Flatpack Architecture: Investigating Circularity Through Temporary, Demountable Buildings

Thomas Bryans, *IF_DO*

Emily Berwyn, *Meanwhile Space*

Peter Swallow, *Grimshaw Architects*

Colin Rose, *ReLondon*

Introduction

Vacant lots exist in every city, and like land everywhere, they carry inherent potential—socially, economically, and environmentally. Sometimes these sites await longer-term development plans but can be used on a temporary 'meanwhile' basis. Demountable and re-deployable structures designed for disassembly offer a potential solution—delivering architectural quality and social value for a low cost. The Hithe in South London demonstrates this potential, and its development explored the broader challenges of delivering circularity in construction.

Defining a New Typology

The most sustainable building, as the aphorism goes, is one that is already built. The nature of contemporary cities, however, is one of constant change. The circular economy is grappling with the ongoing process of renewal and replacement, but the question of what to do with vacant lots presents challenges. Vacancy has negative social externalities and squanders social and economic potential. Often sites are left empty while longer-term development plans are made. Maximizing their potential on a short-term 'meanwhile' basis is often difficult—one that temporary, demountable buildings can help address. Where a site does not have an existing building, perhaps

the most sustainable one exists elsewhere. Developing buildings designed for disassembly (to be assembled, disassembled, and reassembled multiple times) provides lessons that can help develop the broader circular construction industry.

What is Meanwhile?

Meanwhile or temporary use opens the opportunity to utilize underused spaces— buildings or land—while something else awaits. This could be pending planning permission, site assembly, or a new commercial tenant, typically from 1-10 years . Depending on a particular neighborhood's specific needs, it can allow for multiple activities, from pop-up shops, creative and leisure activities, community-led projects, or affordable workspaces. Enabling temporary use driven by local needs brings a bespoke vibrancy to a particular area and can help test, develop, and grow unique and distinctive places.

Vacant space will always exist within the urban environment. Still, the reduction in the acceptability of leaving space vacant for long periods has been brought to the fore, prompting demand for interim uses that maximize opportunities for experimentation, engagement, participation, and social gain.

The social, economic, and cultural backgrounds of those who utilize these spaces are key. “Meanwhile use” can increase access to space for those typically excluded from a commercial property due to financial means or other barriers. Temporary, affordable use reduces the cost of entry and the risk of testing ideas for new enterprises, businesses, or projects. Thus, temporary use allows the opportunity for failure, which is important in entrepreneurialism. Many ‘meanwhile’ projects are delivered in collaboration with the public or private sector and specialists or “meanwhile use” operators who often represent the community sector.

Project as Prototype

While “meanwhile use” of existing buildings has become increasingly common in the UK, the construction of temporary buildings on vacant lots for community and social benefit is not. The

development of The Hithe in Rotherhithe, South London, presented an opportunity to prototype and explore the potential of such an approach.

The site is located on a small local high street and is wedged between low-rise housing on one side and deep cuttings to one of London's major road tunnels and a railway tunnel on the other. It is owned by the local authority, Southwark Council, and is designated for public housing. While working out longer-term plans, Southwark was keen to see a temporary use that would bring social and economic benefits to the local community. It granted an 11-year lease to a developer and meanwhile operator, Meanwhile Space, working in partnership with architect and lead designer IF_DO.

Given the short lease on the site, the building had to be designed to be removable. The need for Meanwhile Space to pay off the capital costs for the project within the 11-year timeframe was challenging, and there was, therefore, an economic need as well as an environmental ambition to extend the life of the building. Designing it to be reused would enable maximum value to be retained. This demanded a circular economy approach from the outset . The project became a demonstrator project for CIRCuIT (ReLondon 2023) (Circular Construction in Regenerative Cities, funded by the European Commission's Horizon 2020 program) and ReLondon (Relondon 2023) (a partnership between the Mayor of London and London boroughs to accelerate the transition to a low carbon circular city). It was delivered in close collaboration with the main contractor, Weber Industries, and Grimshaw Architects, who helped advise on the circular economy principles as one of the CIRCuIT partners.

With large numbers of vacant lots around London, particularly in areas that would benefit from community-focused meanwhile uses, the project was developed as a prototype for a system of demountable and relocatable buildings that could be utilized more widely and as a pilot for building component ownership that is not linked to a particular site.

