SPECTRACENTRIC:
Colour and light as intrinsic design tools

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at the University of the Witwatersrand, Johannesburg, South Africa in the year 2009



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Sections are colour coded, as shown by swatches below and prism logo at the foot of each page

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Just add sunlight!

Note for PDF version:

Sketch pages were originally printed on tracing paper to overlay following page. An attempt has been made to reproduce this but an explanation will help in the reading of sketches and labels that relate to following pages and seem inconsistent with the rest of the document.

Acknowledgements

Thanks, firstly to Paul Kotze, whose encouragement and enthusiasm pushed me through this year, and whose support and humour helped me to enjoy the journey.

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for Grandpa Hardisty,
of whom my only living memory is his teaching me the colours of the rainbow



fig 1. *Bleigiessen* Glass Sculpture, London - by Thomas Heatherwick.
(Photo by Author)



fig 2. Reflected Light
Bleigiessen sculpture detail
(Photo by Author)

Declaration

I, Melinda Jane Hardisty [0705018V] am a student registered for the course
Master of Architecture [Professional] in the year 2009.
I hereby declare the following:

I am aware that plagiarism [the use of someone else's work without permission and/or without acknowledging the original sources] is wrong. I confirm that the work submitted for assessment for the above course is my own unaided work except where I have stated explicitly otherwise. I have followed the required conventions in referencing thoughts, ideas, and visual materials of others. For this purpose, I have referred to the Graduate School of Engineering and the Built Environment style guide. I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my unaided work or that I have failed to acknowledge the source of the ideas or words in my own work.

M.J Hardisty

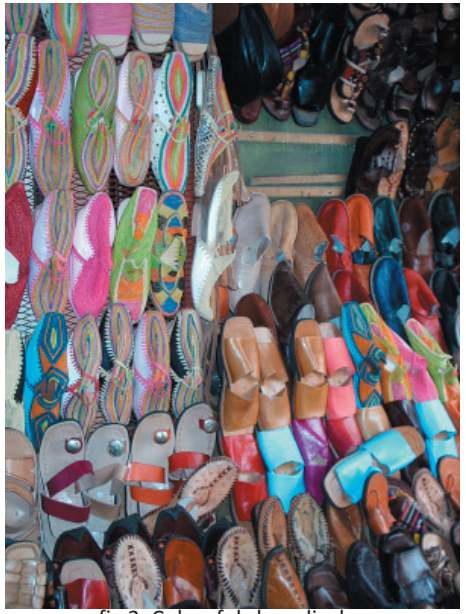


fig 3. Colourful shoe display
Marrakech souq, Morocco
(Photo by Author)



fig 4. Bright World
Blue pot, Chef Chaouen, Morocco
(Photo by Author)

Research Essay Abstract

This thesis aims to show that colour choices in architecture should be considered as intrinsic to the design process. Colour will first be discussed in terms of what it is and how it functions, including the fact that colour and light are inseparable elements. We also see how our eyes function in terms of colour and why we perceive it as we do.

If colour is inseparable from light, and if varying light conditions change the appearance of colour, more attention should be paid to context in terms of natural light when choosing colour for building projects. Africa's unique light qualities will be considered as different to other places and some reasons for this will be touched on.

Colour is believed to affect humans on various physiological and psychological levels. Some of these will be discussed, particularly those that are more widely accepted, but also a few that are more localised beliefs, exploring the effects of culture and upbringing on colour perceptions and associations.

In relation to built space, colour is a large factor in our perceptions of spatial quality. We look at some of the reasons for this and how we can use this colour behaviour to our advantage to manipulate space. This leads on to how colour and light can be used in other ways to relate a building not only to its localised geographical context, but also to its place in time. We look at natural colour and light progressions over days, months or seasons and then explore ways to harness this in our designs.

Finally, further to contextualising a project in place in terms of natural light quality and cultural colour ideals, and beyond utilising nature's cycles to position a building in its time-line, we look at the greater scope of colour and light, their origins in the Universe, and how a design can consider a wider contextuality, revealing a building's position on the earth and, indeed, in relation to the cosmos.

These research findings, with the consideration of precedent studies, will be incorporated into the design of a built complex, namely an astronomy and art centre in the Karoo region of South Africa.



fig r1. *Marco Contemporary Art Museum*. Monterrey, Mexico. (1966) -Ricardo Legorreta
(Image in Mutlow, 1997: 47)

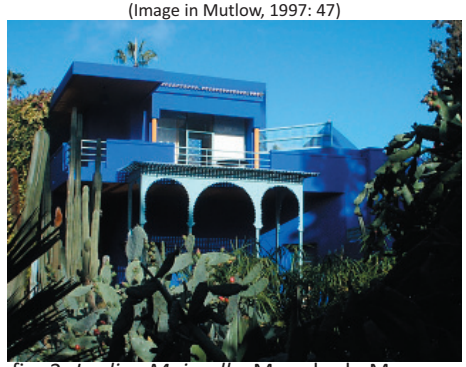


fig r2. *Jardine Majorelle*. Marrakech, Morocco.
(Photo by Author)



fig r3. Spring Flowers. Guernsey.
(Photo by Author)

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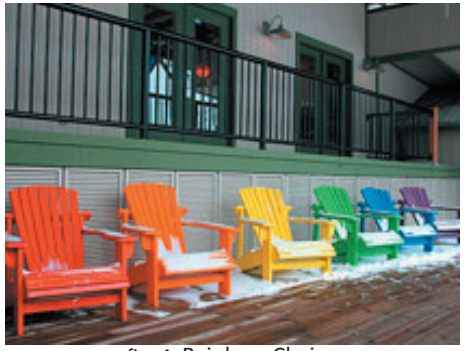


fig r4. Rainbow Chairs.
Colour in the snow.
(Image in Kukkuk, 2009: 1)



fig r5. Blue Steps.
Chef Chaouen, Morocco.
(Photo by Author)

Introduction

"God gave us everything: life, earth, wind, and sun. His gifts have a common value, a marvellous value: He gave them to us with Colour! Without it the world would not exist, our life would be an unbearable monotony. Colour is the basis of our life's happiness and sorrows, it is the symbol of our emotions. Colour is...life!" – Ricardo Legorreta (Mexican Architect 1931-)
(Attoe , 1990: 64)

The importance of colour

Colour surrounds us every day and can affect our thoughts and emotions. Sometimes we may be aware of the effects and sometimes we may not. Architects aim to influence the lives and actions of people using the spaces they create, but often the colours used in a space are not considered as intrinsic to the design. Chromatic choice in the built environment "sometimes stems from the conscious manipulation of colour as part of the architect's design process but, more often, it is applied as an afterthought in the form of a protective or decorative skin." (Porter et al., 1976: 38) As designers in the built environment, we should be much more aware of the power of colour to create space.

Colour is a subjective sensation intrinsically linked to light. Without light, colour would not exist at all.(Porter et al., 1976: 78) Both colour and light are, in turn, dependent on their location or setting. In architecture, this has a lot to do with natural light, related to climate, as well as cultural or vernacular influences. It follows, then, that colour choice for the same building type would vary considerably from place to place.

This thesis will argue that colour is a vital component in any building design and the choices pertaining to colour should be intrinsic to the design process. It will explore what colour is and how and why we see it. It will also look at the psychological and special perception effects that colour has on people, both consciously and subconsciously.

I will also explore how light, and specifically natural light, plays a role in the appearance of colour, how geographical location is influential in this, as well as how a building's location in the world, or indeed, the universe, can be expressed in the space itself. Paying particular attention to our own setting, I will look specifically at local, African influences.



fig r6. *Francisco Gilardi House*.
Mexico City, Mexico. (1976) -Luis Barragan
(Image in Rispa, 1996: 199)

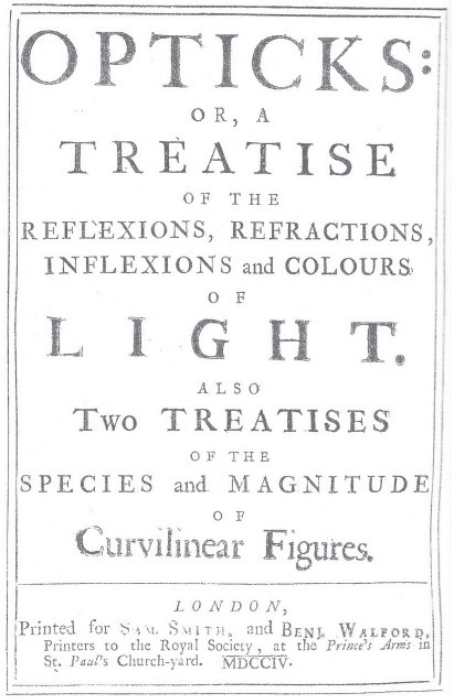

OPTICKS:
OR, A
TREATISE
OF THE
REFLEXIONS, REFRACTIONS,
INFLEXIONS and COLOURS
OF
LIGHT.
ALSO
Two TREATISES
OF THE
SPECIES and MAGNITUDE
OF
Curvilinear Figures.
LONDON,
Printed for SAM. SMITH, and BENJ. WALFORD,
Printers to the Royal Society, at the *Prince's Arms* in
St. *Paul's* Church-yard. MDCCIV.

fig r7. Preface from Newton's original *Opticks* publication.
(Image in Finlay, 2002: 8)

Colour Theory

"In the absence of visible photoelectric radiation 'colors' [sic] cannot exist either. In a completely dark room a blue carpet is as invisible as a red tomato or a white mouse. Colored [sic] objects merely have the property of appearing in their colors [sic] in a certain light."
(Kuppers , 1972: 20)

What IS colour?

The universe pulsates with energy that we call electromagnetic waves. The frequency of these waves (the size of the gaps between one crest or trough and the next) varies considerably. Radio waves, for example, can have more than 10km between them while cosmic waves only have wavelengths of about a millionth of a millimetre. X-rays, ultraviolet, infrared, TV and gamma rays fall in between.*(fig r8)* The human eye can only detect a tiny portion of these, those that fall between 0.00038 and 0.00075mm. This is visible light. The human eye can distinguish about ten million variations of colour within that range. (Finlay , 2002: 4)

In the 1600s, Isaac Newton famously directed a beam of sunlight through a hole in the wall of a dark room and into a prism. The white light was 'split', on exiting the prism, into a rainbow.*(fig r9 & r7, on previous page)* He had expected such a result. However, his real genius lay in the fact that he then directed the coloured light into another prism, this time upside down. (Finlay, 2002: 7) The emergent light had reverted back to a beam of white light. This was the first time a scientist had acknowledged that white light was made up of a 'spectrum' (Newton coined the term) of seven colours.
(Porter et al., 1976: 79-80; Finlay, 2002: 7; De Grandis, 1986: 12)

Newton's experiment was also the first time in recorded history that it was noted that each colour bends or refracts at a different but set angle in the prism. The shorter the wavelength, the greater the deviation from its original course. Red refracts least and violet most.*(fig r10)* (Finlay, 2002: 7; De Grandis, 1986: 12)

This coloured light can be seen through a complex process of cells and signals in our eyes and brains. The way we perceive coloured objects or surfaces has to do with how the coloured spectrum is absorbed or reflected by the object. This will be discussed further later.

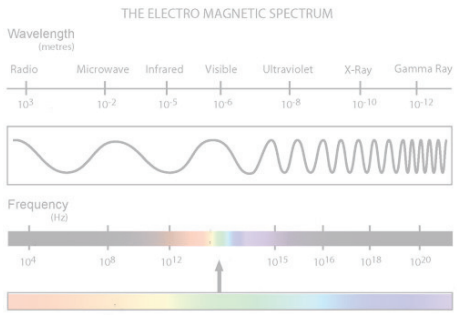


fig r8. The Electromagnetic Spectrum.
(Image in Colour Therapy Healing, 2007)

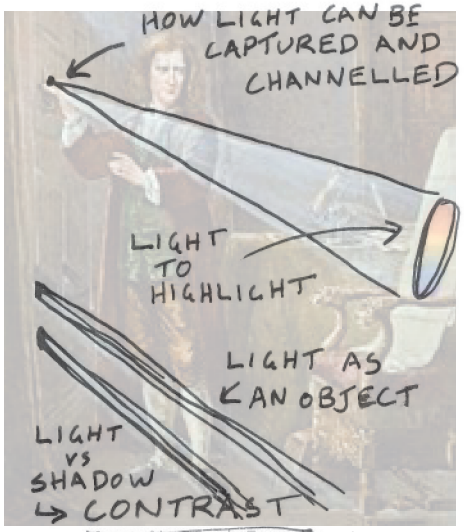


fig r9. Newton's Experiment-
the first time the 'spectrum' is identified.
(Image in Kurtus, 2005)

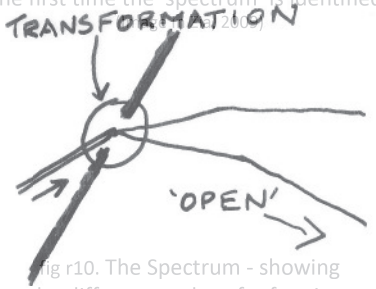


fig r10. The Spectrum - showing
the different angles of refraction.
(Image in Kurtus, 2005)

See project implementation on pages 130 & 131
(Spectrum Concept)

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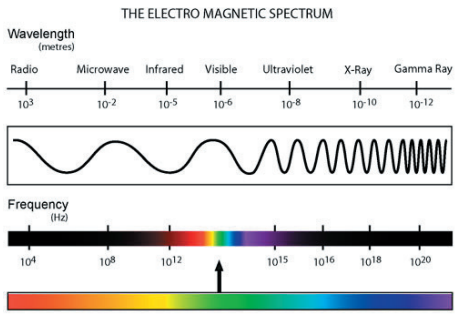


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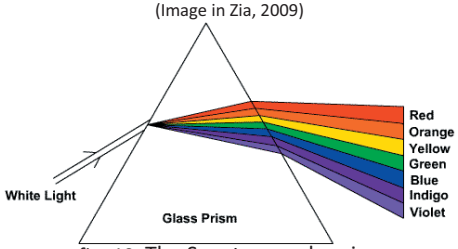


fig r10. The Spectrum - showing
the different angles of refraction.
(Image in Kurtus, 2005)

See project implementation on pages 130 & 131
(Spectrum Concept)

How do we see colour?

In the early nineteenth century, Thomas Young postulated that the eye must contain certain receptors that 'oscillated' with the particular wavelengths of light. He realised that this would mean there would have to be an infinite number of different wavelength receptors. After further research, he narrowed them down to just three basic (primary) colours, red, blue and green*(fig r11)*, and said that all other colours were combinations of these three. This was called the 'Trichromatic Theory', (Fraser et al. , 2004: 24) but is now also called the Young-Hermholtz theory. (Ratliff , 1976: 314)

The existence of these receptors was confirmed by scientists in the 1960s. The receptors were named 'cones', and were divided into three types, each sensitive to a different wavelength (and, therefore, a different colour), namely 570 nanometres (red), 535nm (green), and 425nm (blue). These three primary light colours can be 'additively' mixed to form all other colours visible to the human eye. (Fraser et al. , 2004: 24)

The 'opponent process' theory was developed in the late 1870s by Ewald Hering. He used it to argue against Young's trichromatic theory. His argument centred on the fact that yellow, for example, was perceived as an elementary colour in itself, and not as a combination of its parts, ie as a reddish-green or greenish-red. The theory worked with three opposing pairs, namely dark/light, red/green, and blue/yellow, and he maintained that it was impossible to perceive both elements of a pair at once. Later research has shown that this theory does not debunk the earlier theory, in fact, both theories are true but refer to different stages in visual processing. (Fraser et al. , 2004: 25)

These cones are spread over the back of our eyes in the retina and are especially closely packed in a small area called the 'fovea'. Because of the positioning of the fovea, our colour vision is most accurate in the centre of our vision. (Porter et al. , 1976: 83) *(fig r12)*

Cones operate best in higher light conditions, so they work primarily during the day, or in other well-lit conditions. Apart from the cones, the retina also contains a second kind of light sensitive nerve cell called a 'rod'. The rods are also spread over the retina *(fig r13)*, but they are more densely packed around the periphery, fairly sparse in the central field of vision, and non existent in the fovea. The rods, while being sensitive to light, do not read colour, only black, white and shades of grey, this gives rise to the fact that objects do not appear coloured below a certain level of illumination. (Porter et al., 1976: 79) They are more sensitive than



fig r11. *Red Blue Green* (1963)
A painting by Ellsworth Kelly.
(Photo by Pablo Mason, In Blouin, 2008)

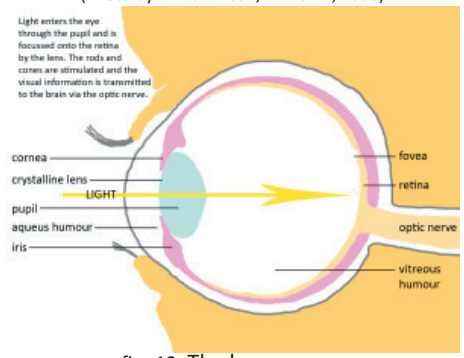


fig r12. The human eye.
(Image adapted from Fraser et al., 2009: 24)

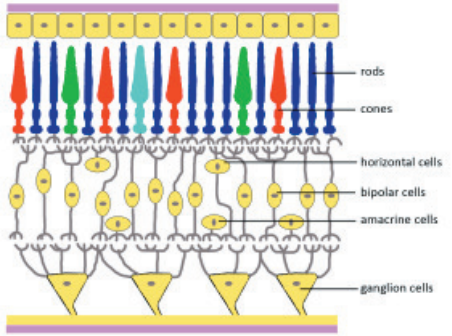


fig r13. Cones and Rods in the Retina.
(Image adapted from Fraser et al., 2009: 24)

the cones in low light conditions, so they come into play in the evenings, as daylight fades, or in other darker environments. (Porter et al. , 1976: 83) *(fig r14).* Nocturnal animals have only or mostly rods so that their night vision is good but they don't usually see in colour. (Murray , 1952: 174)

There is a tiny part of the eye where there are neither rods nor cones. This region is called the 'blind spot'. (Porter et al., 1976: 83) It is so small that we rarely notice it but it is sometimes highlighted in optical illusions. This spot is where the optic nerve connects to the eye. This nerve transfers messages from the receptor cells to the brain. In effect, the sensory image that enters our eye only becomes a colour perception when it is interpreted in the brain. (Porter et al. , 1976: 82)

When light conditions change, there is a switch between the rods and cones, this may happen quickly resulting in our eyes having to adjust when we move from bright sunlight into a dark room, but, in what is known as 'mesopic conditions' (Ratliff , 1976: 313), in the late evening or early dawn, both the rods and cones work together. Under these conditions, one notices that the colours of objects look quite different to their daytime colours. As our eyes start to favour the short wavelength area of the spectrum, reds, oranges and yellows start to appear colourless and darker greens and blues become clearer. (Gerritsen , 1975: 54) This phenomenon was first noticed and recorded in 1825 by a psychologist called Jan Purkinje. He noticed that, as he looked out into his garden in the evenings, the flowers seemed to appear more and more blue as twilight fell. This is due to the shift from the cones to the rods (whose pigments centre on the blue-green region of the spectrum). This is now known as the 'Purkinje shift'. (Ratliff , 1976: 314) *(fig r15)*



fig r14. *Little Venice* in Prague, Czech Republic. Muted colours of dusk
(Photo by Author)



fig r15. A room interior viewed in daylight and at night showing the cone/rod colour change.
(Image adapted from Fraser et al., 2009: 71)

Spaces for nocturnal activities will be in blues and purples to be able to be seen for longer. eg. Observatory, page 147.

Surface colour and colour mixing

We have already established that the three primary light colours are Red, Blue and Green. It follows that any colour we perceive beyond that is a combination of these three. The three secondary colours (the colours created by mixing two primaries in equal quantities) are Yellow, Magenta (a pinkish purple), and Cyan (a bright blue green).

