



Ryder

The WRAP House Waste and Resource Efficiency

The WRAP House is an exemplar resource efficient house constructed using a componentised Modern Methods of Construction (MMC) approach. The use of Building Information Modelling (BIM) was critical to manage the componentised system and reduce overall material use. Our research has shown an eight percent reduction in materials used can be achieved by employing a componentised approach and using net zero focussed BIM processes on projects.

Collaborating to realise net zero design
BIM Academy, our sister company, demonstrated digital processes for planning and quantifying resource efficiency on the WRAP House. They also developed resource efficiency best practice guidance for the [UK Government Waste and Resources Action Programme](#)¹ (WRAP) and [Zero Waste Scotland](#) to deliver an exemplar resource efficient house.²

The house demonstrates how the latest principles in resource efficiency and waste reduction can be applied in housing design and provide a low carbon example of sustainable future living. The design ensures maximum recycling and reuse of products at the end of life. Named 'Tigh Grian', the carbon neutral house made use of a component based MMC approach.

300_m **50%**
less concrete reduction in slab thickness

Utilising BIM to realise net zero buildings
The key to the project was creating a detailed BIM that included all fit out and modularised components. Research on previous projects showed that BIM enabled an eight percent reduction in materials used, 300 cubic metres of less concrete used on one project through optimising column layout and a 50 percent reduction in slab thickness on a large public sector reuse project. The use of BIM was critical in reducing waste and making more efficient use of resources. Our approach was published in WRAP's BIM guides for small scale residential construction.

Design features

The design focussed on reducing materials and material waste, improving thermal performance to reduce operational energy demand and installing a renewable energy source.

It featured tripled glazed windows and roof mounted photovoltaic panels with background heating and hot water installation, powered by an air source heat pump. An all air ventilation system was also installed. The resulting highly flexible house type would be suitable for either a central urban vicinity or a remote rural location.

BIM as a net zero design tool

The project benefitted from a research led approach with a progressive client wanting to create the house utilising BIM processes, in order to show the practical benefits of BIM technology for net zero housing design.

Steps to creating the WRAP House

1 Environmental analysis

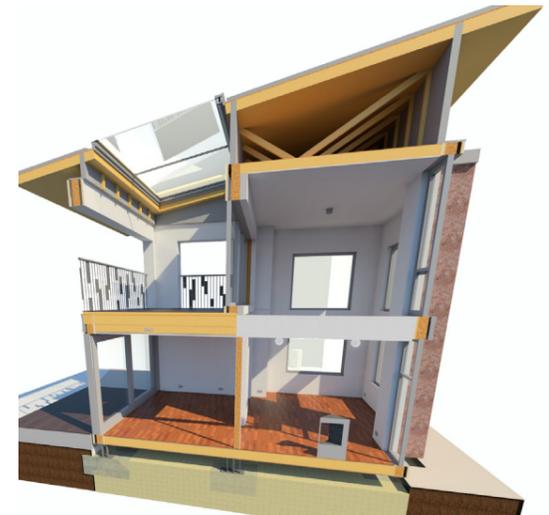
At concept stage, environmental analysis and simulation were undertaken to inform key design decisions. The use of BIM at this stage allowed the rapid testing of alternative design options.

2 Material selection

Each of the building's individual components were modelled, including alternatives, so they could be swapped for environmental performance comparison.

3 Layout optimisation

When selecting prefabricated building components, BIM was used to automate panel and fenestration patterns. This informed the building form and envelope design, significantly reducing the number of alterations and material cuts onsite, which led to a reduction in material waste. BIM was also used for clash detection to improve efficiency.



The WRAP House © BIM Academy

Key achievements

The WRAP House demonstrated how BIM can play a significant role in delivering resource efficiency within residential construction.

It encouraged architects and developers to make improvements to the design, construction and commissioning of a residential project using readily available digital tools.

BIM enabled faster estimation and forecasting of the resource efficiency impacts and benefits associated with the design, construction and operation – allowing for value based decisions to be made throughout the design process.

The use of BIM provided a robust record of the as built construction and as installed fixtures, furnishings and equipment to facilitate efficient operation, maintenance, and enable planning for future repair and deconstruction.

The WRAP House project importantly demonstrated the practical applications and benefits of the approach presented in WRAP's BIM guides for small scale residential construction. BIM was successfully used as a tool to deliver, communicate and market the greater benefits of resource efficient design.



References

1 HM Government. (2018) Our waste, our resources: A strategy for England. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf

2 Zero Waste Scotland. (2014) Resource efficient house case study: A demonstration construction project. Retrieved from <https://www.zerowastescotland.org.uk/sites/default/files/RES%20Resource%20Efficient%20House%20Case%20study%201014%20Final.pdf>

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