Reclaiming the Future:
An Exploration of Innovative Material Reuse in the Tolka Valley

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To my friends for their selfless support since the beginning.

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CONTENTS

Introduction:

The construction sector is facing significant condemnation for its major contribution
to global environmental deterioration and climate change. Although this catastrophe involved all facets of the construction industry, design may ultimately be responsible for the solution and the future. Architects significantly impact the choice of building materials, construction techniques, and overall building footprint, making them essential players in the industry's evolution. Architects can break the current cycle of wasteful material utilisation by opting to specify reusing materials in the existing building stock. Such a decision is not straightforward; to succeed, it calls for intervention in current social, economic, and legislative structures.

The increasing consumption of aesthetic trends and the notion that economic growth is the primary determinant of a prosperous society perpetuate a destructive cycle of quick construction for short-term needs, values, economic advantages, poor quality construction, and ultimately demolition to clear the way for "new" development. The effect of resource consumption on the climate and the world's biodiversity is coming into clear focus as global awareness of the climate problem grows.
Nearly half of the world's extracted materials are required for the built environment, and in many countries, construction and demolition waste is the single largest source of waste. About 85% of a building's environmental costs are related to using materials (Krieger, 2021). However, the demand still grows with ignorance of the situation. By 2050, it is anticipated that global cement consumption will rise by 12 to 23%, and steel production will increase by 30% (Cheshire, 2021). The construction sector faces enormous challenges due to these structural issues, and the anticipated increase in demand for raw materials will exacerbate the world's resource shortage. In contrast to the present linear economy, where materials are mined, made, consumed, and thrown away, a new model promotes a circular economy, where resources are kept in use and their potential is retained. For buildings, this entails developing a regenerative built environment that emphasises preservation and renovation rather than demolition and rebuilding. The European Commission's definition of a circular economy states, 'this means reusing, repairing, refurbishing and recycling existing materials and products. What used to be regarded as "waste" can be turned into a resource.' (European Commission, 2014).

In this thesis, the term “existing buildings” are also represented by the term “linear buildings”. They are used when discussing buildings designed with no plans for disassembly. The abbreviation ‘DFD’ stands for ‘Designed for disassembly’. Here, Designed for Dissasembly is the design of buildings to facilitate future changes and dismantlement (in part or whole) for recovery of systems, components and materials, thus ensuring the building can be recycled as efficiently as possible at the end of its lifespan (Cutieru, 2020).

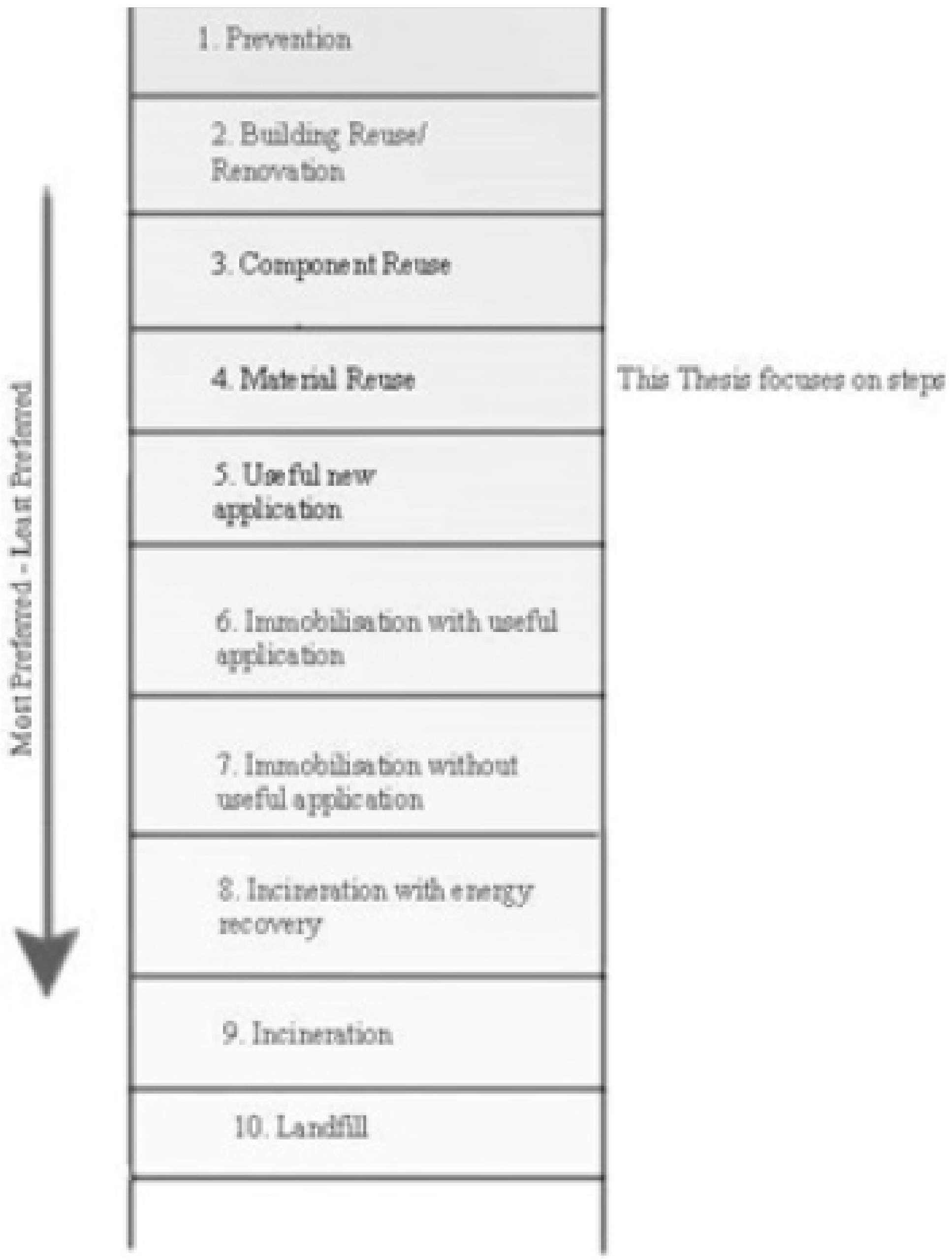
The Argument for Reuse

In his article titled 'DESIGN FOR DISASSEMBLY', Philip Crowther states, "If the design strategy for disassembly was applied to the built environment, the life cycle stage of demolition could be replaced with a stage of disassembly" (Crowther, 2005, p. 3). This leads me to question whether 'designing for disassembly' is the only strategy that can be applied. Or, can the demolition stage be replaced with the disassembly stage in buildings designed linearly? Census 2022 counted 2,124,590 permanent dwellings and 166,752 vacant buildings in Ireland. In 2015, SEAI estimated that there were approximately 190,000 commercial buildings. The current protocol for such buildings' end of use is demolition, as it is unlikely they were Designed For Disassembly. *From this point on in this thesis, the term 'Designed For Disassembly' will be denoted as 'DFD' A practical system is needed to salvage and reuse existing buildings' materials. Some materials that may be reclaimed are brick, steel sections, timber, and even whole elements such as window frames, tiles and door handles. It's essentially a way of looking at 'cities as material stores for the future' (Architects Journal, 2019). Of course, the fact that these structures were not DFD means the process will be more complicated than it is for buildings that were DFD, but it does not make it impossible.

Precedent

Superuse Studios designed and constructed Buitenplaats Brienenoord in Holland, an art centre where 90% of the original structure was reused. The only new components were the fastening materials, five wooden trusses, column boots, and the glazing on the south facade, which was installed in the building's existing frames. Everything else is constructed using materials that have been used before. (Krieger, 2021). The goal
of Superuse Studios is to reuse a whole structure wherever possible. In the Superuse Studios material reclamation process, the initial point is always the supporting structure. They look for the optimal arrangement for the required program while keeping load-bearing capacity and size restrictions in mind. When necessary, they make advancements to make the circular economy work for such linear buildings, such as adding floors if the height permits. According to Stewart Brand's layer theory, they keep all electrical and heating installations apart from other built-in components to simplify maintenance and allow for future adjustments. Superuse uses a decision tree to make the material options clear.

[Fig. 1]



[Fig. 2]

Waste

Waste is a term that is initially simple to comprehend. However, it is difficult to come up with a clear legal definition of what waste is.
“The notion of waste is relative in two main respects. First, something becomes a waste when it loses its primary function for the user. Waste is, therefore, relative to
this primary function. However, and this is the second perspective, what is considered waste with regard to this primary function may be useful for a secondary function. In other words, somebody’s waste is often somebody else’s (secondary) raw material. ... [This is] why certain wastes keep a significant economic value. While a waste may lose its value for whom generated it, it may maintain a value for its secondary user who will be the one to set this value.” (Bontoux & Leone, 1997, p7)

A circular economy does not require every industry to create closed loops for its materials and components. The premise behind industrial symbiosis is that materials considered waste by one industry might become valuable resources for another.
The ten steps of the Delft Ladder are points in a material’s or component’s life cycle where a designer can take action to ensure the material or component is used as long
and as effectively as possible. This prevents or delays the degradation of materials that would otherwise end up in landfills. (Noto, 2020)

[Fig. 1 Buitenplaats Brienenoord in Holland, Superuse Studios
[Fig. 2] Delft Ladder Diagram

A combination of bad design, economic factors, and cultural perceptions contribute to building waste. Building vacancies and continuous renovations show a lack of flexibility and an inability to respond to changing usage and programmatic requirements.
Separating and removing elements as intact, valuable materials can be challenging. Economically, many people prioritise short-term financial advantages and immediate investment costs. Frequently, tearing down old structures and starting over at a new location can be less financially expensive than renovating existing structures.

Reclaiming materials for reuse instead of waste is opportunity architects and interior designers need
to take advantage of. Still, this opportunity must be considered from the beginning of a project. Environmental assessment programs such as the Greater London Authority circular economy statement guidance now call for pre-renovation/pre-demolition assessments (Greater London Authority, 2022). They ask that an external audit be carried out and submitted along with the planning application. One step in the procedure is a pre-demolition, pre-renovation audit. Without cooperation from the demolition contractors, it will not accomplish anything, so the program and contract need provisions to implement recommendations.

Precedent

The London 2012 Olympic site was one project that tried to adhere to these suggestions and reuse materials. On the park's location, approximately 220 buildings had to be taken down alongside walls, bridges, and roadways. The Olympic Delivery Authority set a goal of recycling or reusing 90% of the materials produced by the demolition work; they also prioritised reuse on-site over recycling. All buildings and infrastructure underwent pre-demolition audits, and the results were compared to the demand for materials for the new development. They were forced to concentrate on the parts that could be reused locally as it was determined that the expense of recovering all of the materials for reuse would be too high (Bioregional,2011). Furthermore, sourcing materials is one step in transitioning to a more circular economy. Still, more pressing is whether the traditional systems and contractual relationships can be adjusted to decrease waste and generate a more circular outcome.

[Fig. 3]

Material passports and lifespan analyses are essential components of all stages of sustainable decision-making. Sara Morel is the chief executive of Salvo, a long-established UK-based company providing architectural salvage and reclaimed building materials. She stated,

‘The best way in which architects could reduce their material carbon dependence is through reuse; Reclaimed materials should be mandated, not an option’ (Williams, 2021). In his keynote address at the AJ100 in June 2019, BBM Sustainable Design co-founder Duncan Baker-Brown outlined how architects and contractors must stop digging up materials and use what is already above ground in the future,

‘We need to mine the Anthropocene: rework the already produced stuff; the human layer of stuff, whether it’s ocean plastic, landfill, existing buildings and re-wild our natural world’ (Architects Journal, 2019).

Re-using, recycling, and reclaiming materials can massively reduce the pressure on the earth for resources for the building material industry, thus saving energy and creating less waste.

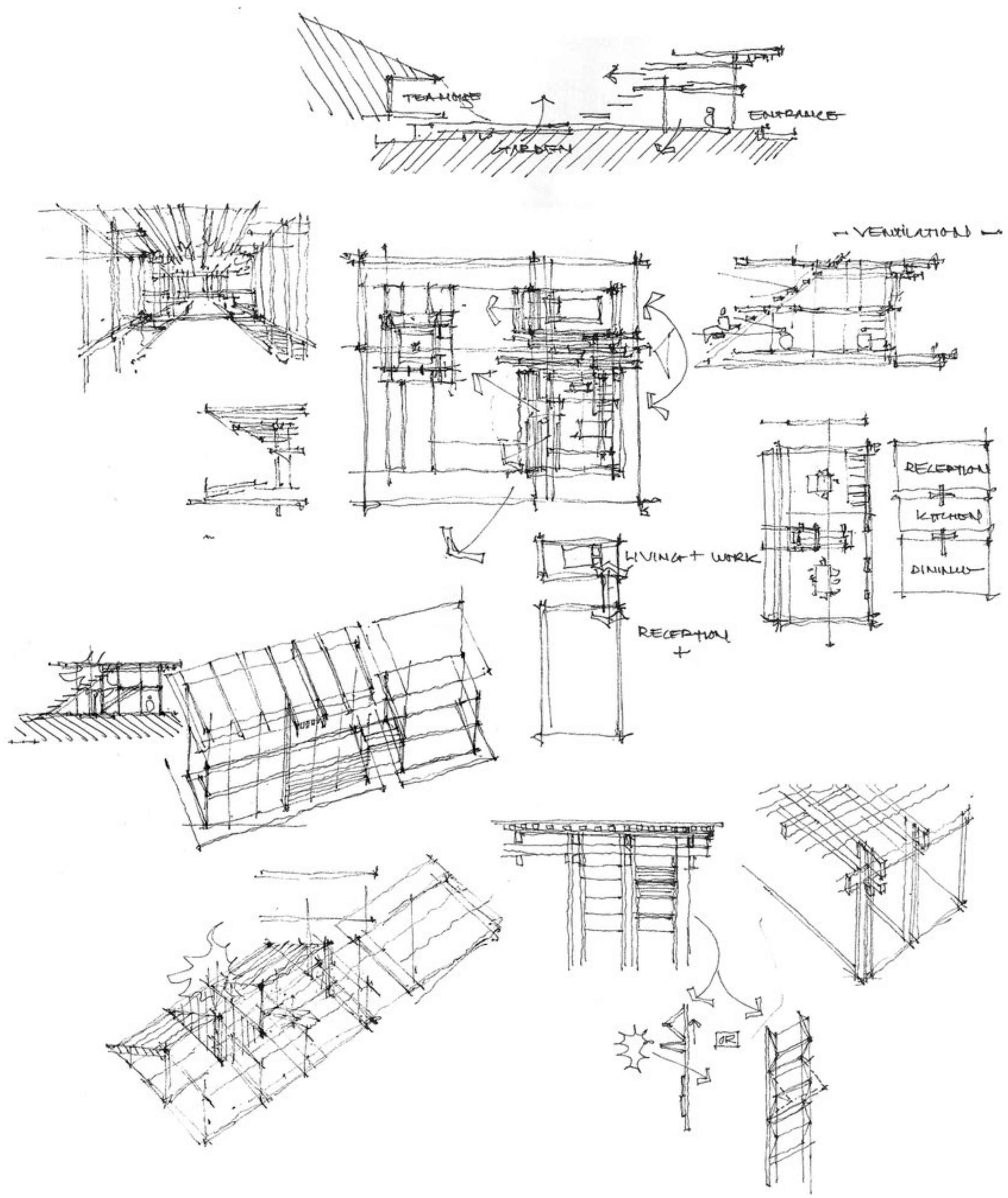
Society

Societal standards of beauty and aesthetics evolve with time. A building’s worth is diminished when people think it’s unattractive in its context. Throughout history, little regard has been given to the tremendous waste, trends, and fashions produced; the focus has always been on keeping up with popular styles. Dublin, like all European cities, once placed a high value on architecture as a crucial component of cultural identity. Nearly all the curvilinear “Dutch Billys” that defined the town were rebuilt into the more popular flat Georgian facades, demonstrating the value of staying current with architectural trends (Colm, 2014). Yet, the social stigma against things considered outdated or used dates back only a few decades. Building materials have a rich history of being rescued and used for rehabilitation or new construction. Spolia from Roman times and the Cordoba Mezquita in Spain are two noteworthy historical examples.

If material perfection was not the norm, society might be more inclined to reuse old structures or buy used materials. This attitude is challenged by the Japanese aesthetic of wabi-sabi, which celebrates imperfection as an equal to beauty.

Precedent

‘Wabi-sabi is the beauty of things imperfect, impermanent and incomplete, the antithesis of our classical western notion of beauty as something perfect enduring and monumental” (Koren, 1994). The Ise shrines in Japan are constructed using intricate joinery techniques, with flexible joints that have sufficient strength to last, rather than needing nails, screws, or glue. At the end of the 20-year cycle, the connections allow the shrine to be repaired and disassembled. The Ise shrines demonstrate the beauty of reuse.



[Fig.4]

[Fig. 3 The London 2012 Olympic site
[Fig. 4] WABI-SABI HOUSE

Societal attitudes must change to encourage circularity through material reuse. Instead of view-ing what we have at our disposal as only temporary and of little worth because of its age or fashionability in pursuit of beauty, society needs to learn to appreciate its potential for the fu-ture. A new program, a refurbishment or a repair can contribute to an item's history or story and increase its worth. It can prolong the useful life of the material, preventing its classification as waste and lessening the demand for new raw materials to take its place. Architects and designers are critical to this solution. They must build beautiful, desired, but sustainable settings if they want society to have the opportunity to value and care for them. As a result, the community will become more sustainable.

