CHAPTER

07

A MATERIAL WORLD

Unpacking the technical investigation of the scheme as a continuation of the design process at a more intimate scale.

7.1

TECHNICAL APPROACH

The importance of human experience within the scheme and the fact that the experience of architecture is an experience of physical matter, the materials that give form to the spaces of the library and define its haptic qualities are the primary subject of this technical exploration. The relationship and joining of materials as well as the materials themselves have been investigated and designed so as to contribute to the overall design intentions and character of place of the scheme.

7.2

STRUCTURE

The role of the structure of the library is that of defining the crust or boundary of the building that separates its interior from the outside world. Considering this role, the structure of the walls have been afforded special significance due to the fact that whilst roofs and floors can only suggest enclosure, the wall can meaningfully enclose or separate two conditions. This celebration of the wall manifests as it being the only plane where the structural material is exposed as a finish. By contrast, the floors and roofs lack the singular character of the walls and are instead built as a series of thinner composite layers where the structural material is not exposed but is rather finished with a different material. The cladding of the hidden structure of the floor and roof planes allows a specific spatial experience to be maintained without compromising the constructability and feasibility of the scheme whilst also providing the opportunity to selectively expose the structural material as a means of articulating the otherwise unbroken surfaces of the finishing materials.

7.3

STORAGE CAPACITY

Due to the importance of storage space in a library that handles physical codices, the treatment of storage in this scheme has been carefully considered for both its experiential and practical value. The kind of storage needed by a community library differs from that of national or specialist libraries. A community library holds no obligation to act as a repository for cultural capital or historic documents, instead, general reference material and codices that are considered good reading are housed within its collections (Neufert et al. 2012:330). In addition, the content accessed by the library user is usually found after browsing the library's physical collections rather than by browsing a catalogue. Because of this civic role, the majority of the storage space of a community library needs to be accessible to the public whilst any archival or dead storage space should be limited to housing codices in need of processing or repair. In order to ensure that the library can house enough content to meaningfully fulfil its functional role well into the future, a square plan (the norm of many contemporary resource centres and information hubs) has been avoided and the geometry has instead been stretched into a rectangular hall. The use of a long rectangular plan is not only typical of the historical library type but also necessitates that a greater surface area of wall be built to enclose an interior area of the same size that a square could enclose with less wall space. This extension of the wall provides more space for shelving around the perimeter of the interior when compared to a square plan of the same area. This combination of large storage capacity in relation to its size along with a well-managed weeding process (the common practice of selling outdated or unpopular library books) will ensure that this library will be able to offer enough content to provide a meaningful service to the surrounding community.

7.4

INTERNAL ENVIRONMENT

The internal environment of the library has been designed to enhance a sense of enclosure and separation from its surrounding external condition whilst ensuring that the spaces of the library are still comfortable and useable. This has been achieved through a manipulation of haptic conditions such as thermal quality, acoustics and artificial light in order to establish an interior environment that is experientially distinct from the outer realm of Venning Park and the placeless environments that have come to typify our experience of public institutions and condition our collective memory of them.

7.4.1 - TEMPERATURE

The interior of the library has been designed to maintain a consistent and cool temperature in the interest of the comfort of its users and the preservation of its collections. The cool interior contrasts the typically warm South African climate whilst enhancing the sense of being within a stone building. Thick walls, small openings and high thermal mass limit heat gain whilst a passive ventilation system facilitates adequate air flow and changes. Utilising a consistent soil temperature and the shape of the roofs, the passive ventilation system pulls cold air from the subterranean corridor that runs the entire length of the library, into each of the pyramidal volumes. Once the air heats up, it rises into the pyramidal volume of the roof where the Venturi effect will force it quickly upwards towards the apex where it can be flushed out. This geothermal system of a sunken, cold spine that runs the entire length of the building was used instead of an evaporative cooling system (that would make use of the lily ponds) to minimise the humidity levels within the library in the interest of protecting its collections. In order to ensure that the building does not become too cold in winter, fireplaces have been scattered throughout the library near gathering spaces which along with carpets (rolled out in winter to help insulate the stone floors) would provide places of comfort and respite during the colder season. Along with these, the library's courtyard is planted with deciduous trees meaning that it will provide a place to use the library's facilities whilst sitting in the sun on an otherwise cold day.

