The construction of any building has negative environmental consequences. The question is at what point do these outweigh the human benefits?

The first and most obvious issue with tall buildings is that to create a useable sqm of space requires more material than other forms of habitation. This is from additional structure, and enhanced and more complex services. The higher the building the more inefficient it becomes in net area against carbon emissions from both operational use and the embodied emissions from construction and maintenance.

It is worth noting here that over the life of most buildings and especially tall buildings more carbon emissions are attributable to materials, construction and maintenance than from day to day energy use. For every sqm built in a tall building each of these is proportionately larger.

In a recent article for the AJ on the Stirling Prize Finalists, I criticized that particularly iconic tall building the Shard, on a number of points.

On the plus side the building scores highly on traditional Sustainability metrics that focus principally on operational energy use. The Building is BREEAM Excellent, it has a triple glazed ventilated double skin façade with adjustable blinds. There is a CHP. This is all good commendable stuff, and the Shard is not alone in this in responding very positively to current legislation and standards.

But this is not enough. In carbon emissions terms these buildings are very poor indeed. In addition to the area point and high mechanical demand, there is another issue common to many Tall buildings, and that is the life expectancy of the cladding. Typically fully glazed unitized cladding of this sort lasts about 40-50 years max before the seals go. This usually means all the cladding needs replacing. This is a very short term and profligate approach to materials.

The Governments low carbon transition plan calls for the UK to reduce its 1990 carbon emissions by 80% by 2050. Therefore it is likely that fully glazed cladding systems of this type will need replacing at the bottom of this low carbon trajectory. This is a major future resource and carbon emissions issue.

Another point is that tall multi use buildings of this type often house several different **lease cycles,** and if purely residential very long leases of say 100 or more years. These leases rarely coincide with cladding replacement cycles. So what happens when the cladding does have to come off?

These points add up to short term thinking, material profligacy and high embodied and whole life carbon emissions. What can be done?

I think there are several directions to go to achieve low carbon, resource efficient tall buildings.

Firstly "Resilience". A tall building is a massive carbon investment, it should therefore last a very long time to justify its vast construction emissions. The Empire State building is over 80 years old and could last as much again. The building with hole in wall cladding allows incremental retrofit, while the basic majority carbon investment endures. So the initial carbon investment is spread over at least a century, and possibly a lot longer.

Another principle is "Appropriateness": This is where you design with the optimum material efficiency for the life expectancy the use requires. For example you design the principal carbon investment ie your primary structure for the very long term, 100+ years, and design low carbon, possibly timber, cladding for the short term, for easy and efficient replacement, recycling and reuse and allowing for a better future replacement. The building envelope and mechanical systems are therefore designed to respond to change and can be updated on a shorter life cycle.
The key point is that any systems proposed must be designed from the outset to ensure maximum recyclability and to therefore be capable of going straight back into the material supply chain, in a positive usable form.

Finally: "Innovation". You design for an evolving and changing future, and concentrate on using low carbon materials, low carbon construction techniques with reusability a basic requirement. You think of a high rise as an evolving organism and not a fixed box. You use better, low carbon materials. This approach accepts and captures change but it means different thinking by architects to achieve lower carbon outcomes.

SOM have, as a research project, designed a 42 storey timber tower with Cross Laminated Timber floors, columns and shear walls.

Farrell's are working on using bamboo as a structural material in Tall buildings,

and Waugh Thistleton have already built a nine storey all timber building in London.

More extreme Chartier-Corbasson have designed an organic skyscraper for London made entirely from recycled trash.

Arups and Fosters are respectively working on structure and cladding made from 3D printing techniques. All this points to future demand led construction resource efficiency.

Even with innovation though I believe tall buildings always be less material efficient than a low rise. So lets force new thinking.

I would do two things:

Firstly in addition to the operational carbon efficiencies already necessary through Part L, BREEAM, and so on I would require a construction embodied carbon threshold to be met. This would start simple, and ratchet up say every three years.
This would promote more holistic capcarb / opcarb thinking and lead to a more efficient integrated approach to carbon emissions reduction.

Secondly I would require designers of high rises or any substantial new building to provide a detailed life cycle analysis showing how their buildings will perform over time and how they will be disposed of.
This would promote long term thinking, better material selection, resilience, innovation, more recycling and ultimately a lower carbon future.

So although high rises are fundamentally inefficient in whole life carbon terms, and banning them seems unlikely, we should force them to be more carbon efficient in the way they are built and used.

Simon Sturgis Edge Debate 11.02.2015