Mapping a Sustainable Building

National Curriculum

Geography – geographical enquiry, developing geographical skills, environmental change and sustainable development.

Teacher's Notes

When you design a building or series of buildings, it is important to look at it from a number of different perspectives from the start so you can make sure different aspects of the building will work well together. This 'sustainability mapping' looks at how the buildings are going to be used, what services they will need (electricity, heating, cooling, water, security, transport, etc) in relation to what is available at the site.

The images and sketch maps used in this activity are actual images from the development of Beaufort Court, the RES head office in Kings Langley. Check out our website once the students have completed their designs to see how the building was actually re-furbished. www.beaufortcourt.com.

Your students are going to create a sustainability map of a building for their client. The client is a company driven by the impending crises brought about by climate change, whose business is to develop and promote all viable forms of renewable energy.

Ask your students to focus on the building's use of water and energy. They might consider recycling water, collecting rain water, insulation of walls, roof and floors (very important), triple glazing, heating the building, providing hot water for hand washing, energy for computers and servers, lighting, telephones and printers.

At Beaufort Court we have a wind turbine which produces 225kW which provides much of the needs of the 180 staff who work here. See B4 Live Energy Generation). We have 22 solar panels producing hot water and 7 of these produce electricity as well. These 7 solar photovoltaic (PV) panels produce about 3-3.5MWh per annum. The hot water generated is stored in a thermal heat store until needed to heat the building in the autumn. We have borehole cooling which takes water from the chalk aquifer to cool the building. Air conditioning is extremely power hungry so think of ways to cool your building using passive solar design or even passivhaus* principles. We also have a biomass boiler which burns wood pellets.

* *Passivhaus means controlling the temperature of a building without the addition of artificial heat or the use of chillers for cooling. Passivhaus uses:*

- *Insulation – keeps heat in when it is cold outside and keeps the rooms cool in the heat of the day.*
- *Natural ventilation (open doors at low levels and windows on the upper floors - draws air through like a chimney)*
- *Shading (trees strategically placed)*
- *Solar gain (big, south facing windows) used to heat rooms.*
- *Body heat – a class of 30 in a well insulated classroom*

With substantial grounds available, we also decided to grow a biomass crop called miscanthus (a type of grass) as fuel for our biomass boiler. We were advised that miscanthus was a good choice for our land as the ground is very dry. However, the boiler didn't burn miscanthus very well so we now burn wood pellets instead and we sell the miscanthus that we harvest every year to power stations, that can burn it effectively to lower their carbon emissions. The miscanthus will carry on growing and being harvested for some 15 years before it will need replacing.

Below you will find images of the site before we started the refurbishment and also an aerial view of the site before work began.

The original horseshoe-shaped building was used as a chick-rearing shed, with a hay loft above. This didn't allow sufficient space for a modern office building. To maximise the space available for offices, substantial modifications needed to be made. The walls of whole horseshoe (with the exception of the two 'towers' at each end) were taken down, brick by brick. A new deeper foundation was dug and the walls were then rebuilt within the original roof structure, incorporating a larger mezzanine space on the second floor where the hay loft had been. The original roof shingles (tiles) were then replaced. On the inside of the horseshoe shape we extended the building by 5m and roofed this extension with grass (excellent insulation).

The building has a computerised management system which opens windows, operates the natural cooling system, and calls for heating from the biomass boiler and/or the thermal heat store as required by the building occupants. The lights are highly efficient, being both daylight-sensitive (they automatically brighten or dim according to the daylight available) and motion-sensitive.

RES operates a Green Travel Policy, so many of the occupants of the building commute to work by train (Kings Langley station is 5 mins walk away), or by bicycle. There is a bike shed on site (northwest end). The car park, which includes 4 electric car charging points, does not therefore need to accommodate all occupants.
If you go to www.maps.google.co.uk and type in WD4 8LR you will find an up-to-date aerial view of the site.

Resources
Copies of the maps and images – one for each group of 3 or 4 students.

Timings
45 mins-1 hour

Outcomes

- Each student will have a clear understanding of the skills required to produce a sustainability map.

- Each student will have an understanding of sustainable sources of power, heat and cooling.

Differentiation
The task in itself will develop those more able students to think creatively about the technologies that could be incorporated into such a building. The research for such a project will also differentiate the students as the more able will be able to apply the skill sets they have developed.
A sketch map is supplied for part 1 of The Brief if required (p8).

Aim
The students work as a team to compete with each other to produce a sustainability map for an existing building using as many different sustainable building techniques and incorporating as many renewable technologies as possible.

THE BRIEF

You are a team of architects who have decided to enter a competition to refurbish an existing building on behalf of a client.

Your client needs a new headquarters. They have given you a design brief to renovate an old building, which insists on the following aspects:

a) The building to be renovated was an important part of local industry in days gone by. Therefore, the external façade of building must remain unchanged once the building is completed.

b) The building must comprise enough office space for 180 occupants.

c) The building must be heated and powered from renewable energy sourced on site.

Here's what to do:

1. Look at the map showing a horseshoe-shaped building. This is the building you need to redesign for your client, but it is in need of extensive renovation. Sketch the building with the coordinates north, south, east and west.

2. Consider the following aspects of the building and the site as a whole:

a) Transport: What forms of transport are available to users of the building? Will the staff generate lots of carbon dioxide getting to work?

b) Noise: What sources of noise will there be on this site? How would you adapt the building/site to reduce the noise in the office spaces?

c) Solar gain: How will the sun move over the site in summer and winter? How will this affect how you heat and cool the building?

d) Wind: If you are considering wind power, where is the wind likely to come from most of the time? Plan where you could position your wind turbine/s, but remember to think about what shadows will be cast and whether this will disturb anyone. You also need to make sure each turbine is 50m from the nearest building or road for safety reasons.

e) Solar: Where would you place your solar panels if you decide to use them?

f) Access: Do you need large delivery vehicles to access the site? Where will your entrance be? (Turbine blades must be delivered to site whole on a low loader. You will also need access for concrete mixers, cranes, lorries of various sizes.)

g) Gardens: How could you use the available land to help the sustainability of the site?

3. Represent on your sketch any of the above factors that are relevant to your design, and the sources of energy you will use. Remember to add a key.

Aerial view of the site

Existing Building looking South, before the redevelopment

Existing building looking North, before the redevelopment

Inside the chicken shed before refurbishment started. The picture above shows the inside of the horseshoe building. The picture to the right is the window in the hay loft.


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