7.4.2 - ACOUSTICS

Accommodating the variety of rituals and user types associated with the library without excessive regulation or compromising the public's sense of ownership over the institution necessitates that the library's spaces be acoustically comfortable in order to create a public space robust enough to effectively fulfil its civic role. The buildings distance from the busy roads surrounding the park along with its thick walls and double sets of windows help acoustically insulate the interior of the building from the outside world. Once within, the library's book lined walls prevents noise from growing beyond comfortable ambient levels by providing a comprehensive layer of sound absorbing material that wraps the perimeter of the building. This layer absorbs and scatters excess noise generated from within the library whilst the articulation of the timber panelling helps break up any large reflective planes to ensure that the library's interior maintains an acoustically gentle atmosphere without absolute silence constantly enforced by staff.

7.4.3 - ELECTRIC LIGHTING

In accordance with the strategy previously laid out for the use of light within the scheme, the use of artificial lighting is not only typical of the library type but also allows for a consistency and control over the atmosphere of the building's interior. Rather than make use of the cold and uniform light provided by the ubiquitous fluorescent tube, warm coloured LEDs (3000 Kelvin) will light the library's lamps and lighting strips. Providing 500-1000 lux directly onto the reading surface to increase letter contrast, adjustable reading lamps that create a brightly lit reading area in an otherwise darker space establish more comfortable reading environments than bright, uniformly lit spaces. The dimmer ambient light reduces eye strain and letter blurring whilst reducing the risk of overhead shadows falling onto pages. Chosen for their energy efficiency, low maintenance and aesthetic flexibility, the LEDs in the lamps also emit very little heat and almost no UV radiation meaning that they present a negligible threat to the library's collections when compared to natural light or other forms of artificial lighting.

