SRT Building Materials Science
Workshop 2, Embodied Energy
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Aim

The aim of this exercise was to:
- learn how to calculate the embodied energy of different materials which make up a construction detail
- Think about how we can lower the embodied energy of the detail by substituting different materials in to the detail or removing materials from the detail.

Method

Firstly I chose my building construction detail, which was the staircase banister detail in the cafe. Secondly I measured the dimensions of the pieces and separated them into individual pieces to make it easier to find the volumes and conceptualise the shapes. Thirdly I calculated the volumes of the materials, and finally I converted them into their appropriate units for calculating EE (embodied energy). Converting to m^3 was an easy task as it is the measurement of volume. However, to convert to tons I had to use the equation, volume of material (m^3) x density of material (kg/m^3), where the meters cubed cancel and leave kilograms, where 1 kg = 1 x 10^3 metric tons.

Result

I have made the following assumptions for my calculations
- The staircase banister detail is 30^o
- The tons were metric
- The silicon sealant in the window detail has the same EE figure of plastic
- All the materials are not recyclable
- The aluminium casing of the glass is solid,

I found these EE results for the chosen materials.

Material	Quantity	Unit	EE figure	EE(GJ)
Steel, structural	100.144 x 10^{-3}	t	85.3	8.542
Hardwood	3.73 x 10^{-3}	m^3	21.3	0.079
Laminate	0.302	m^2	0.200	0.064
Toughened Glass	1.036	m^2	3.66	3.791
Aluminium	1.063 x 10^{-3}	t	253	0.268
Oil Based paint	0.2884 x 10^{-3}	m^2	0.101	2.912 x 10^{-5}
Silicon sealant	2.432 x 10^{-3}	t	163	0.396
			Total EE	13.14GJ

Discussion

As shown in figure one the staircase banister detail is made from an angular piece of C-sectioned structural steel which formed the major structure of the staircase. On top of this is 4 structural steel supports. A toughened glass panel which is capped at the top with a long piece of aluminium sits on top of the C-sectioned structural steel. The glass panel had a base with the same style of aluminium as the cap but with silicon sealant filling the gaps.

Picture missing

There was no EE figure for silicon on the sheet given in the lecture. This limited the use of Treloar's figures on the back of the sheet, as I couldn't find the true figures for silicon. However, after discussing this with my peers we decided that the density of silicon was 2330 kg/m^3.

To optimize the embodied energy of the construction detail, which had a total EE of 13.14GJ, we need to look for a material to supplement the less functional, more aesthetic materials of the window detail. These materials are glass, aluminium, paint and silicon sealant. If we take away the whole window detail of the staircase banister our EE is reduced by 4.519 GJ leaving the banister detail with an EE of 8.621. Unfortunately the biggest contributor to the EE was structural steel, which would be extremely hard to supplement with another material. Any other material would not give the same level of structural support. If the steel was replaced, the material would most likely have a larger EE.

Conclusion

This exercise has shown that we can all leave less of a carbon footprint, by choosing materials with a smaller EE figure. Choosing Materials with a small EE is not difficult and if the concept of embodied energy was more recognised and applied more often the problem of global warming may have been less threatening.