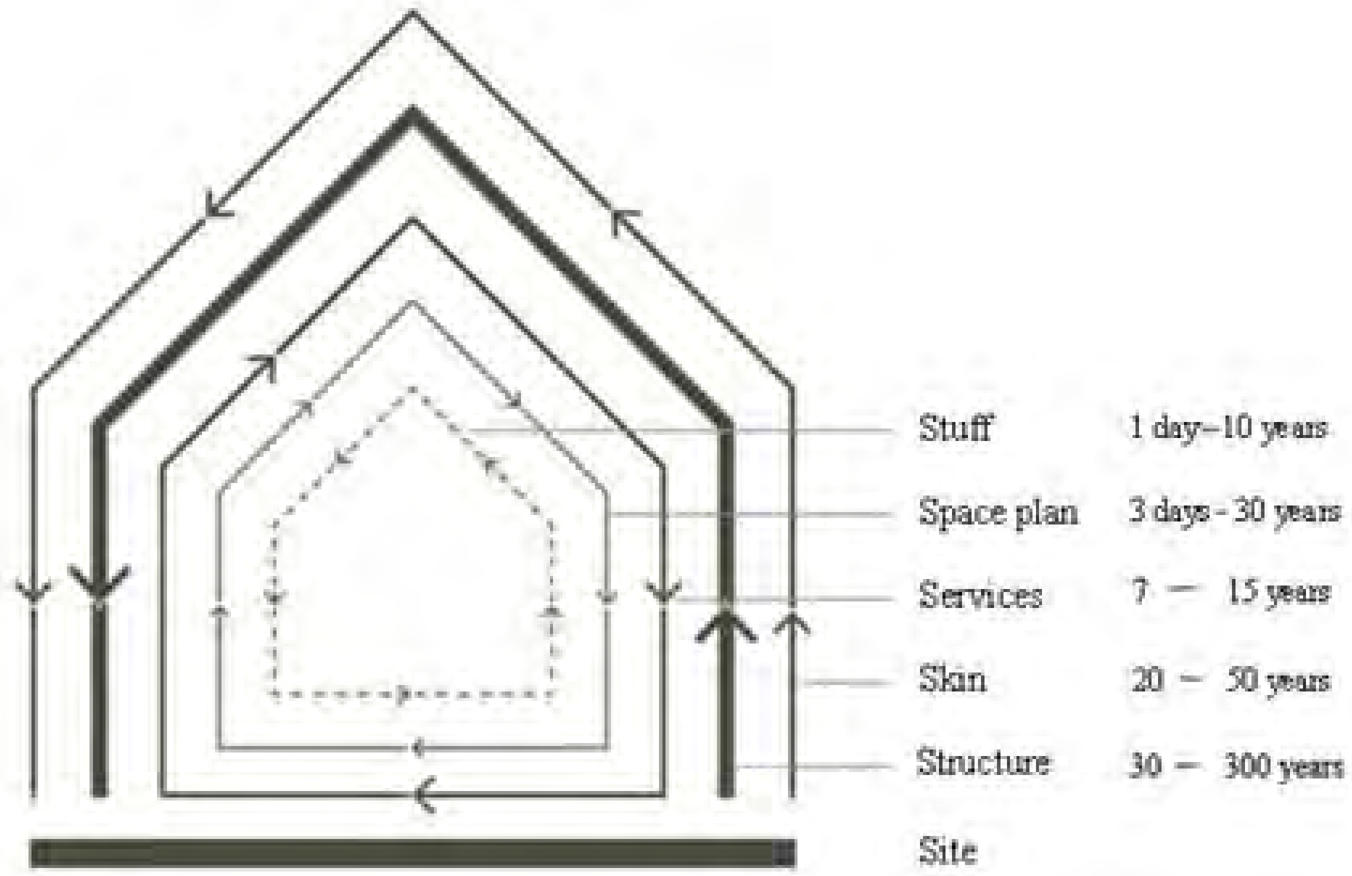
Circular Economy

The principles behind the current conception of the circular economy are strongly tied to the 'Cradle to Cradle' design paradigm created by William McDonough and Michael Braungart and described in their seminal book, Cradle to Cradle (Braungart & McDonough, 2019). Cradle to Cradle proposes that instead of being "less bad" to the environment, the aim should be to be "100% good". Instead of only offering a plan for deconstruction and reuse for the future, emphasis should be placed on what current action we can take in reusing existing materials.

Current practice in disassembling existing buildings shows numerous technical barriers to successfully recovering and reusing components and materials. These barriers stem mainly from current construction practice that sees the assembly of materials and components as unidirectional, with an end goal of producing a final building (linear process). Structures are created, developed, used, and demolished as whole entities (Werner, 2021). Materials are extracted from the natural environment, processed, manufactured, used once, and then disposed of, usually back into the natural environment. These processes result in pollution, resource depletion, habitat loss, and excessive energy consumption (Crowther, 2005). The extraction of materials and waste disposal are the two ends of this so-called "life cycle," which is linear rather than cyclical.

An essential system of circular design is building in layers. According to the “shearing layers” theory, a building comprises several important parts that can adapt or alter over different times. The capacity to effectively access, disassemble, and maintain the separate layers is required to extend the building’s lifespan, considering that the predicted lifetimes of the building’s layers range significantly from one another.

Based on my research, my impression of the circular economy going forward is that it appears to be centred on creating new things. Everything is precise; new materials can be disassembled, reducing the waste generated on-site and saving time because everything is made to fit together like an Ikea furniture set. Elma Durmisevic, the UIA expert on the Super Circular Estate project in Kerkrade, noted, ‘new deconstruction strategies can radically increase the reuse of building elements, but this only provides one more use for the elements- “a stay of execution” before downcycling. To create truly circular buildings, new buildings will have to be designed for disassembly’ (Chesire, 2021). Designing for future reuse has undeniable environmental advantages, such as the potential to cut energy use and material waste. However, there may also be adverse environmental effects, such as higher initial energy consumption and the potential usage of more hazardous materials due to increased longevity. Reusing building materials from existing buildings has massive potential for lowering greenhouse gas emissions and waste. For instance, reclaimed and reused steel sections typically have a 25 times lower environmental effect than new ones (even though new steel sections usually contain 60% recycled material). Recycling 400 bricks, or roughly half a tonne of structural steel, can save 1 tonne of embodied carbon (Bioregional,2011).
This demonstrates that there is more than one solution to an ideal sustainable built environment.

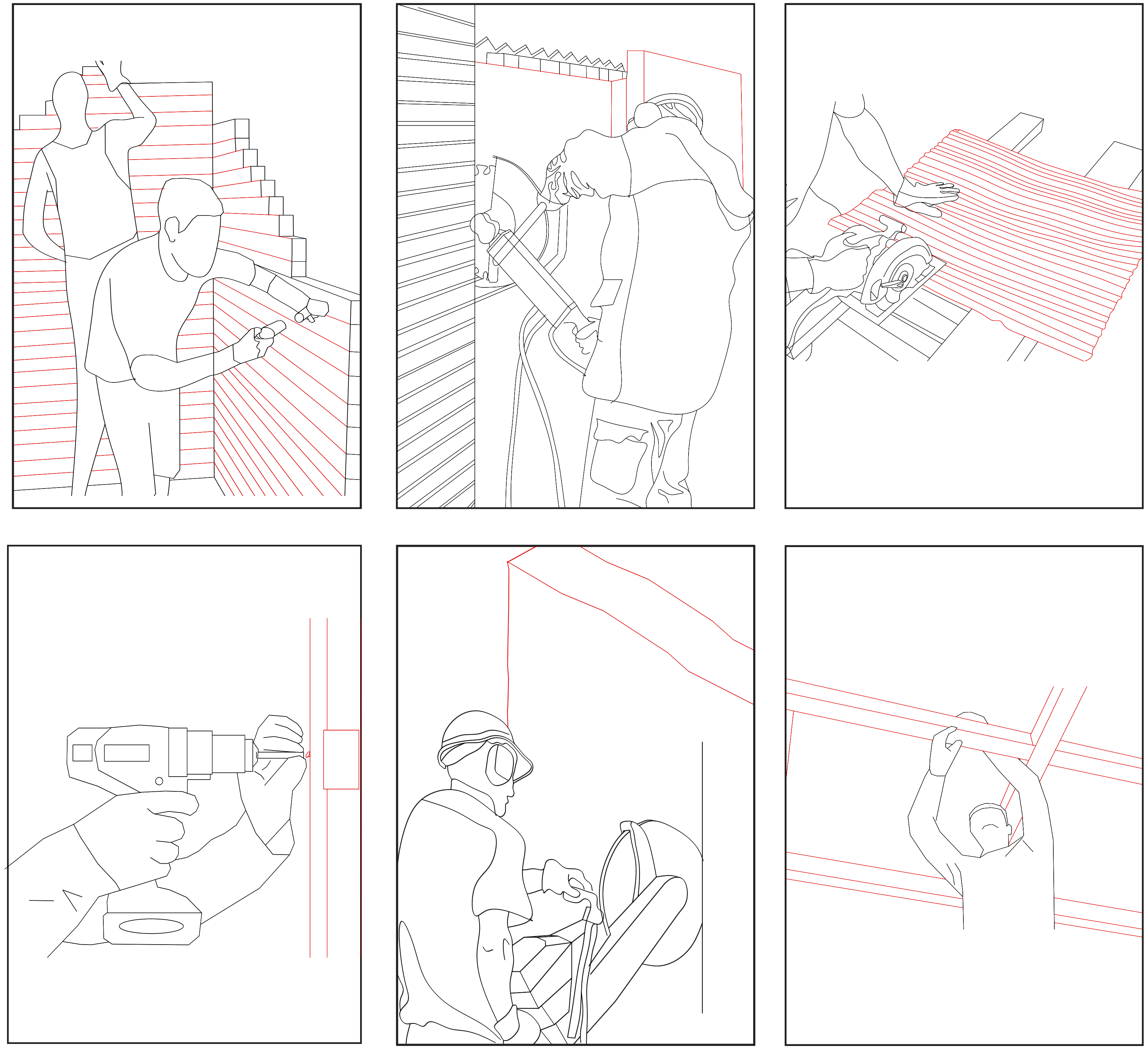


[Fig. 5]

Although most sources conclude that DFD is the way forward in sustainable architecture, this does not rule out the application of 'material reuse' as a viable means of sustainability in building design. As highlighted, there is no one correct way to be sustainable in construction; each method has advantages and disadvantages. Although re-using materials is not always the most time or economically-efficient strategy, it has definite benefits for the environment regarding embodied carbon and reducing waste. Thus, going forward, it can be a viable standard construction practice. Below I will discuss some practices that need to be applied to make this a sustainable approach.

Deconstruction

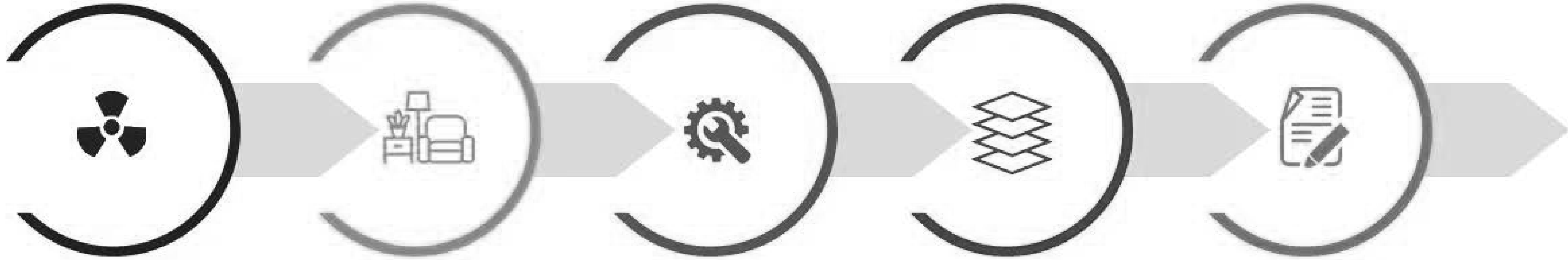
The first step in any reuse strategy is the deconstruction process. In general, the deconstruction process begins once the buildings are identified that are listed for demolition. A typical deconstruction procedure removes the building's windows, doors, appliances, and finishes, many of which can be recycled or sold again. The building is then taken apart, typically starting at the top and working down to the foundations. The process could be considered reverse engineering.



[Fig. 6]

[Fig. 5] Brands Building Layer Diagram
[Fig. 6] Deconstruction Process Sketches

Deconstruction phases of a building:



The first step in deconstructing a building is hazardous material removal or abatement. Testing should be conducted to locate the asbestos in the building and ensure its safe disposal.

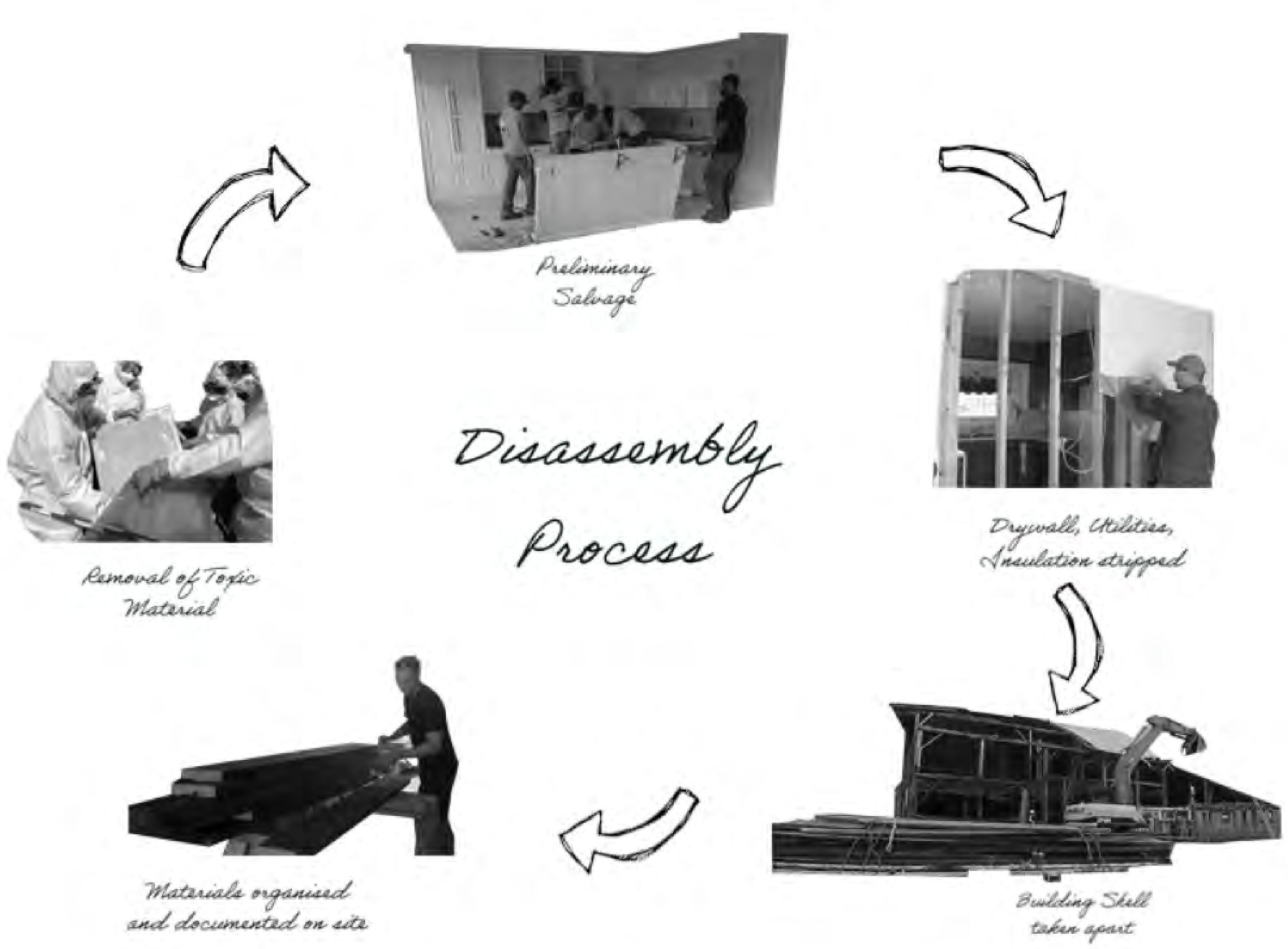
The second stage is the preliminary salvage. The cabinets, appliances, finishes, and fixtures are removed at this stage.

The drywall, insulation and utilities are stripped from the inside. You are left with the wood and the exterior shell, ready to start the deconstruction.

An excavator can assist in pulling the building apart, or a machine to help clean up as you make your way down from the roof of the structure to its foundation.

Usually, the materials are separated on-site to speed up the process and to optimise the salvaging and recycling of components.

[Fig. 7]



[Fig. 8a]

Compliance within deconstruction

Regarding compliance, current regulations must be followed; for instance, asbestos-containing materials must be inventoried before demolition or refurbishment and treated as hazardous waste. When removed, it is forbidden to reuse them. Some types of contamination can be removed to increase the material's lifespan, such as tar adhesives or paints containing heavy metals, to reveal a sound material fit for reuse. These reconditioning procedures must be carried out in line with the applicable environmental and health laws. Furthermore, sufficient safeguards must be put in place to reduce the danger of exposure to workers and any further contamination of recovered materials. (Reuse Toolkit, 2021).

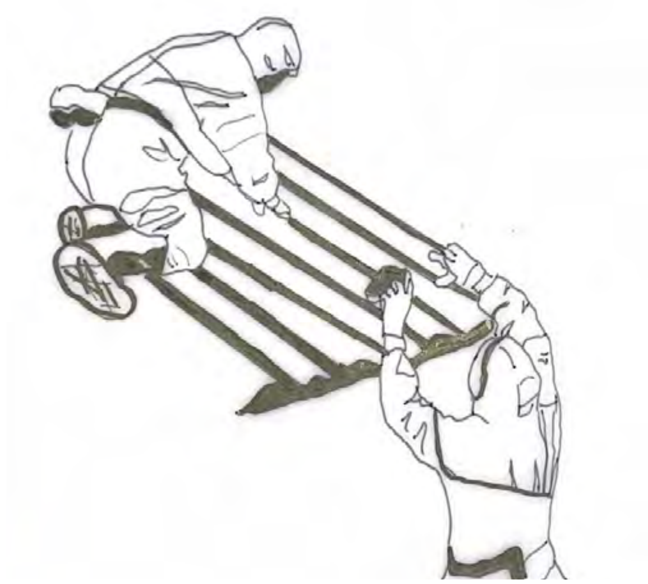
Instead of disassembling a building piece by piece, specific organisations are using alternative methods of disassembly. Dave Bennick from the Building Deconstruction Institute approaches the process with what he calls "hybrid deconstruction", combining the best of demolition and the best of the deconstruction strategies. They make new buildings by cutting sections from existing ones that are the right size. Bennick calls these panels "post Fabs" as opposed to prefabs. The challenges associated with disassembly are avoided by reusing the whole element. (Bennink, 2021).

[Fig. 7] Deconstruction Phases of a building
[Fig. 8a] Disassembly Process

Asbestos Removal

Professionals will wear protective gear, including respirators, coveralls and gloves. Seal off the area with plastic sheeting and warning signs.

Wet the tiles with a mixture of water and detergent to minimise dust.



Use a floor scraper to carefully remove the tiles taking care not to break them.

Place the tiles in heavy-duty plastic bags and seal them.

Clean the area thoroughly with a HEPA vacuum and damp cloth. Dispose of the bags and any contaminated materials at a designated hazardous waste facility. Decontaminate all tools and equipment used during the removal process.