The colours respond along the lines of the following equations:

- Red + Green = Yellow
- Red + Blue = Magenta
- Green + Blue = Cyan
- Red + Green + Blue = White

This mixing, which only relates to the mixing of light, is referred to as "additive mixing". It is also called the RGB Model.*(fig r16)* 'Subtractive mixing' approaches colour mixing from the opposite direction. Using this method, the secondary colours (Cyan, Magenta and Yellow) are mixed to derive the primaries, and get a resultant black, not white, when they are all mixed. This is most commonly used with pigments, especially in most modern printers. It is also called the CMY Model.*(fig r17)* (Fraser et al. , 2004: 25-26) This method is easier to accomplish with pigments as each colour absorbs more light than it reflects and mixing them together will result in a darker colour, and all three mixed will never result in white. This is why printers or painters start with an assumed white background and work from there, mixing all three when black is necessary. (Fraser et al. , 2004: 27) Most of the colours we see daily are formed 'subtractively' because an object 'subtracts' all the colours from the light except the colour it appears. (Porter et al. , 1976: 82; Licht, 1961: 9)

Its worth mentioning that artists, particularly painters, have not exactly followed suit. Any child in a school art class may tell you that the primary colours are Red, Yellow and Blue, and that the resultant secondaries are Orange, Green and Violet. This is thought to be mostly due to the availability of basic pigments over the centuries, but also to the fact that red and blue are probably more useful in their own rights as colours. So, artists continue to use the RYB model. *(fig r18)*(Fraser et al. , 2004: 27)

The colour we perceive an object to be is actually an indication of the light colours that it absorbs or reflects. So, a blue ball in daylight (white light containing all the specrum colours) is blue because its electron make-up is such that it absorbs all the light colours EXCEPT blue (ie. the red and green) but reflects the blue light, which then becomes visible to us. *(fig r19)*

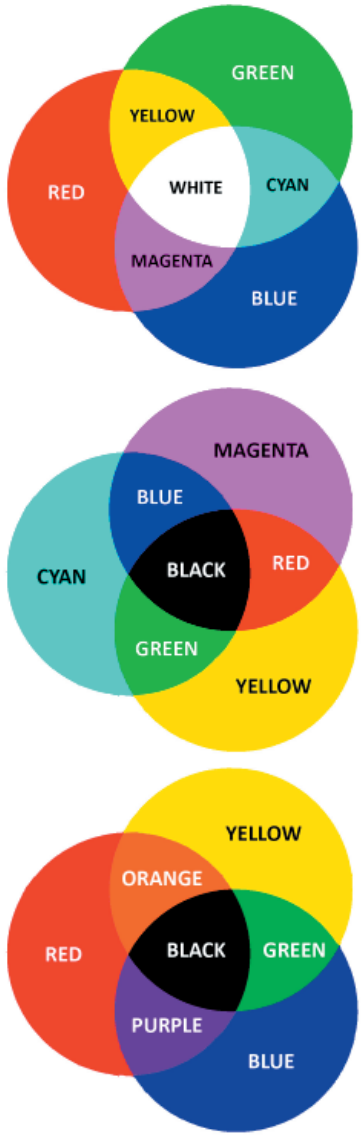


fig r16 (top). RGB Colour Model.
fig r17 (centre). CMY Colour Model.
fig r18 (bottom). RYB Colour Model.
(Images based on Fraser et al., 2009: 26 & 27)

Colour Profiling

Over the years there have been many attempts to create colour wheels, colour charts, and other methods of defining and regulating colour. (De Grandis , 1986: 21-28) Probably the most well known are the Ostwald and the Munsell systems. (Porter et al. , 1976: 82) More recent years have seen the development of the Natural Colour System (NCS). This has the potential to be more useful to designers, especially in colour specification as it can be used universally across materials and manufacturers and it doesn't rely on invented and subjective colour names like "Purple Stillettos" or "Summer Memory". (Hard, 1976: 116) *(Fig r20)*

The Natural Colour System (NCS) is a way of classifying colours based on how humans perceive and understand colour. It is a tool that can be used by designers from concept design and visualisation to specification and production. It is a precise method of identifying colour and is most useful in the fact that it can be cross-referenced between different products like paint, powder coatings, claddings, tiles or textiles. (Taylor , 2009: 29 & 30)

Leonardo da Vinci is often attributed with developing the first colour system in 1510. It was a simple straight line consisting of the '*six primary colours*', Black, White, Yellow, Green, Blue and Red. (Taylor , 2009: 30) Ewald Hering's '*Opponent Theory*' forms the basis of the modern day NCS, (Taylor , 2009: 30) but it was mostly based on the '*Swedish Colour Centre*' theories of the 1960s. (Porter et al. , 1976: 108) NCS was adapted as the Swedish standard in 1979 with 1412 colours. It is also the national standard in Norway, Spain and South Africa, and is reputedly the most widely used colour system in Europe. (Taylor , 2009: 33)

NCS defines a colour in relation to da Vinci's 6 colours. The *hue* of a colour is defined as the degree of similarity of a particular colour to Yellow, Red, Blue or Green. Secondly, the *chromaticness*, or *saturation,* is the degree of similarity to the most conceivable colour strength of a certain *hue*. Lastly, a colour is described in terms of *nuance*, its similarity to black or white. (Porter et al., 1976: 108; Taylor, 2009: 29)



fig r19. Diagram showing how light is reflected and absorbed to reveal colour.
(Image adapted from Fraser et al., 2009: 27)



fig r20. *Plascon* colour swatches.
(shows: *Purple Stillettos* & *Summer Memory*)
(Scanned from Plascon colour sample swatches)

Colours are represented in diagrams as well as being assigned codes. A three-dimensional model called the *NCS Colour Space* or *Colour Solid* (Hard , 1976: 110)*(fig r21)* forms the basis of the colour system. For ease of understanding and use, this model is then divided into two-dimensional diagrams. The first is a colour wheel. The 4 chromatic colours (Red, Yellow, Green, Blue) are placed around the wheel like compass points, and then 100 steps are filled in with the colours in between.*(fig r22)* These colours are the full chromatic colours. In the 3D model, this wheel would have an axis formed by the line between white (top) and black (bottom). (Taylor, 2009: 29-30; Scandinavian Colour Institute, 2009)

The second 2D representation is the colour triangle. This is the triangle formed, in the 3D model, by linking a single chromatic colour with both black and white. All the colours in between can then be graded in relation to these points. So, there will be a colour triangle for each chromatic colour on the colour wheel. (Scandinavian Colour Institute , 2009)*(fig r23)*

The notation code showing nuance and hue is derived from the colour triangle. For example, a code might read **S 1050 Y90R**, where the **S** simply means it is an NSC standard, the **1050** represents the *nuance*, and the **Y90R** represents the *hue* (ø). The nuance figure is made up of *blackness* (s), and *chromaticness* (c). In this case, the blackness is **10**, meaning 10% out of a possible 50%. The whiteness is not shown in the code, but would be 40%, derived from the remainder of the 50% not attributed to blackness. The chromaticness is **50**, meaning 50%. (So the full equation would be 10% Black + 40% White + 50% Chromaticness = 100%). The hue code, shown as **Y90R**, indicates that the colour being described lies between Yellow and Red. The **90** represents the percentage of Red, the Yellow will be the remainder, ie. 90% Red + 10% Yellow. (Scandinavian Colour Institute , 2009:)

In this way, a colour can be described accurately and uniformly across material types and manufacturer's specifications. Where science can only specify spectral energy, the colour system attempts to incorporate experience and perception. The NCS system can produce an endless diversity of colours, exceeding the limits of so called 'closed systems', making it immeasurably versatile as well as easy to use. (Taylor, 2009: 33)

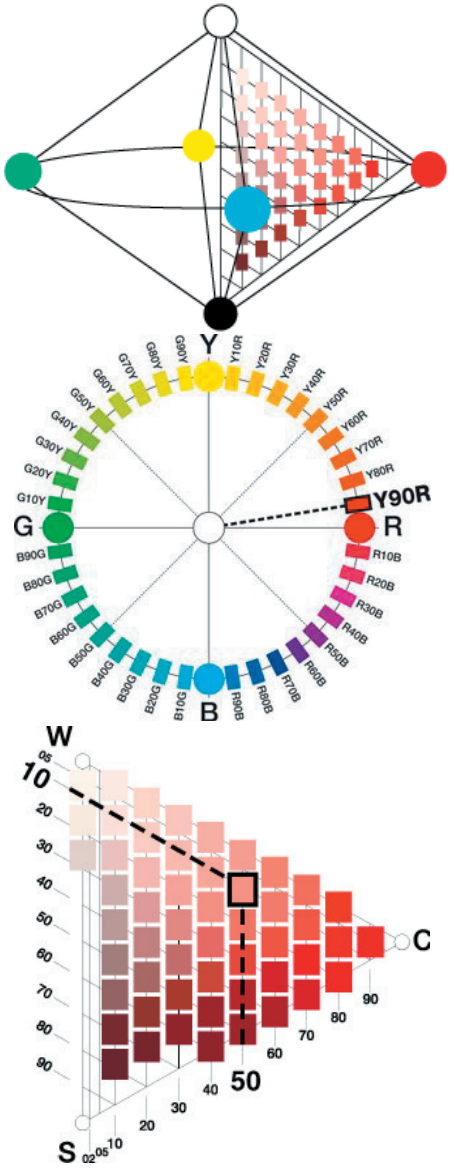


fig r21 (top) *NCS Colour Space*.
fig r22 (centre) *NCS* Colour Wheel.
fig r23 (bottom) NCS Colour Triangle.
(fig 19 in Saayman, 2007)
(fig 20 & 21 in Scandinavian Colour Institute, 2009)

Colour Under African Sky

“Now one might ask which sunlight is meant: sunrise, sunset, cloudless sky or white clouds with blue sky, or grey cloudy sky?”
(Gerritsen , 1975: 29)

While we often note varying climatic conditions when we travel, we don’t necessarily relate this to light quality or colour perception. In Marrakech in Morocco, for example, with bright sunshine and clear skies for much of the year, the *Jardine Majorelle* (Majorelle Garden) is painted in a vivid cobalt blue with stunning results. A guidebook entry for the gardens remarks that “sensitive souls tempted to try Majorelle Garden blue in decorating schemes back home in northern climes should beware – the result depends on bright sunlight filtered by lush vegetation.” *(fig r24 & r25)* (McGuinness , 2003: 334)

The bright, clear atmosphere of Africa, especially, closer to home, the expansive South African interior, has been widely commented on by early explorers, colonial settlers and artists alike. The light quality is undeniably different to, say, Europe, as expressed here by an English immigrant to South Africa in the late 1800s, “...I think that to a considerable extent it [*the writer’s perceived lack of beauty in Africa as compared to her home*] is caused by a want of atmosphere, to use a phrase common to artists. In this part of the world the sun rises, when the sky is cloudless, in a bright yellow halo. It is yellow...and the light it throws on all around is simply a bright yellow light. There are no delicately shaded tints, as it fades into shadow, or plays over an uneven surface.”...”It is very seldom one sees the beautiful rose-flecked sky”, “ the sky is very blue – a cobalt blue, deepening into indigo as it nears the horizon, but without a trace of the rose-pink [of the English sky]... Even the moonlight is not so ethereal as in other countries, although it is often very bright.” (Heckford , 1882: 6-7) (It should be noted that the author’s reference to ‘yellow’ sunlight is more a comment on the brightness than the actual colour. Sunlight is always white light as it contains all the wavelengths and, therefore, all the spectrum colours.) *(fig r26)*



fig r24. *Jardine Majorelle*.
Marrakech, Morocco.
(Photo by Author)

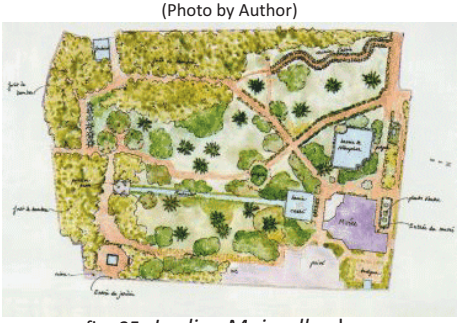


fig r25. *Jardine Majorelle* plan.
Marrakech, Morocco.
(Image in Lacroix-Fournier, 2009: 1)

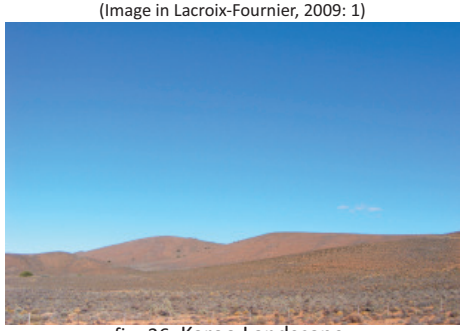


fig r26. Karoo Landscape.
Northern Cape, South Africa.
(Photo by Author)

Christian Norberg-Schulz, twentieth century Norwegian Architect and theorist, attempts to unravel the idea of 'place' in his book, *Genius Loci: towards a phenomenology of architecture*. He maintains that man's identity ultimately depends on his belonging to places. (Norberg-Schulz, 1980: 6) 'Place' is made up of a multitude of tangible and intangible elements, everything that makes up our experience of the world around us. (Norberg-Schulz, 1980: 6) Different activities require different types of places, and so we see differentiation between different settlements, different rooms within a building and the 'inside' and 'outside' realms. The place is created by natural and man-made elements. (Norberg-Schulz, 1980: 8-10)

Though 'place' refers to something more than location, they are often defined in geographical terms, making the natural elements the primary components of place. (Norberg-Schulz, 1980: 10) The site, topography or climate will often be the most obvious factors defining a specific 'place'.

"Each particular place has its light." (Millet , 1996: 6) This characteristic light is affected both by the physical characteristics of a place or region, and by the particular changes that occur in a specific place over time. (Millet , 1996: 6) In terms of adding to a place or landscape through architecture and building, "the spirit of a place, its genius loci, can be conveyed by responding sensitively to its light." (Millet , 1996: 8)

One of the main reasons for this change in character of sunlight from place to place is the fact that solar rays undergo changes in speed, diffusion and direction as a result of variations in composition and distribution of the media it travelled through from its source to the earth. Variations are caused by gaseous, solid or liquid particles suspended in the air. This includes gas molecules, meteoric, terrestrial, volcanic or saline dust, seeds, pollen, bacteria and water droplets. (De Grandis , 1986: 85) It follows, then, that the dry atmosphere and the lack of pollution (especially when first colonised) in rural Africa (or similar parts of the world) are probably the biggest factors influencing the clarity of light noted above. *(fig r27, r28 &r 29)*



fig r27. Sunflower against a Karoo sky.
Sutherland, Northern Cape, South Africa.
(Photo by Author)

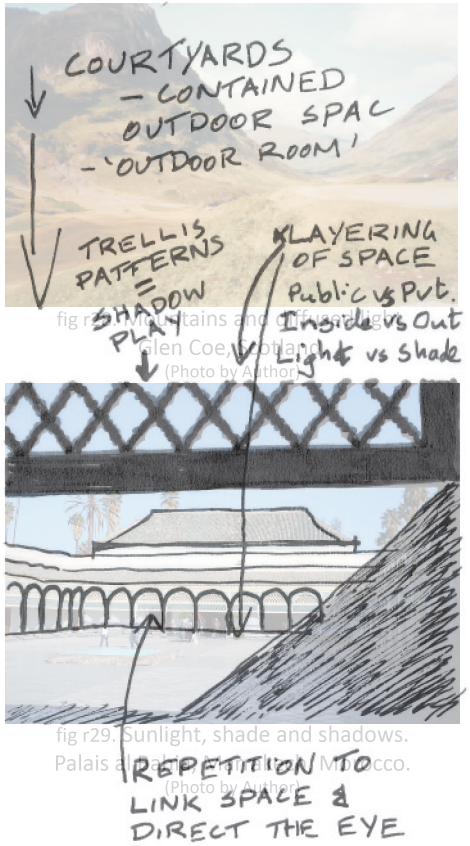


fig r28. Mountains and cliffs, village.
Glen Coe, Scotland.
(Photo by Author)

fig r29. Sunlight, shade and shadows.
Palais a[illegible], Marrakech, Morocco.
(Photo by Author)

Christian Norberg-Schulz, twentieth century Norwegian Architect and theorist, attempts to unravel the idea of 'place' in his book, *Genius Loci: towards a phenomenology of architecture*. He maintains that man's identity ultimately depends on his belonging to places. (Norberg-Schulz, 1980: 6) 'Place' is made up of a multitude of tangible and intangible elements, everything that makes up our experience of the world around us. (Norberg-Schulz, 1980: 6) Different activities require different types of places, and so we see differentiation between different settlements, different rooms within a building and the 'inside' and 'outside' realms. The place is created by natural and man-made elements. (Norberg-Schulz, 1980: 8-10)

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fig r27. Sunflower against a Karoo sky.
Sutherland, Northern Cape, South Africa.
(Photo by Author)



fig r28. Mountains and diffused light.
Glen Coe, Scotland.
(Photo by Author)



fig r29. Sunlight, shade and shadows.
Palais al Bahia, Marrakech, Morocco.
(Photo by Author)

Sky colour is also affected by the atmospheric composition. Where very few particles are present in the air, there will be a high number of blue and violet rays. This results in an azure blue sky. An extensive reflection of short medium and long rays will create white light and result in a paler, even white, sky.
(De Grandis , 1986: 86)

Henry Plummer, author of Masters of Light: First Volume: Twentieth Century Pioneers, states that “every country has as well its own skies, which shape the temperament of the landscape and its people-a metaphysical dimension of place no less remarkable and unmistakable.” (Plummer, 2003: 88) He believes that harnessing this can bring buildings a sense of authenticity and rootedness, and capture the intangible mood of the place. (Plummer, 2003: 88)

In relation to architectural design, to truly design a building that is appropriate for its context, light and colour cannot be ignored. While this does, of course, mean looking at local colour use (landscape, local and vernacular building trends, including materiality and construction methods, and even art *(fig r30 & r31)*), it also has to mean considering the way colour appears in the local climatic light conditions. A colour used on a building in Britain, with its peculiar light conditions, simply cannot be reproduced with the same colour effects in southern Africa.



fig r30. Traditional Ndebele Wall Painting. Botshabelo, Mpumalanga, South Africa.
(Image in Ritztrade International, 2004)



fig r31. Rural Buildings in Fraserburg, Karoo. Limited materials show depth in shadow.
(Image in Fagan, 2008: 77)

The Psychology of Colour

“Colour is as sensitive a subject as religion or politics, and is often bound up with both. Are there universal truths about our interpretation of colours, or is everything relative? Semiotics, psychology, and mysticism tell conflicting stories.”
(Fraser et al. , 2004: 6)

Associations, perceptions and effects of colour
It can be argued that the significance of a colour is completely arbitrary and that the values colours hold are only those that we have attributed to them (Mahnke, 1996: 8) and not an intrinsic quality, much like knowing that when a traffic light is red we are meant to stop. (Fraser et al. , 2004: 19) It is also true that colour associations differ between cultures and individuals. (Fraser et al. , 2004: 10)

Colour therapists and psychologists still maintain that colours carry intrinsic and universal meanings, (Fraser et al. , 2004: 19) that “our reaction to color [sic] is instantaneous and has a profound impact on the choices we make.” (Smith , 2009)

There is much colour symbolism evident in ancient cave art all over the world (though also limited by availability of natural pigments). *(fig r32)* It also appears that they always use the same strong, saturated hues (where available), particularly red, blue, yellow, green, black and white. In some cultures precious metals like silver and gold were also included. *(fig r33)* (Porter et al. , 1976: 22) This choice of materials in ancient and traditional art, be it wood or stone, or precious stones and metals, is also largely due to availability in a place. The culture’s development at a point in time, and its ability to process or work with specific materials also plays a part. The use of the object being created may also determine how much time effort or cost is put into the piece. Religious or ritual pieces are often seen as more precious than the mundane or every day.

These choices of material, based on availability, longevity, workability and symbolism or colour may not just be limited to cultural artefacts. These same choices need to be made in terms of architecture today. When considering the context, the purpose and the users of a specific building, the designer (as with artists the world over) will have to make decisions on materiality (and, with it, colour) and construction process.

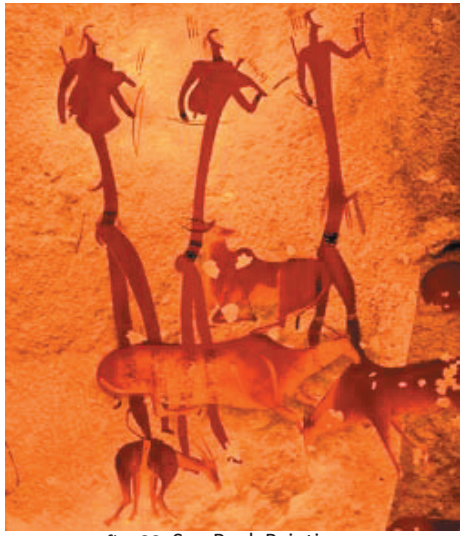


fig r32. San Rock Paintings.
Somewhere in the Karoo, South Africa.
(Image in Lindstedt, 2009)

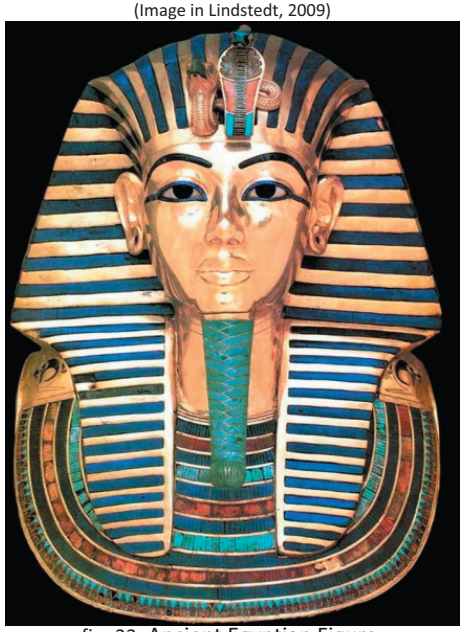
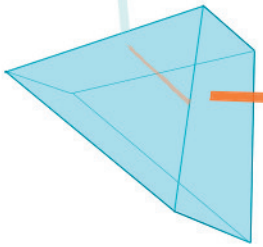


fig r33. Ancient Egyptian Figure.
Shows the use of vivid colours and gold.
(Image in Stower, 2006)



Locally available materials (or materials from the site) will be used.
See materiality pages, 142-146.

There is evidence to suggest that there are some natural colour associations. These are ones that are common to various historic colours and religions. Red, for example, often represents blood and danger, or is used to mean fire, the sun or heat. Blue, with its obvious connections to the sky and the sea, often represents freedom and perspective, but it also has associations with ice or cold, and consequently can represent isolation and loneliness. Green often represents nature, renewal and new growth. (Fraser et al. , 2004: 21) It is easy to see where these meanings and associations have stemmed from and to accept that they could be universal meanings.

