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TITLE:

Collaboration for innovative self-build housing:
the role of the civic university in delivering new homes in the city

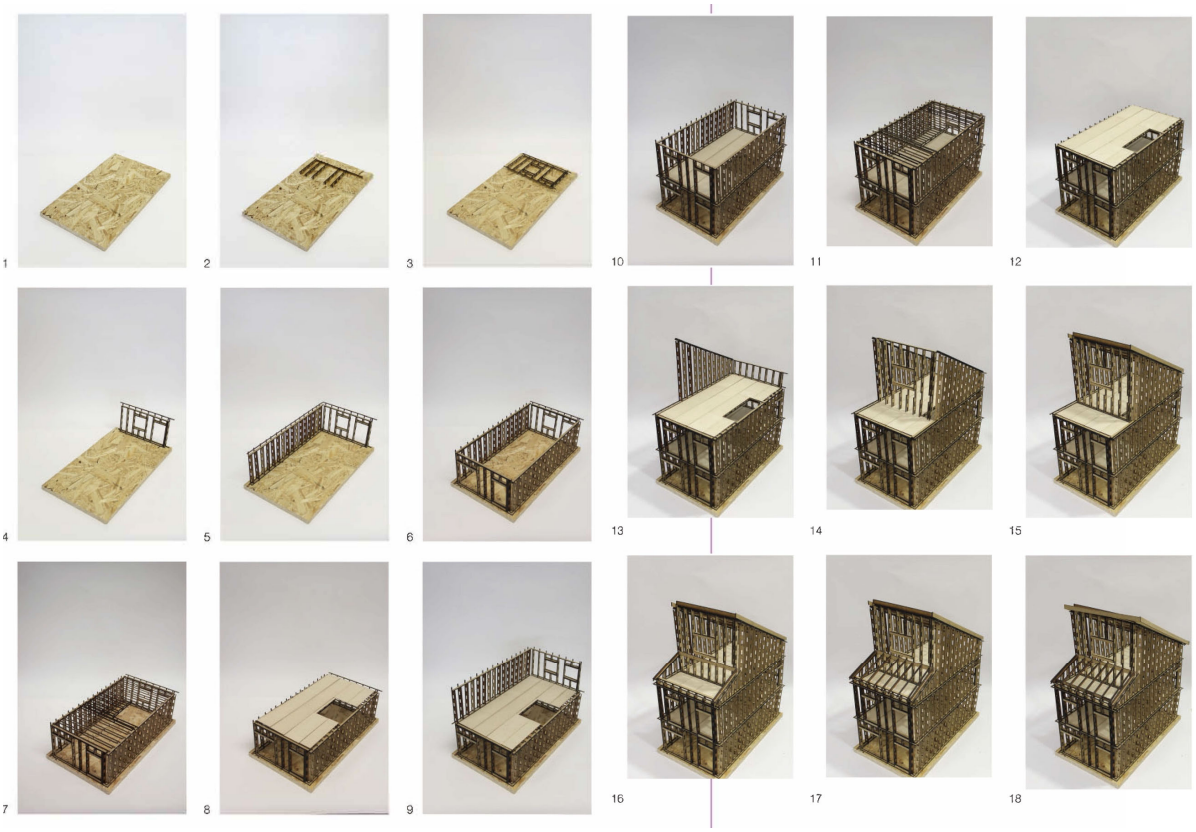

Fig.1 Breakdown of the self-build structural process. Model and photograph by students

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ABSTRACT

This paper discusses the interactions between universities, local authorities and practices in the creation of new housing in the city. Through case studies drawn from the Birmingham School of Architecture and Design from 1950 and the present, the paper sets out to explore the collaborative potential of the civic university in developing innovative housing solutions.

The Birmingham School of Architecture and Design pioneered 'live projects' as a pedagogic model in schools of architecture in the UK and as part of this programme delivered a number of innovative housing projects in collaboration with the public sector.

