

# Better building through design

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Credit: Andreas Levers via Flickr

The construction industry could slash its carbon emissions by as much as 50% by optimising the design of new buildings, which currently use double the amount of steel and concrete required by safety codes.

The construction industry, which uses half of the 1.5 billion tonnes of steel produced each year, could drastically reduce its carbon footprint by optimising the design of new buildings. Smart design could slash the sector's carbon emissions by around 50%, without any impact on safety. If buildings are also maintained for their full design life and not replaced early, the sector's emissions could in total be cut by around 80% - the target set in the UK's 2008 Climate Change Act.

New research from the University of Cambridge has found that the amount of steel used by the construction industry, and the resulting carbon emissions, could be significantly lowered by optimising the design of new buildings in order to use less material.

At present, in order to keep labour costs down, the [construction industry](#) regularly uses double the material required by safety codes. Analysis of more than 10,000 structural steel beams in 23 buildings from across the UK found that on average, the beams were only carrying half the load they were designed for. The results are published in the June 4th issue of the journal *Proceedings of the Royal Society A*.

Over one-quarter of the steel produced each year is used in the construction of buildings. Demand for steel is increasing rapidly, especially in the developing world, and is expected to double in the coming decades.

The iron and steel industry contributes nearly 10% of total global carbon emissions, which climate change experts recommend be halved by 2050. Coupled with skyrocketing demand from the developing world, drastic action is required if a reduction in the sector's carbon footprint is to be achieved.

One option to achieve this reduction is by designing and building more efficiently, delivering the same performance from buildings but with less steel, but this is not common practice at present.

"Structural engineers do not usually design optimised structures because it would take too much time; instead they use repetition to decrease the cost of construction," said Dr Julian Allwood of the Department of Engineering, who led the research, which was funded by the UK's Engineering and Physical Science Research Council (EPSRC). "This leads to the specification of larger steel components than are required."

The researchers found that building designs are exceeding Eurocode Safety Standards by a factor of two and so are unnecessarily using double the amount of steel and concrete needed. "As materials are cheap and structural design time is expensive, it is currently cheaper to complete a design by using safe but considerably over-specified materials," said Dr Allwood.

Additionally, many buildings are being designed to last for 100 years but on average are replaced after just 40.

By designing for minimum material rather than minimum cost, [steel](#) use in buildings could be drastically reduced, leading to an equivalent reduction in carbon emissions, at relatively low cost. The net result of avoiding over-[design](#) and early replacement is that the UK could provide the same amount of built space with just 20% of the materials - and therefore 20% of the [carbon emissions](#) - used at present.

"We need to see a more sensible use of materials in the construction sector if we are to meet carbon reduction targets, regardless of the energy mix used in manufacturing the materials," said Dr Allwood.

**More information:** The report is available online:  
[rspa.royalsocietypublishing.org ... 0/2168/20140170.full](https://rspa.royalsocietypublishing.org/.../0/2168/20140170.full)

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