A Swiss psychologist, Dr Max Luscher, has suggested that the connotations of yellow colouring as being energetic, and of blue colouring as being passive, can be traced to early man. Yellow indicated daylight and prompted an energy burst so that man could hunt and gather food during the day. The dark blue of the evening sky heralded the coming of night time, a time to rest and withdraw to his place of refuge. *(fig r34)* (Porter et al. , 1976: 15-16)

Along with colour connotations, it is commonly acknowledged that there are two 'temperature' groupings. That is to say that reds, oranges and yellows are considered 'warm' colours, and greens, blues and violets are 'cold'. This is probably also due to the associations of sunlight and fire with the former, and sea and sky with the latter. *(fig r35)* The cool colours are less clearly focussed by the eye (there are fewer blue cones than the reds and greens -it is not known why- (Fraser et al. , 2004: 24)) and tend to appear passive or receding while the warmer colours appear aggressive or advancing. (Porter et al. , 1976: 13) This theory has been slightly contested and it is thought that the brightness of colours plays an important role as well. Brighter colours will appear to advance more than pale ones. (Porter et al. , 1976: 100)



fig r34. Day versus Night.
Colours representing energy and slumber.
(Image and Photos by Author)



fig r35. 'Cool' and 'Warm' Colours.
Common colour associations.
(Image and Photos by Author)



fig r36. Bags of Pigments for sale.
Chef Chaouen, Morocco.
(Photo by Author)

There has also been much experimentation with the physical healing power of colour. Laboratory experiments have shown that red tends to stimulate the nervous system resulting in higher blood pressure, faster breathing and increased heart rate. Blue appears to have the opposite effect.
(Porter et al. , 1976: 13-14; Birren , 1976a: 18)

Beyond this, in the western world, experimentation with the healing properties has mainly been limited to patients with brain damage or mental disorders. In the East, however, the physical healing power of colour has been practiced for centuries. In India, for example, coloured lights are projected onto patients. Different colours are associated with different symptoms or stages of a disease. (Porter et al. , 1976: 86-87)

This practice is believed to have roots as far back as Ancient Egypt and Greece, though now it is more common in Indian cultures (and now embraced as an alternative medicine in many other parts of the world). It is believed that the body has seven energy centres or *chakras*. *(fig r37)* Each of these chakras is associated with a specific part or region of the body and also linked to a specific colour. Coloured light, when projected onto the body, will be absorbed by its associated *chakra*, it will then be converted into healthy energies by the pituitary glands. The specific wavelengths of the light are said to stimulate healthy vibrations in the body. This will also affect thought patterns which, in turn, will affect the electromagnetic field or *aura* surrounding the body. (Uma, 2009) *(fig r38)*

In practice, then, medical treatments associated with this cultural belief would involve shining coloured lights onto a patient, or asking them to gaze into the light for prolonged periods. The specific light colour would be selected depending on the physical region or *chakra* that is problematic or diseased. Red energy is seen to govern the *Root Chakra*, Yellow the Spleen, Orange the Solar Plexus, Green the Heart, Blue the Throat, Indigo the Brow, and Violet the *Crown Chakra*. (Uma, 2009) *(fig r39)*

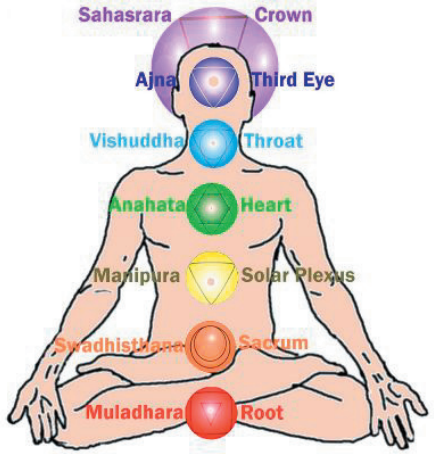


fig r37. Chakra Centres of the Body.
Indian medical/colour associations.
(Image in Ford, 2009)



fig r38. Colour Light Therapy.
A modern therapy light.
(Image in Sundt, 2009)



fig r39. Chakra Crystals.
Stones linked to colour therapy beliefs.
(Image in Permutt, 2009)

There are any number of other colour connotations but very few can be proved. “We do know, however, that what is experienced, learned and associated with different colours comes into contact and interplay with our genetic predisposition. Whether our ultimate response is due to the physical energy of the colour itself or to its associations and symbolic meaning is yet another question involving the nature-nurture controversy.” (Porter et al. , 1976: 86)

The effects of colour are not easy to measure, especially considering the different behaviours of coloured light and surface pigment. There are, however, definite psychological reactions to colour, but they are varied, and “depend upon a number of interrelating factors – social class, age, personal taste, historical symbolism and cultural background.” (Porter et al. , 1976: 15) Individual perception of colour can often be traced back to “early learning processes and, thus, have a cultural bias.” (Sivik , 1976: 123)

An example of the vast differences that exist between cultural colour views is the fact that, in the Western world, the colour black is often associated with death, funerals and bad luck (black cats, ravens) *(fig r40)*, while in the East, the colour white has similar associations. *(fig r41)* (Wong , 2001)

Frank Mahnke, author of *COLOR, Environment, & Human Response*, has devised a pyramidal diagram representing the influencing factors in our perception of, and response to colour. *(fig r42)* Starting with the basic biological reactions, the associations probably inherited from early man, he adds the natural and learned responses through culture or fashion, until eventually culminating in personal ‘taste’. The combination of these influences results in our individual reactions to colour in our environments. (1996: 11)

With all these factors in mind, it is not possible to programme the mind and actions of a specific building user. There is no way of guaranteeing an individual response, but we can use some of the more universal colour ideals and have a good idea of how they will affect the feel and use of a space. If, however, we are designing for a very specific cultural or religious context, there will be more universal meanings of colours to the users of that space and we should make an effort to investigate what they may be.



fig r40. *Mourners* -painting by Rivkah Lapidus. Western idea of black associated with death.
(Image in Lapidus, 2008)



fig r41. Islamic women in mourning. Eastern idea of white associated with death.
(Image in Portnow, 2007)

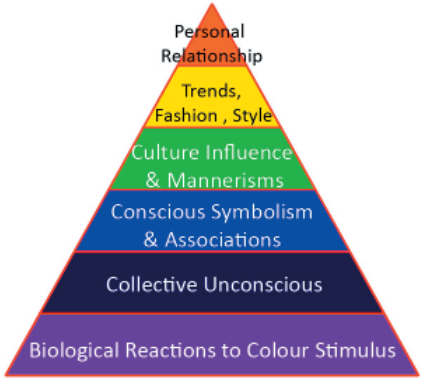


fig r42. Mahnke’s pyramid of colour perception influences
(Image adapted from Mahnke, 1996: 11)

Institutional Colour

It has been said that, in the design of spaces where “the emotional factors of beauty can prevail”, such as homes, hotels, theatres or shops, it doesn’t really matter what colours are used and a degree of creativity and individual taste can be incorporated. “But to let individual notions of beauty serve as criteria in other facilities, such as offices, schools or hospitals, where people are supposed to busy themselves at useful tasks or have their welfare regarded, is to take a supercilious attitude towards humanity.” (Birren , 1976b: 91)

In psychology, it had been thought that manic and aggressive patients would be best served by the soothing, calming effects of cooler colours, and that depressive and suicidal patients could be uplifted with invigorating warm colours. However, this has been somewhat disproved and it is now believed that the opposite is true. A patient behaves and reacts better when in an environment closer to their personality tendencies. (Porter et al. , 1976: 14; Mahnke, 1996: 28)

Generally, the greatest reactions to colour are in two directions, towards red, and towards blue. Yellow, and yellow-green are considered more or less neutral in terms of causing emotional reactions. (Birren , 1976b: 91) This has often been the rationale behind prison colouring where pale green is thought to be calming, therefore reducing inmate aggression and fighting. *(fig r43)* However, the shade is important here too as lime green is thought to induce nausea. (Porter et al. , 1976: 14)

Similarly, yellow is often used in libraries, schools and other learning institutions as it is thought to stimulate the intellect *(fig r44)*, while orange cafeterias stimulate the appetite. *(fig r45)* However, a very bright yellow has also been blamed for stimulating and inciting children to vandalism. (Porter et al. , 1976: 14) So, evidently, a colour’s strength or brightness plays as big a role as its position in the spectrum. (Porter et al. , 1976: 121)



fig r43. Green tinted prison hallway.
Section B, Robben Island Prison, South Africa.
(Image in Tiscover, 2009)



fig r44. Yellow school hallway.
Clear Lake Middle School, Iowa, USA.
(Image in Stockdale, 2009)



fig r45. Orange Cafeteria.
Barcelona, Spain.
(Image in Venere net, 2009)

In a series of lecture experiments where an identical 20 minute lecture was given in two sittings, one group of students attended the lecture in a red room *(fig r46)*, the other group attended in a blue room. *(fig r47)* Responses from the participants indicated that the lecture in the red room appeared more interesting and focussed, and felt as if it was shorter than its actual duration. Students in the blue lecture room indicated that the lecture was long and boring and seemed to last longer than the actual time. (Porter et al. , 1976: 14) Many experiments were conducted during the twentieth century where colour was investigated as an independent factor and measured in terms of an observer's judgement of weight, temperature, depth and size. (Porter et al., 1976: 99)

It has long been thought that white walls are a neutral choice when one doesn't know how users of a space will react to colour. *(fig r48)* This may be convenient in terms of cost and maintenance, and it also allows the inclusion of colour accents and highlights, but more recent evidence suggests that white walls in brightly lit offices, for example, have probably been the cause of damage to countless eyes over the years. (Birren , 1976b: 92) "The lighting industry has perpetuated the myth that low lighting levels and contrasting brightness are harmful to the eye. Ignoring the phenomenal adaptive power of the eye and the need for exercise to retain its elasticity, evenly distributed high lighting levels (necessary only for the most critical seeing tasks) have become standard in most architectural spaces, regardless of the activities for which they are designed." (Preusser , 1976: 89)

In summary, while all the discussed factors should be considered in a design, "it is not just that one colour is better than another, or that red is exciting, green tranquil and blue subduing. What has been learned from research is that variety is, of itself, psychologically beneficial." (Birren , 1976a: 19)



fig r46. Red Lecture Room.
Brunel University, London, England.
(Image in Brunel, 2009) not the room used in experiments.



fig r47. Blue Meeting Room.
Manchester University, Manchester, England.
(Image in Manchester, 2009) not room used in experiments.



fig r48. Meeting Room - Edina van Der Wyck.
Though 'slick', bright white can damage eyes.
(Image in Williamson, 2009)

Colour and Space

"Rather than risk an unpredictable effect on others, we are often tempted to avoid colour altogether. We dress in black for work to avoid sending unwarranted messages. We paint our houses in neutrals before moving out to avoid putting off prospective buyers. In architecture, too, a tendency towards 'chromaphobia' is apparent in our offices, schools and shopping centres. Rather like the standard beige computer, contemporary buildings are often breathtakingly drab."

"The willingness to use colour must be matched by the ability to create and control it."
(Fraser et al. , 2004: 7)

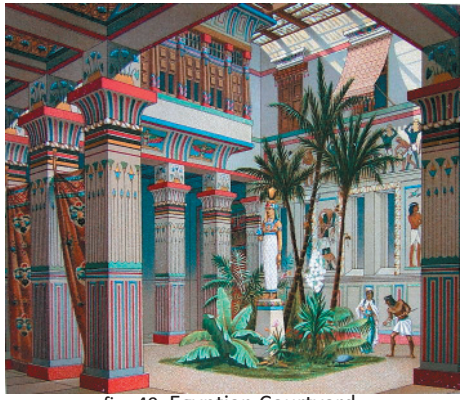


fig r49. Egyptian Courtyard.
Painting by Albert Racinet (1888).
(Image in Martin2001, 2009)

Space, Shape and Distance

Colour, as part of our overall sensory experience of our environment, helps us to perceive and define objects in space. (Porter et al., 1976: 13) Even civilisations as far back as the ancient Egyptians had discovered this quality of colour. They preferred vibrant architectural colour and stark contrasts. *(fig r49)* This was also a response to their geographic location as their colour choices accentuated details in architecture and statuary in a climate where subtle forms were 'washed out' by the bright sunlight. (Porter et al. , 1976: 23)

The space around us is defined by objects that help us to reconstruct an image of the world. These objects have properties such as size, shape, texture and colour. If we take light for granted (and only if) we could see colour as a property of objects. (Porter et al. , 1976: 82) Different colours help us to differentiate one object from another, to differentiate shapes and to interpret spatial depth.

Colour has many ways of affecting the appearance of a space. Contrast and juxtaposition of colours often has the greatest effect. Specific colours in contrast will always have the same optical effects on people (assuming they do not suffer from colour-blindness[1]) as they are due to the scientific operation of the eye and the behaviour of colour. 'Simultaneous colour contrast' *(fig r50)* is the spatial effect of seeing colours side by side at the same time. 'Successive colour contrast' results from seeing colours one after another in quick succession and is a temporal effect. (Porter et al. , 1976: 85)

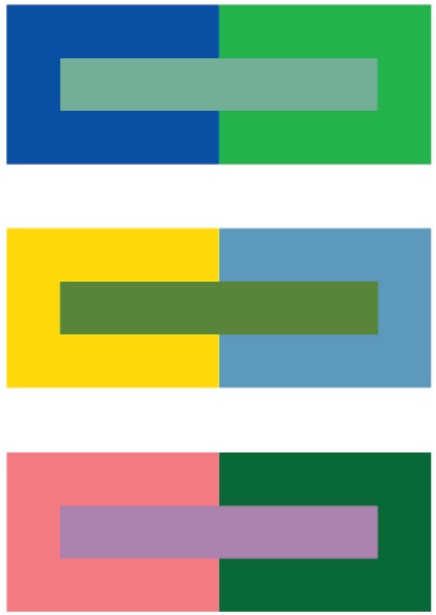


fig r50. *Simultaneous Colour Contrast*. Bars of the same colour & width along their lengths appear varied on different backgrounds.
(Image adapted from Kuppers, 38)

1. Colour-blindness is generally thought to be hereditary and is rare. Total colour-blindness is the rarest, it affects less than 1% of the world's population, followed by yellow-blue colour-blindness. Red-green colour-blindness is the most common. (Porter et al., 1976: 83)

Colour contrasts in courtyards emphasise brightness.External finishes, however, are designed to blend with the landscape. See courtyards on page 148

The most effective form of contrast occurs when fields of complementary colours are juxtaposed. For example, if fields of red and green (using RYB colours) are seen next to each other *(fig r51)*, they will both appear more vibrant than when standing alone. However, if the same two colours are dotted together, they will appear grey from a distance. This is because our eyes tend to mix the colours in a sort of pseudo-additive mixing method resulting in the same type of colour as if the two pigments were mixed together and then applied to the surface. This is the mixing technique that many impressionist and pointillist painters *(fig r52)* used to mix colours. (Fraser et al. , 2004: 32) For the same reasons, it is not usually successful to try and put bright red text onto a vivid green background, this will react more like the juxtaposed dots than the adjacent fields, resulting in an illegible message. *(fig r53)*

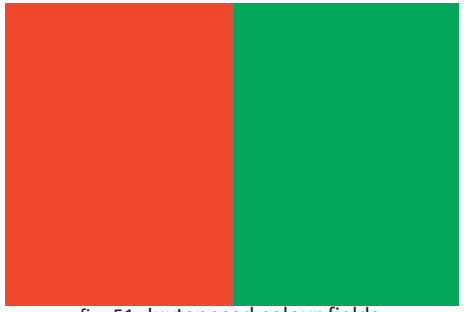


fig r51. Juxtaposed colour fields.
Red and Green appear brighter together.
(Image by Author)

Complementary colours (this time the RGB system) have other effects on viewers too. 'After images' are often used in optical illusions, but they can also play a role in other design areas. If you stare at a particular coloured shape for a length of time and then look away to a blank surface, the shape will reappear in front of your eyes but in the complementary to the original colour. *(fig r54, following page)* (Fraser et al. , 2004: 31) This fact should be considered in environments where people may be doing close work with a particular coloured object for long periods of time. If the walls of the space are white, after images (and possibly resultant headaches) will plague the users. If the walls are painted the complementary of the object, this will off-set the after-image effect.

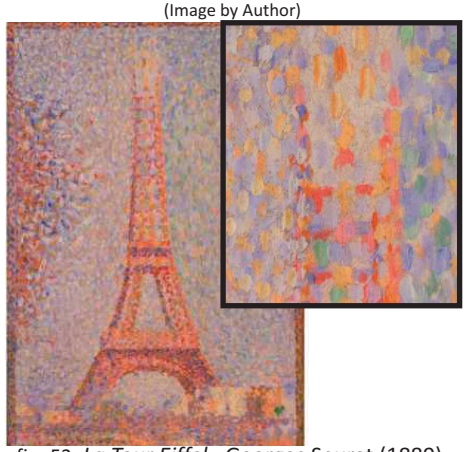


fig r52. *La Tour Eiffel* - Georges Seurat (1889).
Pointillism. Colour mixed by dots (see detail)
(Image in Cross, 2008)

Contrast is not only affected by hue (the spectral colours) but also by saturation and brightness. Saturation refers to the 'purity' of a colour. This can be understood to be the amount of grey in a spectral colour, the more that is added, the more the chromatic strength of the colour is reduced. Brightness roughly corresponds to the intensity of light in which the colour is viewed (Porter et al. , 1976: 80-81), re-emphasising that "designing with colour is easier if one thinks of colour and light together, as essentially inseparable elements." (Esherick , 1976: 58) Leonardo da Vinci was one of the earlier experimenters with colour theory. He is first recorded to have noted that "a dark object seen against a light background will seem smaller than it is. A light object will appear greater in size when it is seen against a background that is darker in colour." (Porter et al. , 1976: 99)

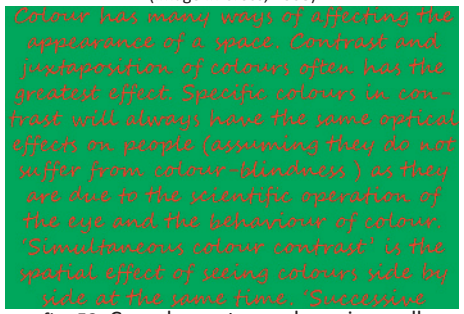


fig r53. Complementary colours in small amounts optically blend. Text is hard to read.
(Image by Author)

In a similar vein, the closer a colour is to the colour of its background, the more it appears to recede. Conversely, the more a colour differs from its environment, the nearer it appears. (Porter et al., 1976: 100) Le Corbusier noted this effect in relation to his beloved white when he said, “As early as 1910, I knew about the bracing quality of chalk white. Practice showed me that the joy of white explodes only when surrounded by the powerful hum of colour.” (Porter et al , 1976: 38)

Colour and lighting, amongst other things, also affect the apparent openness or spaciousness of rooms. In tests, subjects concur that a space seems bigger or more open as the degree of lightness of interior details and walls increases. Spaciousness also seemed to increase with a corresponding increase in the chromatic strength of interior details, but a similar effect was not seen with interior walls. This may be due to the chromatic strength itself, but is more likely to be related to the increased contrast between walls and details that ‘lightened’ the space. (Acking et al. , 1976: 120-121)

Dark surfaces will appear to ‘attract’ each other as a function of the colours wanting to ‘advance’ as discussed earlier. In the same way, light surfaces appear to ‘repel’ each other. So, in practice, a square room with two opposite walls painted a dark colour and the other two light, will appear elongated. (Acking et al , 1976: 121) Similarly, a very long space can be made to feel shorter less like a corridor by painting the ends darker and the long sides light. This is also the reason that ceilings are often painted light colours, so as not to feel constricted in a low-ceiling environment.

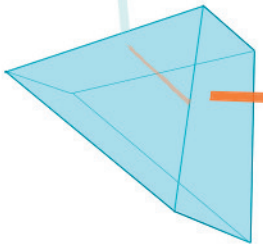
As colour lightness and illumination should be considered together, colour in relation to window positioning can also have a great effect. A darkly painted wall opposite a window can somewhat negate the light, or at least result in uneven illumination in a room. Also, in order to decrease contrast with outside light and sky, light window surrounds (walls, frame and sill) could be considered. (Porter et al , 1976: 121) In fact, removing glare from a person’s field of vision can be one of the most important roles of colour in architecture.(Birren , 1976a: 19) White light reflecting on a coloured surface can also be used creatively. Light reflecting off a brightly coloured wall can wash an opposite wall with colour. *(fig r55)* In this way, the uneven lighting discussed above can be used to enhance a space. It should always be remembered that the texture of a surface also plays a role in how we read reflection. (Fraser et al , 2004: 71)



fig r54. After-image. Stare at cyan shape for a minute, cover it and stare at the dot beneath.
(Image by Author)



fig r55. A stairwell with a magenta wall washed with light results in a white wall reflected pink.
(Image in Fraser et al., 2004: 71)



Bright courtyard finishes, when washed with sunlight, will flood interior spaces with colour.p148.

Colour and time

"[Colour] also indicates time inasmuch as colours change with time, altering during the day cycle and from one season to another."
(Porter et al. , 1976: 13)

Man's Identity and Time

To do justice to the exploration of human existence, we need to interpret it in relation to time, we need to find some way of grasping time as an event and experiencing it. (Harman, 2007: 26) "Before Dasein [*Man in essence 'thrown' into existence in a position in the world*] does any thematical research, it 'reckons with time and regulates itself *according to it*." (Heidegger, 1962: 456) Man "has been surrendered to the changes of day and night. Day with its brightness gives it the possibility of sight; night takes this away." (Heidegger, 1962: 465) He regulates himself in terms of daylight and often understands himself in terms of the activities of the daylight period. He concerns himself constantly with, what the philosophy of Martin Heidegger calls the 'then'. This is always related to a time created by the rising of the sun, a time of light's appearance and the start of a productive day. The day arises as the most natural measure of time. The logical next step is to subdivide the daylight hours, first by using the progress of the sun. Sunrise, sunset and midday become significant time indicators. The further subdivisions of hours, minutes and seconds, and the naming, dating and counting the days came later, all efforts of man to better understand and relate to the world and the allotted time he has in it. (Heidegger, 1962: 465-466) The dates and progression of days, months and years are, again, linked to the movement of the heavenly bodies through space. This connection between earth and sky, man and the Universe, is one that has shaped the way we understand time, but it is often overlooked and forgotten by modern man. We now make the night light enough to work in, and we don't look at the sun to find the time of day. (Heidegger, 1962: 468) *(fig r56 & r57)*

In the contemporary world space and time distances are shrinking. Man travels long distances fast, information is transmitted around the globe nearly instantaneously, processes that take years in nature are captured on film and presented in mere seconds. (Heidegger, 1971: 165) As time compacts into a flat 'present', man loses his connection with the past, he loses his identity as a historical being and lives in fear of the future. (Pallasmaa, 2005b: 36 & 77) His greatest desire is to "halt, suspend, and reverse the flow of time." (Pallasmaa, 2005a: 308)

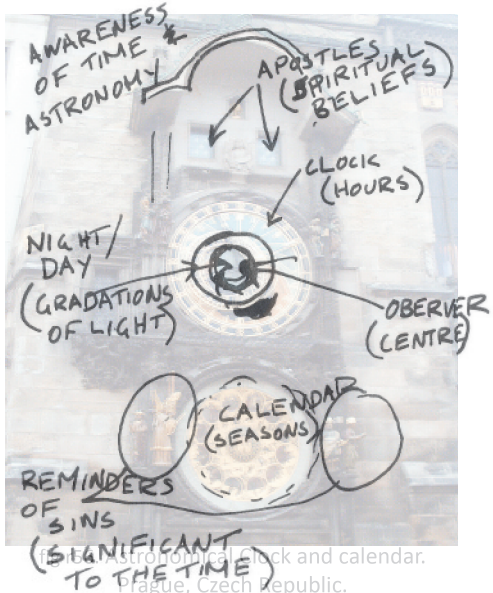


fig r56. Astronomical clock and calendar.
Prague, Czech Republic.
(Photo by Author)

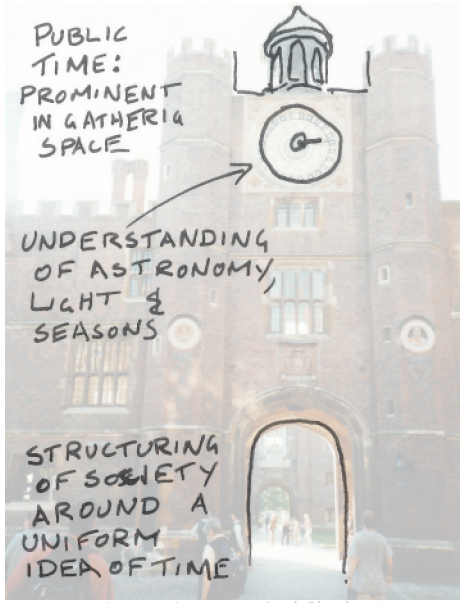


fig r57. Astronomical Clock.
Clock Court, Hampton Court, England.
(Photo by Author)

The observatory connects the built project to the Universe, increasing the awareness of the users.

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fig r56. Astronomical Clock and calendar.
Prague, Czech Republic.
(Photo by Author)



fig r57. Astronomical Clock.
Clock Court, Hampton Court, England.
(Photo by Author)

We tend to forget the slow, regular heartbeat of the world. We aren't attuned to the shadows moving through the day or the setting of the sun when we sit in uniformly lit offices for most of our waking hours. (Millet, 1996: 28) We are not woken by the rising sun *(fig r58)*, but by mechanical alarms. Time seems to revolve around us and bear no relation to the world outside. We are not even always aware of the changing seasons. Though we might notice that the weather is hot or cold or wet or dry, the effects are minimal in our temperature regulated shelters. The earlier winter sunset often goes largely unnoticed, so too do the variations in light quality that come with the atmospheric changes.



fig r58. Sunrise in the Sahara.
Zagora Desert, Morocco.
(Photo by Author)

Architectural theorist, Juhani Pallasmaa, believes that architecture's modern movement went a step further to eradicate our experience of time. By emphasising a set of universal, utopian values, it created spaces that were both 'placeless' and 'timeless'. More recently, we have rediscovered the need to feel we belong to a specific place and time. (Pallasmaa, 2005a: 205) We don't just need to inhabit space, we need to also to dwell in the continuum of time. (Pallasmaa, 2005a: 309)

The idea of treating time as the fourth dimension of space was part of a twentieth century revolution. It was Einstein's theory of relativity that expanded our sense of what space actually consisted of. Space suddenly had to be understood in a more dynamic way leading to the notion of space-time. (Plummer, 2003: 98)



fig r59. African Starlore.
extract from 'Friends of the Universe' poster.
(Image in Laney, 1998)

Identity and Perspective: then and now

Man's understanding of his position in the Universe has changed many times during his existence on earth. This has been due to many factors, but one of the greatest is scientific discovery, particularly in the field of astronomy. *(fig r59)* Man is unique among the animal world in the sense that he has a set of gifts and skills that make him, unlike other creatures, a shaper of landscape and not just a figure in it. (Bronowski, 1973: 19) He quickly developed the skills and tools necessary to make his mark in the world, and by the end of the last Ice Age had already learned to cultivate plants and domesticate animals. (Bronowski, 1973: 60)

So, we can see how, even as astronomers discovered nearer planets and stars and began to understand the earth and its neighbours, our planet was still thought to be at the centre of a revolving universe.



fig r60. Nicolaus Copernicus.
Portrait of an astronomer.
(Image in Schmidt, 2009)

In response to the need for identity in a 'place', the built project will, from a conceptual level, relate back to its Universal location. See concepts on page 129.

