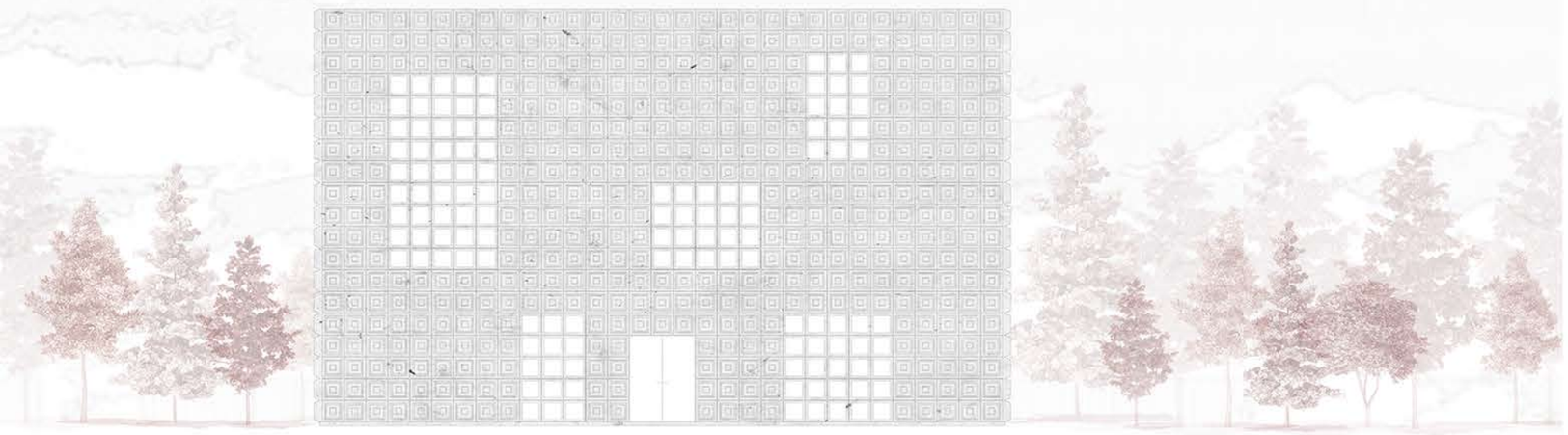
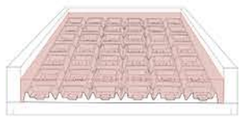
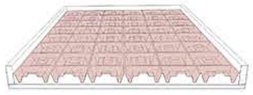


Concrete today is considered to be a crucial material but with a negative connotation in relation to environmental concerns. Today, there is a demand for sustainability. Multiple research recognises the potential of concrete to absorb atmospheric carbon. The ambition to use concrete as carbon sinks in architectural design has not been explored. It is discovered that concrete capture carbon dioxide throughout its lifecycle in a process called carbonation. Carbonation is a chemical reaction that takes place in concrete where atmospheric carbon dioxide and calcium hydroxide from cement react and produce calcium carbonate increasing the concrete's compressive strength. This CO2 absorption process is beneficial from an environmental standpoint which, as architects, should be taken advantage of. The objective of this study is to explore the potential of concrete in architectural design by creating a precast façade panel through formwork, with a maximum surface area for the capture of CO2, while maintaining a minimum embodied carbon, to reduce environmental impact.

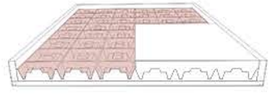
Fabrication



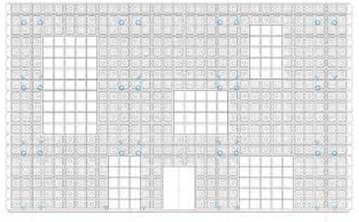
1. The mould is made by first creating the form of the panel with the use of wood.
2. The wooden panel is placed on a 3m by 4.5m wooden frame with a base below to hold the cast mixture and prevent leakage.
3. The wooden form is covered with a release agent to allow easy removal.
4. The casting material for silicone rubber is mixed and poured over the mould.
5. After the rubber mould has set, it is removed



1. The reverse rubber mould is placed onto the wooden frame and secured by adding a base underneath the frame.
2. Release agent is added to the mould.
3. The concrete mixture is then poured onto the mould and cured on top of a vibrating table to release any air pockets that may have developed.
4. After the concrete panel dries, the frame is un-screwed and the flexible rubber mould can be peeled off, revealing the concrete panel.