The School continues the tradition of live projects through its more contemporary initiative, The Co\\aborative Lab:oratory (Co**.**LAB). The module brings together students from across a range of disciplines, academics and external partners to work on inter and trans-disciplinary projects through collaborative working approaches. Working with Cherwell District Council's Build! Team, Co.LAB has led the development of a low carbon timber frame self-build housing system. Continuing the tradition of learning by doing, students tested the system at 1:1 scale. Working with the council, a full prototype is under development for construction.

By comparing historic archival knowledge with our case study, the paper seeks to highlight the challenges and virtues of university-public sector collaboration as a means to deliver innovative outcomes. It makes a case for greater role in collaboration between the university and public sector as a means to develop alternative models of housing in the city.

The Self-Build Context

The UK is facing a well-documented housing crisis. Not enough homes are being delivered at the right quality, in the right places or at the right price. Today home construction is dominated by a few large developer builders. For those seeking an alternative, there are few options available for those on modest/low incomes.

It has long been acknowledged that the UK's self-build sector falls behind those of other countries. Self-build housing is of substantial importance and a major means of producing new housing in nearly all advanced capitalist countries (Benson, 2107). However, statistics released over the last 20 years have consistently reported that the UK's self-building sector is far smaller than other European countries (Benson, 2017). For example, self-build represents barely 10% of aggregate housing production across the UK.

Historically, even though self-build played a large role in the new housing development after World War II in the UK, Hardy and Ward (1984) documented, changes in the political landscape of housing that changed the sector. They noted that an alliance of speculative builders and public bureaucrats introduced planning and conservation legislation which resulted in significant obstacles to housing provision through self-provided methods. Consequently, self-building remained outside the mainstream housing system.

More recent events such as the Banking Crisis of 2008 and the subsequent recession contributed to stalling the housing market in the UK further. banks and building societies demonstrated continued caution when offering mortgages on self-builds as they saw more risks associated with them.

In the last decade however, there has been a notable effort from government to take the self-build sector more seriously, realising the UK's shortfall and the potential barriers to developing it, such as land supply and procurement; access to finance; the planning process; general regulation and red tape. Government policies helped to promote the self-build sector in the UK in 2011 with the Housing Strategy for England, The Right-to-Build scheme in 2015 and The Housing & Planning Act 2016.

Despite policy supporting self-build in principle, the housing model remains far behind the usual construction methods in the UK. The uncertainty and financial risk in the private sector limit its perception as a sustainable method for producing quality affordable housing. This paper documents one example of how the public sector can step in to provide a new solution.

Cross Sector Collaboration

Cherwell District Council are a pioneering local authority in Oxfordshire who have been looking into this question of new alternative housing models. In 2012 the council set up the 'Build!' initiative to deliver innovative projects across the region including self-build solutions. This in-house, multi-disciplinary team has a wide range of building, design and housing experience including architecture, quantity surveying, project management, interior design, sales and housing management.

To date, Build!'s programme has provided over 260 homes, offering buyers a choice of how much they want to be involved in their construction. However, this has predominantly been a self- finish approach where buyers complete internal fit out tasks to a completed weather-tight structure.

Birmingham School of Architecture and Design (BSoAD) is recognised by the RIBA to be distinctive in our support a diverse community of students and creative opportunities that link strongly with the city and wider region. As evidence of this, the school is a co-producer in a number of initiatives and research projects through our Co.LAB initiative as a module and agency model that allows for experimentation with industry partners to generate alternative design approaches to contemporary urban challenges.

In 2019, Cherwell approached BSoAD to develop a new timber-framed construction system that can simplify the self-build process. In doing so, it aims to widen the options for customer involvement including hands on delivery by novice self-builders and custom-build solutions. Another aim is to integrate other sustainable systems and Passivhaus standard equivalence with a self-build model, thereby reducing long term running costs.