Nicolaus Copernicus *(fig r60, previous page)* was born in Torun, Poland in 1473. He studied astronomy at the University of Cracow. (Kusukawa, 1999) *(fig r61)* He became the first astronomer to put forward the theory of a heliocentric cosmos with the sun (light & colour) at its centre (first manuscripts began circulating in around 1514, while the final paper was only published in 1543)[1]. (Kusukawa, 1999; *Copernican Revolution* [Online], 2009) This theory explained observed planetary motions by seeing the earth just as another orbiting planet. (Hawking, 2009) *(fig r62)*

His theory met with strong opposition from the Catholic church, which, for a thousand years had been head of religion, science and politics. As the church had feared, revelation of the new theory caused discord among the masses and a sudden shift from a trust in authority figures to a trust in 'self' and to individual responsibility. (Copernican Revolution, 2009; Gutkind, 1964: 185) A new understanding of 'place' started to emerge as man realised that he was not at the centre of the Universe. (Gutkind, 1964: 35) Slowly, man's whole outlook had to change, he had to accept a new outlook from the periphery rather than the centre. This developed into a wider and more dynamic worldview. (Gutkind, 1964: 35-36)

Copernicus was never actually able to prove his theory, this was left to later astronomers, and it took about two hundred years to replace the Ptolemaic model with the earth as the centre. (Copernican Revolution, 2009; Hawking, 2009) The main flaw in Copernicus' model was that he was still motivated by the classical ideal of a uniform, concentric circular system, which is not an accurate representation of our solar system's movement. (Kusukawa, 1999) It was also still a finite model that ended in a sphere of fixed stars.
(Gutkind, 1964: 35 & 186)

As ideas about the Universe have changed, so too have attitudes to our earthly environments. Compact empires began to be replaced by more scattered settlements. The idea of 'perspective views' started to take root in town planning, and the external appearance of structures took on a new importance. Thinking and planning took place on a far larger scale than in the past as man came to terms with new ideas of spaciousness. At this stage, however, just as the universe was still seen to be heliocentric and have a fixed boundary, towns were still bounded and focussed on a central square or building. Man tried to reflect new ideas of space but did not wish to lose himself in it. (Gutkind, 1964: 36,186 & 188)



fig r61. Royal Palace Courtyard, Cracow.
Virtually unchanged from Copernicus' time.
(Photo by Author)

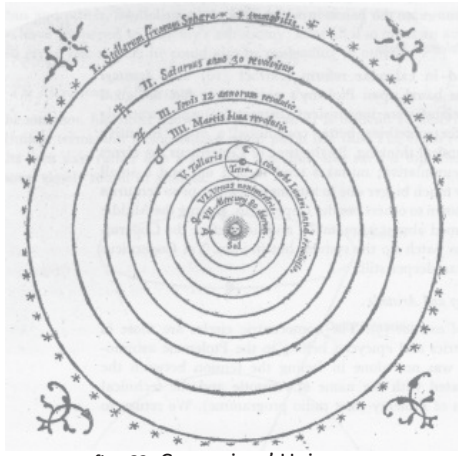


fig r62. Copernicus' Universe.
Heliocentric orbits around the sun.
(Image in Russell, 1972: 43)

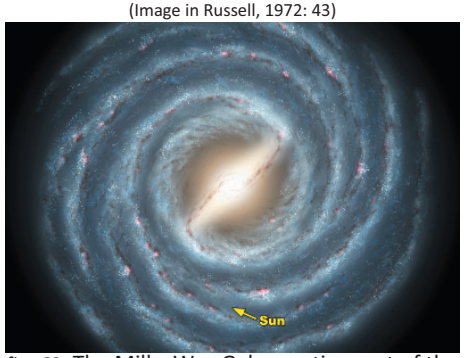


fig r63. The Milky Way Galaxy, a tiny part of the Universe. Yellow arrow shows our sun.
(Image in The Daily Galaxy, 2008)

1. The Greek astronomer, Aristarchus, developed the same theory over 1500 years earlier.
But Copernicus is recognised as being the first to do so in the modern age. (Hawking, 2009)

Copernicus, however, was just a step in the path of understanding the Universe. (Gutkind, 1964: 187) In 1600, Giordiano Bruno was burned at the stake for proposing that the fixed stars were not the limit of the Universe, that the Universe was infinite and that no part of it was fixed or at rest at any time. (Gutkind, 1964: 184) With more recent scientific advancements and discoveries, we find that, though our solar system is heliocentric, this is a tiny part of the Universe at large. *(fig r63, previous page)* A Universe that is unbounded, though not infinite. A Universe where galaxies and solar systems are scattered around randomly, each one having its own shape and following a different set of rules. (Gutkind, 1964: 6 & 37) *(fig r64)*

As our ideas about space have undergone these changes, so too have our ideas about space planning on our own planet. Our cities have transformed in size and scale and no longer have a finite order within them. *(fig r65 & r66)*(Gutkind, 1964: 6) It is the logical order of things that, as our awareness of the shape of the Universe changes, so too does our awareness of our nearer environment change, and with it our views of how we fit into the picture.

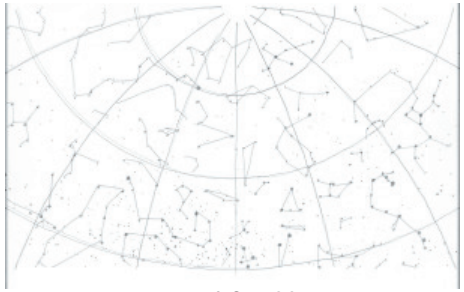


fig r64. A Star Map
Random Constellations on a grid.
(Image by Author, Data from *Skymap Pro* software)



fig r65. Vast, uncontained Modern City.
London, England.
(Photo by Author)

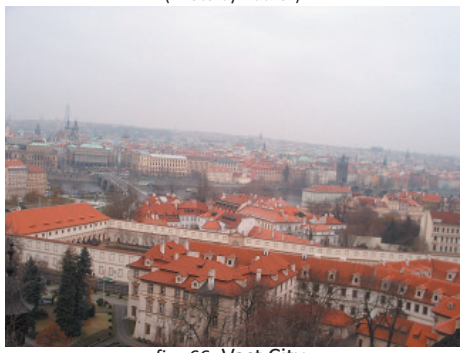


fig r66. Vast City.
Prague, Czech Rebublic.
(Photo by Author)

The shadows of time

In days gone by, the public sundial would have been commonplace. *(fig r67)* The sun would shine on an arm, casting a shadow onto a numbered track, revealing the time of day. (Heidegger , 1962: 469) Though we no longer have a need for such a device with our watches and electric clocks always near at hand (and the added advantage of their accuracy and their ability to operate in the dark), there is still something poetic about the expression in time and space of the earth's rotation and solar orbit.

The Piazza del Campo in Sienna, Italy behaves like a giant sundial (albeit without the time marked on it). As the day progresses, the shadow from the Torre del Magnia (built in the 14th Century) tracks its way around the square, very like the arm of a traditional sundial. *(fig r68)* (Millet, 1996: 29)

In public squares, parks or gardens in hot climates this 'sundial effect' may be observed in the movement of people. As the shade from buildings or trees moves over the course of the day, people trying to stay out of the sun's direct heat will chase the shade. So, the arrangement of people varies through the day with different gathering spaces for breakfast, lunch or dinner spots.

Stanley Saitowitz' *Sundial House (fig r69)*, "extends the site to the sky. All forms and functions pivot around the sun." (Bell, 1996) Saitowitz believes that the architectural site IS the horizon, the earth's crust. The site exists at the point where earth and sky meet.(Saitowitz, 1991: 31) His special kind of regionalism speaks of the specific point in space that architecture occupies in relation to the central pivot...the sun.(Saitowitz, 1991: 31) Through apertures, slits and shadows, he harnesses and channels the sunlight specific to his site to better position his designs in space.

Pallasmaa, in *The eyes of the skin: architecture and the senses*, writes that "in great spaces of architecture, there is a constant, deep breathing of shadow and light". (2005b: 33) He believes that, in order to think clearly, our normally dominant sense of vision should be suppressed. He believes that darkness and shadows stimulates imagination and daydreams. (Pallasmaa, 2005b: 32)

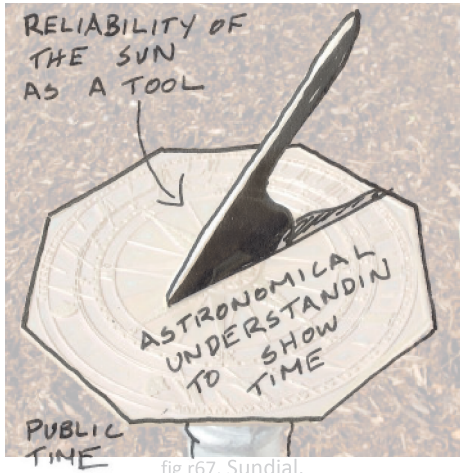


fig r67. Sundial.
(Image in Carpenter, 2009)

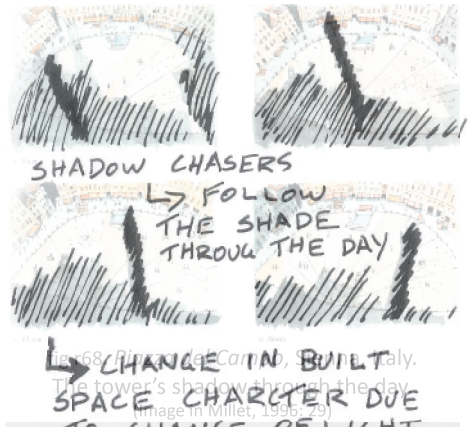


fig r68. Piazza del Campo, Siena, Italy.
The tower's shadow through the day.
(Image in Millet, 1996: 29)

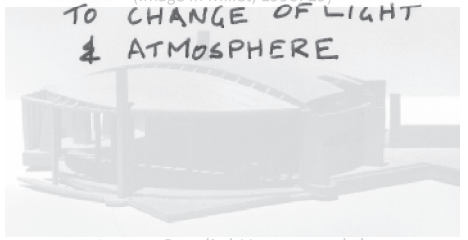


fig r69. *Sundial House* model.
Stanley Saitowitz.
(Image in Bell, 1996)

Stone Columns, on the Visitors' Centre terrace will cast dynamic shadows that shift with the sun's movement. See plan on page 149.

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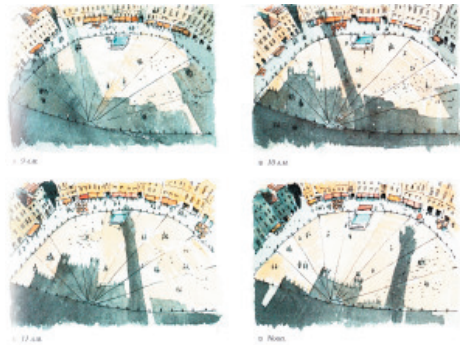


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The tower's shadow through the day.
(Image in Millet, 1996: 29)

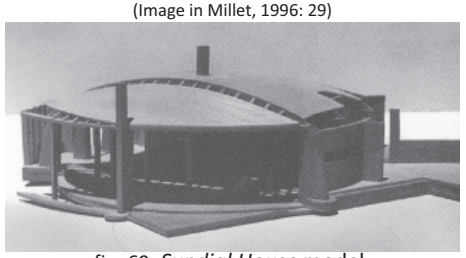


fig r69. *Sundial House* model.
Stanley Saitowitz.
(Image in Bell, 1996)

Stone Columns, on the Visitors' Centre terrace will cast dynamic shadows that shift with the sun's movement. See plan on page 149.

Nature's Rhythms

The daily rhythms of light and colour are evident to everyone, but not always analysed. We all know the sun rises and sets, differentiating the light of day and the darkness of night. In nature, the dimmer light of sunrise and sunset tend to be warm and golden, like candle or firelight. This is due to the refraction angle, and the greater amount of atmosphere between the sun and our viewpoint. *(fig r71, following page)* As the day progresses and the light gets brighter, the colours tend to shift from pink to orange, to yellow and finally white. (Porter et al. , 1976: 90)

As designers, we can utilise this cycle in two ways. Firstly, by learning from it, utilising the lessons in the design of artificial lighting layouts. Dim white light casts an eerie glow, so, to follow nature's lead, we should always make dimmer light sources warmer colours to avoid this. (Birren , 1976b: 90)

The second way to utilise this daily cycle is to engage with it, to write the time of day into a space, to contextualise the building in time as well as site. American installation artist, James Turrell, does this particularly well in his 'skyspaces'. *(fig r70)* Using a combination of sky (viewed from inside a room through a skylight), natural light, and artificial light he creates dynamic spaces that change colour and feel as the day progresses. (Adcock , 1990: 146-147)

The seasonal changes of light due to the sun's position in the sky can also be tracked. Beams of light or shadow lines can be traced into a building, or made to project on certain points at a certain time of day, month or year. Patterns of colour can be achieved with simple stained glass windows, the sun's movements tracing colours across a room in specific ways.

In Heikkinen and Komonen's *Rovaniemi Airport* in Finland *(fig r72, following page)*, the annual movement of the sun has been traced onto the floor where sunlight from a small aperture falls at midday daily. And the movement of the Arctic Circle (which oscillates over this town) has been recorded and expressed with light through a slash in the roof falling on a date graph. This airport is expressing its position in the cosmos and its place in time, through its design. (Janson , 1993: 67-67-71)

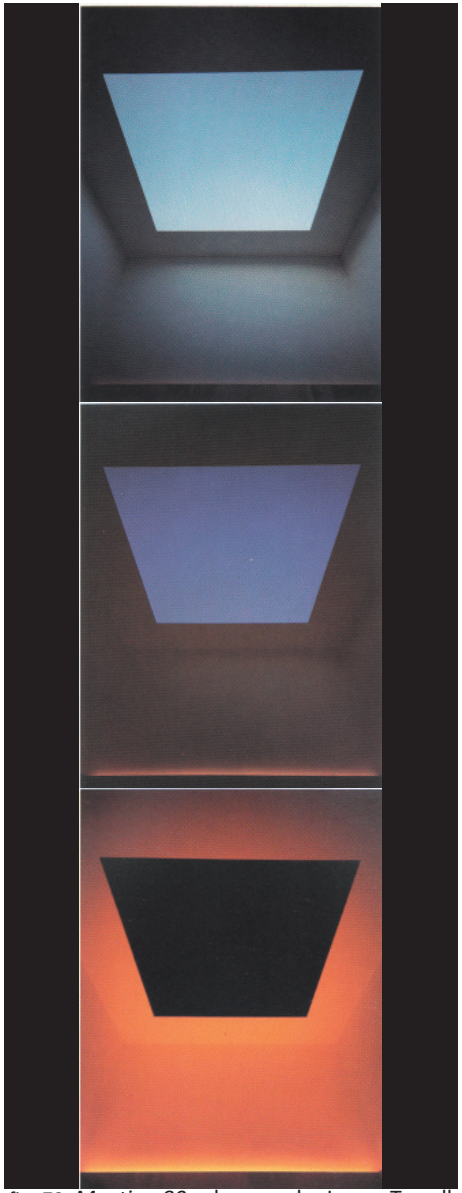


fig r70. *Meeting 80* - skyspace by James Turrell
Photographed in daylight, at dusk, & at night.
(Image in Adcock, 1990: 146 & 147)

See 'skyspace' implementation at the dining hall on page 147.

Similarly, at the *Cambridge Crystallographic Data Centre (fig r73)*, Erik Sorensen tracks the progress of the day through slit windows and mirrors that project a moving streak of light across the building's interior, allowing the building's occupants to engage with time with more than just clocks, despite being indoors. (Ray , 1992: 24-25-37)

Artificial lights can be used to obtain interesting colour effects, often in conjunction with natural light. Stained glass effects or colour washes can be obtained at night with automated filter screen over lights, changing the mood of a room with one switch. (Fraser et al. , 2004: 71) Different coloured lights can also create some interesting shadow effects. "The principles are most clearly demonstrated with red, green and blue lights, but they can be conveyed more subtly when, for example, objects within a room are lit both by electric lamps and daylight." (Fraser et al. , 2004: 37)



fig r71. Sutherland Sunset.
The sun's light refracting in the atmosphere.
(Photo by Author)



fig r72. *Rovaniemi Airport*, Finland.
- Heikkinen & Komonen.
(Image in Heikkinen, 2009a: 1)

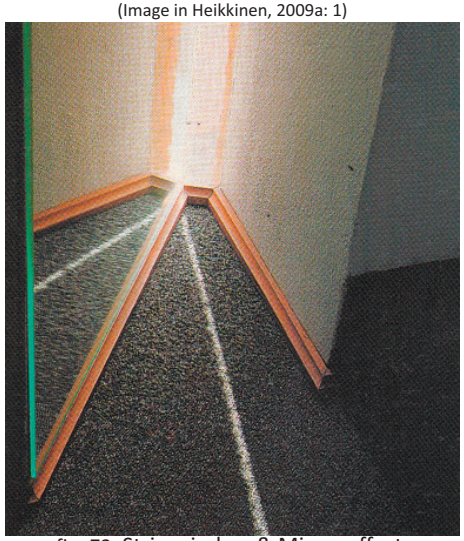


fig r73. Strip window & Mirror effect.
Cambridge Crystallographic Data Centre
(Image in Ray, 1992: 34)

Colour and (Outer) Space

"The sky is the vaulting path of the sun, the course of the changing moon, the wandering glitter of the stars, the year's seasons and their changes, the light and dusk of day, the gloom and glow of night, the clemency and inclemency of the weather the drifting clouds and blue depth of the ether."
- Martin Heidegger (German Philosopher 1889-1976)
(Heidegger , 1971: 149)

The Origins of light

Outer space holds our primary light sources, our solar system's own central star, our sun *(fig r74)*, despite being separated from us by millions of kilometres. (Fairall , 2008: 20) Its light enables us to see colour (this is quite apart from its other life-giving attributes) by day, while at night, it provides reflected light via our moon.

The colour spectrum is used extensively by astronomers and scientists to study our universe. Different scientific telescopes use different ends of the spectrum (ultra-violet or infra-red) to detect different objects in space. (SAAO , 2008a: 1) The rough age of a star is also indicated by colour, ranging from yellow, through white and blue to red as the star is born, ages and eventually dies. (Fairall , 2008: 46) Interestingly, the colour as representative of a star's actual temperature is opposite to our psychological perceptions of colour and temperature. Red stars are actually cooling down, while stars are blue when they are at their hottest.
A process called 'spectroscopy' is also used by astronomers to determine the physical make-up of stars. Different elements tend towards a different point in the spectrum, so, using a spectroscope, scientists can analyse the light emitted from a star and are able to tell by the highlights on a spectrum grid what elements are present in the star. *(fig r75)* (Bronowski, 1973: 336)

Light and colour emitted from space are our only clues to the vastness of the Universe. We can only base our understanding of space on the stars emitting light visible to our own perceptual systems (and the help of scientific instruments). *(fig r76)* Although there may be a lot more beyond our sphere of vision, visible starlight defines the edge of our perceived cosmic habitat. (Millet , 1996: 106)

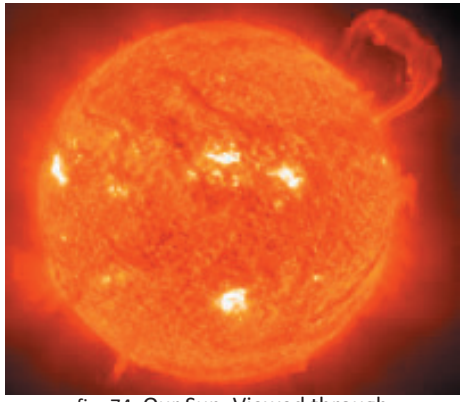


fig r74. Our Sun. Viewed through
an Extreme UltraViolet Imaging Telescope
(Image in Knight, 2009)

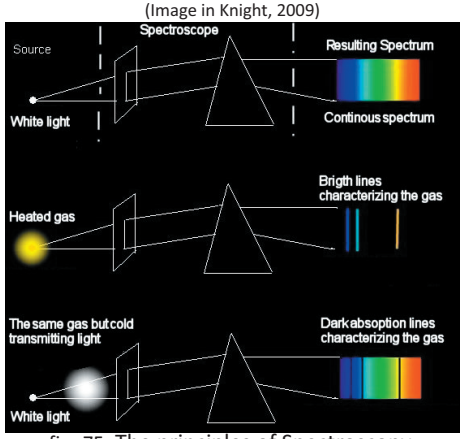


fig r75. The principles of Spectroscopy.
Age and composition revealed in full colour.
(Image in Spectroscopy Principles, 2007)

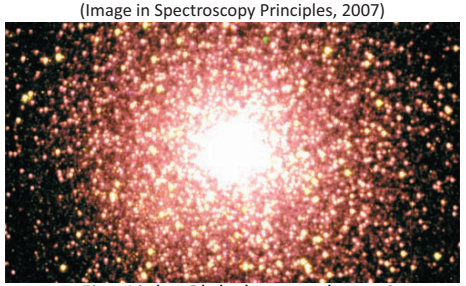


fig r76. *First Light*. Globular star cluster image.
from Southern African Large Telescope (SALT).
(Image in Baird, 2005)

Architecture, elements, and our place in the Universe

Man seems always to have sought to position himself in relation to the Universe. *(fig r77)* His place on the earth and under the heavens has played a significant role in philosophies, religion and identity for centuries. French philosopher, Gaston Bachelard (1884-1962), in *The Poetics of Reverie*, states that " cosmic reverie causes us to inhabit a world. It gives the dreamer the impression of a home in the imagined universe." (1969: 177)

The early twentieth century British novelist, D. H. Lawrence, describes the 'identity' of a place (to which we, as humans, often link our own identities) in his Studies in Classical American Literature. "Every continent has its own great spirit of place. Every people is polarized [sic] in some particular locality, which is home, the homeland. Different places on the face of the earth have different vital effluence, different vibration, different chemical exhalation, different polarity with different stars: call it what you like. But the spirit of place is a great reality." (Lawrence, 1964 cited in Plummer , 2003: 88)