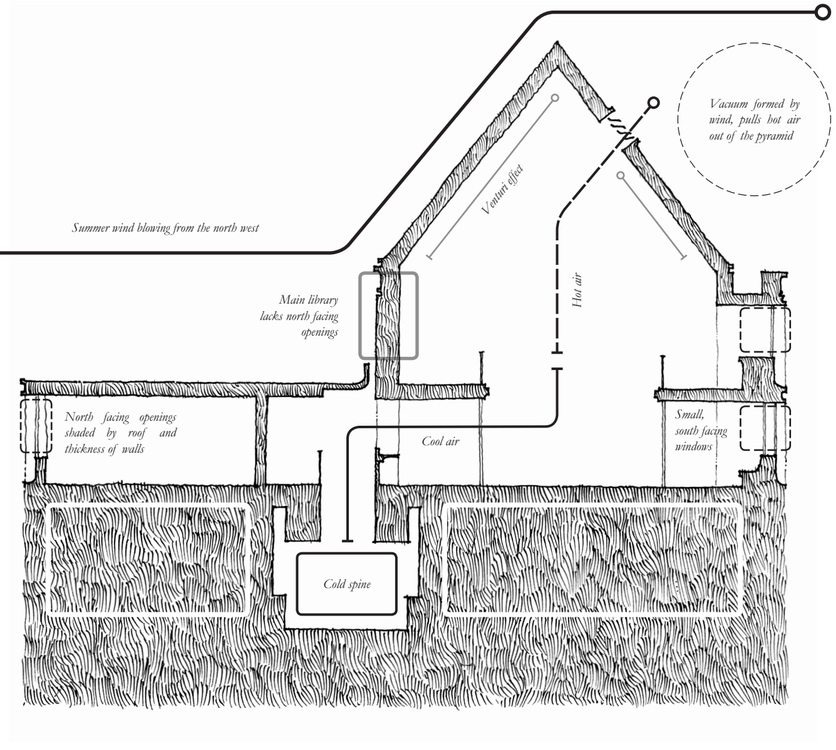


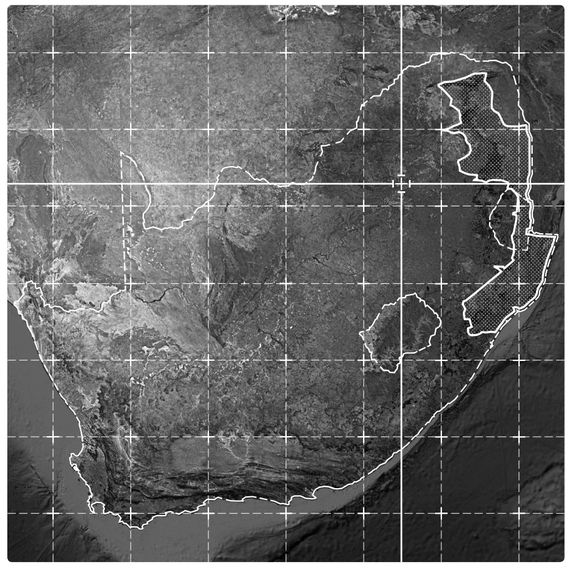
Figure 7.1 - Thermal condition of the library

7.5

MATERIALS

The three primary materials that give form to the library are slate, timber and steel. Each plays a specific role in defining the atmosphere of the library and have been used strategically according to the character and properties of each material. Acting as an articulating material, steel has been used to separate and define the edges of other materials and is primarily used in details and trims where it clarifies and emphasises the separation of elements. It is also used structurally where distances become too large to span economically using other materials. When compared to stone or timber, steel has been used relatively sparingly throughout the scheme due to its high embodied energy. Despite this, the material is contextually relevant due to the fact that it is manufactured in the Pretoria region and has a tendency to oxidise upon weathering. When used in the spouts, gutters and ponds of the scheme, the oxidised steel and the stains it leaves on other materials strengthens the connection between the library and its site through a celebration of the relationship between the building and water.

The use of timber within the scheme takes two forms: an external skin of wax impregnated SA pine for the ancillary buildings surrounding the main library building and an internal skin of Brown Kiaat wainscoting for the main library building. Timber interiors are typical of the library type and have been ubiquitous throughout the institution's history. In addition to this, the haptic qualities of the material establish an atmosphere of warmth and domestic comfort which encourages appropriation and a sense of ownership by the public who use the library. Brown Kiaat was chosen for its aesthetic qualities and availability. A commonly used wood that is prized for its workability, durability and affordability when compared to other hardwoods (Geldenhuys 2013). Along with Kiaat, wood harvested from the two large cypress trees cleared from the site to make way for the building will also be used inside the library for important fittings and furniture pieces.



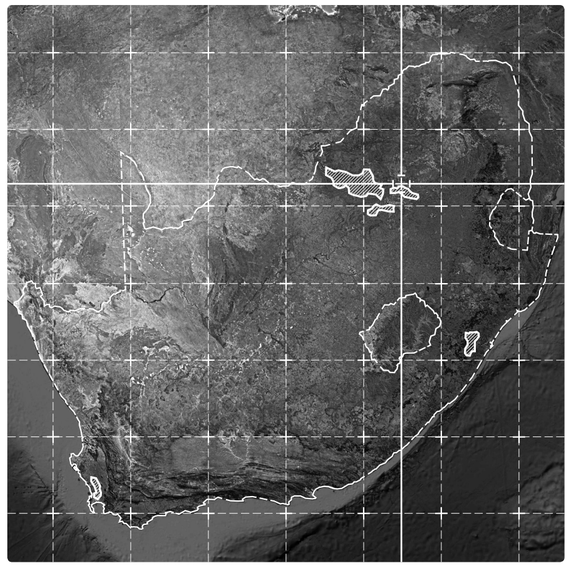
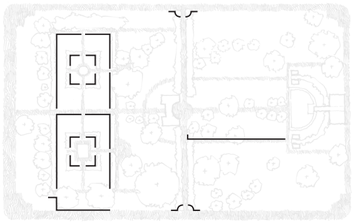