Additional support was provided by Clancy Consulting for structural guidance and Ecological Building Systems (EBS). EBS is a Cumbria-based company that supplies sustainable, natural, ecological building materials to deliver quality, affordable products and training.

A Civic Role for the School

Universities have a civic responsibility to the cities and communities of which they are part and increasingly aspire to creating a positive contribution to society (Sara & Jones, 2018). Our partnership embodies a civically engaged project in the form of a 'triple helix' – between governing authorities, universities and professional industries. Through collaboration across the public/private sectors a socially-driven approach can be developed efficiently and with deep impact to a community. The UPP Civic University Commission report elaborates on the benefits of a helix; "Universities play a key role nationally through their teaching and research work. But they are also hugely important to the economic, social, cultural and environmental wellbeing of the places in which they are located… the public – nationally and locally – needs to understand better the specific benefits that universities can bring." (UPP, 2018).

To be a civic university, its activities need to be a result of a "clear strategy rooted in analysis" (UPP, 2018). To be civically engaged, they need to define what their 'local' is and understand who its civic actors are. Within our school of architecture, we draw on its history to define what these parameters are for us.

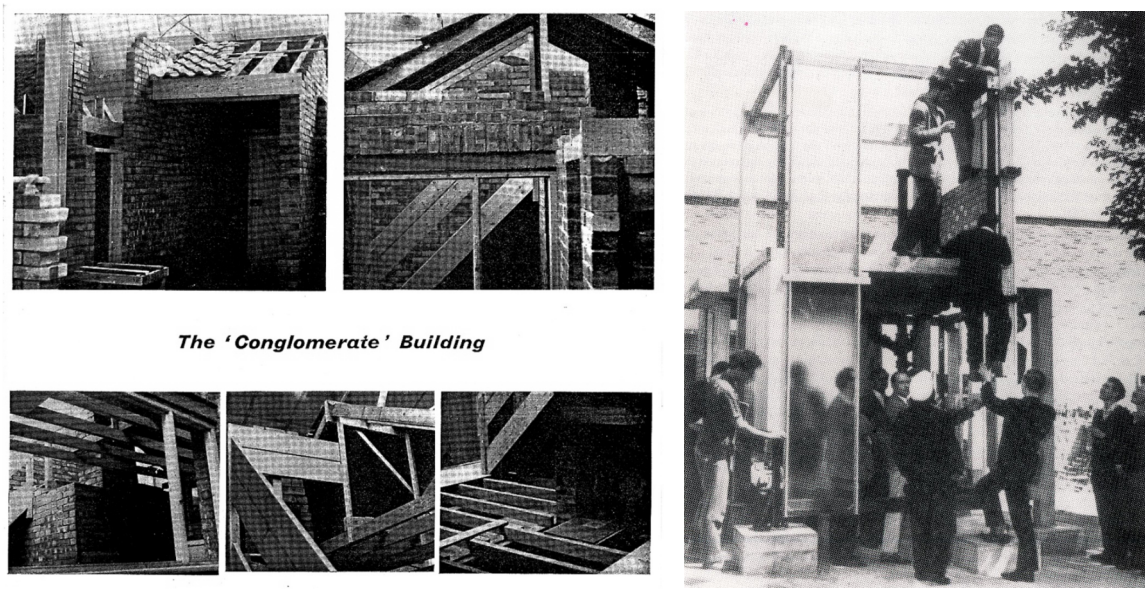


Fig.2. Examples of 'conglomerate' builds in Architecture & Building News, 1961

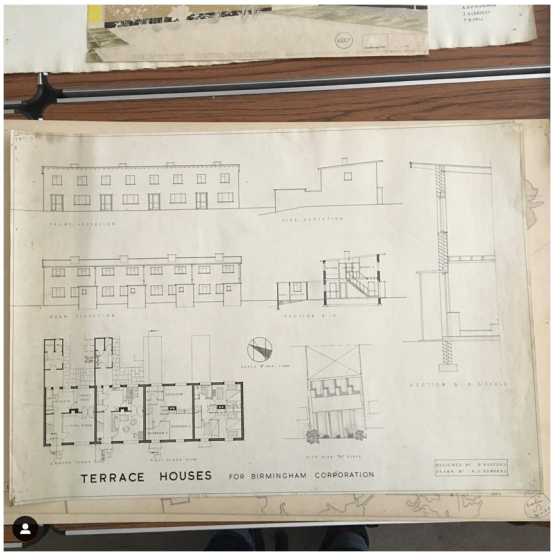
As one of the oldest schools of architecture, founded as an independent vocational college housed in Margaret Street alongside the Birmingham School of Art, it emerged with an independent spirit; the first known 'live project' commenced at the Birmingham School of Architecture in 1951. To appeal to 'better students' Douglas Jones, the Head of School at the time, instigated "a radical aspiration for a teaching in architecture that was both practical, academic and intellectually aspirational" (Brown, 2012).

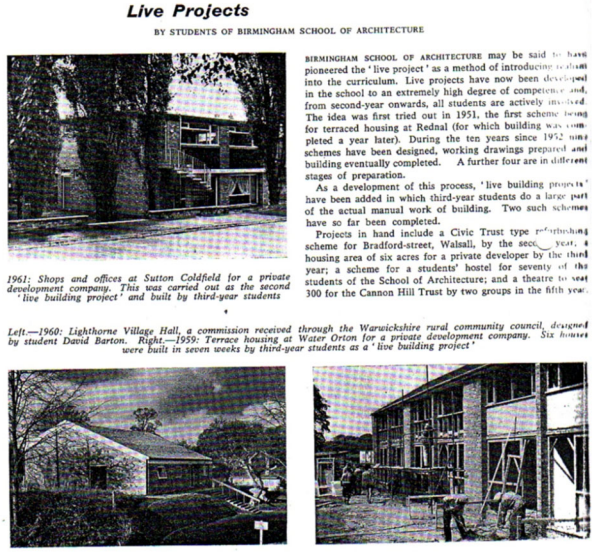
