

Sustainable Design – technical solutions

Sustainability encompasses, and is affected by, a wide range of aspects extending from the broadest concepts and policies to the most focused application and mechanism. Although Architectural Technologists should be aware of all the most important factors in this range, there is a specific sphere within which we can offer meaningful environmental benefits. This sphere of course, is that of Architectural Technology and design. By being conscious of the environmental impact of the materials and solutions we propose, the Technologist is uniquely positioned to achieve levels of sustainable performance which might otherwise be missed.

Sustainability is an attempt to minimise the human impact on the earth's environment in order to assure the well-being of our descendants. 'Sustainability' has become a holistic concept covering a wide range of issues across the social, environmental and financial spheres. These may include:

- carbon emissions
- toxicity
- pollution
- resource depletion
- social justice
- diversity
- water quality
- wellbeing

Despite the number of issues, one of the key drivers of climate change is the excessive emission of carbon dioxide or CO₂. However, it is important to remember that other drivers of atmospheric climate change exist in the form of other greenhouse gases, such as methane, whose effects can be measured in 'Carbon dioxide tonnes equivalent', (usually expressed as 'CO₂e.'). Although as individuals we can affect change in all areas through our own actions, as Architectural Technologists, our profession is largely limited to operating within the construction industry. As the built environment is responsible for a substantial proportion of carbon emissions, this means that we are in a position to influence, inspire and implement solutions which might minimise the impact on the planet.

In recent years CO₂ has become commonly abbreviated to simply 'carbon'. In turn, 'low carbon design', is seen as one method of achieving sustainable targets in building design. So what does 'low carbon design', entail and how can we maximise our contribution to it?

Sustainable design and carbon

The total 'carbon footprint' of a building is split into two categories: operational and embodied carbon.

Operational carbon

Operational carbon is that which is generated from the running of the building.

Hence, this is usually from:

- heating
- cooling
- ventilation
- lighting
- appliances

Everything in these categories often requires a powered system. That power – usually electric or gas – usually carries with it high amounts of CO₂ emissions. Therefore, by reducing the amount of power required for these, we can also reduce the carbon footprint of the building. Often, the provision of on-site renewable power generation is seen as the answer to this. However, without reducing the power demand for the systems in question, it is unlikely that all of the required power will be fulfilled from renewables.

The answer therefore, is to help that reduction in demand by designing a more efficient fabric. Some of the mechanisms by which we might do this are as follows:

- orientation – the direction the building faces will affect how much energy is needed for heating, cooling and lighting.
- insulation – a highly insulated envelope will in turn reduce the energy needed to maintain the desired internal temperature through heating and cooling systems.
- airtightness – in inefficient buildings, a great deal of heat is lost by leakage of air through the fabric. There should be a clear air tightness line around the building – without difficult junctions or shapes – with a suitable barrier to reduce such leakage.
- daylighting and ventilation – achieving the optimum amount of natural light and air without excessively reducing the insulation value of the envelope requires careful consideration of the building's shape, form, and depth.

The regulatory requirement for limiting operational carbon is largely dealt with through Part L of the Building Regulations. However, it should always be borne in mind that Building Regulations are intended to be an absolute minimum standard required.

Embodied carbon

Embodied carbon is that which is generated in the construction of the building and in the manufacture, transport and use of its materials. Until recently, operational carbon constituted the greater part of a building's carbon footprint. However, in recent years, through an improvement in the demands of Building Regulations, the proportion of operational carbon within a

building's carbon footprint has been steadily decreasing. Within the near future, it is likely that the majority of a building's carbon footprint will be of embodied carbon.

This is where the professional skills of the Architectural Technologist can be of benefit. By a clear understanding of how materials are produced and incorporated within a building project, the Technologist can make a significant contribution to reducing the environmental impact of a building. The environmental impact of building materials extends not just to the manufacturing process, however. Other factors to be taken into account include the following:

- pollutants – does the material's production result in pollution? Is it harmful to humans, wildlife or nature, despite being low carbon?
- constituents – where does the material come from? Does its production result in environmental harm? Does it incorporate recycled or re-used materials?
- end of life options – can the material be easily recycled? Does it bio-degrade? Could it easily be re-used?
- application and impact – how will the material be used? For example, concrete can help passively control a building's interior temperature, but cement (a key ingredient in concrete) accounts for 8-10% of manmade global warming emissions.

Despite the above, in the UK, there is, at present no legislative requirement to address or limit the amount of embodied carbon within a new building. In order to achieve a truly sustainable design, therefore, it is usually necessary to go beyond what is normally required as the minimum by legislation.

Conclusions

There is a common perception that sustainable design depends on renewable energy sources. While renewables can help, using them as a 'bolt-on' solution to reduce a carbon footprint will, in reality, achieve very little. A key consideration must be to take into account the form and fabric of the building from the very outset. All too often, sustainability is not taken into account during the early design. However, by adopting a methodology of 'sustainability by design', it is possible to create a far more sustainable building.

In summary:

- reduce operational carbon demand by using passive strategies and efficient envelope design
- reduce embodied energy by using low impact materials and methods of construction

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