1.Get informed

The structural engineer's responsibility in this climate emergency

Will Arnold describes the role structural engineers can play in tackling climate change, by making informed design decisions and influencing other members of the project team.

Science recap

Over the past 100 years, humans have been responsible for releasing more carbon (by which we mean 'carbon dioxide equivalent' (CO_2e), encompassing all greenhouse gases) into our atmosphere each year than the plants and sea life of the world can absorb. Atmospheric carbon levels have risen, global temperatures have followed, and this planet is now nearly 1°C warmer than it was pre-industrialisation. This change in global temperature has manifested itself through increased levels of flooding, drought, storms and fires.

1.5°C is the expected tipping point beyond which the effects of warming become extreme and hard to control[1], an increase of only 0.5°C beyond current levels. Changes clearly need to be made across all walks of life, and to quote the Intergovernmental Panel on Climate Change (IPCC), these need to be *'rapid, far-reaching, and unprecedented'* if they are going to get us anywhere near to the 1.5°C target[2].

Our impact

Let's remind ourselves of how much structural engineering contributes towards climate change. Almost 40%[3] of all global energy-related emissions are due to buildings and construction, a number that has been widely quoted over the last year. In a best-practice modern building, half of those emissions are due to the embodied carbon of the building[4], and two-thirds of that is accounted for by the structure[5].

These percentages are already substantial, but as operational energy emissions continue to drop due to passive building design and decarbonisation of electricity grids, the significance of our contribution will only grow.

With such a large impact, it is clearly important that we all play our part in bringing global emissions down to the levels demanded by governments and the IPCC. So the next question is – what does your contribution look like?

Your impact

Given that skipping a London–New York flight will save 1t of carbon[6], and cutting meat, dairy and beer out of your diet for a year will save 2t of carbon[7], it is tempting to focus on what we can do to our lifestyles when considering the IPCC's call for change.

But we should recognise that the scale of our potential impact as structural engineers is orders of magnitude larger than our potential impact outside of work – with hundreds of tons of carbon within reach for many of us. And while the exact numbers vary with role, project size, and design stage, the examples below demonstrate the ways in which a few key decisions can make a dramatic difference.

Example 1

You design retrofits to existing domestic properties, and this year you convince 20 of your clients to accept 4no. downstand timber beams in their open-plan spaces for environmental reasons. You exchange 80no. UC 152 × 44 steel beams (32t of carbon) for 80no. 300 × 200 glulam beams (4.9t of carbon). You save 27t of carbon.

Example 2

Over a couple of years, you're commissioned to complete the structural design of a total of 120 houses across five new housing developments. You estimate that 2.5km of 800mm depth, 600mm width strip footings will be required – 1200m^3 of RC25/30 concrete, 372t of carbon.

You convince the developer to pay for site investigations across the works. This leads to a justification of increased soil bearing capacities, and reductions in footing size to 600mm depth, 450mm width. Your foundations now use just 675m^3 of concrete, and 209t of carbon. You save 163t of carbon.

Example 3

The architect approaches you at the start of a project, with a brief for a 9000m^2 mixed-use commercial building for a developer that they know well. You propose reducing the building size to 8000m^2 and specifying that the difference is given over to mixed-use space to increase building efficiency throughout the week. You work through the technicalities with the architect and the developer, and the change is agreed. The total expected carbon footprint of the whole building (structure, facade, fitout) drops from 3600t to 3200t. You save 400t of carbon.

Example 4

You are leading the design of the 455t steel superstructure for an out-of-town shopping centre. When writing the material specification, you increase the minimum recycled material requirement from 20% (UK typical[8]) to 59% (European average[9]). The carbon impact of your steel drops by 30% (from 2.3 to 1.6kg CO_2e/kg)[10], reducing the total carbon footprint of the frame from 1050t CO_2e to 730t CO_2e. You save 320t of carbon.

Example 5

You are asked to run the final construction calculations for the same steel frame. So far, member utilisations range from 0.60 (trimmers) to 0.90 (typical members). You choose to resize every member, achieving utilisations between 0.85 and 1.0, and reducing the total tonnage of steel by 15%. You save 110t of carbon.

Starting now

As climate awareness has grown in the public mind, governments have started to respond to growing pressure, and to date 67 countries[11] have laid out net-zero-carbon commitments (including the UK, France, Germany, Italy, New Zealand, and eight US states). Ultimately, this will result in legislation passing that limits and/or taxes carbon use, affecting the way in which we design and specify our structures. But until then, it is the responsibility of each of us to decide how we are going to conduct our work over the next decade.

Even ignoring the commercial reasons to upskill and embrace change (maintaining the ability to win work, hire graduates and satisfy clients in the

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year 2030), our responsibility as members of the Institution and as chartered engineers (or with ambitions to become chartered engineers) is to comply with the Engineering Council's ethical principles[12] and *'work in a way that contributes to sustainable development'*[13]. This means recognising the long-term aspect of our work and minimising our damage to the environment – to fail to act now is to ignore the requirements of the institutions with which we are affiliated.

Our potential professional impact on the climate crisis far outweighs our potential impact at home – and it is our duty as professional engineers to start acting today. The Institution has set up a dedicated Climate Emergency Task Group and will be releasing guidance on carbon footprint reduction throughout the rest of this year, and in the vein of the examples above. Why not start thinking now about what you can change?

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