Early experiments were facilitated through 'conglomerate builds' – as modules completed in the students' second year. Conglomerates introduced basic building skills in compressed and truncated structures that fitted in the studios or the grounds of Margaret Street. These builds were about getting students to condense all different junctions of a structure into one realisable section - "The point was to have the student ask, at every stage of design, how is this to be constructed?" (Architect & Building News, 1961).

There was an element of ad-hocism to the composition but students were tested in the conventions of wall build ups that you would expect to see in traditional builds.

These experiments were followed by housing schemes initially designed and detailed by second year students and delivered by local builders in suburbs of Birmingham. In a later development, third year students undertook on site construction, getting hands-on with the building process to better understand construction beyond what they learnt in the earlier conglomerate activities.

Projects such as terraced housing at Rednal and Selly Oak and nurses' homes at Weston-Under-Wetherle were delivered as collaborations between the School and Birmingham Corporation. The Birmingham schemes were "a quite un-collaborative process, and while it introduced students to real clients, almost all were local authorities with whom there was no critical examination of the brief" (Brown, 2012). In fact, students worked to produce designs, typically rows of semi-detached or modernist terraces, for pre-arranged contracts between councils and commercial house builders. Student outputs substituted planning stages of the design and construction process for the contractors to tender against.




Live Projects

BY STUDENTS OF BIRMINGHAM SCHOOL OF ARCHITECTURE

BIRMINGHAM SCHOOL OF ARCHITECTURE may be said to have pioneered the 'live project' as a method of introducing realism into the curriculum. Live projects have now been developed in the school to an extremely high degree of competence and, from second-year onwards, all students are actively involved. The idea was first tried out in 1951, the first scheme being for terraced housing at Rednal (for which building was completed a year later). During the ten years since 1952 nine schemes have been designed, working drawings prepared and building eventually completed. A further four are in different stages of preparation.