Figure 7.2 - Location of local Kiaat forests

Figure 7.3 - Location of local slate deposits

The final material used to give form to the library is slate, as the boundary between inside and outside, the permanent and heavy nature of the stone is used to establish an atmosphere of mass, enclosure and separation. Chosen as a contextual response, slate is used to root the library to its surrounding place. Geologically, it forms the bedrock of the city of Pretoria and has been used throughout Arcadia to build boundary and retaining walls that can be seen in both the gardens of the Union Buildings and the gardens of suburban houses. In the park, the Arts and Crafts era retaining walls (extant) and flagstone paths (now cement brick) were originally made from local slate and are essential to Venning Park's historic value and character of place. Quarried locally from the large slate deposits surrounding the city, slate is a highly durable building material with a very low embodied energy. The natural property of slate to split along its grain when struck also means that minimal capital and specialist equipment is needed to harvest the mineral, providing the opportunity for entrepreneurs and surrounding community members to easily found small scale quarrying operations (Kayamandi Development Services 2006). Despite its potential to spur economic growth, high quality slate is still expensive and because large quantities are required to build the library, an innovative approach to using the material needed to be developed.



Location of slate retaining walls on site

HERITAGE RESPONSE

Arts and Crafts era slate retaining walls

Figure 7.4 - The use of slate as a contextual and heritage response

GEOLOGICAL RESPONSE

Slate bedrock of the city

DENSITY:
2800 - 3040 kg/m^3

MINERAL COMPOSITION:
clay minerals, silt, quartz, muscovite, feldspar, hematite

COMPRESSIVE STRENGTH:	WATER ABSORPTION:	THERMAL MOVEMENT:	MOISTURE MOVEMENT:
42.5 - 216 MPA	Less than 0.4%	0.93% mm/m per 90°C (requires joints every 3m)	Negligible

MATERIAL PROPERTIES

STONE TYPE
- Sedimentary
- Metamorphic
- Igneous

Stronger in both tension and compression when compared to other dimension stones of the same thickness

Highly durable building material with good resistance to acid and alkali damage, should last in excess of 150 years

Chemically inert mineral making it ideal for reconstitution

Usable as a roof, floor or wall material in both internal and external applications

Rated durable enough for heavy duty commercial applications

THE PROPERTIES OF NATURAL SLATE

7.6

A MINERAL EXPLORATION

As celebration of boundary and mass, the design of the library necessitated enough material to build the thick walls along with large singular blocks of material to articulate the elevations and openings. Although slate is available in large blocks, they would prove to be prohibitively expensive due to the cost of the material, its difficulty to transport and the lack of local stone masons skilled enough to work the material. In order to ensure that the design of the library is rooted to place whilst remaining economically viable, further investigation into the material revealed that great volumes of waste slate in the form of small shards and dust is generated by the quarrying and cutting process. Because of the low cost of this readily available and easily transportable waste, the potential for slate reconstitution was explored through literature on the subject (Anon 1920, Everett and Barritt 1994, Handisyde 1963, Oti et al. 2010a, Oti et al. 2010b) and developing my own samples of proposed new materials (for results of explorations see pp. 103-106). Conceptualised as a building built entirely from "stone" albeit in different forms, the materials that give form to the final scheme is a combination of two kinds of this reconstituted slate and the stone in its natural form.