Limitations of Existing Systems

In their modern usage, temporary buildings have existed for over half a century. Typically used for site offices or temporary classrooms, they are utilitarian structures that do little to fit in with or respond to their surrounding context.

Similarly, the rise of shipping container architecture is usually non-contextual, presenting an aesthetic of demountability (given the implicit portability of containers). Ironically, the modifications required to shipping containers to make them habitable (such as the cutting in of openings for windows) often undermine the structural integrity that makes them portable.

For The Hithe, no existing systems would satisfy the brief's requirements or the local community's desires, so a bespoke modular approach was needed.

Site-specific yet Adaptable

To deliver a project that correctly addressed local needs, the first stage of the commission was an extensive community engagement program. Through direct one-on-one consultation with local businesses and residents, the brief emerged for an incubator space that would support local entrepreneurs and small businesses.

The area around the project has been undergoing significant change for many years as part of large-scale urban redevelopment. One of the engagement outcomes was a clear community desire that the building should not appear temporary. The design needed to look permanent, despite its meanwhile condition. The building was therefore designed both for the specific requirements of its current site and to be flexible and adaptable enough to allow modification for differing site conditions in the future.

Two key aspects of the site helped to define the design:

1. The plan dimensions were established by the existing foundations on the site, which were reused (along with the existing services connections), thereby avoiding the need for any new concrete in its construction.

2. The aspiration for the building to act as a local way-marker that would help attract more people onto Albion Street resulted in the two large lantern-like windows at the first-floor level, which are aligned with key footpaths in both directions.

Although this site specificity may seem at odds with the desire for future relocation, it was an inherent requirement of the brief from the outset. It was part of the careful calibration that had to be made between multiple (often conflicting) requirements. In the project delivery process, three big challenges had to be addressed to meet these requirements: financial, technical, and regulatory.

Financial Challenges

For constructing a new-build building in London, the budget for The Hithe was minimal, and the cost was one of the main drivers for decision-making from the outset. Low budgets are common to most community-focused meanwhile projects, but for T he Hithe, its demountable meanwhile nature raised funding issues. As a temporary building sitting on land with a short lease, it is not commercially mortgageable, being more like a piece of temporarily deployed equipment.

To add to the challenge, designing for disassembly (DfD) is more expensive than designing a permanent structure. The need for all connections to be accessible , easily taken apart, and put back together again added 6% to the overall cost compared to a building not designed for disassembly.

An economic analysis by Stace LLP was used to test whether the additional upfront investment in designing for disassembly would be offset over 30 years by The Hithe's potential for reuse, compared to an alternative business as usual (BAU) base case. In both cases, it was assumed that there would be three consecutive sites, with the building occupying each for ten years. The BAU approach assumed the demolition of one structure and the construction of a new one on each subsequent site (while allowing for some material reuse). For the assessment, it was assumed that the DfD scenario would be finished to a "basic" level with exposed timber panels to maintain flexibility and ease of disassembly.

This life cycle cost analysis found that while the circular construction interventions used for The Hithe resulted in a 6% increase in construction cost, they reduced operational cost by 5%, reduced maintenance cost by 13%, reduced renewal costs by 60%, and reduced the whole life costs by 23%, in comparison to the BAU base case. While there was a minor uplift in upfront capital expenditure to design for disassembly, the benefit over the whole life of the building was significantly increased and could be highly beneficial for sites designated for "meanwhile use" or similar applications. While this outcome is positive from a long-term perspective, the challenges of delivering a low-budget project with a 6% up-front premium led to a need for innovative technical solutions that could be cheaper, better, and faster.

Technical Challenges

From the outset, the conceptual and technical design was grounded in the need for future adaptability to enable the structure to be adapted to an unknown future site with unknown conditions. While that future site could, in part, be selected based on the parameters of the building, the greater the adaptability, the greater the flexibility on relocation.

The project team addressed two key technical challenges to enable this adaptability: the approach to the structure and the panels and the membranes.

Structure

An early decision was made to conceptually split the building into two, separating the compartmentalized ground floor and the more site-specific first floor. Each floor has a different structural solution. The building effectively has two structures stacked on each other that could be separated and redeployed as two different entities (with additional modification). This provides far greater future flexibility, with the building acting more as a kit-of-parts rather than a single object that needs to be reused in the same form.

