The Productive City – Living and Working in Edinburgh - wants to elaborate a series of projects that speculate on what living in the contemporary city means, challenging the rigidity of the distribution of programs and envisioning forms of life that require unconventional spatial distributions and arrangements.

PERSONAL STATEMENT

Throughout my studies I have become increasingly aware that as designers of space we are designers of human reality/habit. This bestows on us an immense amount of power and responsibility, shaping human experience, and on a global scale, human civilisation. With pens (or mouse’s!) as voices - we can specify new ways of living that move towards more self-sufficient dwellings, with food and power production embedded into their programme. Designing structures that holistically sustain their inhabitants.

Through this project I explored integrating urban agriculture, specifically aquaponics, into the heart of the home. I wanted to imagine a future where occupants live in symbiosis with their environment within the fabric of their home. I did this through embedding the maintenance and harvesting of produce into the programmatic ritual and spatial arrangement of the home, and named this concept AquaCulture.

For the complete portfolio of this project and more examples of my work, please visit imogenmcandrew.com
THE CONCEPT

AQUACULTURE

This concept aims to offer a solution to the pending and existential issues that Granton, and generally, urban populations face. Especially with the face of climate change and more recently COVID-19. These issues include access to local healthy food, connection to nature, resource and economic security and the strength of community connections.

THE VISION

AquaCulture is a place where the Granton community can come together around a new ‘hub’ that sustains life through the system of aquaponics. It is a project that aims to reconnect the modern inhabitant to the notion of ecological interdependence, and the environmental and social importance of consuming locally in the technologically evolved world.

It is a proposal that also has the potential to be adapted and morphed into many cultures and climates around the world, not just Granton.

Humans facilitate ecosystematic relationships through ‘gardening’ the aquaponics system. This includes monitoring and controlling the movement of biological inputs and outputs between fish, and plants, through the medium of water.

The ‘gardening’ of the systems would typically be carried out by members of the community with more time or those that are deemed more isolated. For example this could be people reaching retirement, currently retiring, younger members of the community, stay at home parents etc. (see page 10 for more information).

Admittedly, architectural structures are conventionally for humans. And working with nature, to some extent, will still mean that we are exercising control over it to manipulate it for our own interests, albeit survival. However the very reality of living in immediate proximity to these ecological processes and gardening them, will be a sobering affirmation of the ecosystem on which we depend, and provide an opportunity to re-educate the next generation of humans of what is required to sustain human life.

Today, the commodity of resources such as food and water keeps the modern human inescapably at the mercy of the economic system, which facilitates the perpetual reality of working to pay the bills, dictating life as we know it. AquaCulture emancipates occupants from some elements of the economic system by significantly reducing bills for water and food. A reduced economic hold on inhabitants raises the question of what does one work for? And what does one consider as work? Opening a new door into the future, where essential resources are less commodified, as they are temporarily borrowed from the ecosystem, for free within your home!

On the surface this may seem a rather radical architectural proposition. However urban agriculture is increasing popularity and there is a need for more efficient and sustainable agricultural practises.

ENVISIONING A LIFE WITH AQUACULTURE WOULD INCLUDE:

A REDUCED ‘FOODPRINT’

The average meal has travelled 4,200 miles just to get to our table, this is highly unsustainably and causing ecological damage and socially conflicting situations on an international scale. If AquaCulture, or urban agriculture, were to be more widely adopted it could significantly reduce this negative global impact.

A REDUCTION IN LONELINESS AND MORE MEANINGFUL COMMUNITY & ECOLOGICAL CONNECTIONS

Through maintaining systems and selling produce, strong bonds would be formed between neighbours and within the community, decreasing feelings of loneliness and isolation and increasing an individual sense of purpose in the community.

THE CREATION OF JOBS

Be it paid or volunteering roles, AquaCulture will require social ‘coops’ to ensure agricultural productivity, from aquaponic experts, to site managers to ‘key gardeners’. This creates a community with opportunity and a diversity of roles that can be carried out by people from all age groups.

In response to the brief I wanted to design a holistic architectural proposition that places urban agriculture, specifically aquaponic activities, at the heart of the home & the community. A form of urban living where agricultural production and human culture work in symbiosis.

THE BRIEF

The Productive city – Living and working in Granton, encouraged me to challenge the rigidity of distribution of architectural programs and envision forms of life that require unconventional spatial arrangements. I was invited to question the relationship between living, working and leisure and use my design to challenge the societal assumptions of these labels.