1

TONNE

useable, cut stone

8

TONNES

waste tips, shards and dust

Product of the quarrying and manufacturing process

Limited commercial use outside of roof felting

Easy to transport without risk of breakage

Available at a low cost

Ready for reconstitution without processing

Figure 7.5 - Waste ratio of South African slate

7.6.1

OLD SLATE

100%
Natural Slate

COMPOSITION

Rustenburg
and surrounds

Less than
100km away

SOURCE

Ground floor plane
and building plinth

WHERE USED

Old slate is the term used to describe slate used in its natural form which is simply split or cut without any reconstitution. Formed over millions of years by the compression of clay and silt layers in the valley between Pretoria's quartzite ridges, this is the slate in the same form as it is found on site and in its surrounding context. Old slate is used around the lower portion of the library where it connects to the earth such as on floors and the plinth of the building, it is used at this lower level to allow users to meaningfully experience and appreciate this ancient material. The natural stone plinth also mediates the transition between earth and the building whilst referencing the low stone walls found on site. The plinth is built in the same way as these Arts and Crafts era walls, where thick slabs of sawn slate are laid on an equally thick mortar bed which is flush with the edge of the stone. This flush surface allows any excess water to run off the wall so as to not damage the vulnerable cut edge of the slate. Although vulnerable to water causing delamination at its edge, natural slate is practically impervious to water perpendicular to its grain, meaning that the slate plinth also acts as a waterproof base to isolate the dry interior of the library from the damp earth thanks to the layered slate forming a natural damp proof course.

Figure 7.6 - Surface texture of old slate

7.6.2

NEW SLATE

40%
Natural Slate

60%
Clay

COMPOSITION

Clayville, Midrand

Less than
25km away

SOURCE

Wall planes
and roofs

WHERE USED

Because Pretoria slate is primarily made up of mineralised clay that has been compressed into stone, clay and slate have been conceptualised as essentially the same material but in different forms. From this understanding, reconstituted slate which uses clay as a binder is argued to be the closest kind of reconstitution to natural slate because an additional material has not been introduced into the composite and the entire material is made from clay, some ancient and mineralised and some new and un-mineralised. New slate is a clay based slate reconstitution where slate powder is mixed with clay as a grit and then fired into bricks, a black clay mix is used to ensure that the colour of the new slate matches the old slate with the only visual difference being their texture. In order to fit into the module of the library, the new slate bricks are made to a custom size where they resemble slabs rather than bricks in reference to the natural stone used on site and in the building's plinth. New slate is used to build the majority of the library's exterior skin because of its close relationship to natural slate and relative affordability, it also references Pretoria's established regional tradition of building with brick.

