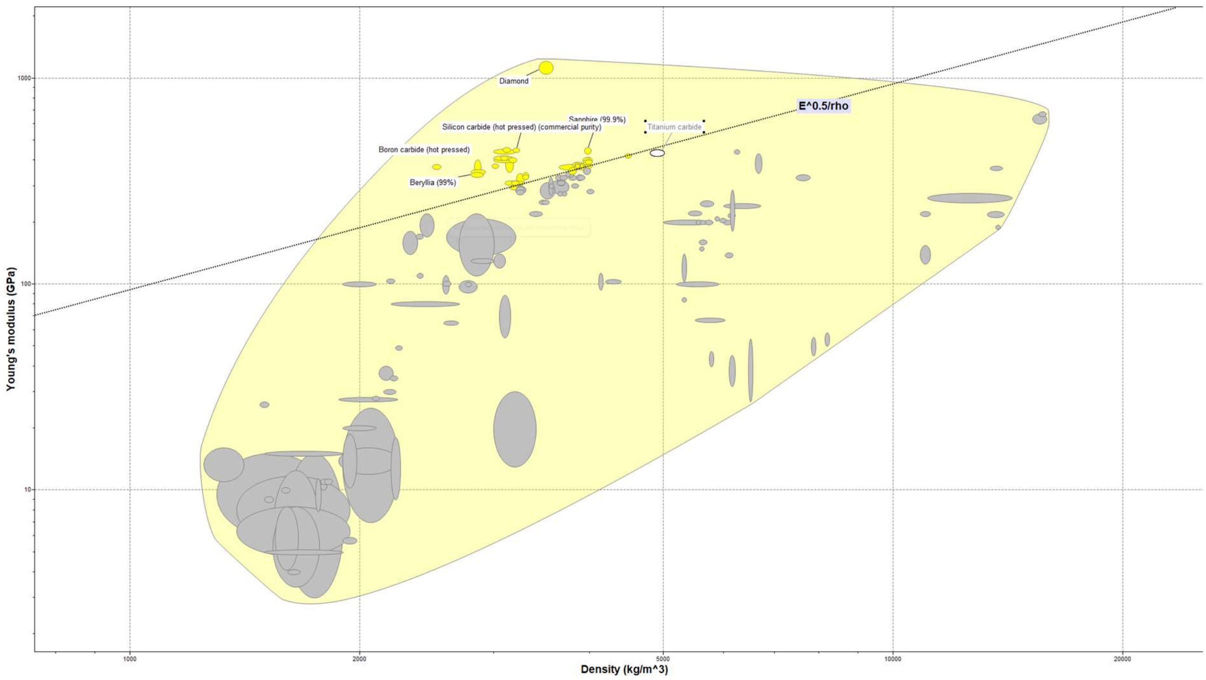
For charting this material index, its slope can be calculated for logarithmic charts.

$$\frac{E^{0.5}}{\rho} = C \rightarrow \log_{10} E = 2 \log_{10} \rho \, + \, 2 \log_{10} C$$

The slope can be determined to be 2.



Task 1_2



In level 3 there are lot more materials that perform poorly. Many of the materials in level 3 are clusters of the same material however with only different processes and treatments.