Granton, the location of this development, is an underdeveloped area north of Edinburgh, that has been earmarked as just Granton.

It is a proposal that also has the potential to be adapted and widely adopted it could significantly reduce this negative global impact.

THE CONCEPT

In response to the brief I wanted to design a holistic architectural typology that allows a blurring of boundaries between these often distinct areas of life – live, work and play. A design strategy that facilitates serendipitous and structured human connection, through the maintenance and harvest of the agricultural system and trade of the produce, unifying humans through shared labour, food and nature.

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Through researching Granton and the initial site information from the brief, I came to a few key discoveries that helped to shape my design and the productive activity I would focus on.

In light of these discoveries and my wider interests, I decided to take the productive activity of urban agriculture, specifically focusing on aquaponics and community synergy through agriculture forward.

KEY DISCOVERIES THAT MAKE AQUACULTURE APPROPRIATE FOR GRANTON

GRANTON IS A ‘FOOD DESERT’
Granton is considered a ‘food desert’, an urban area where it is difficult to buy affordable or good quality food.

EXISTING COMMUNITY
The existing community have a keen interest in producing and making local food. For example the local community garden group have 1000 followers on facebook, and is located directly adjacent to the site (leaf symbol). Demonstrating the local interest and activism in food production and consumption.

However there doesn’t appear to be an obvious urban center in Granton, thus it could be said that Granton is needing a development that serves a community through food, space and nature.

INDUSTRIAL PAST & CONTAMINATED GROUND
Due to the industrial past the majority of land is contaminated and potentially dangerous to cultivate, therefore above ground farming is favourable, until the land has been re-mediated.

FISHING CULTURE
Granton has a romantic connection to fishing, the Granton Trawlers were well known for providing fish to locals, and their assistance with the war efforts during WW II.

Today there is still a small active industry in processing fish. The site is located in close proximity to PM Ranaldi and son’s (fish symbol) the local fish processor, which could carry out the preparation of fish for local retail from the aquaponic units.

AGEING POPULATION
Within Granton 20-25% of residents are between the ages of 35-64. This suggests that Granton could potentially become an area with a large elderly population by 2050.

The data shows that more than 50% of people live alone in the Granton area near the site. This suggests Aquaculture could benefit members of the community who may be more isolated, in generating a community hub.

Within the Aquadwellings members of the community who maybe considered more isolated or with spare time, would have the option to become key gardeners. They would be given training in how to maintain the systems, and through this make wider connections with the community through the comfort of the system.

The structure is incased in a weathered steel envelope which is material chosen for it’s industrial aesthetic due to the rich burnt orange colour, giving the structure material continuity with the adjacent industrial buildings, such as the Medelvic car factory, seen on the top right image.

The concrete portal frame structure supports the entire building and was chosen for it’s structural ability to support the heavy aquatic structure. There is a strong aesthetic of concrete prevailing in the interiors and exteriors of the building. Concrete was also chosen for it’s ability to store heat, as thermal mass, which is useful for regulating the interior temperature.

The site has a mix of new developments and run down abandoned industrial buildings adjacent to it. I have designed my development to strike a balance between the tired industrial past and new modern developments.
GROUND FLOOR

ACCESS
There is a car park in the North East corner and the south east, of the site connected to the path network. This encourages people to walk to their houses/place of work. There are electric charging points for cars with the assumption that electric powered cars will be the main mode of transport in the coming years. Placing the car park on the edges of the site encourages people to pass the gardens, and provides opportunity for serendipitous encounters with nature and one another.

PEDESTRIANISED STREETS
The non-slip resibond paths are wide enough - 3600mm - for a small vehicle/buggy to drive down - enabling people of all abilities to get round the site. Removing cars from the area makes it a safe environment for everyone to get around freely.

Buildings are in fairly close proximity as the facing sides are pedestrianised and above there is the LED plant growing, with very little glazing, therefore there is no danger of occupants feeling overlooked in their dwellings.

CYCLE HIGHWAY
There is the provision for high speed biking next to the road, the track is buffered with plants from the pedestrian area and the road, the current infrastructure has provided this. There is one cycle highway that runs inbetween AQ.CUL 1 & 2 the two buildings which can be used for transporting cargo to the main access points, and other shops on site.