As a development of this process, 'live building projects' have been added in which third-year students do a large part of the actual manual work of building. Two such schemes have so far been completed.

Projects in hand include a Civic Trust type refurbishing scheme for Bradford-street, Walsall, by the second year, a housing area of six acres for a private developer by the third year; a scheme for a students' hostel for seventy of the students of the School of Architecture; and a theatre to seat 300 for the Cannon Hill Trust by two groups in the fifth year.

1961: Shops and offices at Sutton Coldfield for a private development company. This was carried out as the second 'live building project' and built by third-year students

Left.—1960: Lighthorne Village Hall, a commission received through the Warwickshire rural community council, designed by student David Barton. Right.—1959: Terrace housing at Water Orton for a private development company. Six houses were built in seven weeks by third-year students as a 'live building project'

Fig.3. Live Project Drawing by BSoAD student, Radford c.1960. Source: BFCAA Archive / @mid_mod
Fig.4 Photographs of completed live-builds in The Builder journal, 1963

Brown's research further expands the impact of the live project while it ran for over a decade. Further refinement of the process included 'Realistic Project' for fourth and fifth year students that grouped them together with real clients and host architects to generate more expertise and critique of the brief and typology than the initial live project module. The learning outcomes developed practical training with intellectual and creative skills.

Over a 12-year period, at least twenty-two projects were undertaken by students across Coventry, Walsall, Quinton and the wider West Midlands region. It demonstrates the physical impact of a pioneering pedagogic approach in architectural education. Many of the houses survive to this day and are still occupied.

Enabling Civic Collaboration : Co.LAB

It is within this context Co.LAB has been developed in part as a response to the School's civic roots. Started in 2010, the laboratory emphasises collaborative working practices in cross-subject groups. The module combines second year undergraduates and first year postgraduate students. It draws on existing networks amongst the staff and the wider faculty of arts, design and media to connect with collaborative partners – and built up a reputation for building large scale 1:1 structures for festivals and cultural events. This practice then expanded into more complex briefs where partners used the school as a point of research through a learning-by-making agenda. The instruments of academia (student groupings, open learning outcomes, timetabled experiments) allow for an element of freedom that benefits innovative design thinking and external partners benefit from the unique way of thinking that is sometimes difficult to achieve within the public or commercial sectors.

Co.LAB is structured to place value in innovation and vision through collective thought and goes beyond some of the criticisms the school received in their first iteration of live projects in the 1950s as simulated representation of everyday practice.

Fig.5 A cross section of the self-build dwelling, occupied in use. Illustration by students.

Collaborative Designs for Self-Build : Real Homes Real People

The first phase of the Real Homes Real People project with Cherwell District Council and their Build! team aimed to develop a house type and timber frame system suited to self-build construction. A group of 18 students visited the Council offices for a briefing, visited the project site in Bicester and toured Graven Hill, the UK's largest self-build site. Returning to the school's studios, the project was developed in three stages:

1. Research in self-build construction, timber frame construction systems, low carbon technical solutions and healthy materials.
2. Design and resolution of a repeatable house type suited to the site.
3. Exploration of technical resolution through a full-scale mock-up of the system.

Small regeneration sites are common amongst councils and are often allocated for the provision of affordable housing. A 579m2 project site located to the south of Bicester town centre was selected as an ideal 'typical' site for the project in that any solutions created would be readily applicable to local authorities across the UK. It is owned by Cherwell District Council and is currently occupied by a vacant library building which is to be demolished to make way for new affordable housing. Residential archetypes across the area are varied ranging from medieval cottages to 1960s bungalows.

