Putting the net-zero hierarchy into practice

Build less

Conor Hayes continues this series of notes signposting key climate resources for IStructE members by looking at the second level in the hierarchy of net-zero design: building less to minimise material usage and reduce carbon emissions.

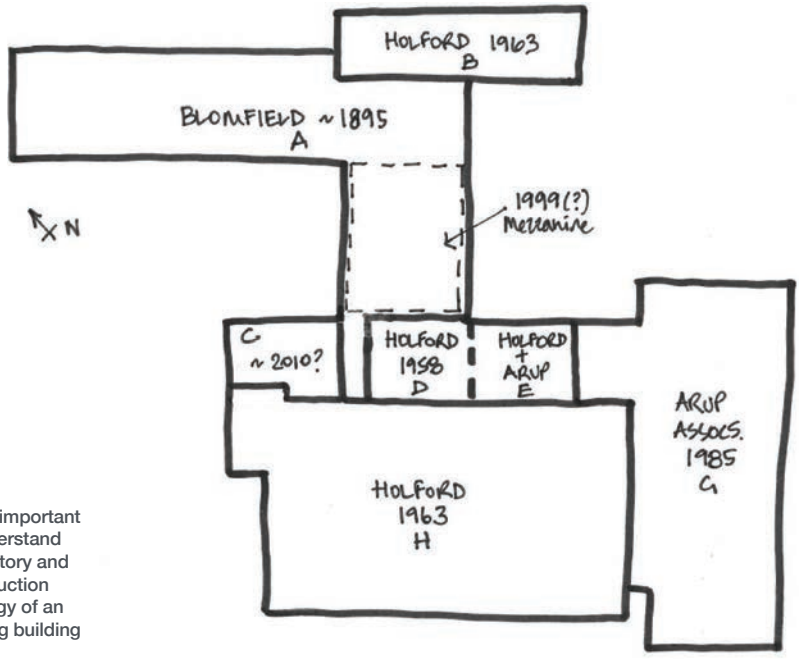
A key way that structural engineers can provide value and minimise the emission of greenhouse gases is by using our skills and expertise to refurbish, extend and make the most of existing assets. The early consideration of such opportunities and persuasion of your client is a necessary step. Steve Fernandez has written an article on how structural engineers should go about identifying opportunities at the feasibility stage[1], and a follow-up piece on how to maximise these opportunities at the design stage[2].

To make the most of such opportunities, the structural engineer must be capable of understanding existing structures. Fiona Cobb writes about five studies to complete before design work starts[3]. This article gives useful advice on how to efficiently compile and collate a desk study to give clues as to the different types of construction, likely structural capacities and possible latent defects, as well as plan out investigations and communicate with project partners.

Then the structural engineer must be capable of analysing the relevant portions of the existing structures[4]. In particular, this might include design criteria or phenomena not always coherently considered in historic structures, such as lateral stability, ductility or disproportionate collapse. That being said, author Mathai Mathew ends with a heartening reminder, '*For the most part, existing structures behave similarly to new structures. Gravity acts identically for both*.'

One way, common in cities, of adding useable floor area while retaining existing material banks is with vertical extensions. It will often be the case that the existing core will have spare capacity and that with some level of strengthening the existing vertical structure and foundations can accommodate additional stories. Jenny Pattison has written about the challenges involved specifically in the context of carbon[5], with a focus on vertical extensions to residential apartment blocks.

Charles Gillott has collected a series of his 'favourite' such projects from the UK and Ireland across a range of building use types: residential, office and retail[6]. This includes key statistics in each case. It may serve as inspiration or indeed help you convince a client that your vertical extension is likely to prove commercially and technically feasible.



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It is important to understand the history and construction typology of an existing building

Reuse of existing foundations is mentioned above, but Henry Taylor sets out the key considerations, including potential benefits, risks and investigations required, in his article, 'A short guide to reusing foundations'[7]. Similarly, it may be necessary to strengthen existing load paths. Lizzie Blaisdell Collins and Joe White discuss how strengthening an existing building can enable changes of use, achieve compliance with modern building codes, resist a previously unforeseen environmental load or increase resilience[8].

Finally, there are a number of articles tying several of these threads together in the form of a project case study. Diego Padilla Philipps' article on 22 Bishopsgate explains how the project team managed to design and erect a new 62-storey building on the site of an abandoned project, reusing 100% of the existing foundations from three previous buildings, and incorporating more than 50% of the basement built for its predecessor[9].

Andrew Robertson and Eric Sturel's article on 1 Triton Square describes the structural reuse and strengthening strategies adopted to enable three additional storeys to be added to the existing building in order to increase the floor area by 70%[10], while resulting in an overall carbon footprint per unit area for the scheme of 136kgCO_2e/m^2 and a SCORS A rating.

Lastly, an article on the adaptive reuse of Quay Quarter Tower, Sydney explains how the design life of the retained portion of the building was extended by 50 years with minimum structural intervention[11], while new construction increased the net lettable area from 45 000m^2 to 90 000m^2 and resulted in a carbon footprint for the gross internal area of 247kgCO_2e/m^2.

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SEE ALSO

Halliwell E. (2024) 'Putting the net-zero hierarchy into practice: Build nothing', *The Structural Engineer*, 102 (1), pp. 10–11; https://doi.org/10.56330/WSKW8501