GROUND FLOOR FLEXIBLE MIXED USE
The flexible ground floor space consists of cafe’s, grocery stores, fish shops. Also places such as swap shops where residents and locals can exchange tools, books and clothes.

The flexibility offers and opportunity for the community to shape the space according to their needs and skill set. The mixed use nature of the ground floor will maximise social interaction and community synergy as people will travel to different units in order to get what they require.

SITE PLANS & CONTEXT

> Site plan showing how all the units are labelled, surrounding roads and landscape strategy.

< Diagramatic massing model of the different elements of AquaCulture.
THE AQUADWELLING

The dwelling units are modest in size. The fish tank acts as a partition wall between the two dwellings and each dwelling has their own growbed. On the North side of the dwelling is the LED growing section, which is not an occupied dwelling space, but glazed, so the occupants have views into the space. The dwellings are encased by productive activities on three of their walls. The use of transparent surfaces and varying heights, turns the productive activities into functional architectural features.

< A floor plan with diagram overlaid, showing the first floor plan, annotated to show the pipes (thin pink), circulation (thick pink), visual connection (dotted pink arrows) and rest spots (pink dots) growbeds (green), fish tanks (dark blue) and sump tanks (light blue) on the first level of the dwelling.

An interior view looking towards the front door from within the aquadwelling. The growbed and the fish tank are both visible.

Exterior view looking towards the front door of unit 1.4. The fish tank, growbeds and pipes can be seen from the outside.

An interior view from one of the bedrooms looking towards the fish tank from the second floor.
This section highlights the key components to the AquaCulture development. Highlighting the groundfloor as a place for community, commerce and public gardens, whilst the upperfloors are the location of the Aquadwellings and water harvesting.

The drawings on the right handside demonstrate firstly the consideration of the structure within the environment and its utilisation and integration with the water cycle. The drawings below that show two key architectural components that sit outside the dwelling, the water harvesting tower and the reedbed, which are both important for the environmental symbiosis of the structure.
ARCHIPONICS FISH TANK DESIGN

In response to my research findings I designed the fish tank accordingly. It is to be no direct sunlight & a temperature of 20-30 °C. The structure provides shading from direct light, yet is still heated from sun, via the greenhouse effect, helps to maintain the optimum conditions for fish. The weathered steel overhanging also doubles up as a porch space for both dwellings, therefore commanding the occupants to stop in front of the fish tank before they enter the dwelling.

The glass roof has an automated opening, allows for air to leave when humidity or heat becomes too much, replenishing the air. It also protrudes above the pitched roof to capture heat. The pipes have Nodes this means they are easy to detach if necessary, to fish/ clear any blockages.

The journey from rainwater harvesting tank to the grow bed is as follows:

1. Rainwater from the water harvesting tower - gravity fed.
2. Water flows into the sump tank, where the water is redirected into the dwellings, and the fish tank through separate systems.
3. Centrifugal force facilitates circulation of water, and reduces “toxic” zones of stagnant water.
4. Water pipes to the grow beds are located at the top of the tank. This allows redundancy as the fish tank will not “run dry” if something goes wrong. Furthermore, it reduces the amount of solid waste through the pipes.
5. Mechanical & Biological filter clears any solid waste through graduated mesh.
6. Water enters the grow bed, where ammonia is converted into nitrate. The ammonia carried in the water is converted into nitrate by nitrifying bacteria, the nitrate is then assimilated by the plants. The water (minus the ammonia and cleaned by the plant) flows into the temporary sump tank, where it is pumped upwards to back to the sump tank. The glass roof

GROWBED DESIGN

This section shows the interior of the growbed of the smaller dwelling.

From left to right, 1. The hydroelectric spinners, there is a constant steady flow coming from the fish tank, which means that the water can be utilised to generate an electric current, which powers 9. The mechanical and biological filter. 2. The batteries. 3. The pipe opening from which the water enters the grow bed. 4. 300mm of Graduated volcanic tuff, starting with fine volcanic tuff (20mm diameter to larger diameter 60mm). 5. The plastic container with a 2% sloping bottom to direct water flow towards the bell siphon. 6. Concrete platform to support the grow beds. 7. The bell siphon (see next page). 8. Power generated from the hydroelectric spinners travelling to the electrical pump. 10. The intermediate storage sump tank. 11. Accessable wooden cover, for maintenance. 12. Pipe ‘nodes’ with one way valves to assist the rise in water vertically. As the water is pumped upwards the pressure increases forcing the water up into each compartment. The nodes also enable the compartmentalisation making water flow management easier. 14. Water is then transported back to the large sump tank, and 1/6th will go to flush the toilet.
LIQUID ARCHITECTURE

To understand how the water moves through the building I had to understand the different thresholds it passes through. I spatially modelled the vessel and pipe components and placed the openings relative to their place in the structure. Working in this way helped me to understand where I could work with gravity, and find opportunities for electricity generation.