[Fig.8b]

[Fig.8b] Asbestos removal process drawing

Precedent

Another successful example of new deconstruction methods is the EU Urban Innovative Actions (UIA) project, The Super Circular Estate, in Kerkrade, removed specifically designed parts from a 10-storey flat building developed in the 1960s and used them to build new dwellings. The consortium disassembled the tower block building and cut out concrete pieces in the shape of tunnels, which were then utilised to build the framework for the new homes. Reclaimed concrete chunks were employed for the lightweight partition walls, reclaimed bricks for the façade, and other structural barriers for recycling aggregate (Super Circular Estate - First Circular Social Housing Estate for 100% Material and Social Circularity, 2021).

The above examples demonstrate that building disassembly and material reuse alternatives
can open up many new possibilities for including existing building materials in the circular economy. I intend to use the tactical and opportunistic technique of reusing whole building components in a new project as part of my design strategy.

[Fig.9]

Challenges

The deconstruction industry has four significant challenges:

1. Cost: Demolition typically costs half of what a deconstruction job would (Deconstruction Vs Demolition, 2020). It is not so much the cost of deconstruction that's the issue, but rather how cheap demolition is.
2. Time: Usually, a crew of four to six people carefully removes each layer of the structure. While machines can speed up the process, demolition is still much faster.
3. Policy: Currently, most regions' policies strongly favour demolition. The industry is tailored to destroy and get rid of buildings as quickly as possible because there are no waste separation policies and no salvaging criteria.
4. Infrastructure for materials: we need the appropriate outlets to separate these products on-site. Identifying and making known the markets where they could be sold is also necessary.

To ensure we can address these issues in Ireland, we must begin with policymakers and local industry (Deconstruction Vs Demolition, 2020). "A transition to a more circular economy means creating new industries and business models that focus on retaining the value of products and materials, not redefining ownership by providing services rather than selling products" (Cheshire, 202, p5).

A circular economy is more than just designing for reuse; it is about establishing the industries and models needed for reusing and reclaimed materials. Professional dealers of reclaimed material and deconstruction teams are a vital part of the future of the circular economy, just as much as designers and project owners.

Overcoming Challenges

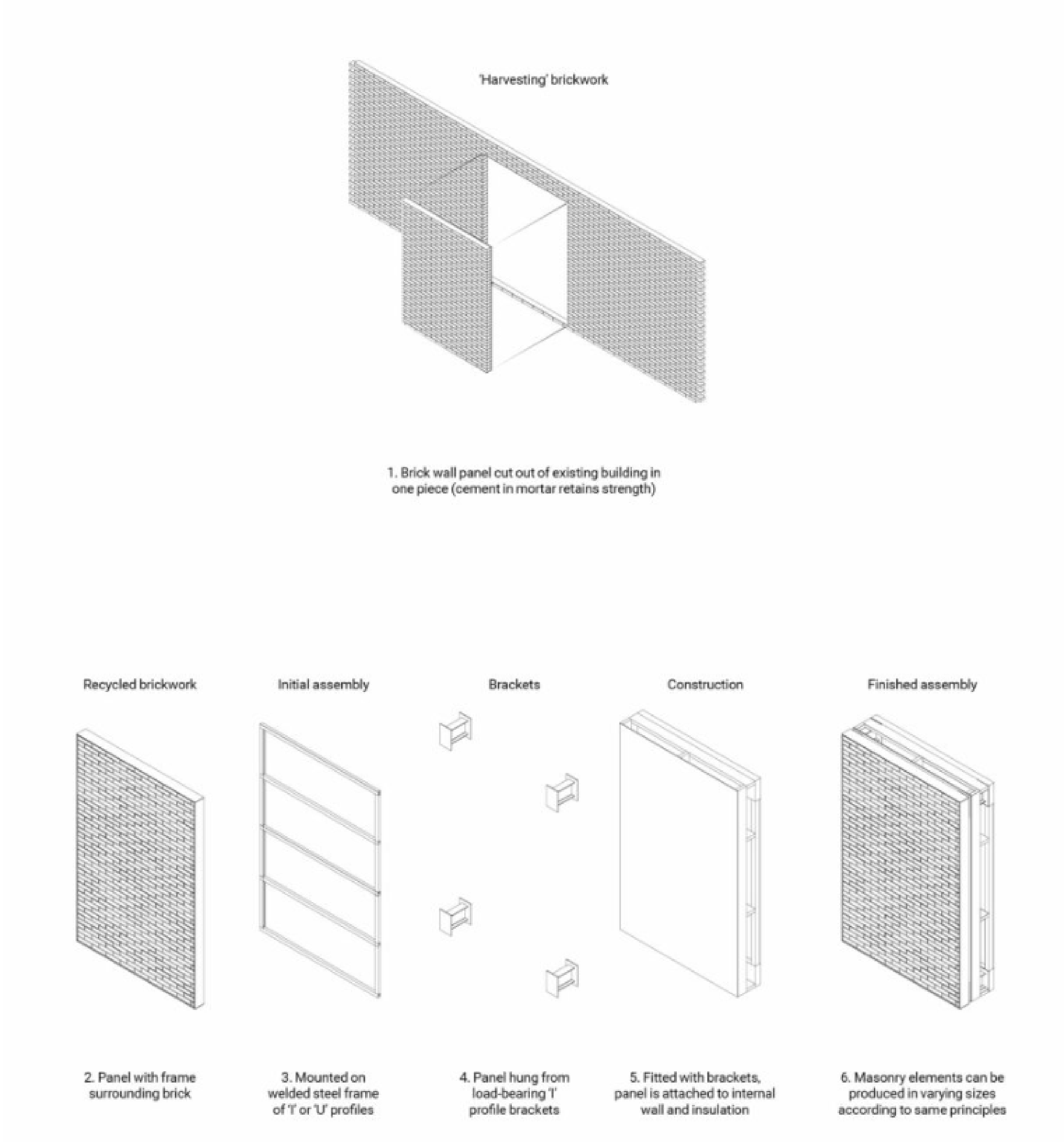
Several criteria determine what a reusable material is and what is not, but the following stand out:
Regarding economic factors, most frequently, a material will not be a good alternative for reuse if the resale price on the secondary market is higher than the material's price when it was brand new. For example,
red brick produced in large volumes may be similarly priced to a reclaimed red brick that had to be recovered and treated from an existing structure. In technical factors, the methods used for construction and disassembly affect the potential for material recovery. For instance, old bricks set with lime mortar are clean and straightforward to disassemble, making them reusable. (Handbook for reuse off-site, 2015). It is far more challenging to recover the same bricks from cement mortar. What can ultimately be deconstructed and salvaged depends heavily on the time allotted for the disassembly step in the site schedule.

Precedent

The Leandegar group overcame some of these challenges in their Copenhagen project 'Resource Rows'. They used bricks from three buildings, including the Carlsberg Factory and a Steiner School. The mortar between the bricks was stronger than the brick itself. Therefore, it was a challenge to disassemble the bricks. Their idea was to cut down buildings as building blocks and reuse them as complete components. The facade is created by mixing various brick cut-outs and re-casting in a mould. The practice founder Anders Lendager described the process as 'harvesting' material from old buildings. He sees it as the future of new build, a way of immediately and massively cutting CO_2 emissions from the construction process. (Wilson, 2020).

[Fig.10]

[Fig. 9] The Super Circular Estate, in Kerkrade
[Fig. 10] Resource Rows by Leandegar Group



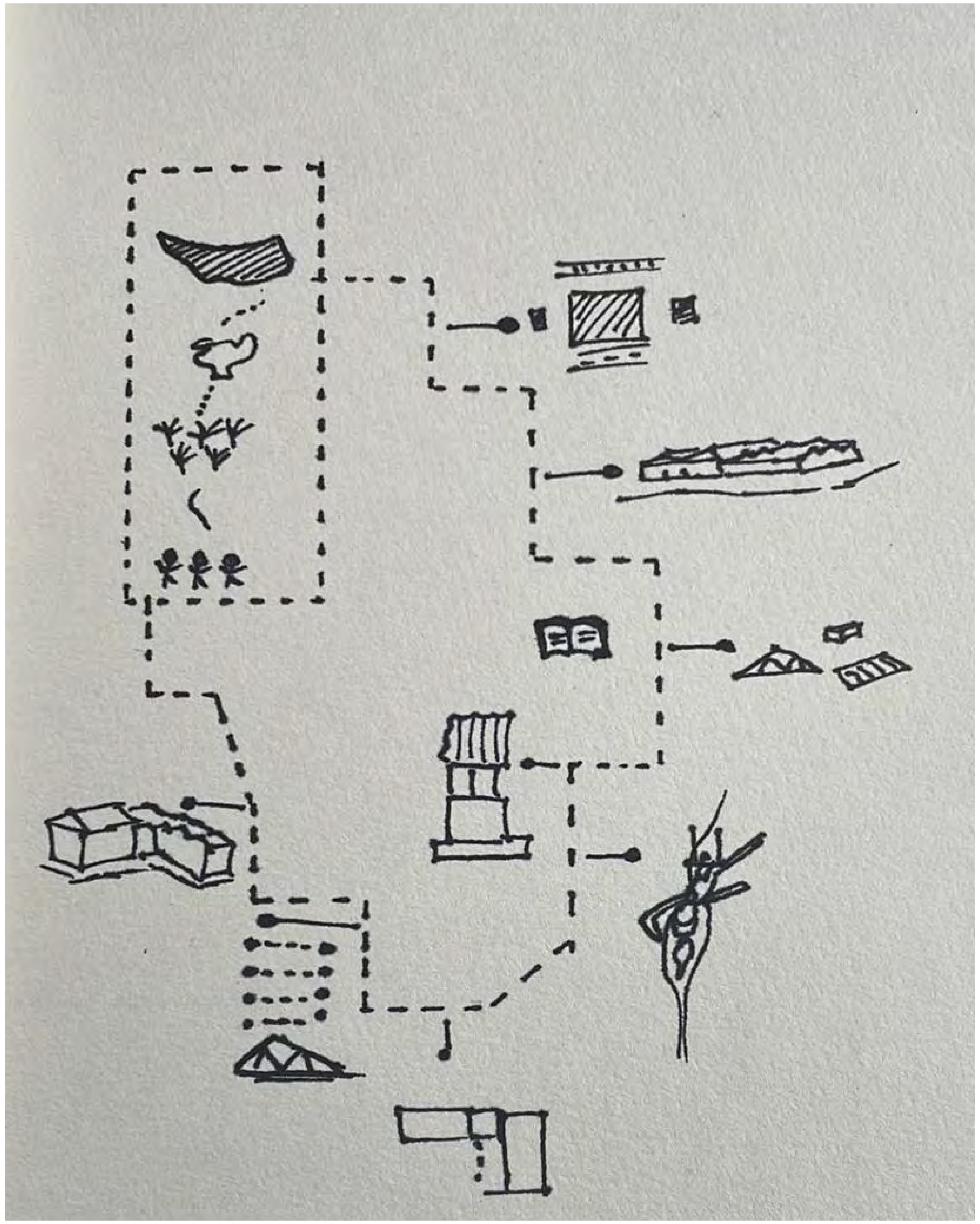
[Fig. 11]

Therefore, the contracting authority's approach to reuse needs to
be informed by a perspective that is both curious and responsible. Despite appearing unremarkable to some, a material may contain a rich history or a unique technical quality that will attract certain users. It is essential not to disregard a material too quickly as an option for reuse. Additionally, a material that may appear highly valuable might not
be required for various reasons (economic, time-related, etc.) that are unrelated to its condition.

In conclusion, there is no such thing as a list of materials that will always be reusable (Handbook for reuse off-site, 2015). Furthermore, there are solid barriers in the practice of reuse, but there are solutions too. Reclaimed material catalogue websites are becoming more common, and as the practice of reuse gains popularity, it will become more commonplace to document materials.
Before destruction or disassembly, building material inventories of existing buildings must be completed to prevent components from entering the waste stream and identify their best future applications. By doing this, the condition and quantity of the building materials can be determined, and a time- and cost-effective strategy can be developed for the material's careful disassembly, correct sorting, and management. For a successful reuse project, the material should be sourced from a combination of second-hand construction material stores and structures that will be demolished (from within a roughly 100km radius.

[Fig. 11] Resource Rows Material Detail

The Design



[Fig. 12]

Theme

In developing my thesis on sustainable development in the Tolka Valley, the theme of 'urgency' played a critical role in shaping my thinking around material reuse. Urgency in this context highlights the need for immediate action to address the pressing environmental challenges facing our communities. Reusing materials from neglected buildings can reduce waste and contribute to a circular economy model by emphasising the benefits of reuse and recycling of existing resources.

Urgency can also be reflected in the design process, where time-sensitive decision-making and innovative solutions are required to respond to climate change challenges. Taking the theme of urgency in this context inspired me to think more proactively and boldly in my approach to sustainable design and to actively seek out opportunities for environmental regeneration and social impact in the Tolka Valley.

[Fig. 13]

[Fig. 12] Design Process Sketch
[Fig. 13] Temporary Design Models

The Tolka Valley

The Tolka Valley is a green space located in North Dublin, Ireland, extending over 140 hectares. The area is home to a variety of natural habitats, including woodlands, wetlands, and meadows, providing a valuable ecological and recreational resource for the surrounding communities. The Tolka River, which runs through the valley, is also an essential feature of the landscape, providing a vital habitat for a range of plant and animal species.

Despite its natural beauty, the Tolka Valley faces numerous challenges in terms of sustainability, climate change, and resource depletion. One of the main issues facing the area is the impact of urbanization and development on the natural environment. Over the years, there has been a significant increase in the amount of built infrastructure, including roads, housing, and commercial buildings, which has led to habitat loss and fragmentation. This has resulted in a decline in the quality of the natural environment and a loss of biodiversity.

[Fig. 14]

The Site

Several prerequisites were identified in the search for a suitable site, such as the requirement for community engagement, under-appreciated quality structures, and well-defined boundaries that would impose physical limitations. The project eventually focused on Bannow Road in Cabra, Dublin, a neighbourhood located only 30 minutes luas from the city centre but feels somewhat isolated and abandoned.

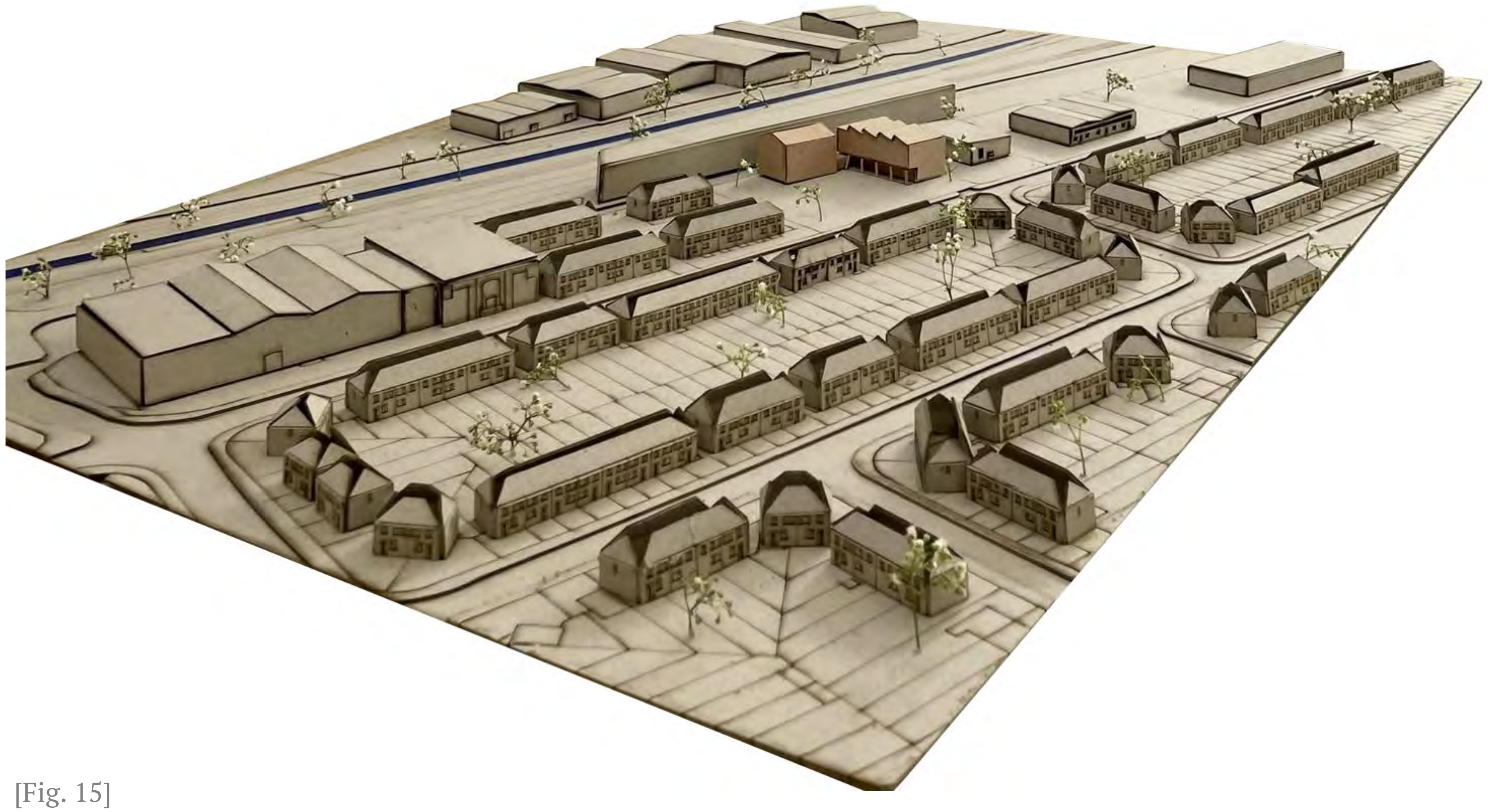
Bannow Road is a residential street that was constructed in the early 20th century as part of Dublin's suburban expansion. The neighbourhood experienced significant growth during the early 20th century, with numerous new houses being built to accommodate the city's rapidly growing population. However, in the mid-20th century, the area underwent a significant redevelopment that saw many of the old houses being replaced by new housing developments.

The area's typological language is not unusual for the industrial character of the region, but it is noteworthy to observe the different characters present. There are several abandoned factories and warehouses, and the structures have a shed-like quality, with large spanning spaces. Although viable materials were used in the construction of these buildings, their structures are not currently serving any particular purpose.