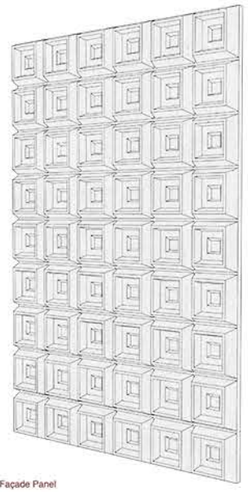
Eccentric panels such as those on parapet level and panels which contain part of a window or door are cast using the same master form as the standard panel and are adjusted by blocking off sections using wooden inserts.



Façade Elevation
Scale 1:100

The elevation façade's precast panel are mapped out in red on the builging's elevation. The panels are 3m in width and 4.5m in height. The design of the surface of the panel consisting of 480mm by 480mm cubes which are hollowed out in the middle and indented with another cube in its centre.

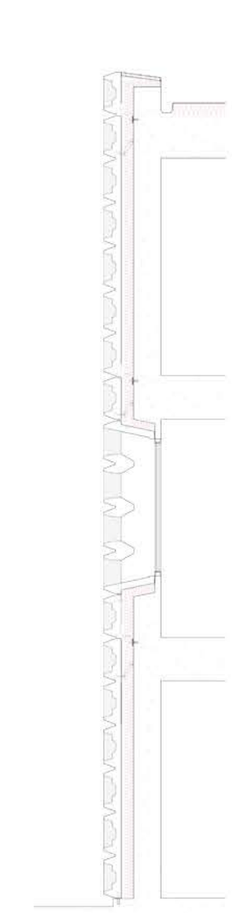
This panel has been designed to allow a maximum surface area for greater carbon sequestration as opposed to a conventional flat panel. This precast concrete façade panel's surface area is 29.69m2 which attained a carbonation factor of 20.46 CO2 Kg/panel over 50 years and an embodied carbon factor of 390.42 Kg CO2e using CEM III-73% GGBS concrete mix.



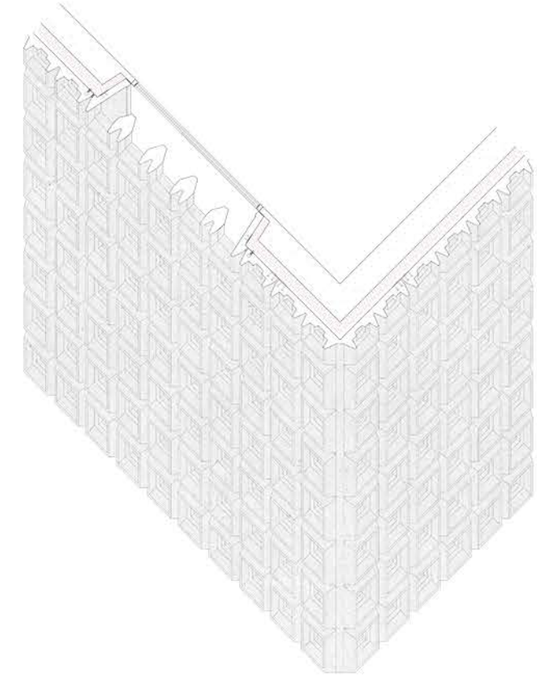
Façade Panel

Connection details
These precast panels are connected to the solid wall using welded tieback connections at the top corners of each panel and two fixed bearing connection at the bottom corners of the panel as shown in section. The panel at the foundation level is secured using a bearing wall to foundation connection. The individual panel is then further secured to its adjacent panels using a steel plate slip connection (shown in plan). The section shows an air gap between the panel and the insulation and is vented through the gaps of the panel joints. The ventilation will allow the back of each panel to be carbonated. The window pieces which are made separately from the master form are cast using an envelope mould which would create one solid piece and are connected to the facade panels using a threaded loop insert with an angled steel plate as shown in section and plan.

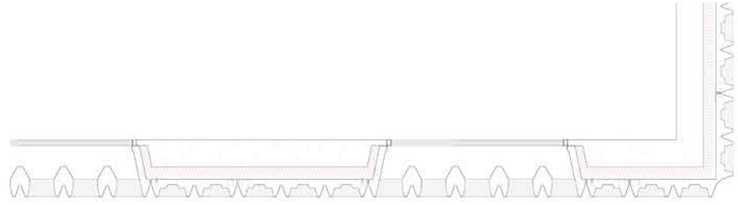
Conclusion
By selecting a concrete mix with a balance between overall embodied carbon and carbonation potential per panel, we can take advantage of the natural process of carbonation in concrete and utilise this in architectural design to combat climate change. This study confirms that utilising the surface area of façade panels for CO2 sequestration through formwork and using a concrete mix with a low embodied carbon may consider concrete as a carbon sink and sustainable material in the future.



Façade Section
Scale 1:25



Façade Part Axo
Scale 1:25



Façade Plan
Scale 1:25