The ground floor was conceived as five equal volumetric modular units, with the rigorous compartmentalized square grid of the plan allowing for a clear delineation of elements. The modules comprise lightweight steel 'cage frames' infilled with timber stud walls, rock wool, and

fiberboard paneling. Two larger spaces, pitched roofs, and double-height windows at the first-floor level demanded a more bespoke approach. A timber glulam frame and SIPs infill panels allowed for larger spans, with steel plates forming the timber splices and untrimmed bolts creating a simple, demountable kit-of-parts.

The ground floor modules were developed to be constructed on site: arriving as panels and assembled into their volumetric forms. It was a pragmatic approach driven by cost, a lack of space to assemble them off-site, and by design for disassembly requirements. Building one way (as panels) but enabling the structure to be unbuilt another way (as volumes) saved money up-front and will save money in the future by reducing the number of elements that need to be taken apart when it moves. It was an innovation born of accidental efficiency.

The lightweight steel cages that frame each ground floor module are required purely for future lifting and transportation: the timber-framed infill panels do all the static load bearing, with the fiberboard providing the necessary racking strength. Each module is bolted together, with cutouts in the fiberboard to allow ease of future access to the bolt connections. Had The Hithe not been designed for disassembly, the steel cage frames would not have been required. They were an additional carbon cost that needed to be factored in for the future transportability of the structure.

Grimshaw Architects carried out a Life Cycle Assessment (LCA) study to assess the whole-life carbon impact of the design for disassembly approach compared to the more traditional 'business as usual' (BAU) option. As with the life cycle costing, it was assumed there would be three consecutive sites, with the building occupying each for ten years. The results found an identical uplift as for cost, with a 6% premium in whole-life embodied carbon for the design for disassembly approach for the initial use of the building (compared to the BAU base case). This initial uplift, however, is offset when reused over multiple cycles. After the first relocation/redevelopment cycle, there is a 30% saving in whole-life embodied carbon. After the second, this increases further to a 46% saving.

Panels and Membranes

Designing for disassembly raised challenges concerning the SIPs panels and membranes, particularly ensuring that the building's components could be easily reused and watertight in future redevelopment cycles. This was investigated through a test rig which helped develop solutions to construct the finished building.

In typical (non-DfD) construction, adjacent SIP panels are joined with insulated splines overlapped by the outer sheathing of the SIPs and sealed with expanding foam. Expanding foam is incompatible with designing for disassembly because of its adhesive quality. The alternative investigated was to use gasket foam tape, which was found to both aid future disassembly and provide the necessary thermal performance. Once in place, the SIP panels were fixed with removable screws, with larger-gauge screws required for future reassembly, using the same screw holes.

Similarly, the standard approach to breather membranes was unsuitable for disassembly and reuse. To avoid the wastage of removing and replacing the entire breather membrane in each relocation, a solution was developed on a panel-by-panel basis, enabling the SIPs to be disassembled and reassembled with the membrane attached. When the membrane is fixed in place for the first time, lines of staples are positioned on either side of all SIP panel seams, with a line drawn for the future disassembly crew to identify the cut line. On reassembly, double-sided roofing tape is stuck on either side of the seam, with new strips of membrane adhered over the seams. This slice-and-patch approach should minimize wastage while ensuring the continuity of the membrane.

The test rig successfully demonstrated that the demountable SIPs system could be deployed with simple modifications to an existing commercial system. Establishing this principle gave the project team confidence to adopt these construction details as part of the final design.

Regulatory Challenges

While the greatest challenges to overcome were undoubtedly financial and technical, regulatory issues, particularly the lack of clarity over meanwhile use, present longer-term systemic barriers for this type of project.

The UK planning system has evolved over the last decade to incorporate ‘meanwhile use’ into the standard terminology. Temporary use has also become recognized for its value in urban development, not only in plugging the gaps and reducing dereliction but in testing longer-term uses.

Any use that has a duration of over 28 days requires planning permission. This requirement means that unless a project occupies a building or site for 28 days or less, it will require full planning permission, to be applied for through the same process as any permanent building. Contradicting the planning system, the UK Building Regulations (a particular regulatory requirement) define temporary as anything under two years.