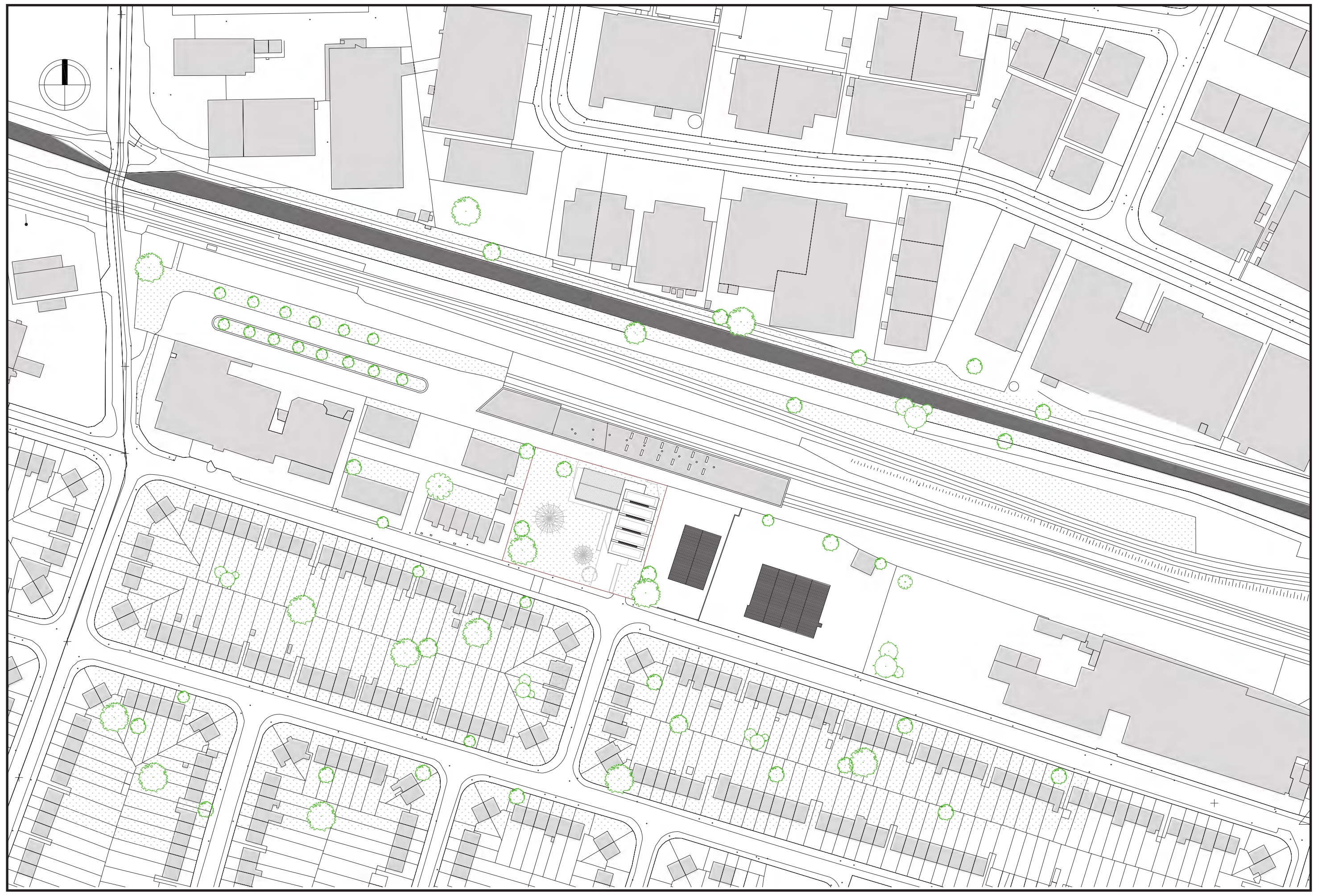
Bannow Road is primarily a residential area with few amenities for its inhabitants. However, it is located close to the canal and adjacent to public transportation (Broombridge Luas), which enhances its connectivity to the larger Dublin metropolitan area.

While investigating this area, the negative impacts of neglect on local communities became evident visually.

It causes visual disparity, wasted space, and physical disconnection. This thesis is an envisioning and revelation of the possibilities and opportunities of embracing materials reuse and urban upgrade.



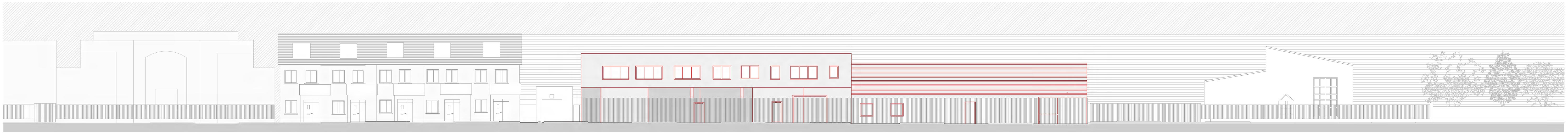
[Fig. 15]



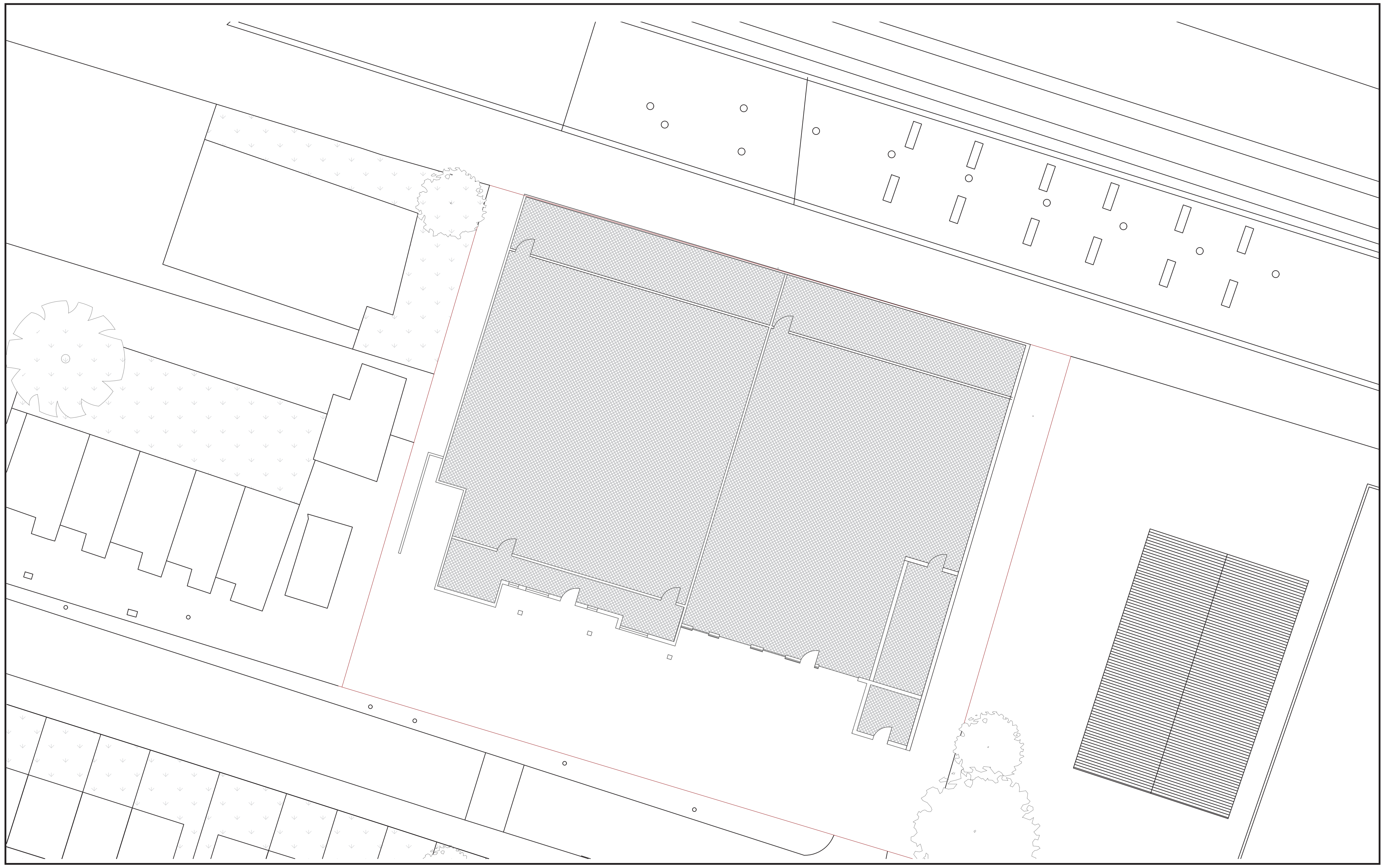
[Fig. 16]

[Fig. 14] Drawing of Scribblestown lane, The Tolka Valley
[Fig. 15] Site Model Bannow Road
[Fig. 16] Site Map 1:1000

[Fig. 17]



[Fig. 18]



[Fig. 19]

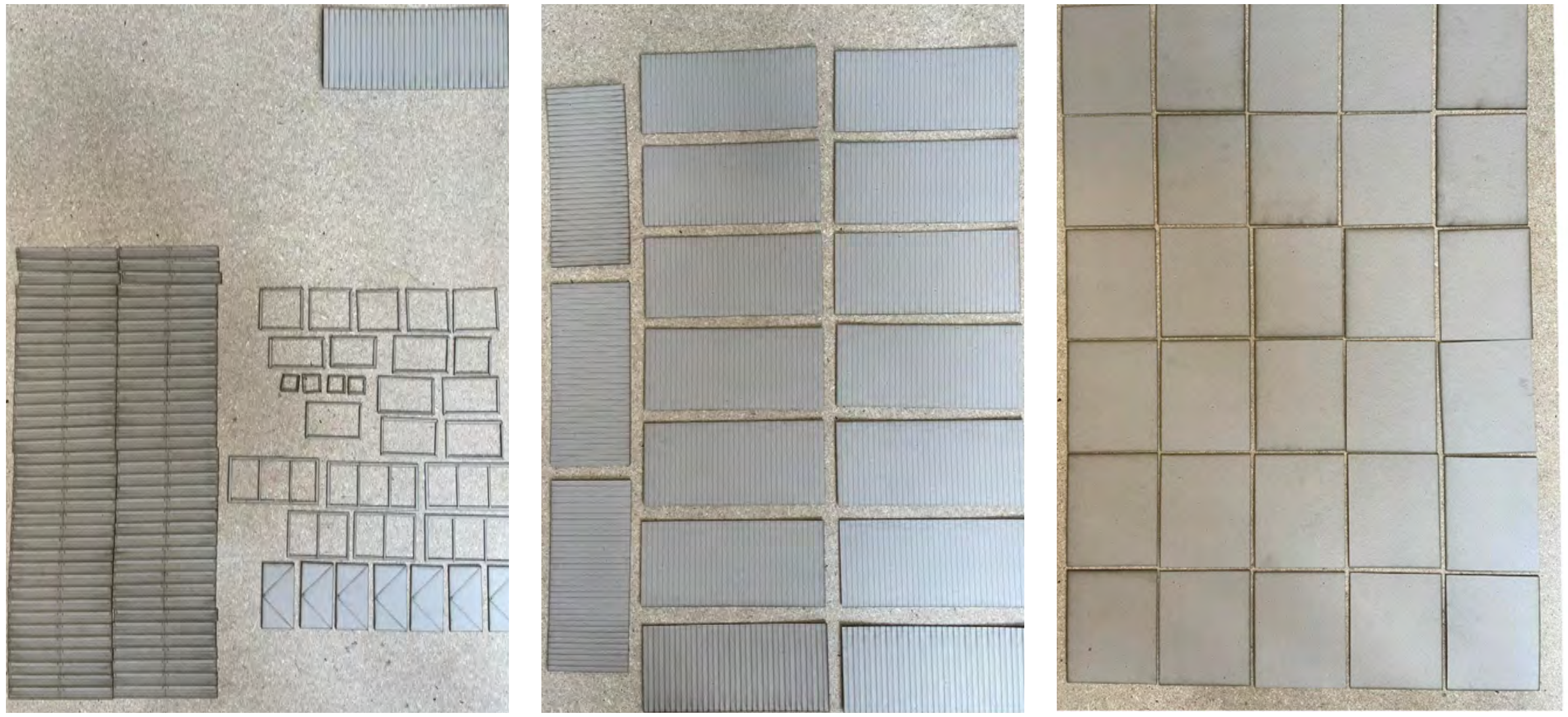
The existing structure is a shell, needing more insulation and discernible purpose. It comprises two unconnected units unified by a blockwork partition. Its past employment has been varied, albeit mainly unrelated to its architectural blueprint. The unit designated 176 was formerly utilised as a food distribution centre, alma packaging, and, more recently, a kickboxing gym. The adjacent building on the site previously accommodated Irish cycle technician training functions and the Dublin circus school.

[Fig. 20]

[Fig. 17] Images of Existing Building
[Fig. 18] Existing Elevation
[Fig. 19] Existing Plan

Material inventory

Performing an inventory of available materials on site was an essential step in my design process. By conducting an assessment of the quantity, condition, embodied carbon, and dimensions of materials, I was able to determine which materials were suitable for reuse in the project.
This process was not only crucial for reducing waste and increasing efficiency but also served as a foundation for the entire design process. By incorporating existing materials, structures, and systems, this created a sustainable and efficient use of resources. The goal was to use as many feasible materials as possible to create a design that fits within the constraints of the existing site while achieving my desired project objectives.



[Fig. 21]

[Fig. 20] Existing Building Layout
[Fig. 21] Model Material Inventory

Material Inventory
288 Bannow road

01
Aluminium Roof Sheeting
Amount: 30
Size: 2.8m x 6m
Material: PVC Plastisol Colour Coated Sheeting
Location: Flynn's Fruit & Veg Warehouse
Status: 95% Re-usable, 5% Damaged
Emodied Carbon: 79,710.4kgCO_2 eq
Used: 27 Sheets

02
Metal Truss
Amount: 8
Size: 14.5m x 2.5m
Material: Steel
Location: Flynn's Fruit & Veg Warehouse
Status: Re-usable
Used: 8 Trusses

03
Metal Sawtooth Truss
Amount: 32
Size: 5.6m x 2.2m
Material: Steel
Location: Flynn's Fruit & Veg Warehouse
Status: Re-usable
Embodied Carbon(All Steel) : 60,160 KgC02
Used: 32

04
Cut Concrete Slabs
Amount: --
Size: 3m x 2.5m, PC 3m x 1m
Material: Concrete, Pre-cast Concrete
Location: Flynn's Fruit & Veg Warehouse
Status: Re-usable
Embodied Carbon: 69130.1 KgC02
Used: 15 , 15

05
Windows
Amount: 6
Size: 3m x 1.5m
Amount: 2
Size: 2m x 1.5m
Amount: 2
Size: 1.5m x 1m
Material: Aluminium
Location: Flynn's Fruit & Veg Warehouse
Status: Re-usable
U-Value: 3.688W/(m2
Used: 6

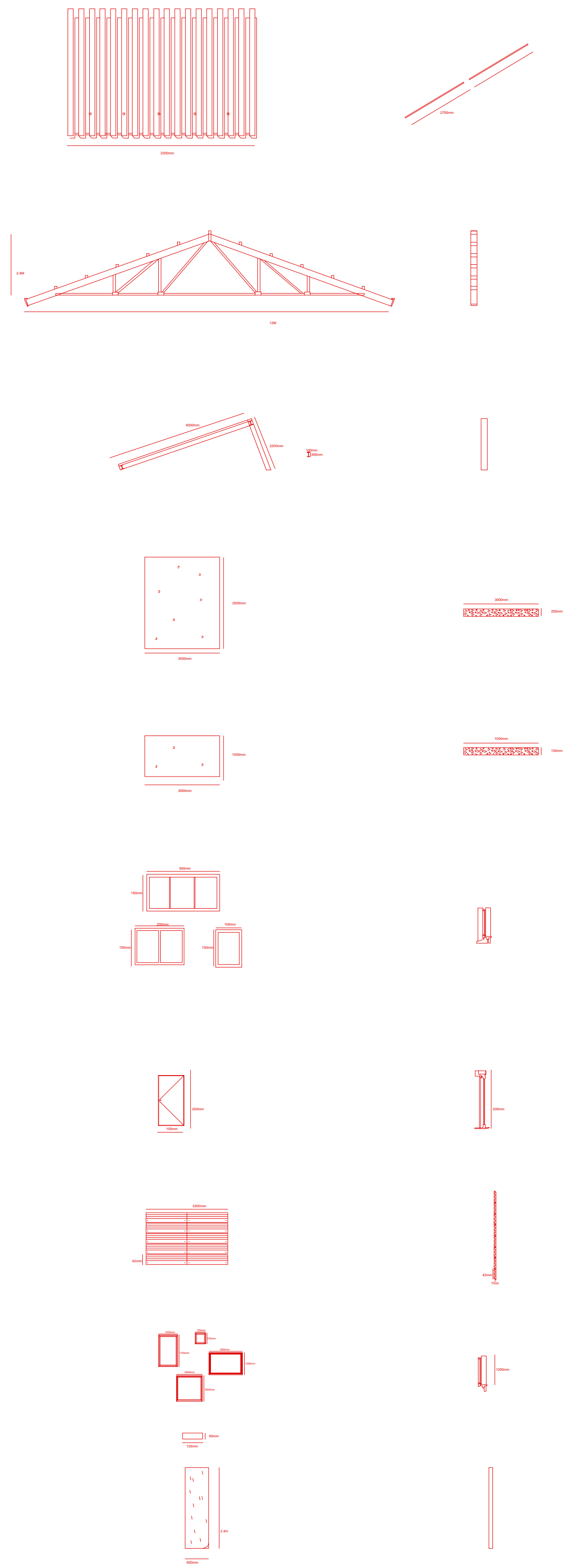
06
Doors
Amount: 7
Size: 2m x 800mm
Material: Oak
Location: Flynn's Fruit & Veg Warehouse
Status: Re-usable
U-Value: 3.688W/(m2
Used: 7

07
Plastic Facade Panels
Amount: 110
Size: 3300mm x 42mm
Material: Oak
Location: Flynn's Fruit & Veg Warehouse
Status: Re-usable, 4 Damaged
Used: 104