Water leaves the system through the toilet and subsequently the reed bed, therefore the sump tank will need to be replenished every couple of days from the rain water.

A section and elevation from the street, looking towards the ‘Productive shoot’.

This is the north facing side of the building, and it is mostly without windows. It is where the intensive LED growing takes place, and the processing and harvesting of most produce takes place. Therefore humans only spend minimal time there to check on the crops and fish.

The ground floor is where excess produce is traded and sold, the first floor is dedicated to plant growth and processing and the top floor is dedicated to fish harvesting and maintenance. The ‘productive’ shoot can be loaded on the 1st floor for vegetables and the 2nd floor for fish. Both shoots can be accessed on the ground floor from the inside of the block and on the street side. This is to provide flexibility to the ground floor, so not all shops next to the shoot are required to sell the produce. The produce can be picked up from the ground floor by authorised individuals using a fob system, and taken to the nearest shop onsite.

Below a diagram showing how the building utilises and redirects the path of water.

* Photo showing the components of the entire water system.

< Stills from Water Flow Experiment #2, showing the movement of water from one component to the next.

At the start, the water is filling up the system. For the first time, then it reaches an equilibrium where all the water levels are at a dynamic equilibrium.
When programmatically designing the dwelling I had to understand the human, plant and fish occupant, and their ‘comfort’ zone to ensure a ‘productive’ environment. I divided the section into three types of zones to suit the occupant and the programme of the space.

CLIMATIC ZONES

There are three types of climatic zone within the building, the warm, cool and controlled.

THE WARM

This south-facing, warmer zone, generally containing the human, plant and fish (although the fish are shaded, see diagram on the next page) occupants. South-facing spaces are an important factor for both human and plant wellbeing and survival. Automated windows would be programed to be responsive to the internal environment and adjust according to occupant comfort. This zone is where the symbiotic relationship between humans, plants and fish is realised.

THE COOL

The ground floor of the building has an ‘indoor street’ feel with sliding doors on both sides, given the permeability of the groundfloor it would remain a cooler temperature as people move in and out regularly, allowing air to flow freely in and out.

CONTROLLED

For the more intense growing of the plants, there is the controlled zone, in which the lighting and temperature can be more closely monitored and controlled by the key gardener dependent on the crop growing. This is a contained climatic zone.

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THE ‘SOCIAL COGS’ OF PRODUCTIVITY

In order for the aquaculture to be successful it requires social cohesion and organised roles within the community. This is so everyone who uses the site is aware of who is responsible for the different elements of the system, so everything is appropriately managed.

The production of food provides a platform for social, cultural, and economic opportunities, however there does need to be clarity over certain responsibilities to make sure the systems function with maximum efficiency.

HOW WOULD THE PRODUCTIVE ACTIVITY WORK?

THE KEY GARDENER

The key gardener is an allocated person or persons from each dwelling (of 4 dwellings) they are responsible for the day to day management of the aquaponic system. They are paramount in the management and therefore productivity of the Aquaculture system.

When they are elected or chosen to become a key gardener they are given training on how to maintain the system and how to recognise issues, through water testing and observing the plants and fish, if they do have a problem they will report it to the site manager and they will bring in the required specialist.

Through the key gardeners each unit could communicate what they are going to grow - each growing different fish and crops in their aquaponics system - to generate variety across site and provide more opportunity for trade and balanced diets.

THE SITE MANAGER

The site manager would be a collective or individual that carries out decisions based on the best interest of the Aquaculture site, i.e. the dwelling occupants, allotment owners, ground floor programme residents and the local community.

They would consult these groups of people through casual and structured conversation. The site manager acts as an essential ‘go to’ figure if anything were to go wrong, or if improvements and or opportunities were thought of. Lots of this conversation carries out decisions based on the best interest of the Aquaculture site, and or opportunities were thought of. Lots of this conversation goes to figure if anything were to go wrong, or if improvements to the site manager and they will bring in the required specialist.

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