Under current regulations, the building will be defined as new when relocated to another site. It will require full planning permission and must meet the relevant building regulations of the day. This process could present future difficulties with the building’s reuse. Because of budget limitations and without knowing what future building regulations would require, The Hithe was designed to align with current regulatory standards. For example, if minimum levels of energy efficiency are increased, the thermal performance of the building would need to be improved. While enhanced environmental standards are to be encouraged, the need to meet changing regulatory requirements with each future relocation presents a barrier for this type of project. All buildings become non-compliant over time, but existing buildings on the same site do not need to be recertified every ten years.

Future Unknowns

Meeting changing regulatory requirements is not the only challenge that must be addressed further down the line. Crucially, the disassembly and relocation of the building are not going to be tested for at least ten years. The team that designed and delivered it may not be available for the demount, so a disassembly guide was produced to help guide those involved. Whether that guide is sufficient—indeed, if known and used—will only be determined then.

Fundamental to the project’s overall success will be the amount of reusable material when relocated. The Hithe is considered ‘100% demountable’, but building elements, such as

plasterboard walls, have been skimmed with plaster and painted . There are elements with lifespans that mean general wear and tear will likely lead to their replacement in the building's second and subsequent uses. Therefore, a waste allowance of 5% during disassembly and 5% loss due to wear and tear has been assumed but will only be confirmed in practice. The logistics of taking the building apart are critical: the elements that come off first (such as the cladding) will go on last. The potential for damage to individual pieces will significantly affect the wastage and replacement rates.

Several questions are unknown about the redeployment of the building. Firstly, where it goes next: what are the conditions of the site(s) that it will be relocated to, and what adaptations will be needed as a result? Secondly, there are legal questions: who has liability for the rebuild? Moreover, will manufacturers still accept warranties on products moved from one site to another, even on the same building? These are questions that will need to be answered in the future.

Lessons Learned

The project began on the premise that there was a gap in the market for demountable modular buildings that deliver more than just temporary space. In the response, The Hithe has had from local authorities across London and elsewhere, this is indeed the case.

The Hithe is, however, a prototype: there are many compromises, and it is not a perfect solution. It has required collaborative decision-making around the efficiency of choices (pragmatic, smart, and circular). The outcome of this process has developed a series of innovations that have the potential to support circular construction approaches more widely. For example, rethinking the assembly of SIPs panels through a design for disassembly approach requires minor changes but could result in significant end-of-life benefits in deconstruction.

One of the biggest learnings has been assessing capital and carbon costs for designing for disassembly, compared to more traditional 'business as usual' construction. Despite The Hithe's initial capital cost and whole-life embodied carbon being higher than the BAU base case, when evaluated over multiple reuse cycles over 30 years, it outperformed the base case after a single

reuse cycle. This is positive news for developing demountable meanwhile structures, but it requires the theory of relocation to be carried out in practice for that additional investment to be proven worthwhile.

References

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Thomas Bryans is an architect and co-founder of the London-based architecture practice IF_DO. Thomas leads the practice’s research projects and is passionate about a holistic approach to architecture: creating sustainable, beautiful, and useful buildings that will be of long-term value to the communities and environment around them. He explored these ideas in his TEDx talk ‘Architecture’s Ripple Effect: Designing for Big Impact’. In 2020 he was named one of the *Architect's Journal's* 40-under-40.

Emily Berwyn is the founder and Director of the pioneering social enterprise Meanwhile Space. As the market leader in Meanwhile uses since 2009, Meanwhile Space designs innovative community-led solutions to vacant space, from demountable structures to retrofitting challenging redundant spaces. These multi-award-winning projects create better places to live and work by working with communities to bring disused space into affordable temporary use.

Peter Swallow is the Sustainability lead for Grimshaw’s London, Paris and Dubai studios. His work focuses on developing net-zero carbon and regenerative (net-positive) solutions for the built

environment. He currently leads Grimshaw's involvement to the EU-Horizon2020 funded Circular Construction in Regenerative Cities project (circuit-project.eu) and recently collaborated with the University of Cambridge to develop an carbon/energy/cost decision support tool - https://www.refficiency.org/ecm/energy-cost-metric/.

Colin M. Rose, PhD is a Strategic Advisor for the Built Environment at ReLondon, a Senior Research Fellow at University College London (UCL), and a UK CLT LLP founding partner. He contributes to the CIRCuIT project at ReLondon and leads circular economy research investigating the reuse of secondary timber at UCL. He is the winner of Ramboll's Flemming Bligaard Award 2020.