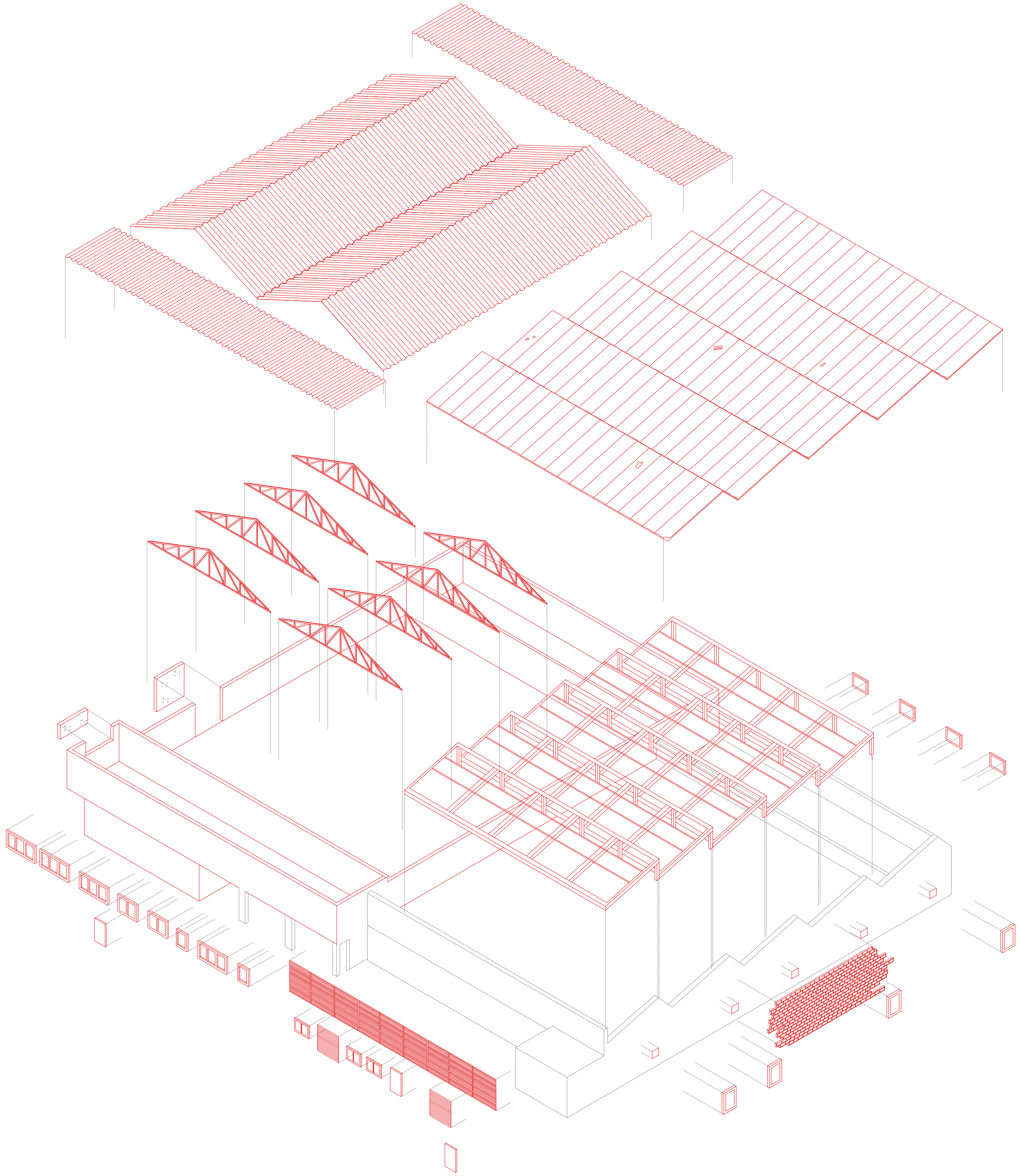
08
Windows
Amount: 17
Size: 1700mm x 1000mm
Material: Aluminium
Location: Flynn's Fruit & Veg Warehouse
Status: 15 Re-usable, 2 Damaged
U-Value: 5.5617W(m2.k) W/(m2
Used: 15

09
Red Clay Bricks
Amount: 20,713
Size: 125mm x 65mm
Material: Red Clay
Location: Flynn's Fruit & Veg Warehouse
Status: 90% Re-usable, 10% damaged
Embodied Carbon: 12879 KgC02
621g C02 per brick

10
Fibre Cement Roof Tiles
Amount: 100
Size: 600mm x 2.4m
Material: Fibre Cement
Location: Flynn's Fruit & Veg Warehouse
Status: 85% Re-usable, 15% damaged
Embodied Carbon: 50.3 kg CO_2 eq



[Fig. 22]



[Fig. 23]

The role of the project

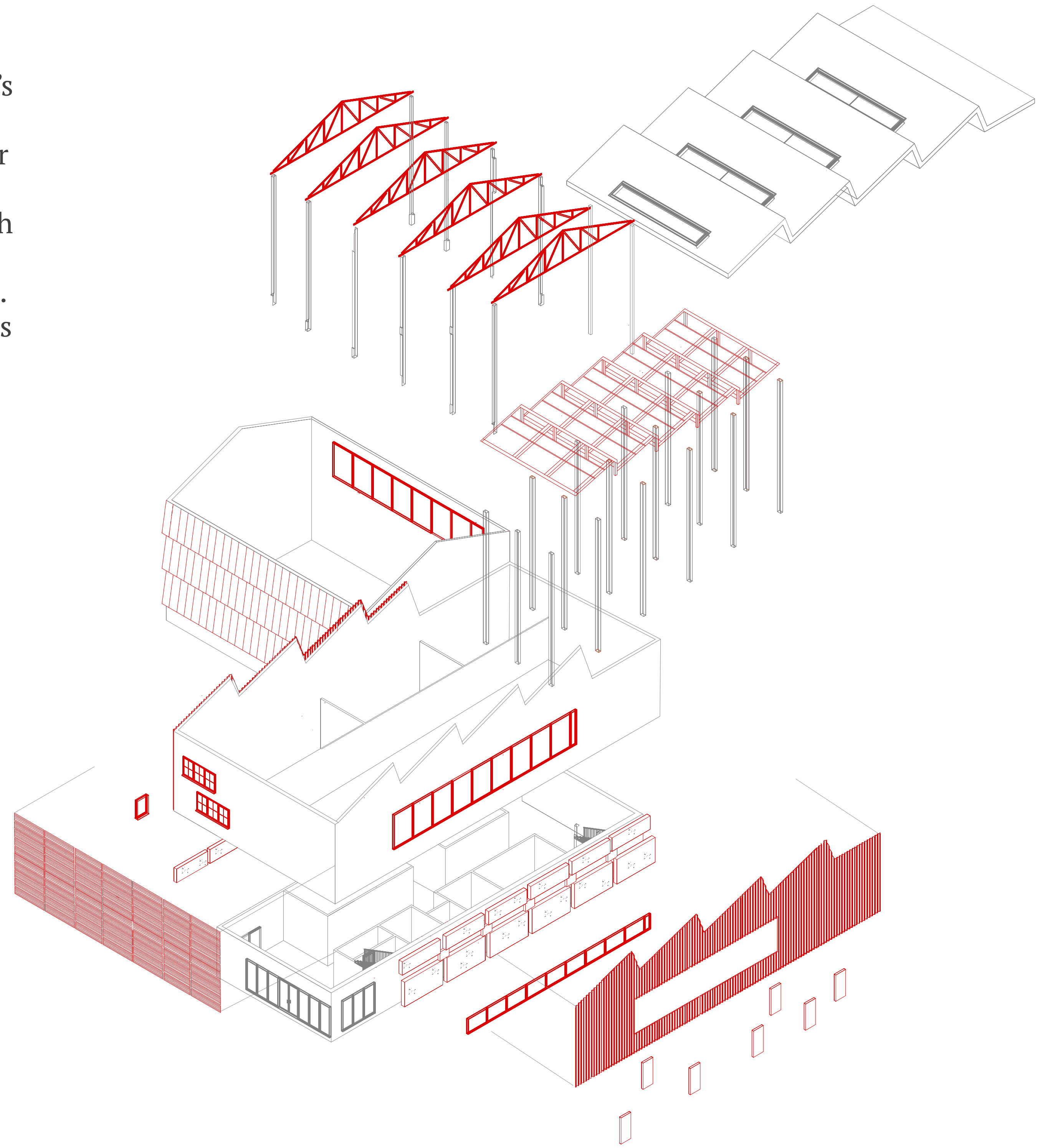
My main objective was to demonstrate the numerous advantages of material reuse and showcase how existing materials can be utilised to create innovative architectural designs.

I aimed to prove that there are massive advantages to material reuse and that using existing materials has the potential to create some of the most interesting architecture yet.

My objectives for this project were to densify an underutilised site, design a low-carbon structure using reclaimed materials, and make it beautiful.

Densifying the site

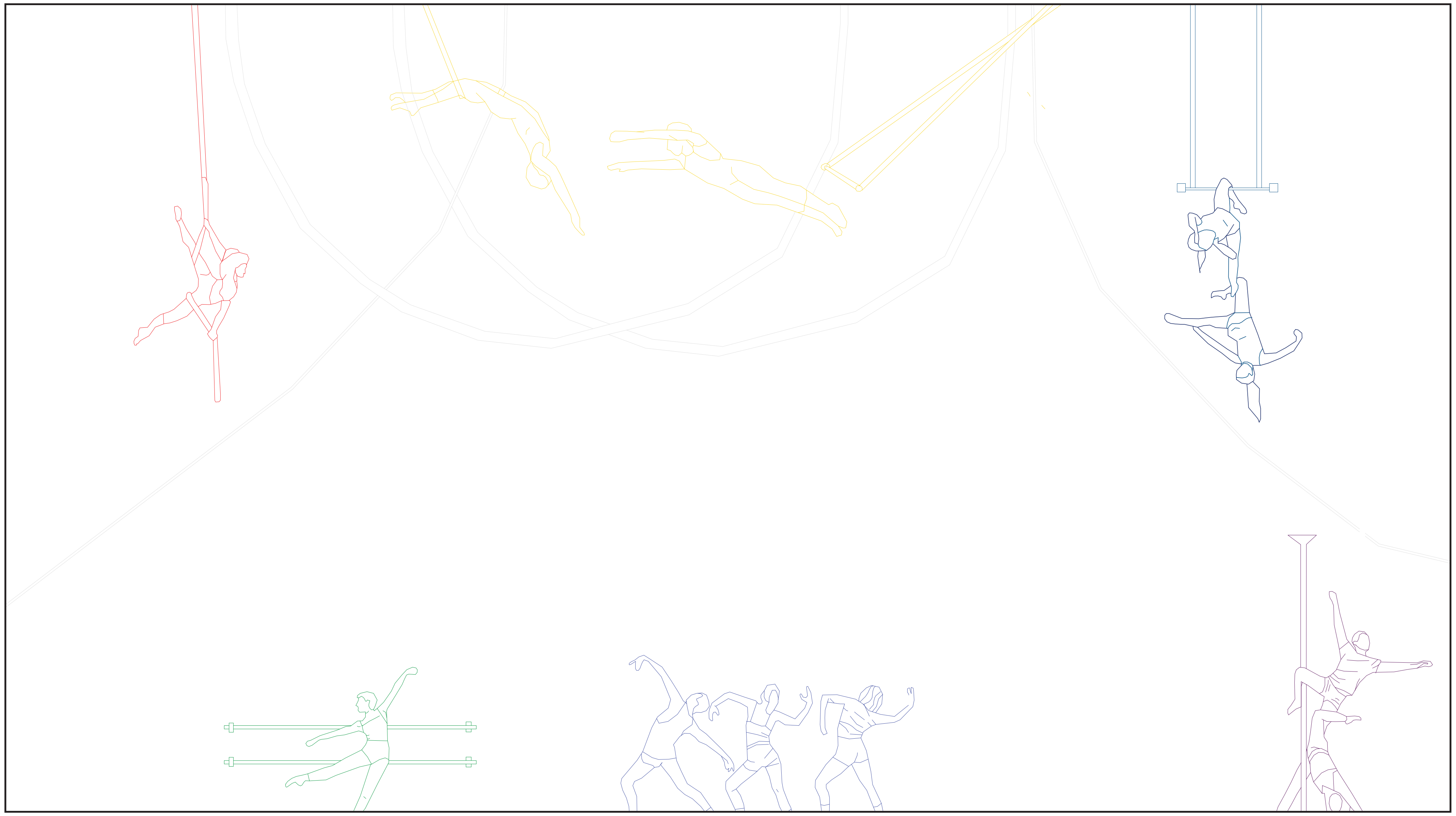
A crucial objective of this design scheme was to significantly reduce the site's footprint relative to the pre-existing buildings. Through this approach, I am creating a substantial expanse of available land, which can be repurposed for future use, whether for residential housing, fostering biodiversity or as outdoor spaces suitable for events hosted by the new building. This approach optimises land use, transforming previously underutilised space into a multifunctional area that enriches and elevates the surrounding community. Additionally, the project adopts a sustainable ethos by recycling all materials from the pre-existing structure, ensuring that it operates in a highly resourceful and conscientious manner, which does not compromise its overall efficiency.



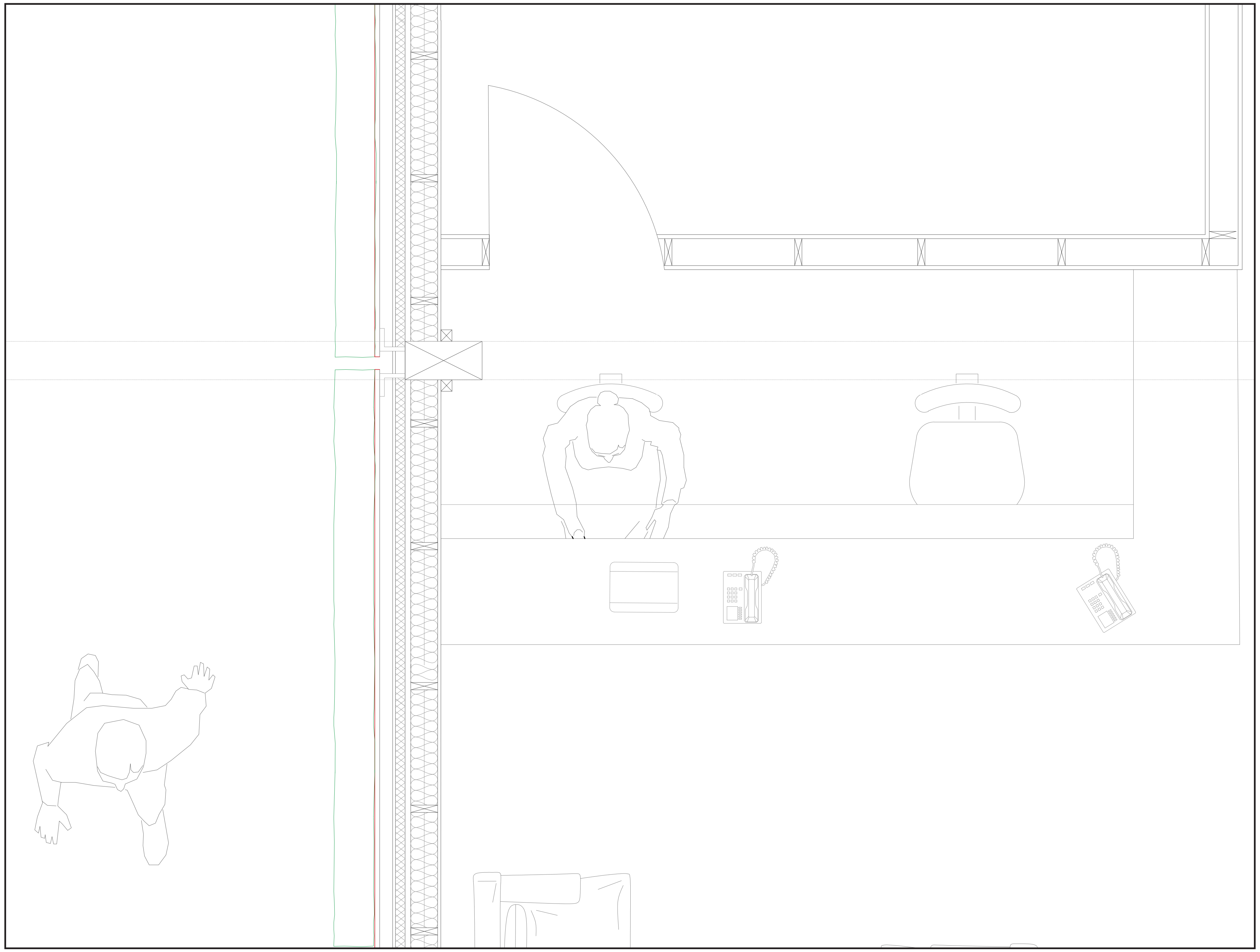
[Fig. 24]

[Fig. 22] Material Inventory
[Fig. 23] Exploded Axonometric of Existing Building
[Fig. 24] Exploded Axonometric of Aerial Dance School

Programme:
Acrobatics Gym
Dance Studios x2
Aerial Practise
Rom WC's x2
Cafe
Reception
Break Room
Changing Rooms
x2 Office
Storange Space

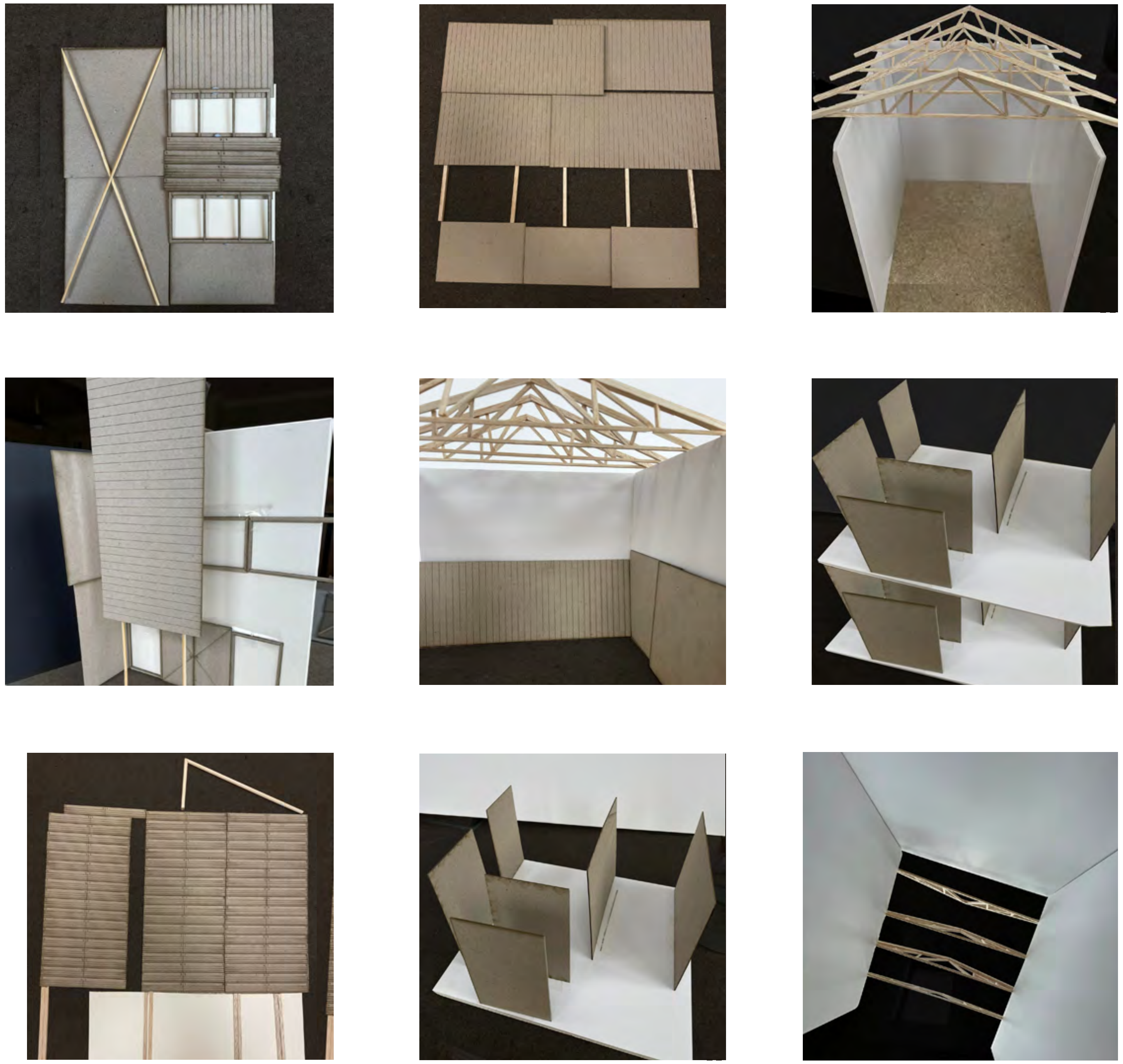


[Fig. 25]



[Fig. 26]

[Fig. 25] Drawing of Aerial Dance
[Fig. 26] Detail Plan



[Fig. 27]

One of the defining features of the space is the deliberate use of reclaimed window frames, meticulously positioned in response to the strategic placement of other reclaimed materials. This thoughtful integration not only defines the character of the space but also elevates its overall aesthetic and functionality. Their careful placement creates a harmonious interplay between natural light, structural integrity, and visual appeal. By utilising reclaimed materials in this intentional manner, the design achieves a remarkable fusion of sustainability, creativity, and functionality. To arrive at this conclusion, temporary models were employed to explore various design ideas and test different arrangements of the reclaimed materials for the design.