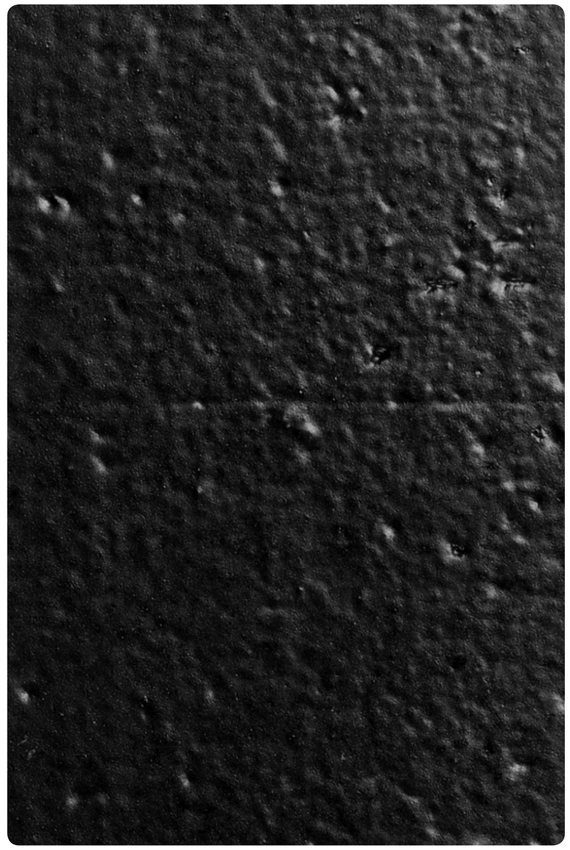


Figure 7.7 - Surface texture of new slate

7.6.3

CAST SLATE

80%
Natural Slate

20%
Portland Cement

COMPOSITION

Daspoort, Pretoria

Less than
6km away

SOURCE

Articulation
around threshlds
and openings

WHERE USED

In order to be able to use large blocks of material to communicate the mass and solidity of the building's walls, a reconstituted slate material needed to be developed that had the same singular character as a block of natural stone. This reconstitution needed to be able to be easily poured into moulds to make precast elements to ensure quality due to the scarcity and expense of skilled stonemasons who would be able to cut such precise elements. Cast slate uses dyed Portland cement to bind a mixture of slate shards and powder into large blocks or elements. These elements are used wherever a sense of mass or solidity needs to be expressed such as where the interior of the building meets the exterior such as arounds thresholds, windows or chimneys. Alternatively the flexibility of form making offered by the casting process makes cast slate elements useful where intersecting geometries or levels need to be mediated. Once cast, the aggregate of the cast slate is exposed and then polished to reveal the natural colour of the slate which matches the colour of the cut edges of the old slate and the satin black of the new slate whilst differing in texture from both. In order to determine the final mix that would result in an appropriate colour and texture, multiple test blocks were made to compare cast slate recipes against the appearance of cut natural slate (fig. 7.9).

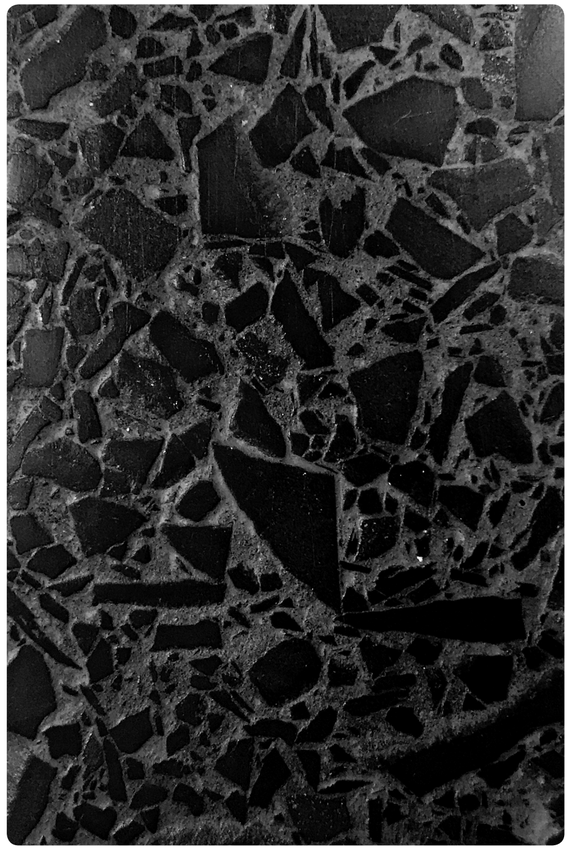
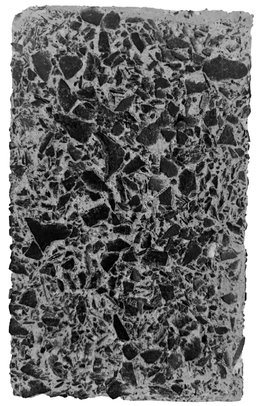


Figure 7.8 - Surface texture of cast slate

Figure 7.9 - Exploration samples made to create cast slate with the desired finish

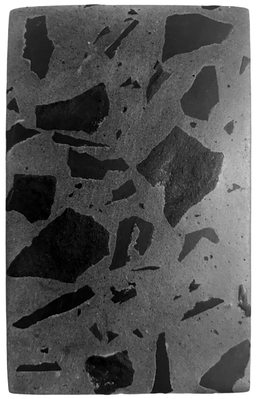


FINISH:
Exposed
aggregate

COMPOSITION:

85% Slate Shards
and Dust
15% Cement

01



FINISH:
Polished

COMPOSITION:

30% Slate Shards
70% Cement

04

FINISH:
Exposed
aggregate

COMPOSITION:

