

Timber and Harbours: Insights into Sustainability in Design and Construction

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SUMMARY

The built environment evolves across time. In that time, the materials used in construction are worn down both by the environment and through persistent use, leading to the replacement of materials and the evolution or demolition of buildings. The energy used and carbon emitted during the manufacture of materials used in buildings is understood as ‘embodied’ energy and carbon, which is a measure of the impact that these materials have had on our environment. Timber also has embodied energy and carbon from its processing, but in addition stores carbon absorbed from the atmosphere while it was growing as a tree, so its use as a building material can offset the impact from its processing. Keeping building materials in use through refurbishment or recycling at demolition also helps to reduce emissions of further carbon to the environment as our built environment evolves. Thus our choice of materials, and our approaches to remodelling, reuse and rebuilding has a significant impact on the environment.

Associate Professor Elizabeth Shotton at UCD School of Architecture, Planning and Environmental Policy is looking forward in time at how we can make more environmentally sustainable use of timber in the built environment, and she is looking back at the construction of small harbours in Ireland to both preserve and learn from their history.

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Wood functionality over time

Dr Shotton’s research explores design with an eye to the future and the past. She has a particular interest in how we use wood, and how ‘cascading’ wood functionally over time and re-using it for different purposes could make it more environmentally sustainable.

“Usually we use a piece of timber as a beam, or in a door or window, and at the end of its life it is thrown into a skip and put into landfill or burned for energy,” explains Dr. Shotton. “But if that initial beam is disassembled and reused in, say wood flooring then we use it for longer. Then when the wood flooring is taken up, parts of the wood could be used for furniture, and after that it could be chipped for board products, and finally after a long and useful life it can be used for energy. This means the piece of wood is potentially used and stores carbon for hundreds of years after the tree is felled, which is in stark contrast to the use of newly felled timber as a fuel source, which immediately releases the stored carbon into the atmosphere.”

As well as modelling how we can more sustainably use wood from mature trees and from thinnings (young trees removed from managed forests), Dr. Shotton has also explored the wider potential for ‘wood welding’, a technique that uses the lignin that is naturally present in wood as a means to bond pieces of timber together, to replace the use of glues.

Much of Dr. Shotton’s work also looks into the past. She is particularly interested in the development of minor harbours in Ireland and recently carried out a pilot survey of nine small harbours along the east and south coasts of Ireland.

“Many of these harbours date back to the 17th century or earlier and were trade harbours, but now they face the prospect of being lost as they fall out of use,” explains Dr. Shotton. “So with funding from the Irish Research Council Horizons programme I have scanned several minor harbours using LiDAR scanning technology to capture their form and structure as well as gathering information about the history of their construction.”

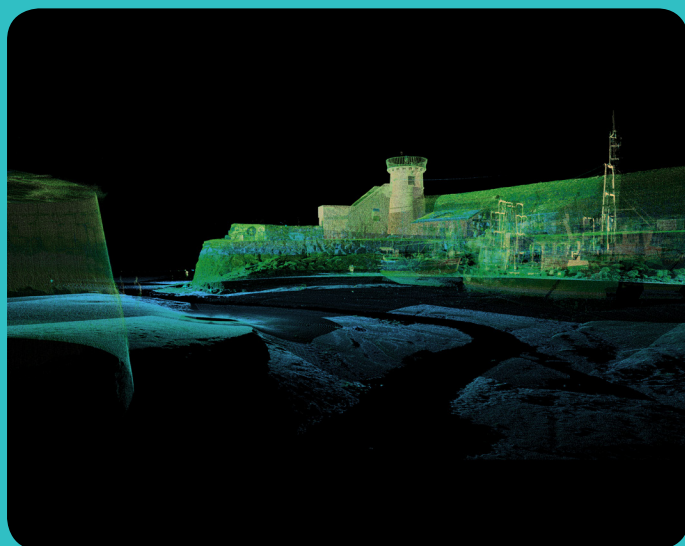
A More Sustainable Approach to Timber

Dr. Shotton's research addresses major issues in the sustainable use of timber in Ireland that affects the economic return on wood and its environmental impact. "Timber stores carbon from the environment, so if you chip a tree and use it for chip-board, that carbon will remain stored for the life time of the product, perhaps another decade or so, but will be released once the panel is disposed in landfill or through incineration," she explains. "But if you cascade the use of wood from that tree by using it for a beam and then into a series of other products, the carbon is stored for a longer period, which means it delays the inevitable carbon emissions when it is incinerated."

Along with colleagues at the University of Limerick, Dr. Shotton's research group mapped and modelled wood flow and cascading in construction in Ireland, and has highlighted the importance of the sustainable use of timber and thinnings, or young trees removed from forests.

"The use of timber thinnings for energy, which is common in Ireland, is not climate neutral, as the carbon they store is returned to the atmosphere on incineration," she explains. "But we have modelled how we can lengthen the lifespan of timber products by diverting more timber into engineered timber products and using broadleaf thinnings as timber laminates in these products and thus reduce Ireland's carbon emissions over the course of a century."

Dr. Shotton's research on wood welding has also yielded new insights into its application for working with beams and laminates in construction: "We showed how the process of wood welding could be useful beyond making furniture."



New Data and Insights on Small Harbours

Dr. Shotton's research on small harbours in Ireland is archiving the structures and construction history of these important historical, social and economic and often rural hubs. To date, her work has digitally captured the structure of nine small harbours between Louth and Waterford in 3D LiDAR point

clouds. "It's important that we have an accurate and resolved record of the stonework at these sites before they fall apart or disappear under rising sea-levels," says Dr. Shotton, who has also sourced information about the history of each one. "It's interesting to see where these harbours were built - it was often at the discretion of a local landlord - with the labour and materials being sourced from the locality too."

To progress the work, Dr. Shotton was awarded a Fulbright TechImpact Scholarship to work with the Digital Humanities group of the UCLA Cotsen Institute on strategies to digitally visualise these harbours. "That gave us some radical and important insights into the how to make the best use of the 3D LIDAR point cloud data," she says.

Shared Data will Preserve Built History

A major output of the project on minor harbours is an open source database of the information and models from each studied harbour, which will be made available on the UCD Digital Library website. "This will be a central repository for the findings, and the aim is that researchers, policy-makers and other interested parties can use the information and help us to add to it," she says.

Dr. Shotton, who is now writing a book about the evolution of concrete harbours in Ireland in the 19th century, is building up a consortium around the harbour project and will seek to expand the project with European funding: "In Ireland, this work has potential to impact conservation authorities, local councils and the architectural and historical records," she says. "And what we learn from the process can more generally inform researchers how best to curate and share such data so it has an impact now and into the future."

Research References

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Fulbright TechImpact Award 2017-2018

Fulbright TechImpact Scholar Awards are research grants to complete short-term, non-commercial projects and research in the U.S.

CASWOOD: Economic and Environmental Mapping of Cascade Use of Wood 2014-2016 (DAFM)

MHI: Minor Harbours of Ireland 2015-2017 (IRC)