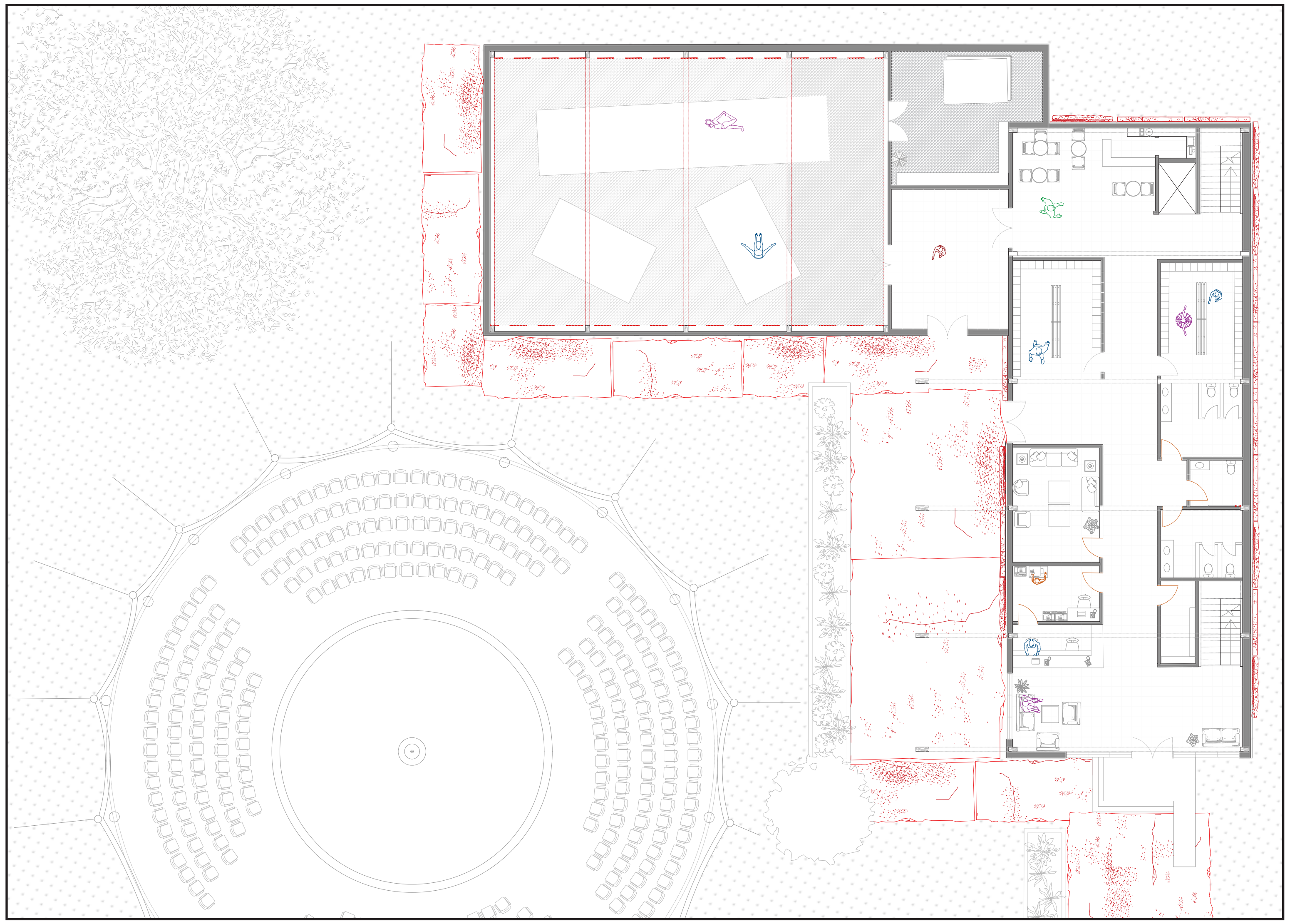
[Fig. 27] Temporary Model Images

Spaces

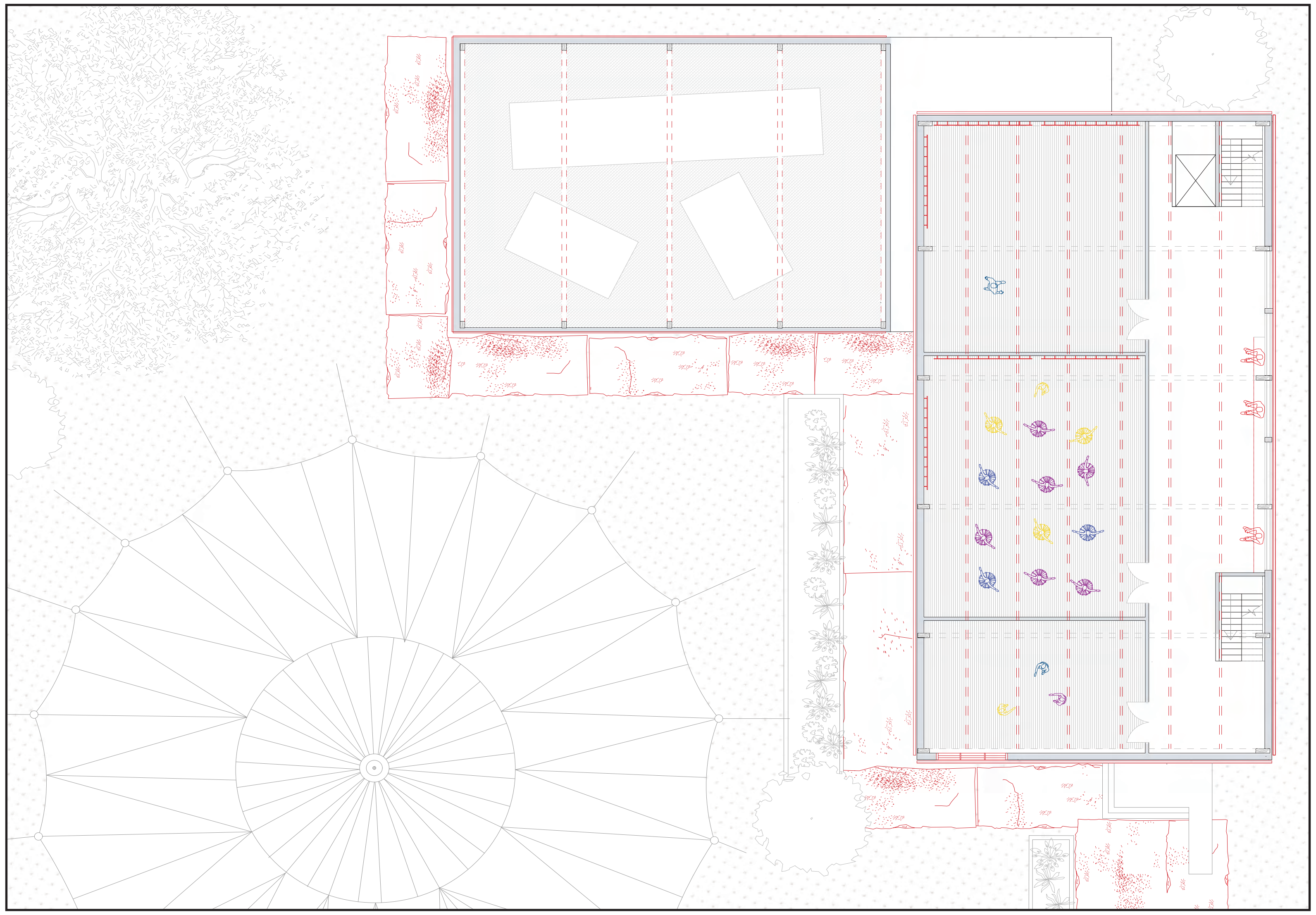
The previous use of the site's food storage warehouse proved impractical and consumed valuable space. Initially, the warehouse had accommodated the Dublin Circus School; however, the building's inadequacy forced the school to relocate.

In response, my design was carefully tailored to meet the specific needs of an Aerial school and similar activities. The layout encompasses well-designed changing facilities, office spaces, break rooms, and accessible toilets on the ground floor. Moving to the first floor, the design thoughtfully incorporates dedicated practice dance halls for aerial performances, alongside a smaller space designated for a skills lab. A distinguishing feature of the space is the utilisation of the reclaimed sawtooth roof structure, which optimises the intake of natural north light, while thoughtfully avoiding distracting windows that are typically undesired within dance studios of this kind.
Within this section of the building, featuring high ceilings, a careful integration was made to create a communal waiting space that takes full advantage of the site's natural east light.

The design encompasses a spacious and inviting communal area, crafted to foster a sense of community and comfort. The utilisation of the natural east light, carefully harnessed through strategic positioning and design elements, enhances the ambience of the space, enveloping it in a warm and welcoming atmosphere.



[Fig. 28]



[Fig. 29]

[Fig. 30]

Systems

To effectively utilize the reclaimed materials from the existing structure, innovative attachment systems were incorporated into the design. Some materials proved unsuitable for their original purpose, necessitating the exploration of alternative uses. It was during this process that cladding emerged as the most fitting solution.

Through the implementation of a rainscreen system, the reclaimed materials were securely bolted and clipped to the new building structure. This integration served a dual purpose: providing effective weatherproofing for the new construction while simultaneously giving rise to a dynamic and visually captivating façade design. Moreover, the unique characteristics of the cladding system influenced aspects of the interior layout, adding a dynamic and interconnected dimension to the overall architectural composition.

[Fig.28] Ground Floor Plan
[Fig. 29] First Floor Plan
[Fig. 30] Perspective Section

Reclaimed Material New Detail 1:20 South Elevation

Reclaimed Fibre Cement Roof panels attached to the facade on metal C supports

12mm ----------

Weather-resistant barrier 10mm ---------------

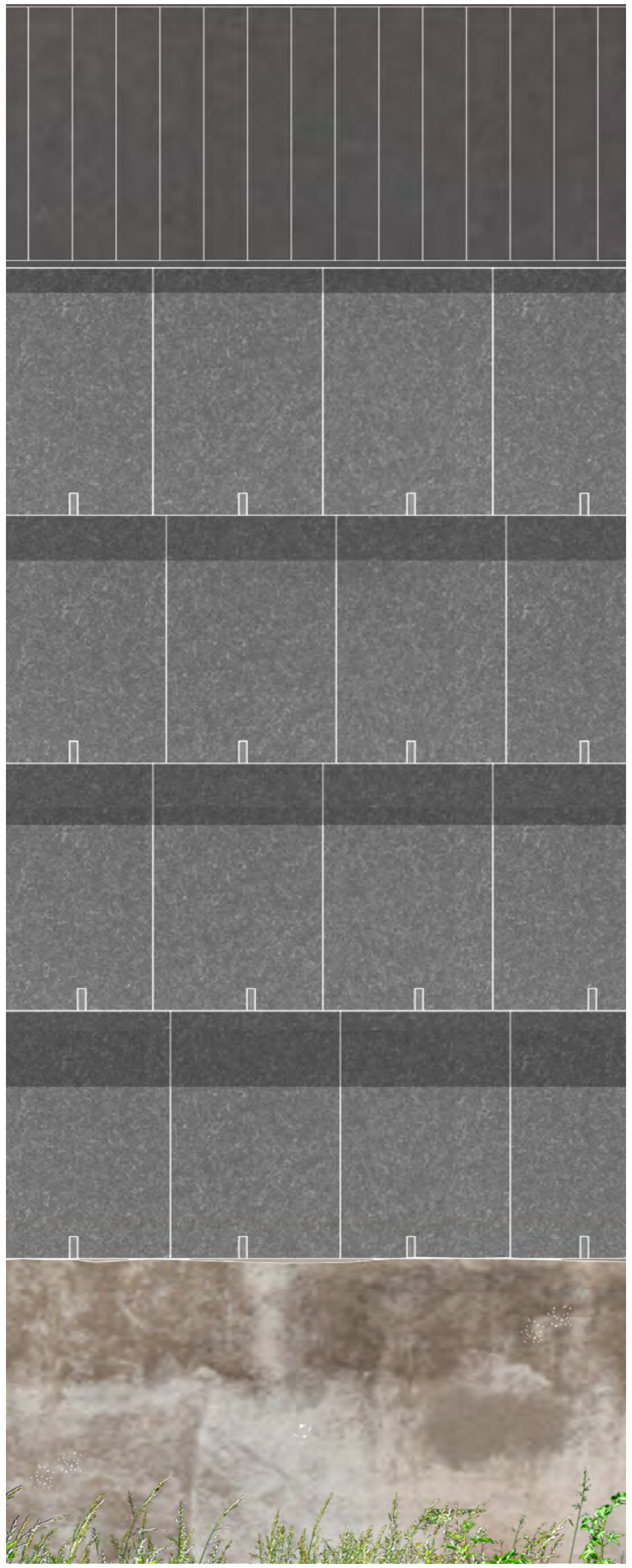
PIR Rainscreen Insulation-----------------------

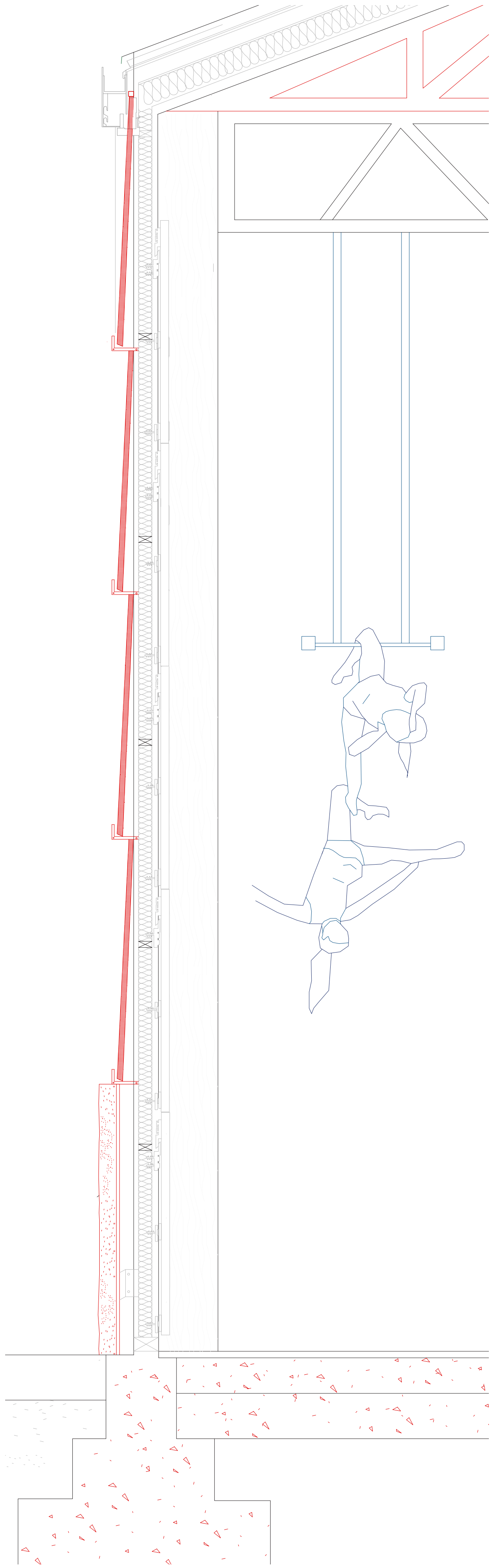
Timber Battens--------------------

OSB board 11mm-------------

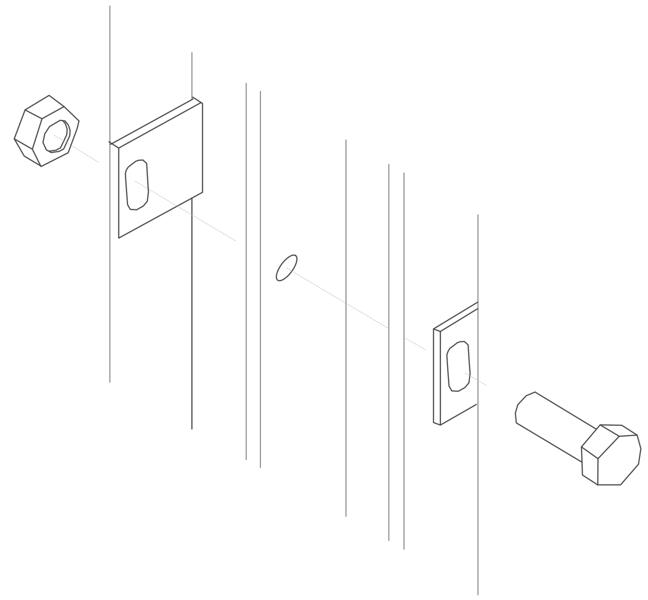
Acoustic Sound Absorption panels attached with Z clip mounts 60mm --------