10% Slate Shards
laid on formwork
90% Cement and
Black Oxide

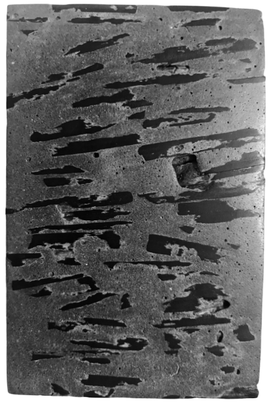
02

FINISH:
Exposed
aggregate

COMPOSITION:

70% Slate Shards
30% Cement and
Black Oxide

05

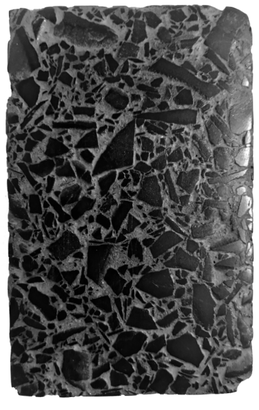


FINISH:
Polished

COMPOSITION:

40% Slate Shards
stacked upright in
formwork
60% Cement

03



FINISH:
Lightly Exposed
and Polished

COMPOSITION:

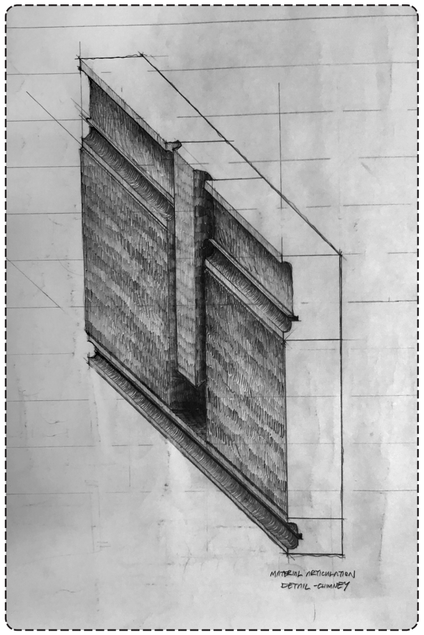
80% Slate Shards
20% Cement and
Black oxide

06

7.7

A NOTE ON MOULDINGS

Described as a play of light, shadow and water (Michael and Peter 2015), mouldings have been used throughout the scheme to articulate edges, connections and individual elements. In contrast to the contemporary tradition of understanding materials as flat, unbroken planes which are only significant and varied at their connections to other materials, this scheme explores the value of articulating not only these connections between different materials but also the surfaces of the materials themselves. The articulation of large surfaces ensures that the library maintains a human scale despite the actual size of its volumes whilst establishing specific atmospheres for different spaces such as on the elevations of the main library building, where horizontal mouldings are used to emphasise the heavy and static quality of the building by breaking the continuous vertical lines suggested by lined up windows. On closer inspection of these articulating elements, each moulding has been designed to describe its own role and contribute to the overall character of the building such as in the abovementioned horizontal moulding which is made up of two symmetrical cavettos separated by a deep sunken fillet, a form which uses the play of light and shadow to evoke a notion of separation by creating a continuous 'groove' that wraps the entire perimeter of the building and suggests where its top half and bottom half are joined. Along with an artful mediation of light and shadow and facilitating the appropriate weathering of the building, mouldings also reveal the mathematical sophistication of the modular system used to order the design of the library with each of their details and components lining up with an entire module or fraction thereof.