The proposals illustrated 3no. 5-person units in a terraced formation, with an approximate gross internal floor area of 93-99m2. The structural design uses a Larsen wall truss system which is made up of two parallel studs joined by a rectangular gusset. The inner stud (2"x6") carries the roof and intermediate floor loads to the insulated raft foundation. Whereas the outer stud (2"x2") is applied with the insulation and sheathing layer. The upper floors and part of the roof are built using 253mm deep Posi joists to span the shortest length of the house. The joists are doubled where a wall lands on the floor to transmit the loads laterally to the walls and into the ground. The shorter part of the mono-pitched roof uses regular timber rafters. Structurally, it demonstrated that it was possible to incorporate a self-build timber frame home that was optimised for Passivhaus equivalence.

In a parallel to the 'conglomerate' builds, a detail modelled at 1:1 scale tested a complex junction and been constructed by students with limited experience of making or on-site experience. Although not an abbreviated structure as the historic examples of conglomerate tests, it is more focused towards a specific formation and setting, and therefore directly useful in the exploration of the self-build system.

Students' ability to fabricate the 1:1 section was seen as a good test for the ease of construction for self-builders. A particular challenge was the casting of the ground floor slab and lapping of airtightness membranes. Our experience indicates the system as designed needs specialist input in the construction process for this stage. Exploring alternatives to a concrete slab has further potential.

Achieving airtightness in a self-build process is particularly challenging. The use of an airtightness board as the inner sheathing for the timber frame worked well, but the cost implication of this needs considering. There were additional unresolved challenges in ensuring airtightness at intermediate floor level.

Incorporating Technical Investigation in the Process

The system needed to be considered in detail at each junction. The Co.LAB has explored the ground floor to wall detail but further work was needed to gain a similar understanding of each key detail on the upper junctions of the section. We developed a plan to expand on the initial Co.LAB output through another technical module in the following year for final year undergraduate students. The Technical Investigation module included some of the students from the previous session to further build on their knowledge acquired.

Whereas conglomerates tested technologies as isolated exercise before undertaking complete live projects in the following year, the reversal of the process for Cherwell's self-build follows a conventional staging of an architectural design.

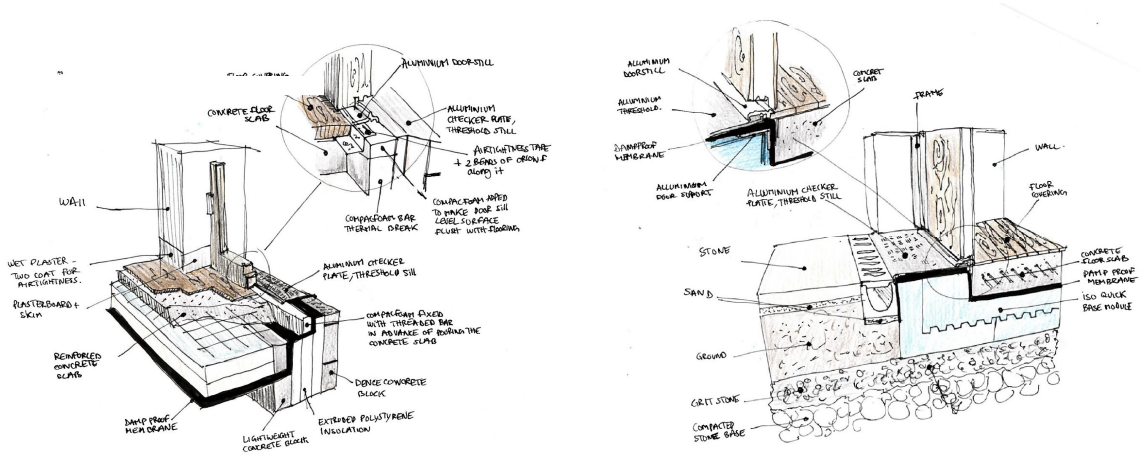


Fig.6 Outline development sketches from the students

The module outputs set students to prototype key components of the self-build system as a further proof of concept and to integrate with the innovative structural frame developed in the first module. Keeping it within the academic setting maintained the emphasis on open exploration and refining the design through making at 1:2 – making connections between sketch work and the material effect of the design decisions at near full scale.