Ancient civilisations looked to the skies too. The light and positioning of the heavenly bodies, though not understood in the scientific terms we think of today, were studied closely. The course of the sun and moon, and the position of stars, provided both directionality, and understanding of position in space. The light from the sun and moon was often associated with religious beliefs, resulting in ancient built forms that mark time and space in their forms. This is evident in the streaks of sunlight at Stonehenge *(fig r78)*, where stones are aligned to emphasise the sun's rising and setting. We see it too in the shafts of light allowed into Egyptian temples at specific times, and also in the tracking of the sun on the Pantheon floor when it enters through the central oculus in the roof. (Plummer , 2003: 102)

Man was probably much more aware of his place in the Universe before the invention of electricity. "Starlight and moonlight were the definers of the night – parts of a larger whole of which humans are but a miniscule part. The mysteries of the universe were open to wonderment..." (Millet , 1996: 2) More recently, light pollution from human settlements masks the stars for city dwellers. Earth's lights are so bright they can even be seen from space. *(fig r79)*

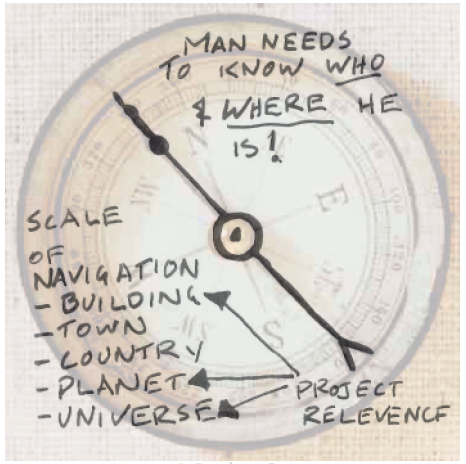


fig r77. A Pocket Compass.
One of the earliest navigational tools.
(Image in Max Energy Ltd., 2007)

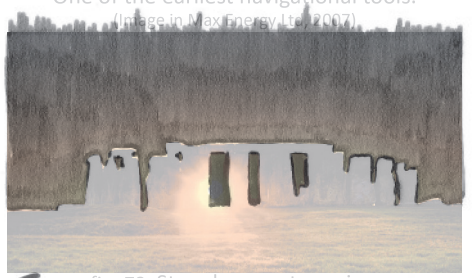


fig r78. Stonehenge at sunrise.
Wiltshire, England.
(Image in Wakefield, 2008)

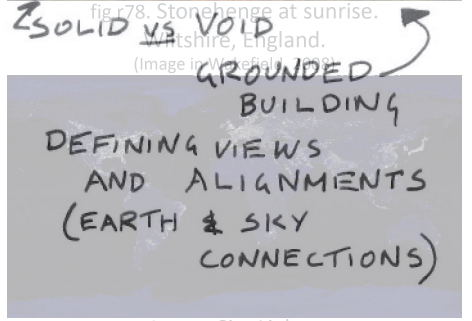


fig r79. City Lights.
Earth's lights viewed from space.
(Image in Hasan, 2009: 1)

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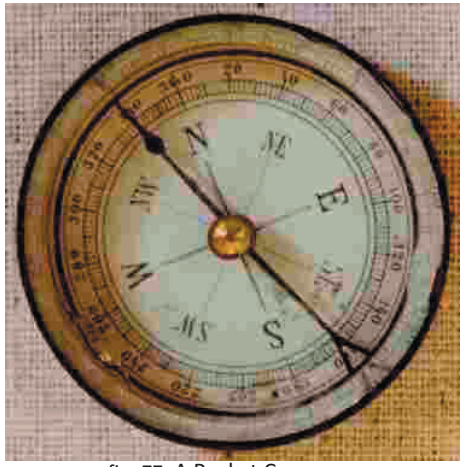


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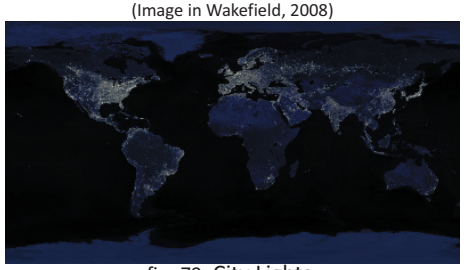


fig r79. City Lights.
Earth's lights viewed from space.
(Image in Hasan, 2009: 1)

The four cardinal points, North, South, East and West, have been used in orientation and navigation for centuries. *(fig r81)*They still play an important role in the design of the built environment, particularly as it relates to the position of the sun. We consider the aspects of the sunrise in the East, and sunset in the West, as well as the greater amount of light from the North (in the southern hemisphere) and the more uniform, indirect light from a southerly direction (also in the southern hemisphere). But, some ancient civilisations evidently paid far more attention to directionality, aligning structures with particular patterns or movements in the sky. (Plummer , 2003: 102)

The classical Greeks placed great importance on another 'quartet', they believed that the Universe was made up of four elements, Water, Air, Fire and Earth.*(fig r80)* (*Classical Element*, 2009: 1; Alexander , 2004: 318) It was believed that all creation was made up of these elements and they played a huge role in Greek philosophy, science and medicine. These elements were believed to represent and explain the realms of the cosmos. The Greek thinker, Aristotle, later added a fifth element, Aether, as a mediator between the other four. He reasoned that the other four elements, being earthly and corruptible, could not make up the stars in the Universe as they were perceived to be unchanging. The stars, therefore, must have been made of another, more 'heavenly' substance. (*Classical Element*, 2009: 1)

Similar elemental structures were developed in ancient Hindu, Buddhist, Japanese and Tibetan science and philosophy. With the advance of science, the elemental philosophies have fallen away from the studies of the make up of the universe, but do still exist in some spheres, particularly in ancient religions or even modern astrology. (*Classical Element*, 2009: 1) Beyond these spheres, the elements are remembered more for their symbolic value, the representation of the world, and of the unity and interaction of substance.

If these four elements are the symbolic building blocks of the Universe, surely they can be used in our environments to link us to our planet and cosmos? Building materials today can still be linked to these four elements. Stone, for example, clearly references its geological origins. It is durable and a symbol of permanence. (Pallasmaa, 2005a: 324) It is undeniably 'earth'. *(fig r82)* Similarly, glass has its roots in earth, but its real transformation comes through fire. Depending on its application, it may allude to both water and air as it appears as a translucent light filter or as a 'weightless' object.

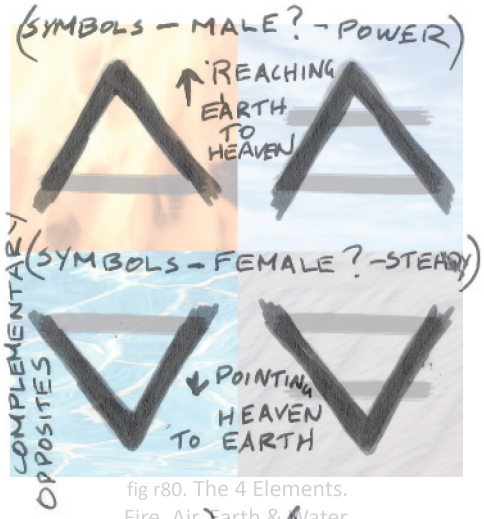


fig r80. The 4 Elements.
Fire, Air, Earth & Water.
(Photos by Author & Sketches from Classical Elements, 2009)



fig r81. The stars & sun guide desert nomads, even today, as navigational methods are used.
(Image by Author)



fig r82. Stone: durable, rooted, historical.
Rural Cottage, Isle of Skye, Scotland.
(Image by Author)

See materiality/element links on pages 142-146.

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fig r80. The 4 Elements.
Fire, Air, Earth & Water.
(Photos by Author. Symbols from Classical Elements, 2009)

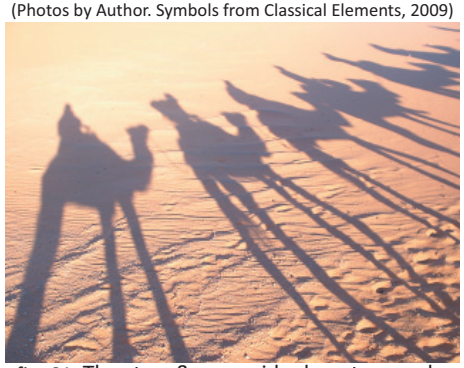


fig r81. The stars & sun guide desert nomads, even today old navigational methods are used.
(Image by Author)



fig r82. Stone: durable, rooted, historical.
Rural Cottage, Isle of Skye, Scotland.
(Image by Author)

See materiality/element links on pages 142-146.

Material qualities in Architecture can be harnessed to connect the user to the Universe, to feel a part of the elements, to be connected to earth and sky. They also allude to a long history (Pallasmaa, 2005a: 324; Sharr, 2007: 104), aiding man in his connection to a historical timeline, the fourth dimension of 'place'.

Gottfried Semper, nineteenth century architect and architectural writer, proposed another list of four elements, these related specifically to architecture. They are the hearth, the roof, the enclosure, and the mound. (1989: 102) These appear to be closely linked to the classical elements, the hearth *(fig r83)* is the domestication of fire, the mound (site or position) *(fig r86)* is the earth, the roof *(fig r84)* protects from the falling water, while the enclosure *(fig r85)* keeps out the wind (air). Semper maintains that, while different cultures placed different importance on each element, and developed them in different orders, these elements are always evident, even in the most primitive of shelters. (1989: 103)

The first sign of human settlement was the fire. This was the place of relaxation after the hunt or the battle, a place of warmth and safety and the focal point of social activities of ancient man. However long the settlement remained, the fire had established a 'place'.*(fig r83)* (Bronowski, 1973: 50; Millet , 1996: 106; Semper , 1989: 102; Unwin , 1997: 14) Fire is the only one of the Greek elements that no animal inhabits, and the relationship between man and fire is one of mystery and fascination. It is usually regarded as a transforming element more than a destroying one. (Bronowski, 1973: 123-124) The only reason that man's forefathers survived the ice-age is the fact that they discovered fire. (Bronowski, 1973: 50) It was also the element at the heart of some of mankind's greatest leaps in development. It is this element that enabled the discovery, transformation and use of metals (Bronowski, 1973: 124 &142), something we now generally take for granted.

Semper believed the fire to be the primary, 'moral' element of architecture, the one around which all the others gathered, just as it was the place of gathering within a community. (Semper , 1989: 102) Gaston Bachelard explored fire as a source of 'reverie', an element before which man couldn't help but think deeply. He explored fire as a social reality as well as a natural one. (1964b: 10 & 14) He was particularly interested in the many extremes of fire when he wrote that "it is intimate and it is universal. It lives in the heart. It lives in the sky. It rises from the depths of the substance and offers itself with the warmth of love. Or it can go back down into the substance and hide there, latent and pent-up, like hate and vengeance."
(Bachelard , 1964b: 7)



fig r83. The fire or 'the hearth'.
The first sign of settlement.
(Image in Sodahead, 2009)



fig r84. 'The roof' at *Rick's Cafe*.
Casablanca, Morocco.
(Photo by Author.)



fig r85. 'The enclosure'. Karoo dry-packed stone walls. A tradition of centuries.
(Photo by Author.)



fig r86. 'The mound'. Walled city on a hill.
Kasbah Ait Ben Haddou, Morocco.
(Photo by Author.)

This seems to point back to 'place', indicating that fire is as much a part of our context (land and sky) as earth itself. Its existence in the form of sun (and other stars) shapes our time and points out direction. Domesticated, it warms, cooks and gathers. But it is an element that is far from tame. If we continue a sectional exploration from the sky right through the earth *(fig r87)*, we find a burning centre. This fire only becomes evident to us in volcanic eruptions *(fig r88)*, or in the shifting earth plates resulting in rifts and quakes. These occurrences help to remind man about what lies under his feet.

Fire as an element preoccupied chemists more than any other element. For a long time, it was believed that if one could uncover the essence of what fire was, it would answer all questions about the enigma of the Universe. (Bachelard , 1964b: 60) Bachelard posited that fire was taken to be a constituent element of the Universe because it was already the primary element of human thought. (Bachelard , 1964b: 18) The hearth's warming qualities add to the feeling of 'home', create a 'dwelling', something intrinsic to man's very existence on earth. (Heidegger , 1971: 149) The house will appear even warmer when it is juxtaposed with cold, a haven in a harsh winter. (Bachelard , 1964a: 39)

Martin Heidegger (1889-1976), German philosopher, put forward his own variation of four elements that dominate the existence of 'mortals'. In his *Poetry, Language, Thought*, he speaks about man being on the earth and under the sky *(fig r89)*, while at the same time remaining before the divinities and belonging to man. "By a primal one-ness the four – earth and sky, divinities and mortals – belong together in one." (1971: 149) He goes on to explain the "simple one-ness of the four", the fact that, when observing the sky, we are already thinking of the other three without even knowing it. Similarly, when we consider the earth, with its blossom and fruit, rock and water, plant and animal, or when we think of the divinities in whatever form we choose, or when we look at ourselves and fellow man, wrapped in mortality, we always observe one, but experience all four together subconsciously. (1971: 149-150)

Heidegger believed that 'dwelling' was, in essence, the peaceful interaction between individuals and the world, and that it could be achieved through building with the fourfold conditions. (Sharr, 2007: 37) He felt that the realities and technologies of everyday life (particularly in the Western World) distracted from the real priorities of life by dulling the reminders of human frailty that are inherent in the world around us. These reminders are the very things that appeal to human emotion and root man in his world.
(Sharr, 2007: 7 & 61)

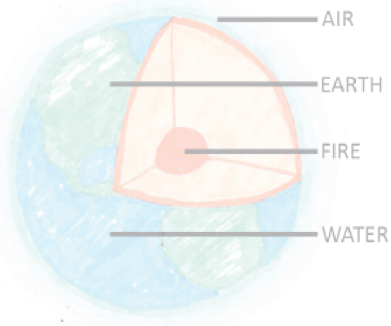


fig r87. Section Through the Earth.
Elements underfoot and overhead.
(Image by Author)


fig r88. Destructive Fire From Below.
Pompeii: ruins with volcano, Vesuvius, behind.
(Photo by Author)

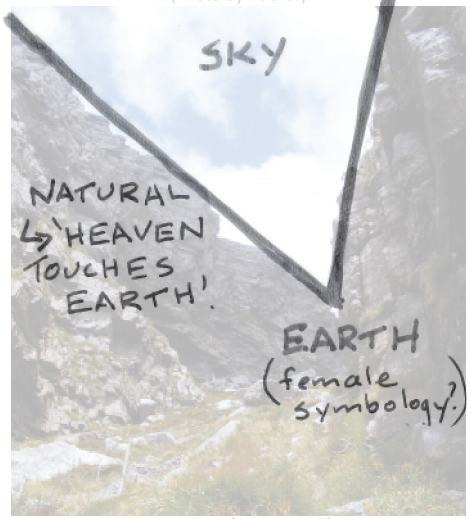


fig r89. Earth meets Sky.
Platteklip Gorge, Table Mountain, Cape Town.
(Photo by Author)

See fire/hearth project implementation at the Visitors' Centre Terrace, pages 147 & 148, and in the Astronomers' hallway and dining courtyards, pages 149 & 150.

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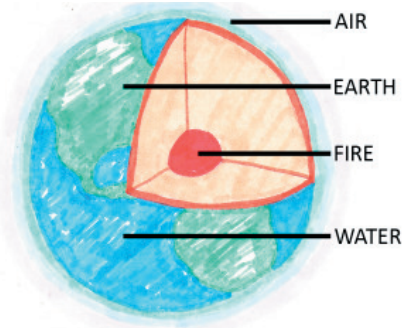


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fig r88. Destructive Fire From Below.
Pompeii: ruins with volcano, Vesuvius, behind.
(Photo by Author)



fig r89. Earth meets Sky.
Platteklip Gorge, Table Mountain, Cape Town.
(Photo by Author)

See fire/hearth project implementation at the Visitors' Centre Terrace, pages 147 & 148, and in the Astronomers' hallway and dining courtyards, pages 149 & 150.

As man ‘dwells’, his “being-in-the-world mirrors the between of earth and sky”. (Norberg-Schulz, 1983: 67) The place where this ‘dwelling’ takes place is a landscape. Landscape is “therefore not a mathematical, isomorphic space, but a ‘lived space’ between earth and sky.” (Norberg-Schulz, 1983: 65) A building, by a simple act of ‘being there’ allows life to happen between earth and sky, divinities and mortals. It creates a concrete space for life and dwelling to exist. (Heidegger, 1971: 154-155; Norberg-Schulz, 1983: 67) It can be said that a bridge doesn’t simply connect two river banks, but that the banks only emerge as banks as the bridge crosses the flowing water. *(fig r90)* The bridge “brings stream and bank and land into each other’s neighbourhood”, the existence of the one allows the others to exist more fully. (Heidegger, 1971: 152)



fig r90. Bridge at Waverley Abbey. Surrey, England. (Photo by Author)

Further to this, Heidegger, in describing a Greek temple in his essay, *The Origin of the Work of Art*, said “standing there, the building rests on the rocky ground. The resting of the work draws up out of the rock the mystery of the rock’s clumsy yet spontaneous support. Standing there, the building holds its ground against the storm raging above it and so first makes the storm itself manifest in its violence. The luster [sic] and gleam of the stone...first brings to light the light of day, the breadth of the sky, the darkness of the night. The temple’s firm towering makes visible the invisible space of air.”*(fig r91)* (1950 Cited in Norberg-Schulz , 1983: 62) Buildings relate to their environment by resting on (or digging into) the ground and reaching up towards the sky. (Norberg-Schulz, 1980: 10)

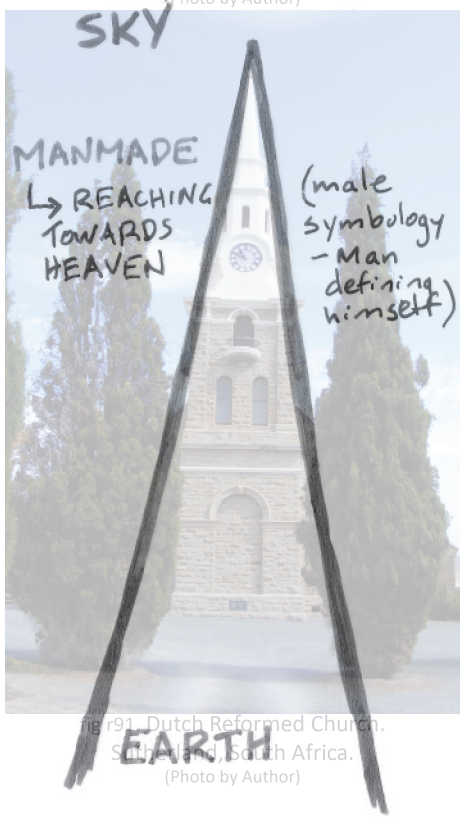


fig r91. Dutch Reformed Church. Stellenbosch, South Africa. (Photo by Author)

“The existential purpose of building (architecture) is therefore to make a site become a place, that is, to uncover the meanings potentially present in a given environment” and “its purpose is to help man to dwell”. (Norberg-Schulz, 1980: 18 & 23)

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fig r90. Bridge at Waverley Abbey. Surrey, England.
(Photo by Author)

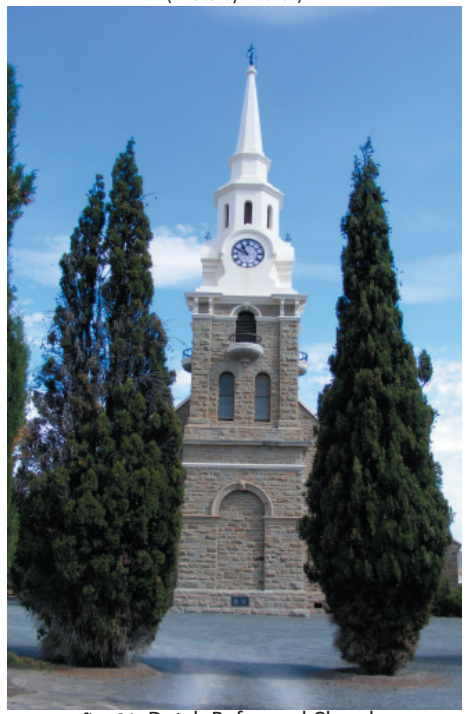


fig r91. Dutch Reformed Church. Sutherland, South Africa.
(Photo by Author)

Building 'place'

In creating 'place' through architecture, there is first a distinction between the natural and the man-made, between "landscape" and "settlement". "The man-made place visualizes [sic], complements and symbolizes [sic] man's understanding of his environment". (Norberg-Schulz, 1980: 10 & 58) Swiss architect and writer, Peter Zumthor, believes that some buildings appear to complete the landscape in which they sit. We don't pay any special attention to these buildings and yet it can be virtually impossible to imagine the place without them. They seem to be firmly anchored in the ground and sensitively 'belong' to their setting. (Zumthor, 1999: 17-18) In these cases the natural and the manmade seem closely intertwined.

The second distinction to consider is the aforementioned relationship between earth and sky, the horizontal and vertical relationships of the building in its context. (Norberg-Schulz, 1980: 10)

The next consideration is that of the relationship between 'inside' and 'outside'. *(fig r92)*The 'inside' generally functions as a place of gathering what is known. (Norberg-Schulz, 1980: 10) The enclosure is defined by a boundary of some form. The boundary should not be seen as the point at which something ends but the point at which something begins. The boundaries of a built space most often take the form of floor, wall, and ceiling. There needs to be openings through these boundaries in order to connect to the 'outside'. *(fig r93)*The boundaries of landscape are similar to that of building, but they take the form of ground, horizon and sky. (Norberg-Schulz, 1980: 13)

Scandinavian architect, Alvar Aalto, believes that there is "invariably something helpless and aesthetically impure about the way in which the interiors of a building open outward." (Aalto, 1984: 215) The garden or courtyard is as much a part of the home as any of its rooms, therefore the step from the inside of the house interior into the garden should be less of a contrast than the one from the street to the garden. The garden and the interior decoration should be very closely related. (Aalto, 1984: 216)

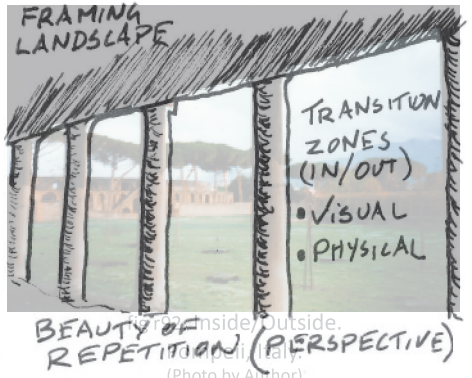


fig r92. Inside/Outside.
Masseria Cimino, Fasano, Puglia, Italy.
(Photo by Author)

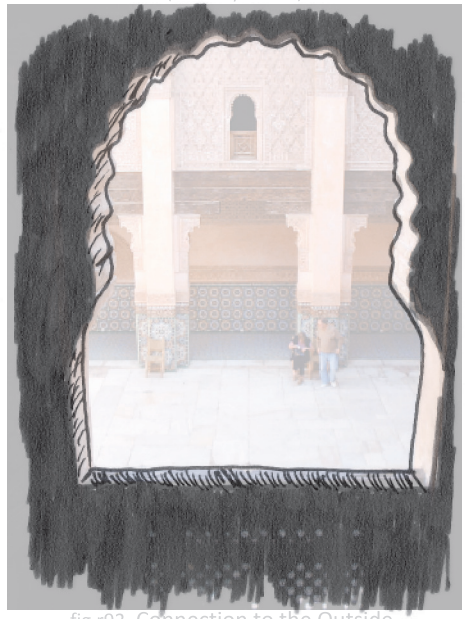


fig r93. Connection to the Outside.
Majorelle Garden, Marrakech, Morocco.
(Photo by Author)

See inside/outside relationships in the courtyards and terraces around the Visitors' Centre and the accommodations. pages 149-150.