Reclaimed Cut Concrete Panel 250mm used
as a rainscreen for facade, attached to structural elements with C channel
for movement 150mm ------------

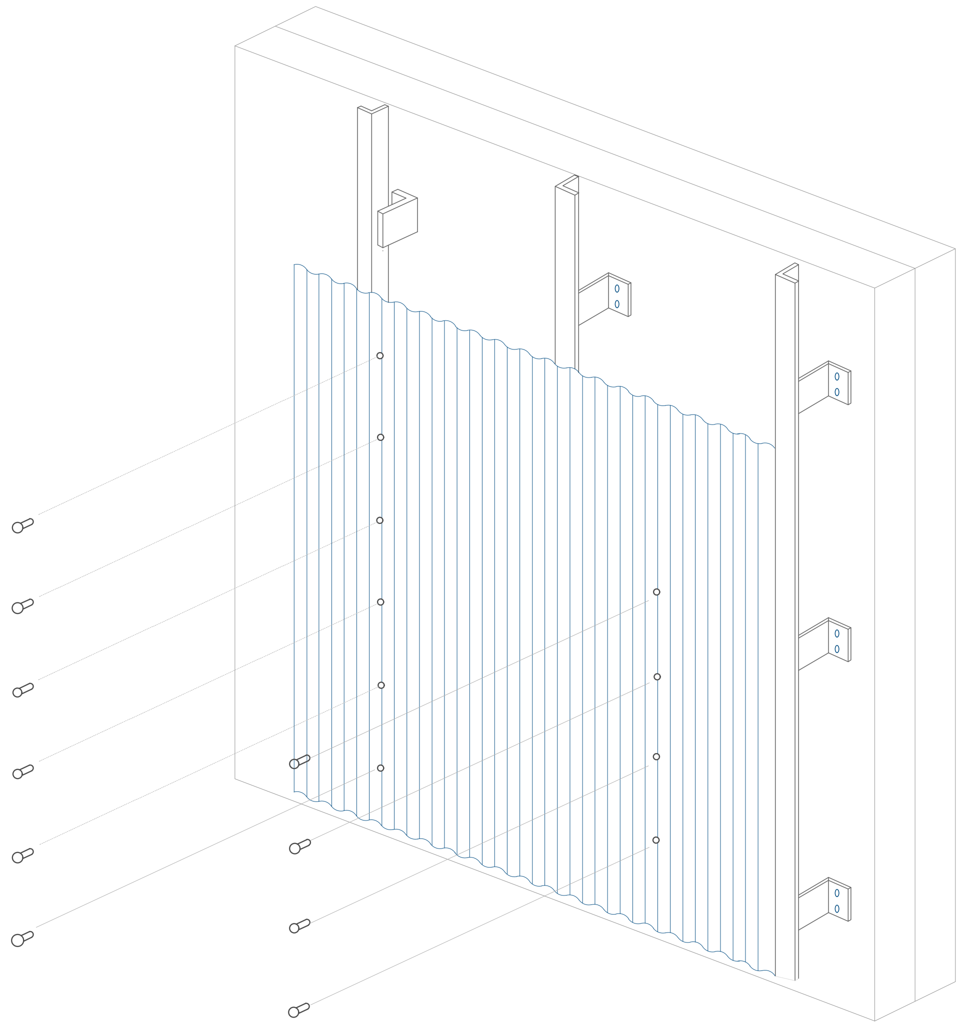




[Fig. 31]



The building design skillfully incorporated the reclaimed materials, taking into consideration their original form. Cut concrete slabs were repurposed and integrated into the lower section of the façade. The height of these slabs played a significant role in determining the positioning of windows, which, in turn, influenced the layout of the rooms on the ground floor.



[Fig. 33]

[Fig. 32] Material Detail Build-up 1:20
[Fig. 33] Facade Connection Diagram

Reclaimed Material New Detail West Elevation 1:20

Reclaimed Cut Aluminium Roof Sheets used as a rainscreen for acade, attached to structural elements with T- Bracket 6mm-------

Weather-resistant barrier 10mm ---------------

PIR Rainscreen Insulation------------------------

Timber Battens--------------------

Rockwool 300mm-------------------------

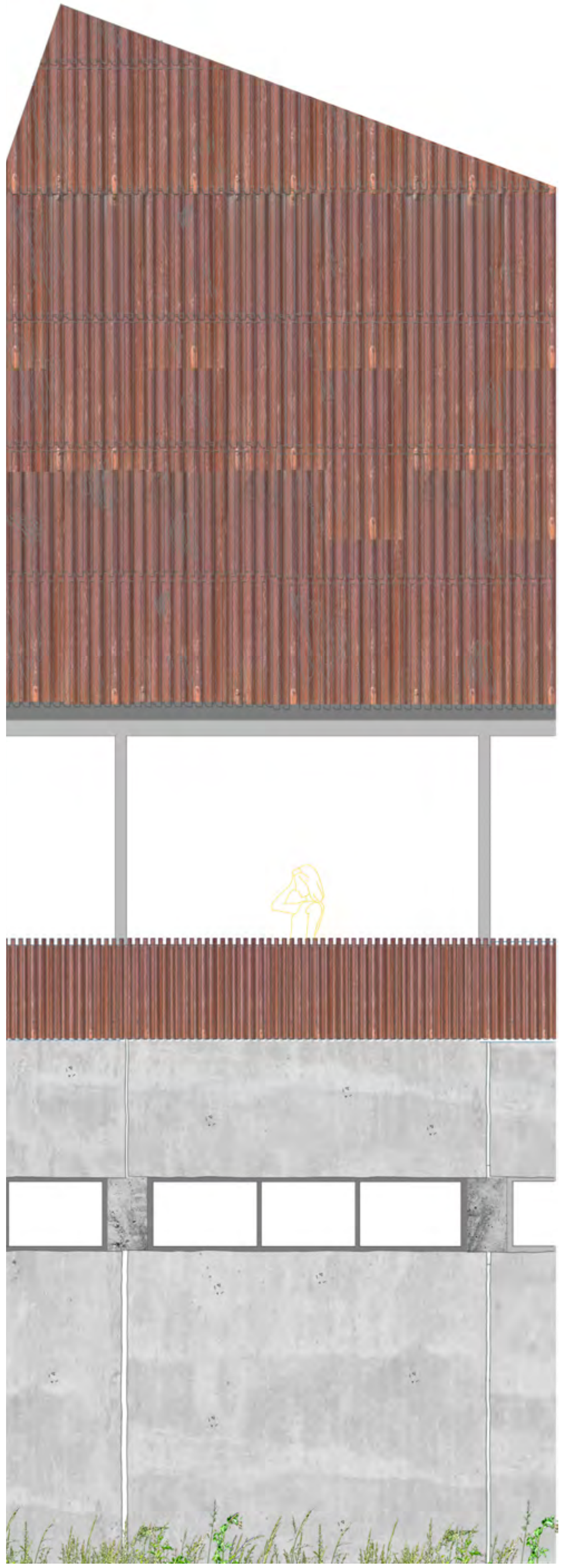
OSB board 11mm--------------

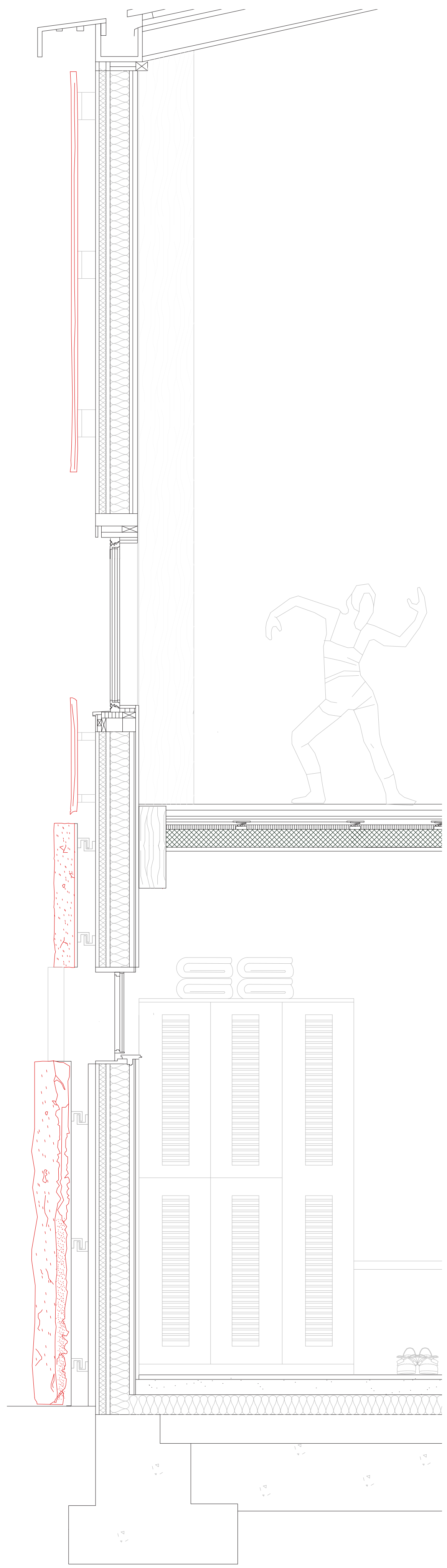
Reclaimed Window -----------

Flashing 150mm-----------

Reclaimed Cut Pre-cast concrete panel used as a rainscreen for facade, attached to structural elements with C channel for movement 150mm----------

Concrete block for load transfer from top concrete panel to bottom 100mm-------------------------





[Fig. 34]

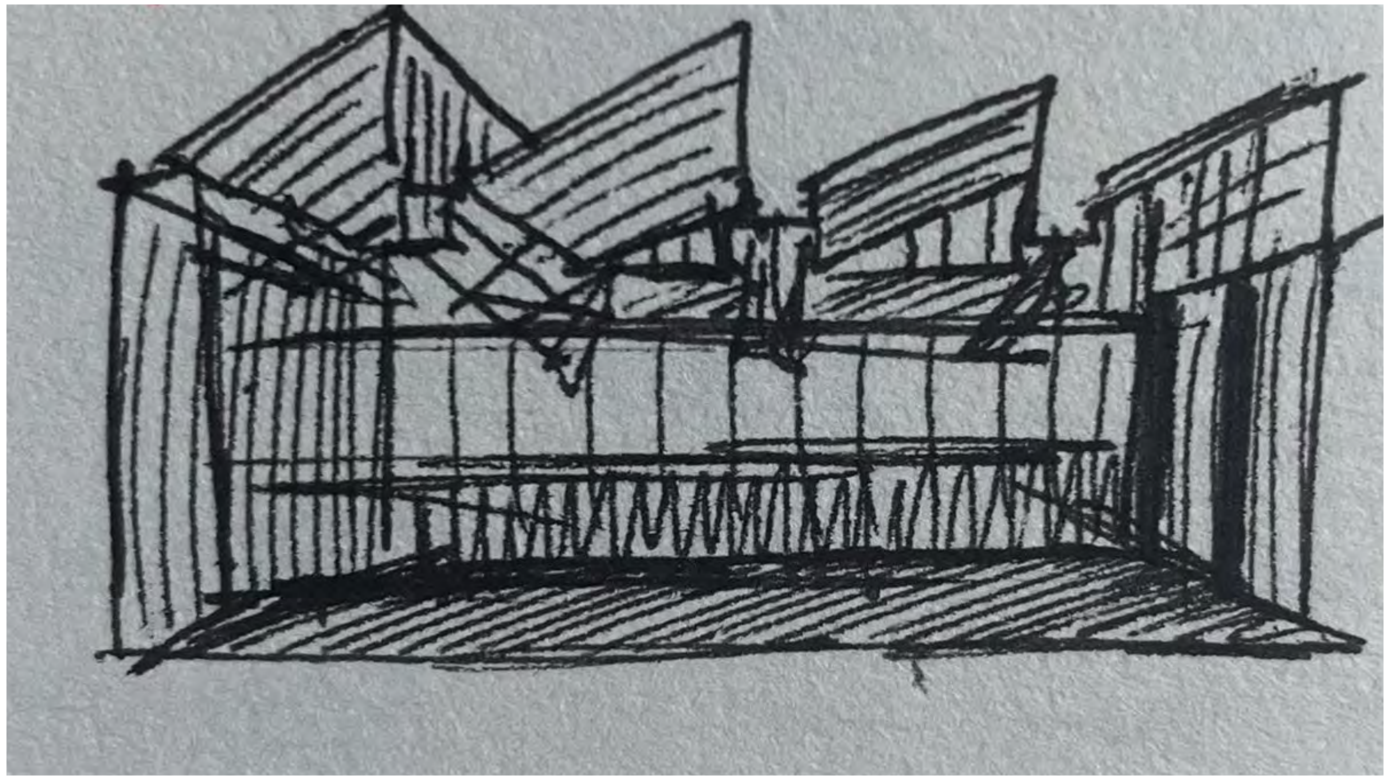
[Fig. 35]

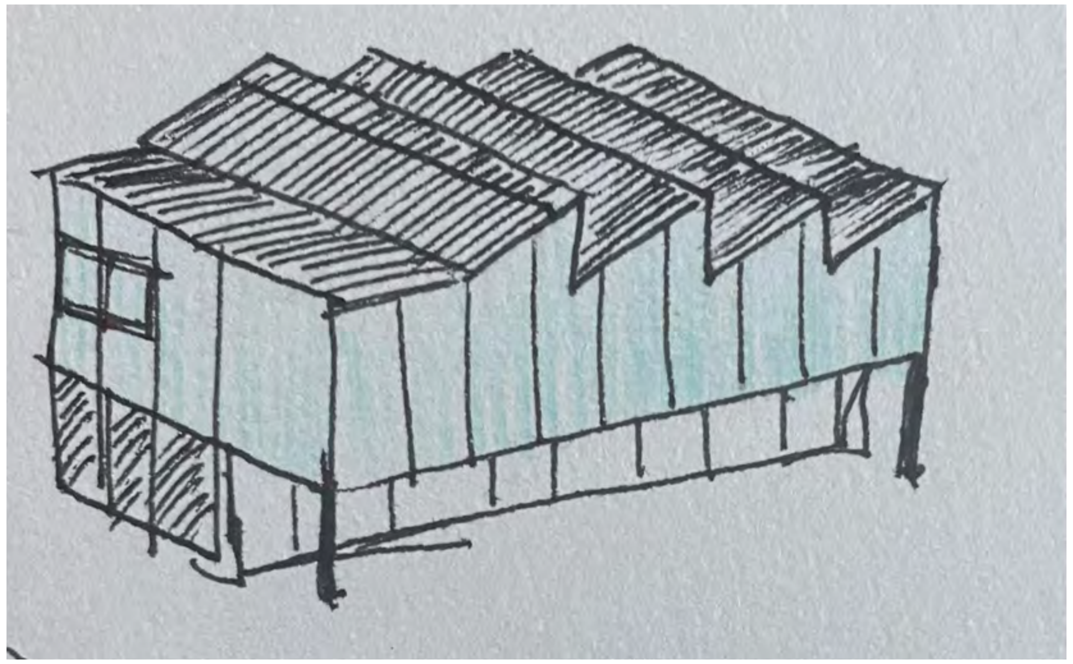
[Fig. 34] Material Detail Build-up 1:20
[Fig. 35] Material Detail Build-up Model 1:20

Existing roof structure

As an integral part of the material reclamation initiative, the roofing structures of the existing buildings were salvaged and repurposed. The versatility and durability of galvanised steel make it an ideal candidate for such a process. The sawtooth roof structure of one building and the eight triangular trusses of the other were reclaimed and became the primary inspiration for the design of the new roof. This deliberate choice greatly influenced the project's outcome, as it operated within the confines of the pre-existing structure.

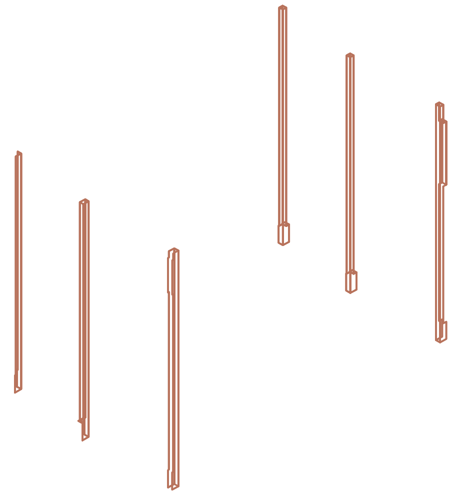
With its ability to allow north light into the space, the sawtooth structure proved particularly suitable for the dance studio room's function, as it provides optimal lighting for the studio's activities. Similarly, the triangular trusses, with their ability to create expansive spaces and grandeur, proved ideal for the ariel room, which demanded a sense of vastness and awe-inspiring presence.



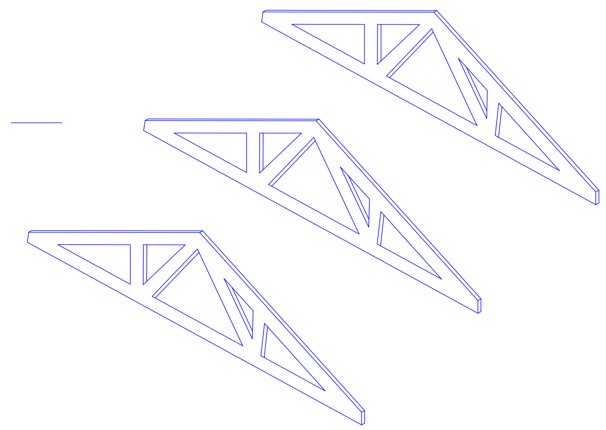


[Fig. 36]

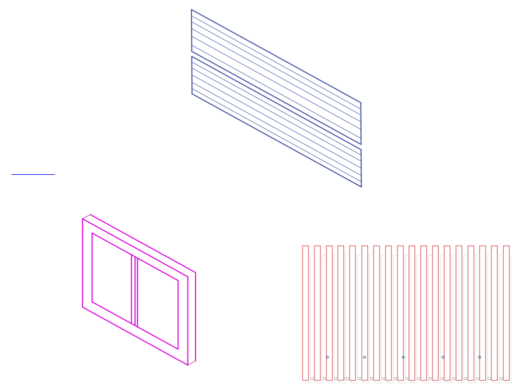
The final design extensively incorporates the reuse of materials from the existing building on-site, along with a new glulam structural system. This integration leads to significant carbon savings and contributes to sustainability efforts.
Utilizing reclaimed materials and implementing a low-carbon structure, the design surpasses carbon-neutral and achieves a carbon-negative status when compared to using solely new materials.
The incorporation of a sawtooth roof structure and roof trusses serves the purpose of creating ample vertical space and harnessing north light, which is crucial for aerial dance performances.
Considering the design program requirements, the design called for high ceilings and spacious rooms with consistent natural light throughout the day. As a result, the design optimizes vertical space while minimizing the site's footprint, opening possibilities for additional uses such as rewilding, biodiversity initiatives, or future housing.
Aligning with the design program, the site layout was thoughtfully developed to accommodate visiting circuses, ensuring ample space for their activities.