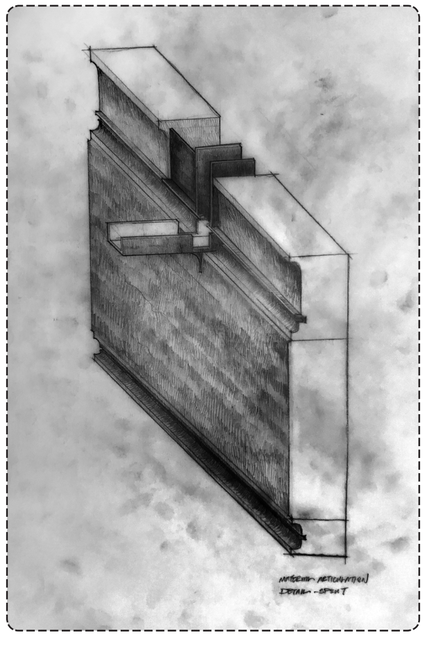


Figure 7.10 - Surface articulation and moulding explorations

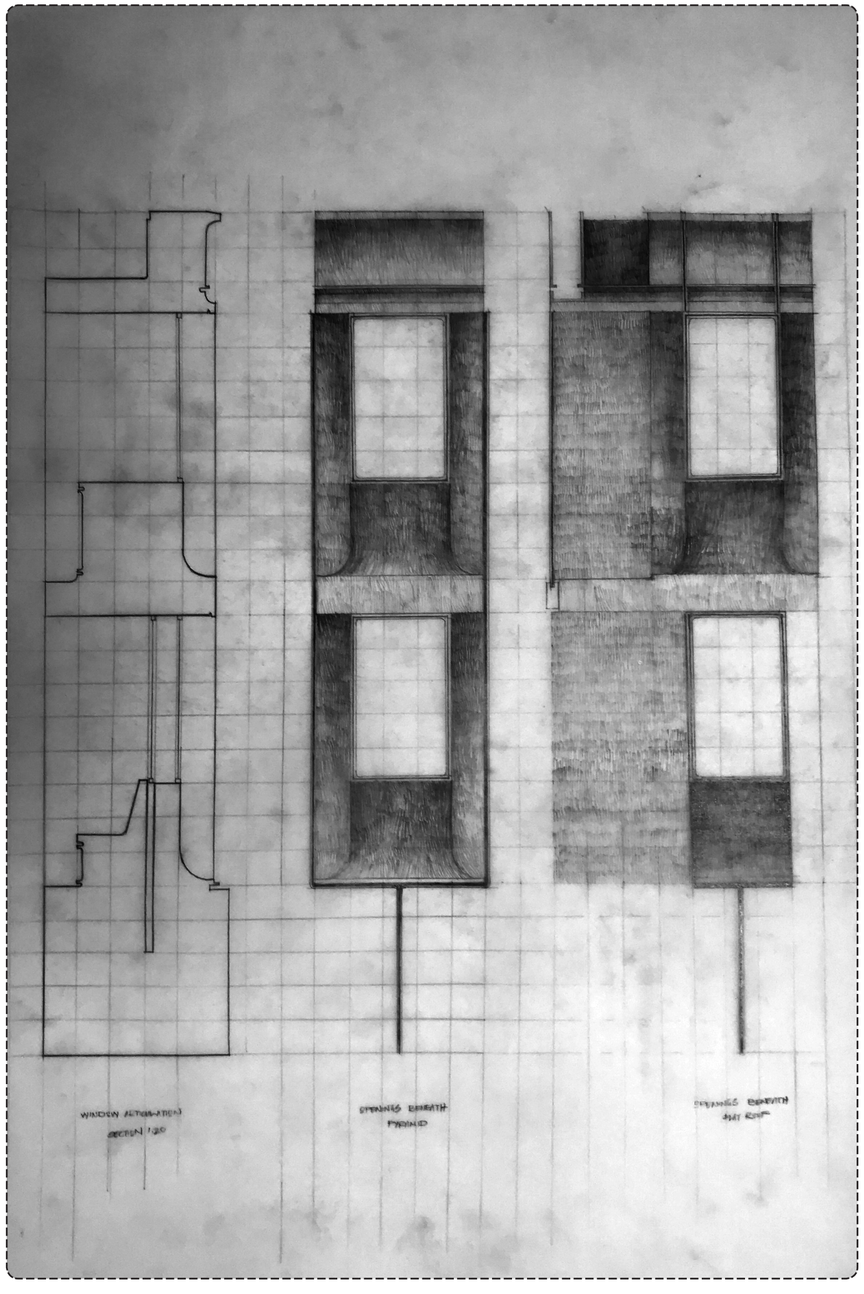


Figure 7.11 - Designing the treatment of openings