Building 'place'

In creating 'place' through architecture, there is first a distinction between the natural and the man-made, between "landscape" and "settlement". "The man-made place visualizes [sic], complements and symbolizes [sic] man's understanding of his environment". (Norberg-Schulz, 1980: 10 & 58) Swiss architect and writer, Peter Zumthor, believes that some buildings appear to complete the landscape in which they sit. We don't pay any special attention to these buildings and yet it can be virtually impossible to imagine the place without them. They seem to be firmly anchored in the ground and sensitively 'belong' to their setting. (Zumthor, 1999: 17-18) In these cases the natural and the manmade seem closely intertwined.

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fig r92. Inside/Outside.
Pompeii, Italy.
(Photo by Author)

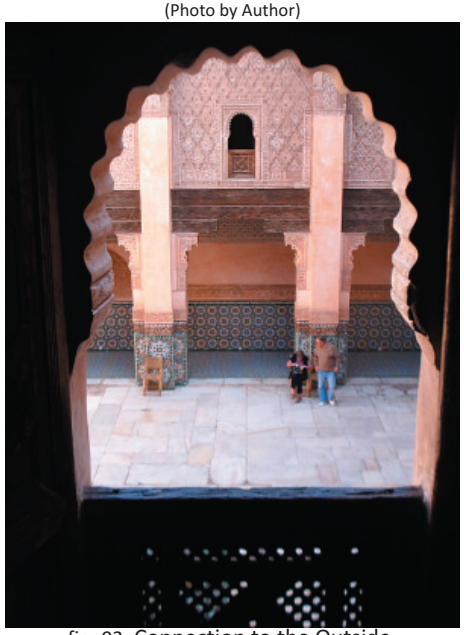


fig r93. Connection to the Outside.
Medersa in Marrakech, Morocco.
(Photo by Author)

See inside/outside relationships in the courtyards and terraces around the Visitors' Centre and the accommodations. pages 149-150.

In a similar way to the garden being part of the interior, some of the interiors can appear to be outside. A large open space with a fireplace, a rustic floor and a different form to the rest of the house can, psychologically, appear to be an outdoor space. (Aalto, 1984: 216) To take that a step further, an 'inside' space can be left open above, allowing the sky to become the ceiling. This space then, in spite of lateral boundaries, becomes part of the 'outside'. (Norberg-Schulz, 1980: 59) *(fig r94)*

The final step in the making of 'place' is that of defining 'character'. Character is determined by *how* things are, and it is only by understanding it that we can begin to come to terms with the 'spirit of place' or *Genius Loci* which man has to come to terms with in order to really be able to dwell. (Norberg-Schulz, 1980: 11) To some extent, the character of a place is closely linked to light and how it changes in relation to time, both through the day and the year. (Norberg-Schulz, 1980: 14) *(fig r95)*

To understand character better we need to ask the '*how*' question of everything. We need to ask "*how* is the ground...", "*how* is the sky...", or "*how* are the boundaries...". (Norberg-Schulz, 1980: 14) All of this relates to how the building is built in its environment and, therefore, its character. *(fig r96 & r97, following page)*

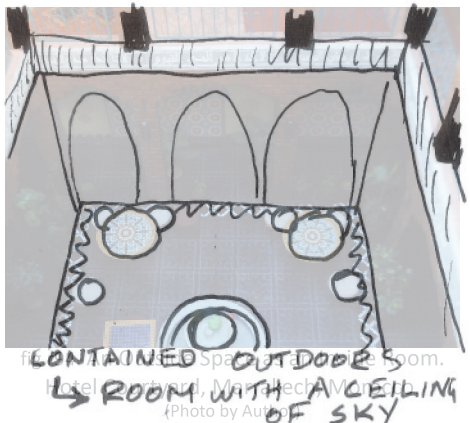


fig r94. Contained Space: Outdoor Room.
Hotel Courtyard, Marrakech, Morocco.
(Photo by Author)



fig r95. Filtered Light.
Souq, Marrakech, Morocco.
(Photo by Author)

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fig r94. An Outside Space as an Inside Room.
Hotel Courtyard, Marrakech, Morocco.
(Photo by Author)



fig r95. Filtered Daylight.
Souq, Marrakech, Morocco.
(Photo by Author)

Science, Art, and Man

Scientific exploration has indeed brought our understanding of the Universe a long way since the Greeks posited the four elements as the smallest components of matter. In *The Nature of Order*, architect and critic, Christopher Alexander (1936-) writes that there are "two worlds in our minds. One is the scientific world which has been pictured through a highly complex system of mechanisms. The other is the world we actually experience. These two worlds, so far, have not been connected in a meaningful fashion." (2004: 13) Alexander believes that our scientific understanding of the Universe is wonderful and powerful, that it has not detracted from our ideas of beauty or identity. But he speaks of needing to find a crack in which to inject a new structure that could give the whole meaning. (2004: 12)

His idea of the "*the I*" speaks about an inner element, a spirit within every individual, the thing that makes us feel related to a work of art, an element of nature. He believes that feeling of relatedness, of identification, is necessary to animate life in each living centre. (2004: 2) This is the point at which science alone cannot fulfil our needs, there has to be more of an interaction between science and art as it is the art that helps us to identify with the science around us. The importance of this relationship is echoed by, contemporary South African artist, Marcus Neustetter, as he endeavours to arrange retreat/discussion weekends for Astronomers and Scientists with artists of various kinds. He believes we can gain more from the interactions of the two groups than we can from the work of either one alone. (Neustetter , 2009a: -)

Art and science are both uniquely human actions, two things that animals cannot do. (Bronowski, 1973: 56) A popular cliché in philosophy is that science is like taking the rainbow apart while art is putting it back together. This, however, is not necessarily true. The two have far more in common than that, and the roots of both come from first analysing nature. (Bronowski, 1973: 113)

With specific reference to architectural design, Alexander goes on to write, "I believe that all architecture depends on relatedness. Those buildings which work are the ones which create relatedness between a person and the Universe."*(fig r71 & r72)* (2004: 50)



fig r96. Doorway to the Desert
Merzouga Desert, Morocco.
(Photo by Author)

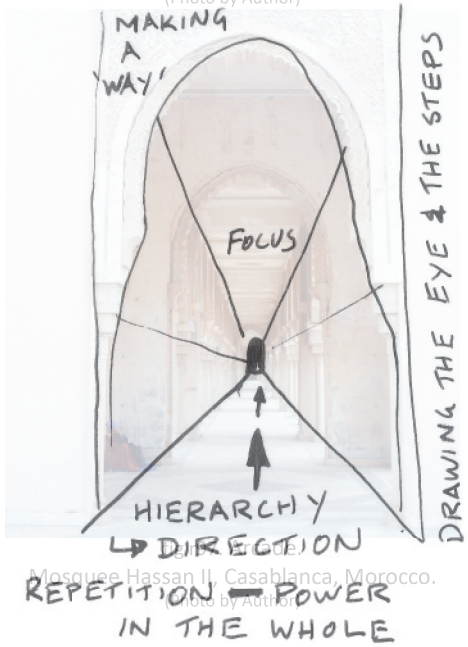


fig r97. Steps
Mosquee Hassan II, Casablanca, Morocco.
(Photo by Author)

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fig r96. Doorway to the Desert.
Merzouga Desert, Morocco.
(Photo by Author)



fig r97. Arcade.
Mosquee Hassan II, Casablanca, Morocco.
(Photo by Author)

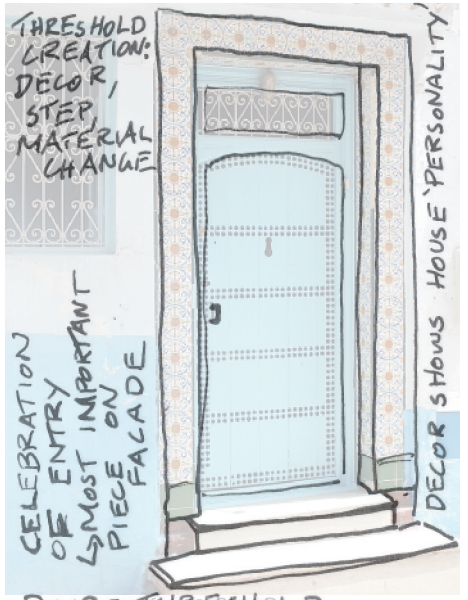
Conclusion

If we, as architects, hope to create spaces and habitats that humans can feel related to, there is far more to consider than just bricks and mortar.

Colour, as surface pigment or as light, affects humans on many levels. Though the reaction of an individual may not be totally predictable, we can make educated choices of the type of feeling or mood that a particular colour palette will evoke in a space. Choosing a 'neutral' palette of white paint and finishes, and stark white lights, may not evoke a 'neutral' reaction. We may, in fact, be detracting from the rest of the careful planning and detailing in the space. The possible eye damage caused, the glare, and the lack of spatial identity, may be the negative results of a design without proper considerations for colour.

If indeed, as has been discussed, man longs for a feeling of identity and place, and if, the feeling of relatedness to a building or space is linked to a feeling of relatedness to the Universe, then this too should be an important concern in the design of good buildings. Regionalism and contextual design should not only look at local traditions and materials, or relate to site topography and views. Though these considerations are important and should not be forgotten, we, as designers, also need to consider the site in its greater context of earth and sky.

The other part of 'place' that we should be considering is the context of time. Nothing we build, no space we inhabit, exists outside of time. In the modern age, we are often acutely aware of time in terms of minutes and seconds, appointments and deadlines. However, we often lose touch with the transitions of day and night, or the passing of seasons. So, when we speak of a building making us aware of a time context, we are not talking about the particular period or fashion prevalent at its construction. The important factor in relating ourselves to time is our current position and becoming aware of it. If a building can harness the cycles of the sun, the orbit of the earth, the tracking of the seasons, it has gone a long way in enabling its users to identify their place in time.



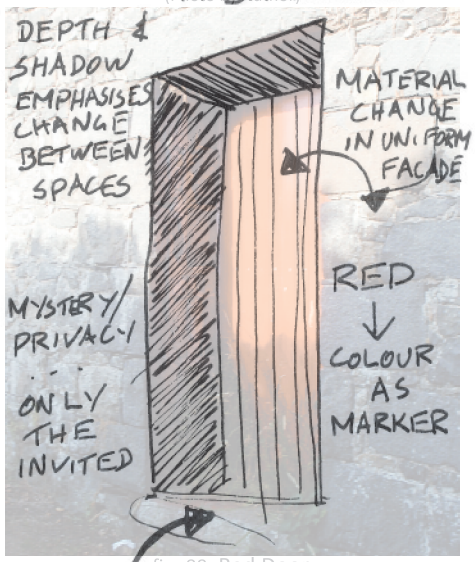


fig r99. Red Door. Guernsey. (Photo: Author)

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fig r98. Blue Door.
Chef Chaouen, Morocco.
(Photo by Author)



fig r99. Red Door.
Guernsey.
(Photo by Author)

The latter considerations, of context in space and in time, may be more challenging to achieve in urban environments than in rural ones. Rural environments tend to naturally maintain a sense of connection to the earth and sky. The landscape may be closer to its natural form and easier to read. The stars may be more visible without city lights drowning them out. Farmers, dependent on understanding the weather and the seasons, are far more aware of the course of time through a year than city dwellers in regulated environments. These areas provide exciting opportunities for contextual design which shouldn't be wasted.

Cities, by their very nature have lost touch with the original landscape on which they were founded. Land gets flattened and smoothed, trees are removed (or planted in more 'convenient' positions), soil and rock are replaced by concrete and paving. Stars become all but invisible. Internal and external environments are uniform and regulated. These factors make it more difficult to find contextual pointers to link our designs to. These factors also make it an even more valuable task. Where people have completely lost connection to Time and to the Universe, contextual design considerations become more valuable.

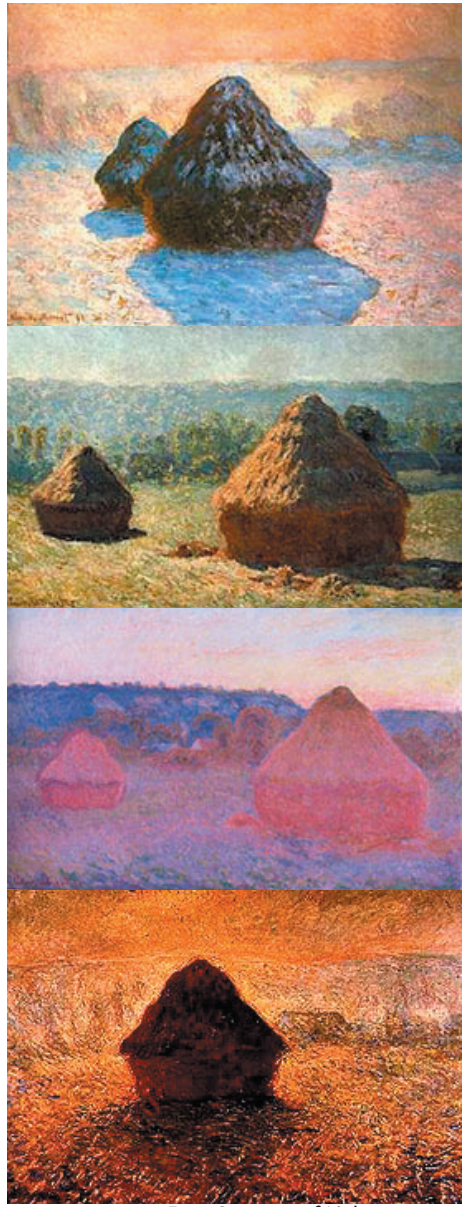


fig r100. Four Seasons of Light.
Haystacks. Light studies - Claude Monet.
(Image In McKinney, 2009)

Precedent Studies:

Similar precedents have been grouped under headings. They are each first discussed in some detail. A 'lessons' page follows each group which summarises the relevant information derived from the studies. Specific page numbers for the 'lessons' pages can be found in the Contents on page 2.

Ancient Arrangement

Adam's Calendar,
Mpumalanga, South Africa

"This is possibly the only example of a functional, mostly in-tact [sic] monolithic stone calendar in the world."
- Michael Tellinger, Explorer and Author
(Tellinger, 2009b)

At the top of the Mpumalanga escarpment, about 5 kilometres from the town of Kaapsehoop, lies Adam's Calendar. This ancient collection of stone monoliths, arranged in a circular configuration is reputedly the oldest calendar in the world. (Starke, 2009: 24)

These stones are just one part of a collection of ruined stone settlements scattered over a 10 000km^2 area between Nelspruit and Carolina. These 'cities' appear to have been linked by roads and terraces carrying irrigation networks. *(fig p1 & p2)* (Starke, 2009: 25) Adam's Calendar itself was discovered by a fire-fighter pilot in 2003 and has been extensively studied since then. But the wider region has long been considered a sacred area by African cultures. (Starke, 2009: 24)



fig p1. Agricultural Terraces.
Aerial View of the region in Mpumalanga.
(Image In Starke, 2009: 25

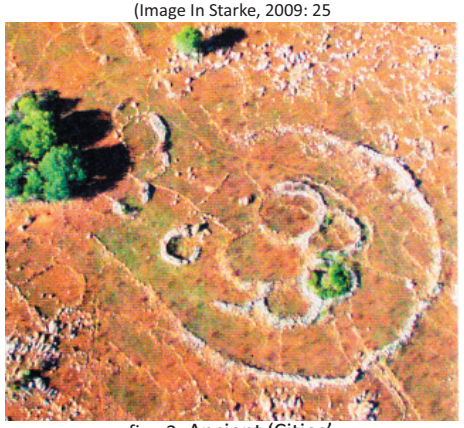


fig p2. Ancient 'Cities'.
Aerial View of the region's ruins.
(Image In Starke, 2009: 25)



fig p3. Central Monoliths.
Adam's Calendar, Mpumalanga.
(Image In Starke, 2009: 24)

The Calendar is believed, by some, to be one of the oldest man-made structures in the world. How the massive stones *(fig p3)* were moved is as much a mystery as how the pyramids were built, but there is evidence of other ancient tools in the area. This evidence has suggested that the people who moved the stones also mined gold in the region. (Starke, 2009: 24) It is worth noting that the information about these stones is hotly debated by scientists. Michael Tellinger, an explorer and author, firmly believes in the authenticity and age of the stones. Several scientists and specialists in various fields stand behind his claims and their research seems to coincide with his theories and tests have been done to date the structure. However, there are also many experts who strongly disagree with the theories, particularly in some of the methods used to date the structure. So, the evidence is by no means conclusive. (Starke, 2009: 25)

The stones, arranged in a circular pattern, are aligned to the four cardinal points, and also mark the summer and winter solstices, the equinoxes and the constellation of Orion (Orion's Belt specifically). The North-South arrangement of stones correlates to the Earth's position in space 75 000 years ago (contributing to initial speculations of the age of the structure). The two main dolorite stones form the main sundial. *(fig p4)* The taller stone tracks its shadow across the smaller stone. The shadow takes exactly a year to progress across the rock and back, marking the time of the two solstices, and all the days in between. (Starke, 2009: 24)

Michael Tellinger has further explored the layout of the stones, concluding that there was a strong understanding of geometry and mathematics used in the building of the circle. He shows how the site plan displays the 'golden ratio', the geometric Phi factor (1.618) by which all natural things grow. *(fig p5 & p6)* Two quantities are in 'golden ratio' if the ratio of the sum of the quantities to the larger quantity is the same as the ratio of the larger quantity to the smaller one (a+b is to a as a is to b). This ratio has often been considered a ratio of true beauty and has been used in art and architecture through the ages. (Golden Ratio, 2009)

A structure such as this could tell us a lot about early human civilisations. We may also be able to learn from the building choices made by people with a far greater awareness of the Universe in their everyday activities, despite their not having as much scientific proof as modern man has at his disposal.

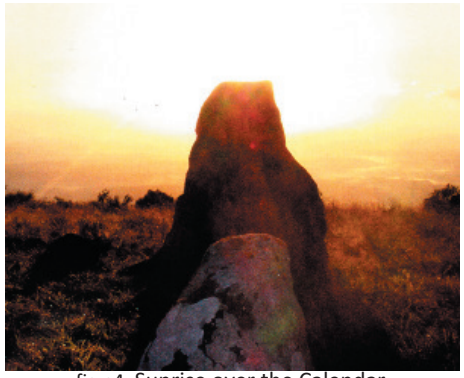


fig p4. Sunrise over the Calendar.
One of the stone alignments.
(Image In Starke, 2009: 24)

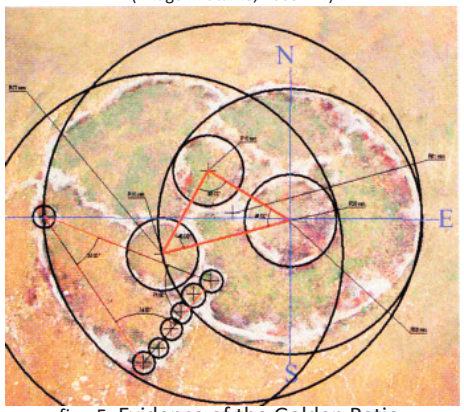


fig p5. Evidence of the Golden Ratio.
Diagram showing the Phi Ratio in the layout.
(Image In Starke, 2009: 25)

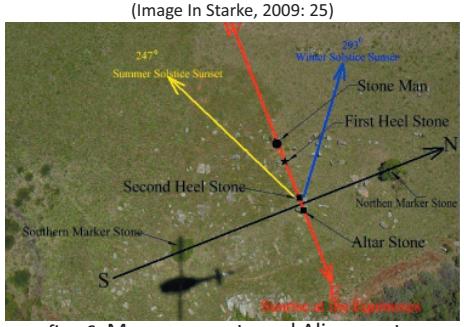


fig p6. Measurements and Alignments.
Orientation of the Calendar.
(Image In Tellinger, 2009a)

Ancient Egyptian Buildings

"Many Egyptian buildings were built with an astronomical orientation. The temples and pyramids were constructed in relation to the stars...Temples were often built so that sunlight entered a room at only one precise time of the year."
- Egyptology website
(Astra Corporation Limited, 2008)

Ancient Egyptian buildings had different associations to various religions and gods throughout the country. Their orientation was often dependent on those relationships and so would have varied in different regions. (Astra Corporation Limited, 2008) Much religious symbolism went into the design and construction of Ancient Egyptian pyramids *(fig p8)* and temples. This investigation will only look at astronomical relationship.

There is much evidence to tell us that the Ancient Egyptians had a keen interest in astronomy. The heavenly bodies were linked to various religious practices and, in many cases, the sun, moon and constellations were given the status of deity *(fig p7)*. (Hiebert, 2005) The astronomical ceiling in Senenmut's tomb *(fig p9)* is, in fact, the oldest known astronomical representation. It is a complex map of the skies as well as an early calendar (probably to help plan planting and harvests and predict the flooding of the Nile). It is divided into two parts representing the Northern and Southern skies. The Southern (depicted at the top) represents the night and shows the southern constellations and various deities riding in boats in the night. In the Northern skies, at the bottom, the Northern constellations are shown and deities carry sun disks, representing the day. (Hiebert, 2005)

The faces of the Great Pyramid (as with most others) are almost perfectly aligned with the four cardinal points. (Hiebert, 2005; Ancient Alignments - Examples: Egyptian Pyramids, 2005; Fairall, 1999) This would have been done by observing the sun and the movement of the stars around the North Celestial Pole and noting the symmetry between the rising and setting points of stars. (Fairall, 1999; Ancient Alignments - Examples: Egyptian Pyramids, 2005)



fig p7. The sun god, Ra..
A depiction of an Ancient Egyptian god.
(Image In Kompak, 2006)

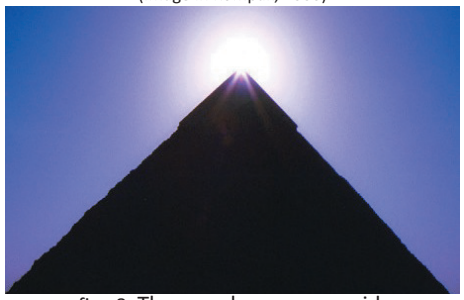


fig p8. The sun above a pyramid.
Egypt.
(Image In Edwards, 2008)

The Great Pyramid at Khufu also had four 'star shafts'. *(fig p10)* These shafts pointed at transit points of various significant stars or constellations in around 2500BC. These are thought to have pointed the spirit of the entombed king to the gods associated with these stars. However, due to the earth's changed position over the years[1], these no longer point to the constellations. (Fairall, 1999)

There is also a theory that that the arrangement of the pyramids at Giza *(fig p11)* is based on the constellation of Orion, specifically the three stars representing his belt. This theory has been put forward to explain the slight offset of the third pyramid. However, this has been contested and is by no means fact. (Fairall, 1999; Hiebert, 2005)

To the Ancient Egyptians, positioning of structures and knowing where you were in relation to the Universe was central to their lives. So much so that it carried through, even in their beliefs of the afterlife.