1. New Structure



2. Reclaimed Roof Structure



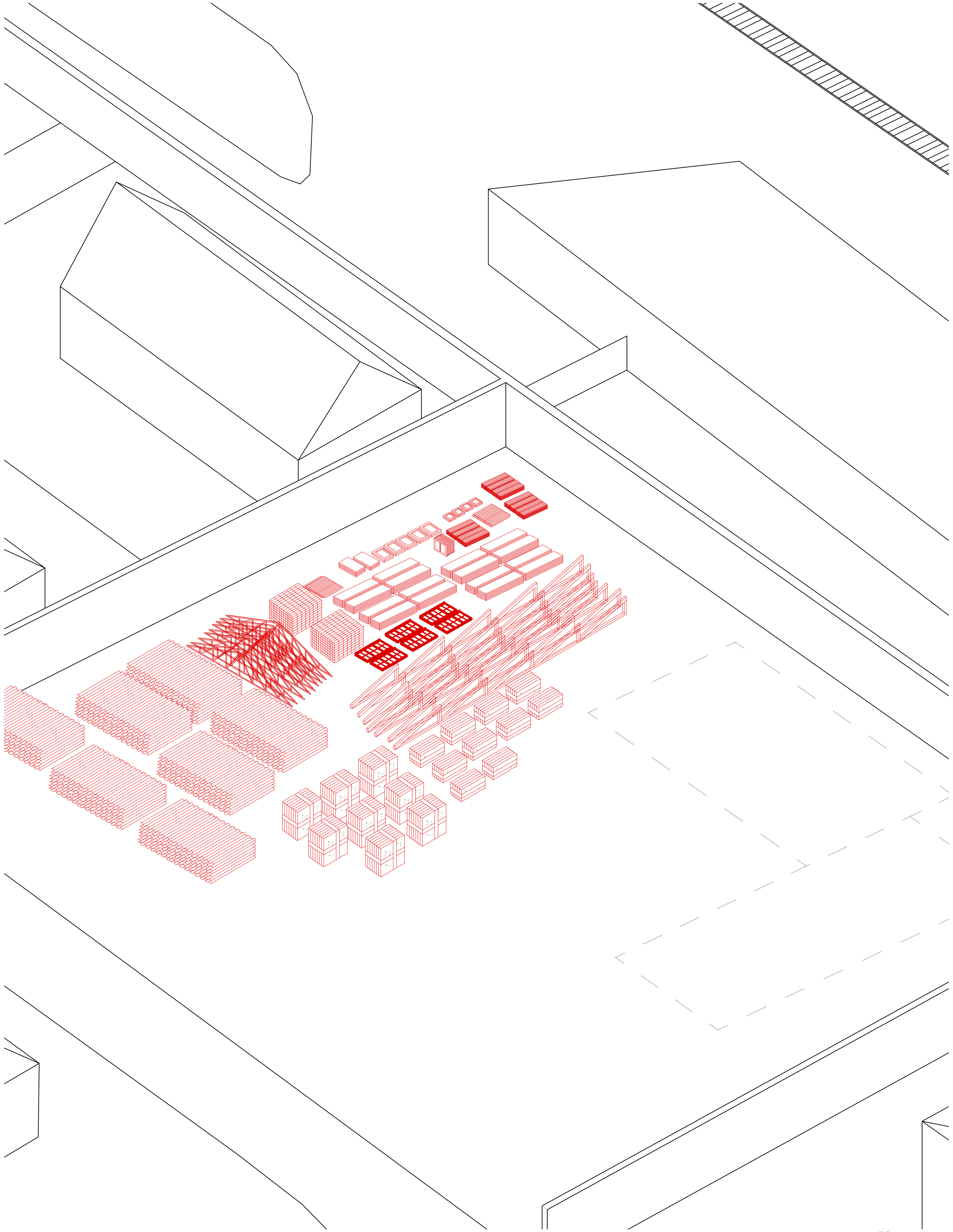
3. Reclaimed Materials

[Fig. 36] Process Sketches
[Fig. 37] Design Principles

[Fig. 38]

An integral aspect of the design concept is the retention and on-site storage of materials reclaimed from the existing building throughout the construction process. This deliberate approach effectively eliminates transport emissions associated with the embodied carbon of these material.

[Fig 38] Rewilding Drawing
[Fig 39] Drawing of Materials on site]



[Fig. 39]

By reclaiming and re-using all feasable materials from the existing building, this design saves an embodied carbon total of

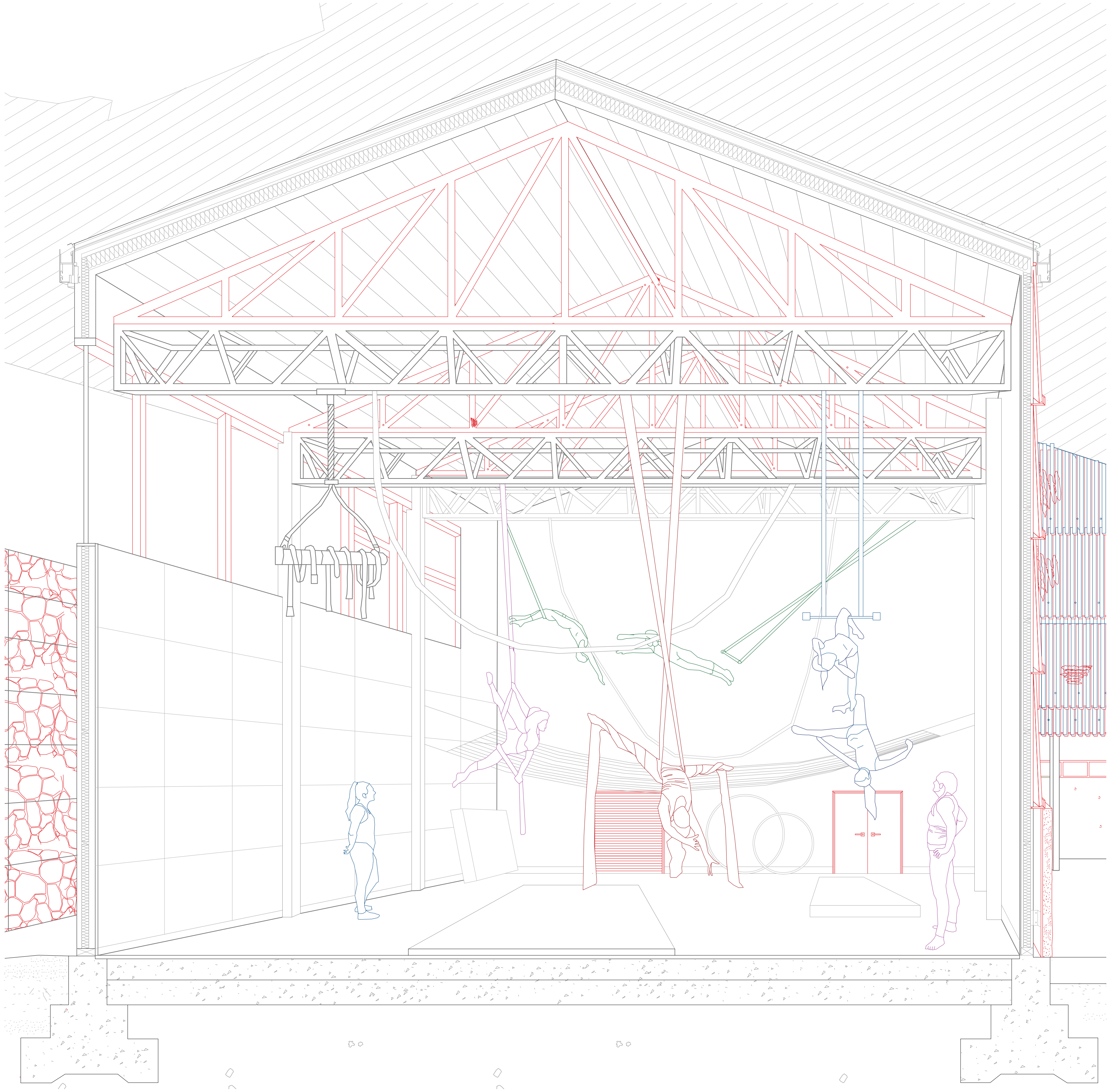
629,150kg C02 eq

If this design were to use 100% new materials the embodied carbon would total

559,712kg CO2 eq

Through the use of reclaimed materials and a low carbon structure, this design results in a carbon negative fi gure of

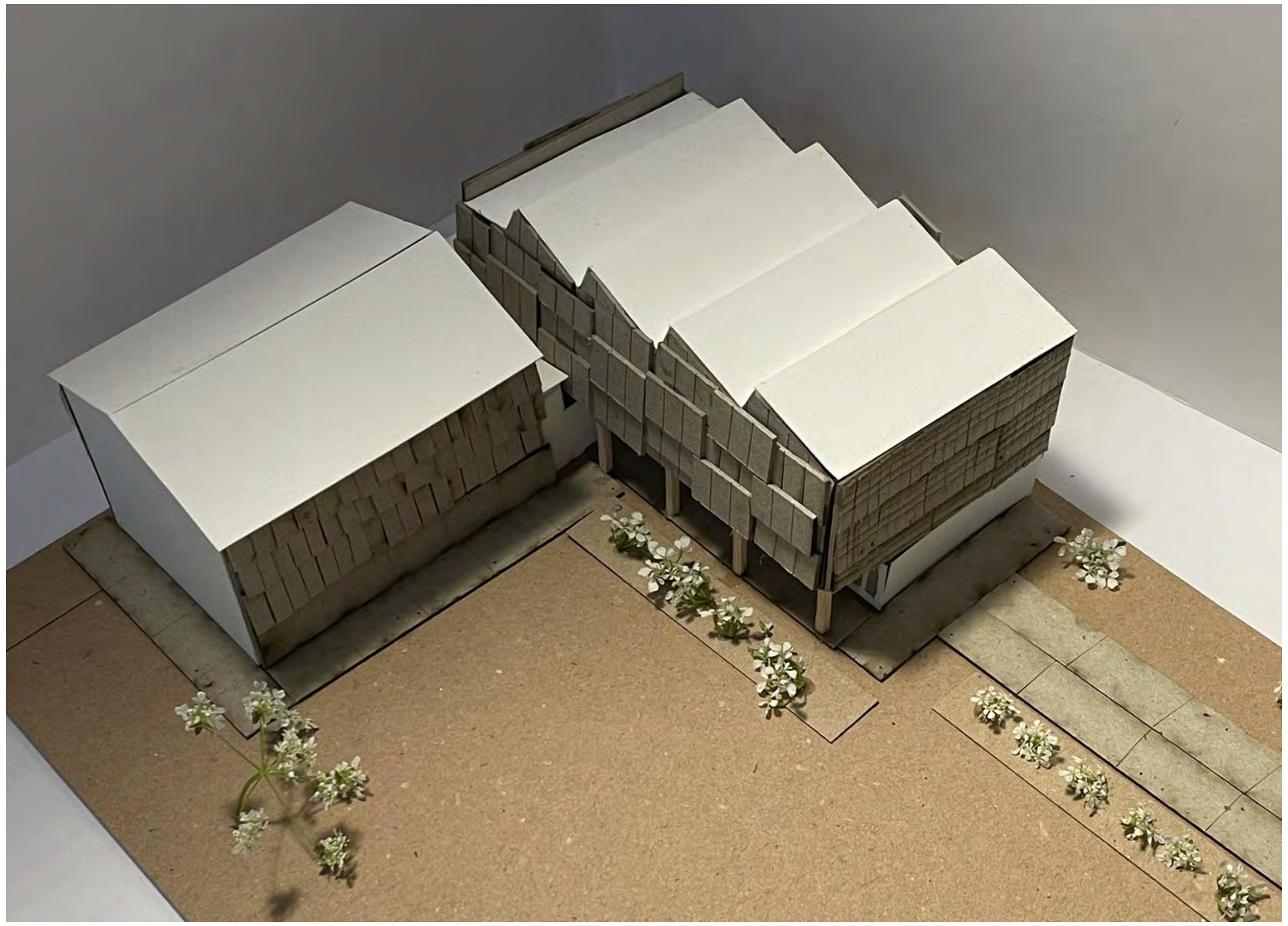
-69,448kg CO2 eq



[Fig. 40]

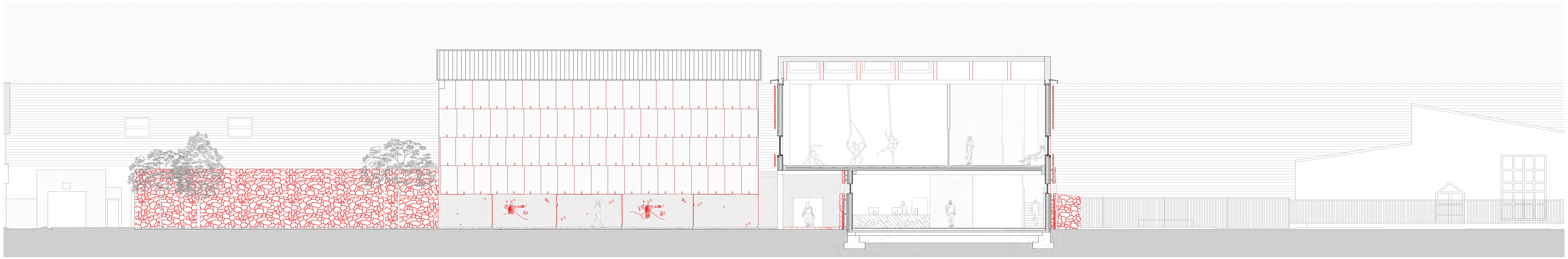
Programme

The aerial dance school's program encompasses the development of a performance space specifically designed to accommodate activities that are not typically found in conventional venues. With a generous height of 12 meters, the room offers ample space for various aerial performances, including trapeze acts. The space is carefully designed to provide access to consistent north light, while incorporating acoustic panels to enhance sound absorption. This program challenges traditional norms and fosters creativity and uniqueness. It aligns with the building's design philosophy, which focuses on the innovative use of reclaimed materials. Both the program and the utilisation of unconventional materials demonstrate an alternative approach, illustrating beauty and functionality within unconventional parameters.
Through this strategy, the aerial dance schools' program and the building's unconventional design intersect, resulting in a distinctive space. This showcases the possibilities that emerge when pushing boundaries and highlights how unconventional elements can harmoniously combine functionality and aesthetics.

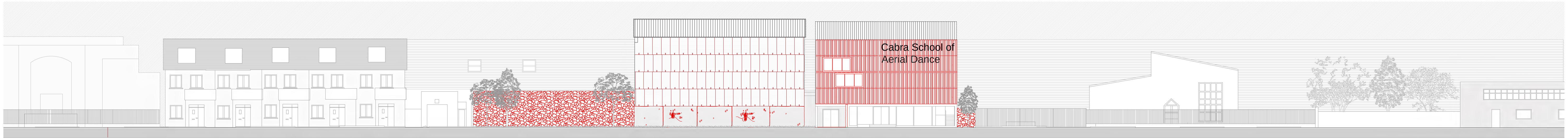


[Fig. 41]

[Fig. 40] Aerial Performance Gym Perspective Section
[Fig. 41] Building Model 1:200



[Fig. 42]



[Fig. 43]

[Fig. 42] Section through Aerial Dance Studios
[Fig. 43] Building Elevation

[Fig. 44]

Beauty

Initially, my objective was to challenge the notion that utilising existing materials would result in a design that appeared worn out or 'stuck together'. Instead, I aimed to demonstrate that the design's true beauty lies in these imperfect materials' ability to contribute to a vibrant new recreational facility while significantly impacting the environment through a low carbon footprint.

These materials' rough surfaces, overlaps, and bent edges now embrace a new sustainable architecture that harmonises with its surroundings without imposing further environmental demands. In this way, the design achieves a unique type of beauty that arises from the successful integration of reclaimed elements and the revitalisation of an underutilised site. Through this process, my perception of beauty expanded to encompass the intrinsic value and aesthetics derived from sustainable practices, demonstrating that beauty can be found in the thoughtful reuse of materials and creating a living space that breathes new life into its surroundings.

[Fig.45]

[Fig.44] Building Render Close-up
[Fig. 45] Building Render

Conclusion

This thesis investigation posed the question, ‘Can existing buildings not designed for deconstruction fit into the circular economy model?’ to engage with the more significant issue of climate impact from the construction industry. When we examine the current ecological state of the planet and the effect the resource demand has on the climate, we can conclude that change is necessary for how we design and construct our buildings. While several potential solutions for systematic change and tactical methods of creating with reuse have been presented, several challenges have been raised but left unresolved as they require frequent changes to legislation, economic attitudes and building practice. Emphasis is placed on the importance of a material inventory and the selection process, including selecting materials with the lowest harmful chemical content available.

Complete material inventories should be made a standard practice when building owners apply for building renovation or deconstruction permits to compile a catalogue of available materials, their contents, condition, and quantities. It is also critical to record and gathers information on reclaimed materials on a large-scale material database for future reuse possibilities. By storing this information in a public database, efforts to develop a circular economy can become more organised and have a greater chance of success.

The choices made by architects in the building sector have far-reaching impacts. If architects start using reclaimed materials from existing buildings in their designs, this will encourage attitude changes by the general public and thus will standardise material reuse in a larger context. The key theme is that architects need to learn to adapt their designs to what is available in existing local resources, highlighting the importance and beauty of those reclaimed materials and the designs they produce. Circularity concepts should be applied when designing for future construction material and component reuse. Designing in layers (for maintenance), establishing standard dimensions, using high-quality materials, and detailing for disassembly are examples of these. It is essential to acknowledge DFD’s potential for a future design and how it will drive the circular economy model. However, it is also essential to recognise the many resources available through reusing materials from existing buildings.

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