During this process, the input from specialists honed the students understanding of the tectonic build up. This was their second attempt to refine the details, an iterative design process that spread over a 9-month period. The final models used EPS insulation rather than wood fibre due to time pressures, but the type of insulation requires further investigation. In particular a Passivhaus assessment will still need to be carried out to assess whether layers of insulation inside and outside the Larsen truss are required.

The intermediate floor junction is best resolved. The challenge here are the lapping of airtightness membranes around the joist penetration and the reduction in insulation thickness due to the timber rails and packers around the joist. One solution may be to increase the thickness of the Larsen truss to alleviate this problem, which may also reduce the need for additional layers of insulation.

The roof construction detail was simplified from the Co.LAB iteration into a standard pitched roof. The joists span between party walls, but this creates some awkward details to the roof pitch such as timber fillets above the joist. Spanning the joist from the ridge to the eaves would simplify this detail and make it more suited to a self-build process. A concealed gutter was designed as an elegant design solution but introduces a new challenge in the construction process (particularly waterproofing) for customers to execute, and reduces the thickness of insulation at the eaves. Replacing this with an external aluminium gutter would resolve these issues as an option depending on customer's willingness to tackle the detail on-site.

Developing The Opportunity For A Self-Build Live Project

Both modules have resulted in a 'proof of concept' for a timber frame self-build housing system. The principles of the system have been defined, a first iteration has been drawn and several key details modelled. It has a strong alignment with the school's research strands and in particular our focus on Future Homes for the region. The school has the facilities, expertise, and wider professional services to scale up and develop a prototype house to test the buildability, thermal performance and finishing of a whole house in partnership with the public and private collaborators.

Fig.7 Final junction models integrating Passivhaus details with the self-build structure

There are major aspects outstanding including a full planning application process and costing exercise to develop the proposal. There are to be considered in tandem with a full business case to support Cherwell achieving their aim for sustainable and affordable self-build housing: their research suggests the system can be used as a standard construction approach to reduce delivery costs across all Build! development sites including non self-build sites. Previous research undertaken by Cherwell District Council concluded that by year 4 of production, circa £550k could be saved per year through the use of an in-house system over the purchase of timber frames from external providers - assuming the sale/delivery of 200 frames per year (Swallow, 2020).

Should a final self-build product be taken to market, it would widen the options available for customer involvement for hands on delivery by novice self-builders and custom-build solution. A recent report published by NaCSBA and the Right-to-Build Task force indicates that they are targeting a 231% growth in the self-build sector over the coming years, 35% of which is to be aimed at creating new options for low-income households and to move away from products that are only available to affluent individuals which currently dominate the industry (Swallow, 2020).

Conclusion: Can the civic university help deliver new homes?

This paper has recounted how a contemporary self-build housing project has been developed based on collaborative practice that is part of a wider strategy in the School's approach for a civically engaged university. Parallels can be drawn between the School's conglomerate builds and early housing and the experimental prototyping of the self-build system which demonstrate the changing role of the university in the city. The former focused on replicating professional practice experience and knowledge of standard construction techniques suited for practice. However, the collaborative self-build prototype looks beyond professional experience, exploring the role of the civic university in addressing societal challenges in

creative and innovative ways. What emerges from the study is a demonstration of the triple helix approach where close collaboration between universities, public sector clients and professionals can lead to a inventive solutions with potential for positive long-term benefits for local communities. The potential of restarting the scale of housing delivery seen in the School in the 1950s through a civically engaged model has the potential to be transformative for both participants and the city. The project demonstrates our first step in realising this vision. Real Homes for Real People: self-build sustainable, affordable homes delivered through a civic partnership in response to the difficult political and social setting of the 2020s.

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