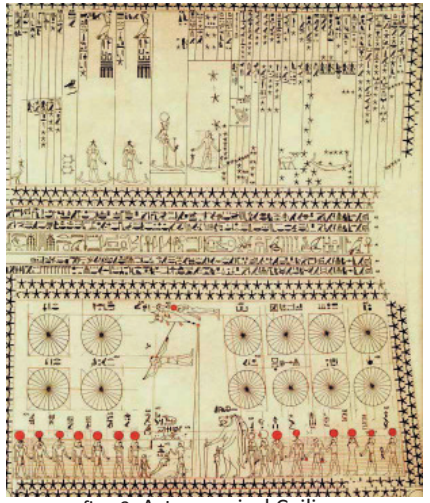


fig p9. Astronomical Ceiling.
Senenmut's Tomb, Egypt.
(Image In Hiebert, 2005)

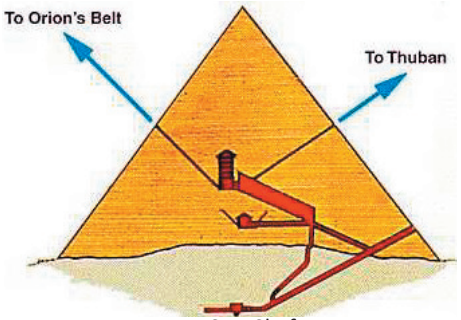


fig p10. Star Shafts.
Khufu Pyramid, Egypt.
(Image In Babul, 2004)

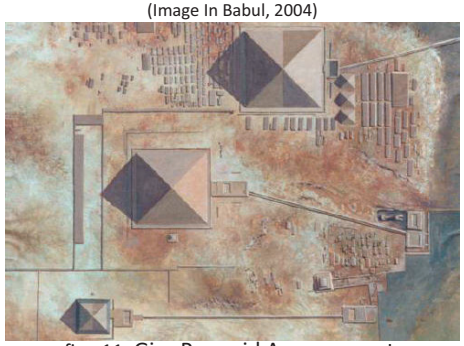


fig p11. Giza Pyramid Arrangement.
Giza, Egypt.
(Image In Ancient alignments - ..., 2007)

1.The earth spins on a tilted axis (+-23.5°). This axis slowly varies between about 24.5° and 22.1°, completing a cycle over about 41 000 years. This axis wobbles in a clockwise circle as it does this. This is called 'precession' and accounts for the changed position of stars relative to the earth over thousands of years.

Stonehenge, Wiltshire, England

"In any case, for whatever reasons those Stonehenge builders built as they did, their final, completed creation was a marvel. As intricately aligned as an interlocking series of astronomical observing instruments (which indeed it was) and yet architecturally perfectly simple, in function subtle and elaborate, in appearance stark, imposing, awesome, Stonehenge was a thing of surpassing ingenuity of design, variety of usefulness and grandeur – in concept and construction an eighth wonder of the ancient world."
- Dr. Gerald S Hawkins (1928-2003), Professor of Astronomy at Boston University in the 1960's.
(Hawkins, 1966: 152)

Stonehenge consists of a ring of earthworks (a bank and ditch) with a circular arrangement of standing stones within it. It is thought to have been built around 2500BC. The earliest earthworks are currently dated at around 3100BC and various stages of stone building were added later *(fig p12)*. (Stonehenge, 2009) Some scientists differ from 3100BC to 1600BC.(Stonehenge, 2009; Hawkins, 1966: 119)

The earliest version of Stonehenge (c 3100BC) consisted of a circular bank and ditch, 110 metres in diameter, with a large entrance to the North East and a smaller one to the South. (Stonehenge, 2009) A second phase, no longer in existence, could have consisted of some sort of timber structure. It seems the area may have been used as a cremation cemetery at this time. (Stonehenge, 2009; Alexander, 2008: 39) The earlier phase may well have embodied different beliefs to the later stone monument. (Alexander, 2008: 37)

By about 2600BC timber was abandoned in favour of stone. The construction was obviously modelled on timber structures as is evident from the use of carpentry techniques such as Mortise and Tenon joints. (Stonehenge, 2009; Alexander, 2008: 36) Many types of stone were used and there are many theories of how the stones (+-4 tons each) were transported huge distances. (Stonehenge, 2009) Many of the stones are believed to have come from the Preselli Hills in Wales. This region was believed to already have had a reputation for holding mystical healing powers. This has prompted theories that Stonehenge could have been built as a place of healing. (Alexander, 2008: 57-58) Up to 80 stones may have stood in a ring here. Various others were added and holes were dug. But it appears this phase was abandoned unfinished and some of the stones may have been removed and holes purposely filled in.

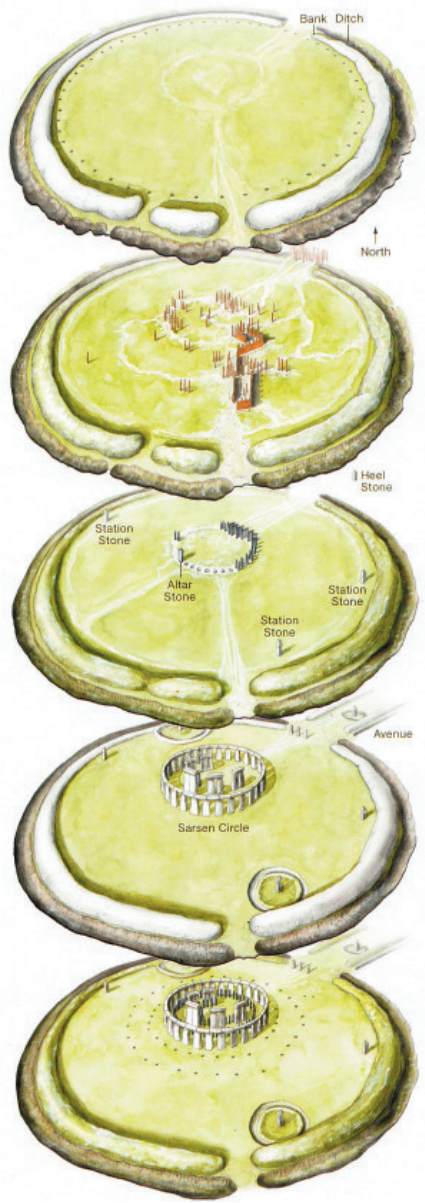


fig p12. Stonehenge Phases.
How Stonehenge developed over time.
(Image In Alexander, 2008: 39))

The ‘Heelstone’ a sandstone monolith erected outside the North East entrance was probably also part of this phase. ‘Stonehenge Avenue’, a parallel pair of ditches and banks was constructed to stretch the 3km distance to the River Avon, indicating a strong link to water. (Stonehenge, 2009)

The final addition (+-2600BC to 2400BC) consisted of 30 enormous ’Sarsen’ stones, dressed and erected with 30 lintels in a 33m diameter ring around the earlier stones. Each standing stone is about 4.1 metres high, 2.1 metres wide and weighs about 25 tons. The standing stones widen slightly at the top to counteract the effect of perspective and the lintels are slightly curved to enhance the circular shape. (Stonehenge, 2009; World Mysteries - Stonehenge, England, 2005)

It is not known whether the circular shapes were once all complete (the widely accepted theory) or whether more of the work was left incomplete. (Stonehenge, 2009) There has also been much speculation about the original uses of the structure (which may even have changed over the years with the different users and with each new phase). With no written documents to help us understand the cultures of the time, the uses are left largely to the imagination. Some possibilities include a temple to the sun or moon, an astronomical calendar, a city of ancestral dead, a place of healing, a stone representation of the gods, or a symbol of status and power. (Alexander, 2008)

One of the most convincing theories may be that of Dr. Gerald Hawkins, astronomer and author of *Stonehenge Decoded* in 1966. He stated that “all the evidence indicated that Stonehenge was a sophisticated and brilliantly conceived astronomical observatory”. (Hawkins, 1966: 1;) It had long been acknowledged that Stonehenge had many astronomical alignments, the main one being that the central axis (and the North East entrance) which aligns with the sunrise on midsummer’s day (Summer solstice). (Hawkins, 1966; World Mysteries, Stonehenge, England, 2005) The question remained why so much rock was moved and erected when two aligned stones would have been sufficient to mark the position of the rising sun. Hawkins, with the help of new computer technology in the early 1960s, analysed all the stone positions in relation to the sky. (Hawkins, 1966: 122)

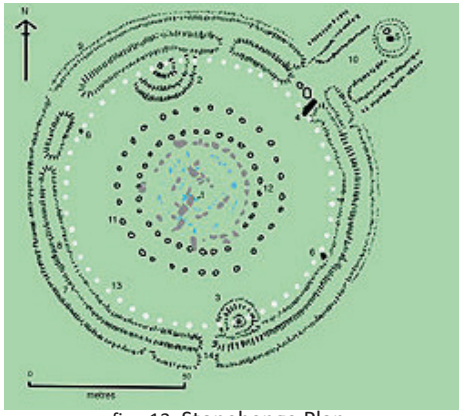


fig p13. Stonehenge Plan.
Overall Plan including Bank & Ditch.
(Image In Stonehenge, 2009)

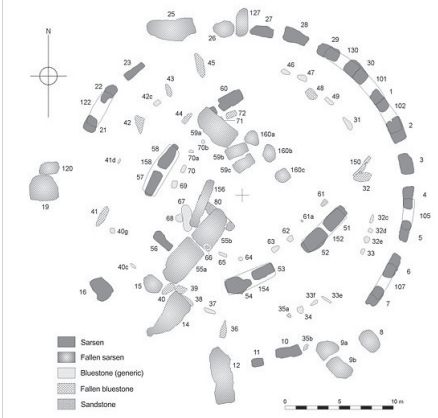


fig p14. Stonehenge Plan.
Layout of Central Stones.
(Image In Stonehenge, 2009)

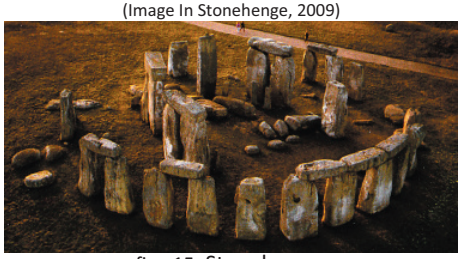


fig p15. Stonehenge.
High angle view of the central stones.
(Image In Alexander, 2008: 59)

The results were astonishing. The entire structure seems to have been aligned with the heavens, tracking the rising and setting of the sun and the movement of the moon at different times of the year. All of the 14 stones considered key to the earlier phase of stone works were involved in at least one alignment view, altogether producing 24 alignments! The last major stone erection phase produced a further 8 alignments, without diminishing the views of the earlier ones. (Hawkins, 1966: 171)

Views were framed so tightly that you couldn't have helped but look at what was meant to be viewed. The central trilithon arches are very narrow. To align one of these arches with the arch in the outer ring your view is narrowed even further. Added to this, a view through both arches is only possible from a very specific viewpoint (separate points as opposed to customary architectural practice to radiate vistas from a central point). The builders clearly meant the viewer to be focussed on one very specific point in each case. (Hawkins, 1966: 124)

The fact that the structure was added to over generations makes the alignments even more spectacular. Each alignment was maintained, duplicated and emphasised with each new stone making it organic in its growth yet accurately scientific in its planning. (Hawkins, 1966: 147)

Hawkins further speculates on how some of the holes dug around the site may never have been intended to hold structures, but could have been a sophisticated calendar system able to count months and days as well as predict eclipses with a high level of accuracy. (Hawkins, 1966: 168-186)

So, whatever the actual purpose of the Stonehenge structure was, through a series of alignments, vistas, windows and angles, the building provides a tool to predict and view cosmic occurrences specific to time and place.

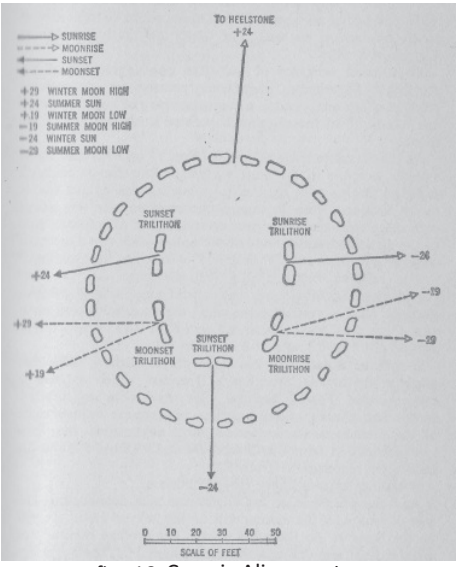


fig p16. Cosmic Alignments.
Diagram showing sun & moon alignments.
(Image In Hawkins, 1966: 141)

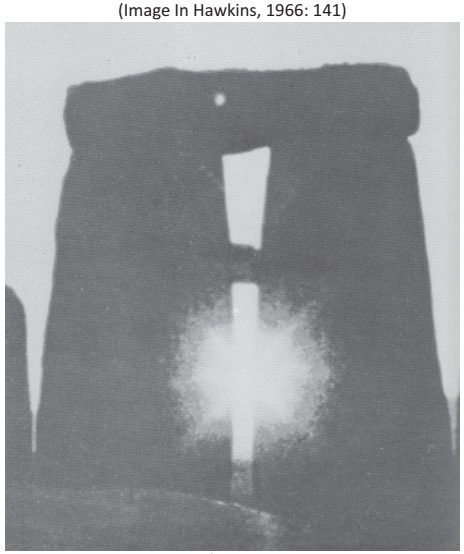


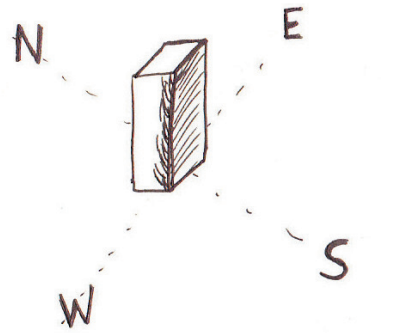
fig p17. Midwinter sunrise.
Sunrise through a Trilithon and Outer Arch.
(Image In Hawkins, 1966: 130)

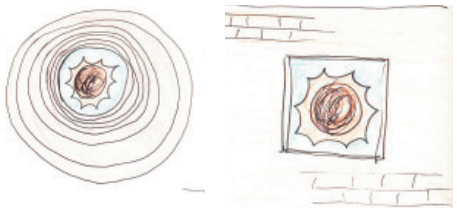
How to align in relation to the compass?
'best light' - North orientation for best warmth and bright light (screening considerations). South for even light

Special Alignments - sunrise/sunset?
What is important and **when**?
(solstice? equinox? Symbolic day?)
Moment event or full day tracking?

Sun alignments are easier to achieve than moon or star alignments, which vary more over time .

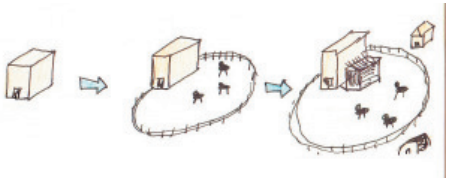
Organic 'life cycle' -
a building adapts and grows with different users over **time**.
Structure never complete or static.
Scope to 'contribute' or 'leave behind'?
Beauty in the ability to **mould over time**











Symbolic **alignment**?
Religious directions (east/mecca...)

Cardinal point alignment
related to sunrise or sunset?
eg. East facing building may have 'new beginnings' associations.

How can alignments be achieved or highlighted?...

a hole or tunnel channels eye to **specific point**

a window, slot or aperture **frames** the selected view, object or event

a **vista** or pathway directs the eye to a specific, distant point. repetition emphasises perspective

elements arranged to form **alignment**.
marker/pointer (see Stonehenge 'heelstone')
specfic **viewer position** must be clear

Cosmic Orientation

Roden Crater, Arizona
-James Turrell

"We left Flagstaff airport just before sunrise in the clear desert air. As we reached altitude, we faced the huge full moon sitting on the horizon directly in front of us. Jim [Turrell] began to make the plane circle and when we were 180 degrees around, we were facing the brilliant rising sun as it rested on the other horizon. Jim continued to circle as the images of the sun and moon continued to appear in a rotating pattern of bright hotness [sic] and cool reflection. After several revolutions, Jim straightened the plane and never said a word about it. He didn't have to...That one moment showed me the tremendous beauty in the nature of light, our solar system and our own small earth in this immensity. I think that is the power of Jim's work."
- William Earl Cook, a friend of James Turrell,
describing his experience on a flight back from Roden Crater to California.
(Cook, 2004)

Roden Crater is less of a 'building' than a large-scale piece of installation art. James Turrell bought the extinct cinder cone crater *(fig p18)* in Arizona's Painted Desert with the intention of transforming it into a space for experiencing light in different ways, something he was already used to experimenting with on a smaller scale. (Adcock, 1990: 156) The project was started in 1972 and was expected to be complete by the end of the 70s. However, major construction only began in 1999 and it is yet to be completed. Funding problems seem to be the main causes of the prolonged construction process. (Cook, 2004)

The unfinished project is not open to the public (Cook, 2004) and only invited guests have been allowed to view the site.



fig p18. Roden Crater.
Painted Desert, Arizona, USA.
(Image In Betsky, 2002: 146)



fig p19. Roden Crater.
Aerial views of roof opening of the crater.
(Image In Betsky, 2002: 148)

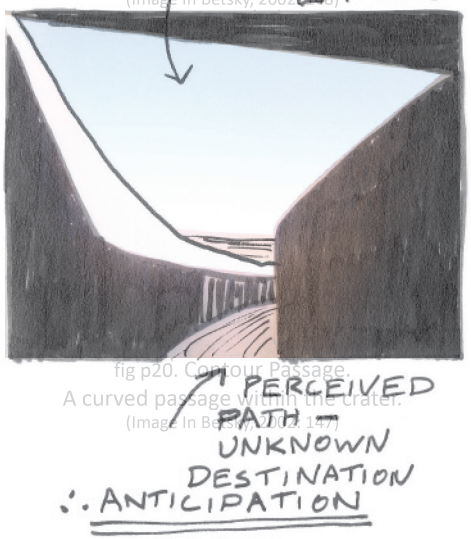


fig p20. Contour Passage.
A curved passage within the crater.
(Image In Betsky, 2002: 147)

See how the astronomers' rooms access passage distorts to align with the contour angle on page 147.

Cosmic Orientation

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fig p18. Roden Crater.
Painted Desert, Arizona, USA.
(Image In Betsky, 2002: 146)



fig p19. Skyspaces.
Aerial views of roof openings in the crater.
(Image In Betsky, 2002: 148)

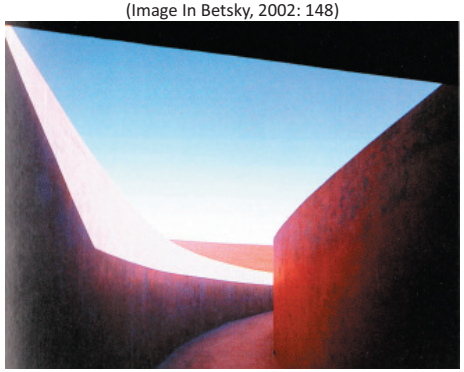


fig p20. Contour Passage.
A curved passage within the crater.
(Image In Betsky, 2002: 147)

See how the astronomers' rooms access passage
distorts to align with the contour angle on page 147.

An important aspect of viewing the crater seems to be the approach. With limited access routes through the desert, the direction of arrival is fairly controlled. As the visitor nears the site, the first view of the crater's mound will be from a raised distance. (Adcock, 1990: 159) This is the start of the 'journey' through the spaces.

The structure comprises a number of spaces and tunnels in and around the crater itself *(fig p19, p20 & p21)*. (Adcock, 1990: 159; Betsky, 2002: 146) The sole purpose seems to be the experience of the light of day and its progression towards night, the sky, the sun, moon and stars. Each space presents the experience in a different way.

There are spaces relating to each of the four cardinal points *(fig p22)*. These chambers offer viewers a range of viewing options and will respond to the desert's changing atmospheric conditions. (Adcock, 1990: 162) A main, central space is formed primarily by the natural shape of the crater. 'Fumaroles', the holes near a volcanic crater through which vapours would rise in an active volcano, are transformed into subsidiary spaces. (Adcock, 1990: 162)

Turrell uses his 'skyspace' concepts, used in other installations around the world, in these spaces too *(fig p23)*. The viewer will experience the changing daylight through skylight apertures, or glimpse the moon, framed at the end of a 300 metre tunnel. (Betsky, 2002: 147) 'Celestial Vaulting', the perceptual impression of the sky forming a dome over the earth, is a central theme in the project and the sky can be experienced as the ceiling in various spaces. (Adcock, 1990: 180)

All the spaces are connected tunnels, passageways and stairs. These too are part of the experience. Each one has its particular light quality or alignment. It may frame a view (of the moon or the sun at a particular moment in time), or it may be designed to let the viewer experience the natural curvature of the earth. (Betsky, 2002: 147) The network of spaces, tunnels, axes and openings is reminiscent of the plans of ancient structures of the Egyptians or Aztecs. Every space and tunnel considered in relation to the Universe. The whole calculated to ensure an experience related to a particular place and time.

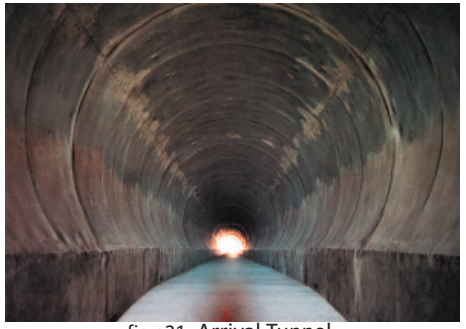


fig p21. Arrival Tunnel.
Main access to the crater.
(Image In Betsky, 2002: 147)

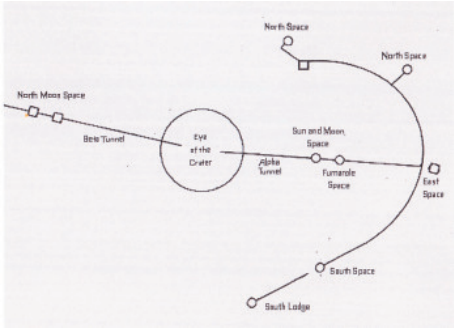


fig p22. Sketch Plan.
Diagram showing main spaces and tunnels.
(Image In Betsky, 2002: 147)

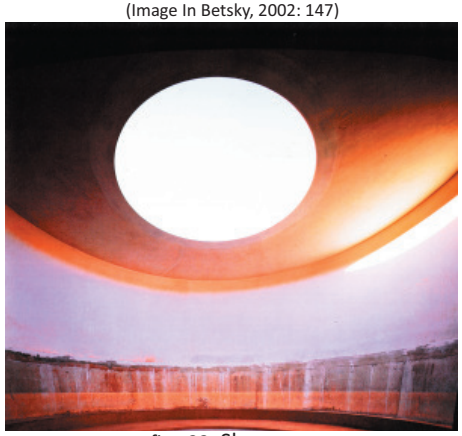


fig p23. Skyspace.
One of the skyspaces from within.
(Image In Betsky, 2002: 149)

Rovaniemi Airport, Finland
-Heikkinen & Komonen Architects

"Heikkinen and Komonen are concerned with creating simple, powerful spaces modulated by poetic interventions of light."
- Eva Janson, Architectural Journalist
(Janson, 1993: 67)

Rovaniemi is the capital of the Finnish Arctic. It is a fairly prosperous town, owing most of its recent growth to tourism. The built form of the town is new as it was virtually destroyed during the Second World War. (Janson, 1993: 67)

The town lies roughly on the line of the Arctic Circle (above which the sun doesn't rise in mid-winter, or set in mid-summer). As a result of the earth's changes in rotation (due to the interplay of the gravitational pull of the sun and moon), the Arctic Circle oscillates over the region where Rovaniemi lies *(fig p24)*. (Janson, 1993: 67) It's this unique positioning that Heikkinen and Komonen chose to harness in the design of their airport for the town.

This small town airport is primarily a grey metal, rectangular box on a concrete base. An arc-shaped canopy stretches North and South, providing shelter for passengers arriving from the car park *(fig p25)*. The box structure is arranged in such a way to allow the long West and East sides to be largely free of support. Arrival is through the metal wall on the east. Once inside there is a direct view through the glass west wall to planes on the apron beyond. The slight slope of the site makes the planes, on a higher level, seem closer than they are. (Janson, 1993: 68)

Almost the entire interior space is readable as a single volume as all the necessary separation of Arrival and Departure functions is done with glazed walls *(fig p26)*. Shops line the east wall, and a restaurant overlooks the main passenger hall from a level above on the north.



fig p24. The Arctic Circle.
A Diagram showing the Circle's Oscillations.
(Image In Janson, 1993: 68)

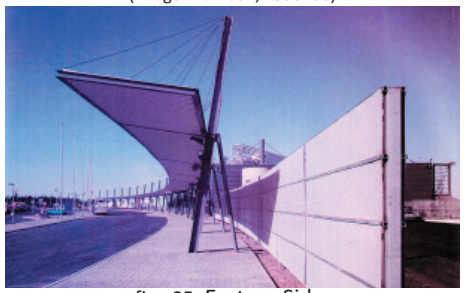


fig p25. Eastern Side.
Entrance View showing Arc Canopy.
(Image In Janson, 1993: 67)

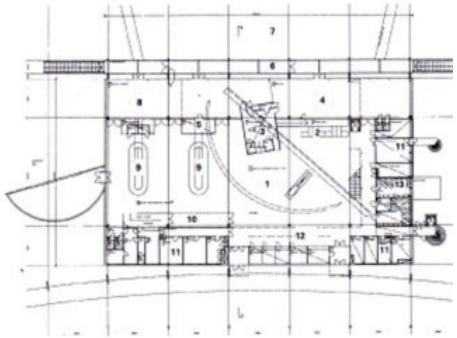


fig p26. A Box divided.
Ground Floor Plan.
(Image In Janson, 1993: 68)

In contrast to the regularity of the box, and providing a sense of containment to the large passenger hall, is a curved, white, suspended screen (used for projections), and a large skylight, like a random gash through the roof and metal mesh ceiling *(fig p27)*. (Janson, 1993: 70)

This gash is not, however, as random as it may seem. The position of the opening is carefully calculated to be parallel to the Arctic Circle and it casts a strip of sunlight onto a chart mapped out on the floor. The chart shows the position of the Circle in the town, in 9648 BC, 1958, 1962, 1974, 1984, & 1990. It will only pass this way again in 47957 AD (recent decades have seen it cross Rovaniemi more regularly due to the fact that it oscillates in smaller waves within the larger sine curve). (Janson, 1993: 68) This element is an attempt to give an airport, often a generic space, a sense of place, an identity in terms of its Universal location.

A piece of installation art by Lauri Antilla takes this expression of location further. She opened a small aperture in the ceiling for a few minutes at around noon each day for a year. The spots of light were mapped out on the floor, resulting in the pattern of an elongated figure of eight. *(fig p28)* This piece of art expresses in a simple graphic format the elliptical orbit of the earth around the sun. (Janson, 1993: 70)



fig p27. Main Passenger Hall.
Showing Skylight 'gash' and Curved Screen.
(Image In Heikkinen, 2009a: 1)

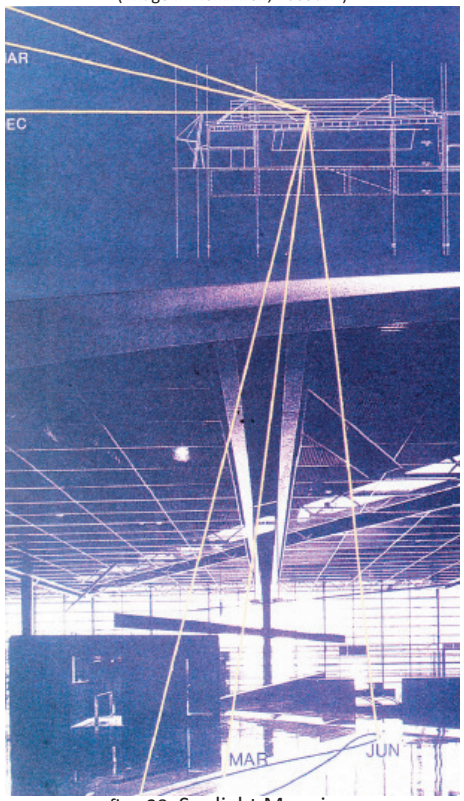


fig p28. Sunlight Mapping.
Principles of Lauri Antilla's work.
(Image In Janson, 1993: 70)

Sundial House, California (unbuilt)
-Stanley Saitowitz

"It [Sundial House] is a cosmological device that, as well as focusing on key aspects close and distant, organises life into a round that celebrates the cycle of the sun through each day and season."
- Peter Buchanan, Architecture Journalist
(Buchanan, 1986: 44)

Sundial House *(fig p29)*, conceived in 1980 but never built, has a form that is generated by the path of the sun. Its functions, therefore, are located following the rotation of the earth. (Saitowitz, 1982: 96) The concept of a house as a cosmological clock was initially inspired by a fortuitous connection between site and cosmos already existing where the house was to be built. A line created by a small valley and a creek led directly towards a mountain peak that rose above a range of hills in the distance *(fig p30)*. This particular peak lies 30 degrees South of West, the exact spot at which the sun sets on the shortest day of the year (winter solstice). (Buchanan, 1986: 44)

Daily routines in this house would revolve around the sun's movement and the time of day, possibly recreating the awareness our early forefathers would have had of the progression of days and seasons. The entrance on the East is marked by sunrise, and the breakfast room also lies on this side, gathering the morning sunlight and its warmth. The dining room sits to the west *(fig p31)*, allowing sunset views over dinner.

The living room, on the south, takes advantage of the sun's directionality and will be the brightest, warmest space, while the bedrooms sit to the north, with barely any direct sunlight. But even here, in the rooms with least light, the sun is in evidence. The rooms are entered from the east, and each morning a ray of sunlight will creep into the room to herald the morning. The main window views face west, towards the trees, and the setting sun. (Saitowitz, 1982: 96)

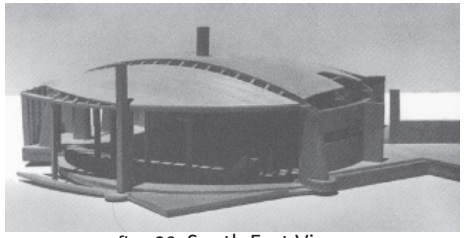


fig p29. South East View.
A view of the model, showing roof arc sundial.
(Image In Bell, 1996)

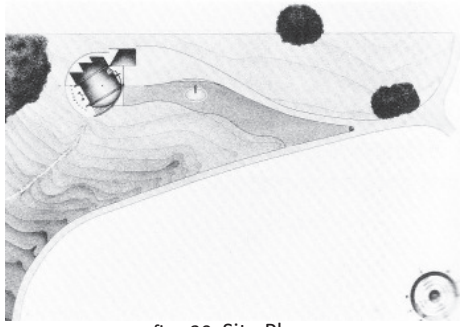


fig p30. Site Plan.
Shows Orientation and Ditch stretching East.
(Image In Saitowitz, 1982: 96)



fig p31. West Elevation.
Showing Bedroom (left) and Terrace (right).
(Image In Buchanan, 1986: 45)

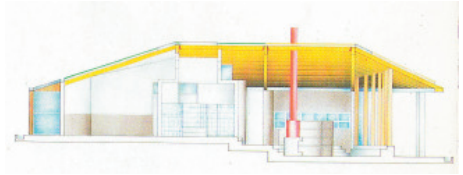


fig p32. Section.
Showing Central Hearth & Terrace (right).
(Image In Buchanan, 1986: 45)

The main activities revolve around a central hearth (just as the activities of early man would have done). *(fig p32 & p35)* The kitchen is folded into a triangular spiral in plan. It and the bedrooms spin off the plan in an anti-clockwise direction *(fig p33)*. A pergola spins off the main living space. Counterpoint to the hearth, but still central to the plan, is a cylindrical services space housing the bathrooms, a light well and a solarium space. The bathrooms are heated through a glass roof which gathers warmth in winter but can open to release steam in the summer. (Buchanan, 1986: 44)

Beyond the programmatic arrangements, the structure and form of the house is driven primarily by its orientation in terms of the cosmos. The roof supports mark the cardinal points, three columns to the east demarcate the position of the sunrise at summer and winter solstices and at equinox. Similarly, four columns to the west mark the point of sunset in each of the four seasons. A further twelve columns represent the twelve seasons. *(fig p33 & p34)* These columns are coloured in different proportions of green and blonde to represent the colours of the landscape in these months. (Buchanan, 1986: 44; Saitowitz, 1982: 96)

The arc of the roof's two main laminated timber beams represents the arc of the sun. The arc is 48 feet (14.6m), with rafters at 2 foot (0.6m) centres. The spaces between the rafters represent half an hour each out of twelve hours of daylight. The shadows cast by the sun shining on the rafters marks the time of day off on a wall, hence the building itself becomes a sundial (prompting its name). (Saitowitz, 1982: 96)

The house also takes into account the more conventionally considered aspects of site and context. The structure is in the warehouse vernacular of the area. The gentle curve of the roof repeats the undulations of the landscape and the palette of blond and green gravel connect the house to the sun to the east and the trees to the west. (Buchanan, 1986: 44) The front door frames the view that prompted the design in the first place, the rift leading and the mountain peak. (Saitowitz, 1982: 96)

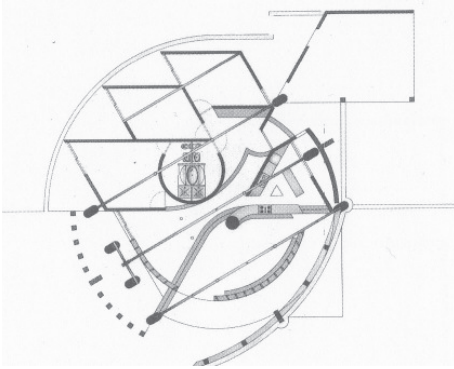


fig p33. Ground Plan.
Overall Layout of the Proposed House
(Image In Bell, 1996)

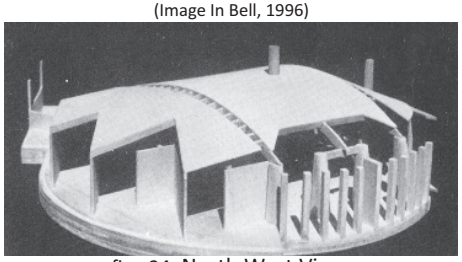


fig p34. North West View.
Model of the Proposed House
(Image In Buchanan, 1986: 44)

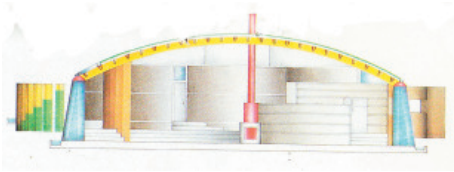


fig p35. Section.
View through the house's core
(Image In Buchanan, 1986: 45)

Site analysis before starting a design
is the first step in establishing
what **features or elements could be emphasised or harnessed** in a design.

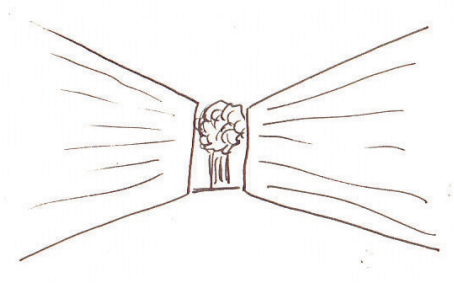
Elements could be **dramatic** and **unusual**
(like a Crater or the Arctic Circle),
a **fortuitous view**
(coinciding with a rift AND the sunrise),
or they could be more subtle.

Different spaces can have a different focus
or character, this is conducive to adapting
space for different activities
(see the different space emphases
at Roden Crater)

The **sun's movement** is a useful tool to
trace patterns or **track things** on a graph
this can have direct solar correllations
or be unrelated information

Different **light qualities**
(throughout the day or the year)
=
varying space characters

Therefore, consider this along with
uses/activities in a space

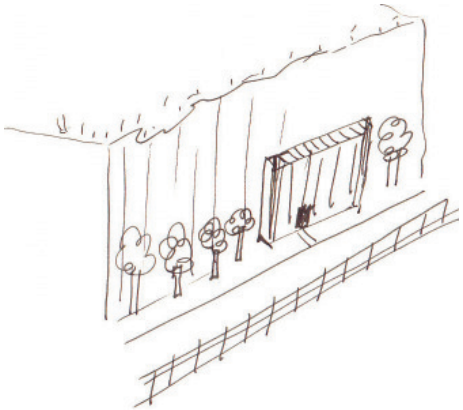


Emphasising natural features
can be done in various ways,
especially through **repetition** or
drawing attention to a feature (subtle or dramatic)
(Passengers at Rovaniemi may
not even be aware of the significance
of the roof slit)

Framing, vistas, directionality can emphasise
(as in *Ancient Alignments* section)



Repetition or **mimicry** for emphasis -
repeating the shape of hills in a roof can
emphasis the hills



Reinforcing a feature can emphasise it -
strengthening the line of a cliff
through linear building, movement
or planting reinforces the stark line

Vibrant Colour

The buildings of Ricardo Legorreta,
Mexican Architect.

"Most references to Legorreta's work stress color [sic] as the primary force, but this is an incorrect premise. For Legorreta, color [sic] is an integral part of the world around us, a symbol of our emotions, a fundamental, vernacular element."
-John V Mutlow, Biographer.
(Mutlow, 1997: 18)

Ricardo Legorreta (more recently, with his son, in the form of Legorreta & Legorreta Architects) is well known for his use of bright, vibrant colours in his buildings. Colour always seems to have played an important role in his native Mexico, from the greens and browns of the mountains, to the intense reds of the traditional foods and clothing. (Cuito, 2002: 6) Legorreta claims to derive a large proportion of his inspiration from Mexican folk art. He says it is through this that he learned that colour has no set rules, it's about freedom and emotion. (Attoe, 1990: 56)

Legorreta also does not separate light from colour. However, rather than looking at them scientifically or technically, he sees them as spiritual elements to be used with the heart and spirit. (Attoe, 1990: 25) He believes that "Light and architecture go together. Light gives value to walls, windows, materials, textures and colors [sic]. During hours, days and seasons it changes space and is a fundamental tool for shaping our emotional response." (Attoe, 1990: 25) In this way he recognises the value of natural light in all its forms, and strives to utilise and emphasise it in his work.

In Mexico the plane of the wall dominates in traditional architecture, the floor and roof tend to play a subsidiary role. (Mutlow, 1997: 15) This is true of Legorreta's work too, it is an architecture of walls. It is these walls that are often painted bright colours or washed with light. Externally, these colours are particularly vibrant in the bright, clear Mexican sun, sometimes contrasting with the surroundings, sometimes blending with the sky *(fig p36)*.


fig p36. Walls match Sky and Water.
La Casa Azul Resort, Mexico.
(Image in Attoe, 1990: 149)

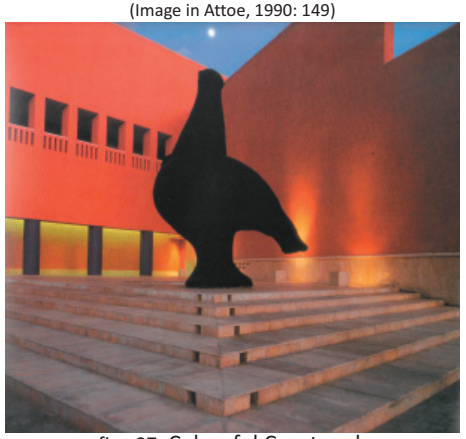

fig p37. Colourful Courtyard.
Marco Contemporary Art Museum, Mexico.
(Image in Mutlow, 1997: 39)


fig p38. Reflection Pool.
Marco Contemporary Art Museum, Mexico.
(Image in Mutlow, 1997: 45)

It has long been acknowledged that form appears when light falls on it. Legorreta believes the opposite is also true, that "floors and walls, ceilings and recesses allow us to sculpt light, to paint with light, and, in this way, to shape the ambience of a place." (Attoe, 1990: 44) Internally he uses light to differentiate between spaces without the need of raising a solid divider. He combines the use of light and shadow, reflections in water, or iridescent material finishes to create spaces for specific purposes, whether it be work, relaxation, or dreaming. (Cuito, 2002: 6)

In the *Marco Contemporary Art Museum* in Monterrey, Mexico *(fig p37, previous page)*, Legorreta found inspiration in the traditional Mexican house plan. Though much larger in scale than a house, the museum has a central courtyard surrounded by an arcade providing access to all the adjacent spaces. (Mutlow, 1997: 38) He uses both colour and light to differentiate spaces. Shallow pools reflect light in patterns *(fig p38, previous page)*, and strategically placed rays of natural light illuminate specific spaces or works of art. (Mutlow, 1997: 38)

An office building *(fig p39)*, built in 1995, also in Monterrey, Mexico, sits on a large, triangular site. The shape of the site set up the building's sculptural plan and shape. Scaled to address the urban context in which it sits, intimate courtyards bring spaces down to a human scale. (Mutlow, 1997: 175)

The complex actually consists of two independent buildings. The first has an art collection integral to the design, and courtyards and spaces are set up to best display the works. *(fig p40 & p41)* The second was built as a speculative office space. (Mutlow, 1997: 175)

External colours were selected according to orientation and projecting cubes provide shade from the Mexican sun and cast interesting shadows on the bright facades. Vistas have been set up through spaces to enable framed views of the distant mountains. (Mutlow, 1997: 175)



fig p39. Colourful State Plant.
Office Building, Monterrey, Mexico.
(Image in Mutlow, 1997: 176)

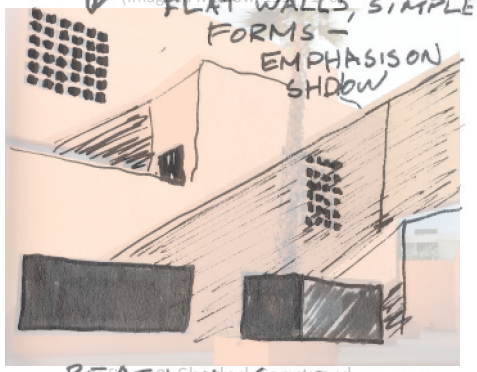


fig p40. Shaded Courtyard.
Office Building, Monterrey, Mexico.
(Image in Mutlow, 1997: 179)



fig p41. Sculpture Courtyard.
Office Building, Monterrey, Mexico.
(Image in Mutlow, 1997: 178)

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fig p39. Colourful Statement.
Office Building, Monterrey, Mexico.
(Image in Mutlow, 1997: 176)



fig p40. Shaded Courtyard.
Office Building, Monterrey, Mexico.
(Image in Mutlow, 1997: 179)

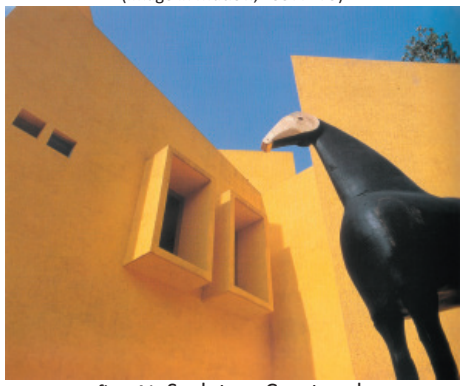


fig p41. Sculpture Courtyard.
Office Building, Monterrey, Mexico.
(Image in Mutlow, 1997: 178)

The buildings of Luis Barragan,
Mexican architect.

“Barragan transformed the International Style into a vibrant; sensuous Mexican aesthetic by adding vivid colours and textural contrasts and accentuating his buildings’ natural surroundings.”
-Design Museum biographer.
(Design Museum, 2006)

Luis Barragan (1902-1988), another Mexican Architect, though seemingly less prolific than Legorreta, is now regarded as one of the most important architects of the twentieth century. (Design Museum, 2006)

Barragan’s designs were based on the use of flat planes (walls) and light (windows). (Craven, 2009) He used colour in much the same way as Legorreta. The same local influences produced vibrant coloured walls and courtyards. However, Barragan once said that his own favourite themes were light and water, which he skilfully manipulated to create his spaces. (Design Museum, 2006)

Many of Barragan’s buildings are hard to read from the street. To create a sense of peace and silence on the inside of a house, he would shelter it from the street with large rendered walls and very few windows, keeping its contents a mystery. (McKenzie, 2008) He embraced Modernism’s functionalism but blended it with influences from traditional Mexican architecture. He used bold colours, traditional materials, and followed traditional plan sequences of rooms within rooms. (McKenzie, 2008)

In Barragan’s own house and studio in Mexico City, designed in 1947, he again uses a stark facade *(fig p42)* to hide his gallery of colour, form, texture, light and shadow. *(fig p43 & p44)* (Rispa, 1996: 123; Craven, 2009; Design Museum, 2006) The main room has a high ceiling and is partitioned only by low walls. Skylights not only let in plenty of natural light but accentuate the changes in light throughout the course of the day. (Craven, 2009)

Barragan, who enjoyed landscape design as well as that of buildings, allowed the back of his house to open onto a private garden, allowing the outdoors to become part of the architecture, and various windows frame views of nature. (Craven, 2009)



fig p42. Anonymous Facade.
Barragan’s Own House & Studio, Mexico.
(Image in Casa Luis Barragan, 2008)



fig p43. Warm Hallway.
Barragan’s Own House & Studio, Mexico.
(Image in Casa Luis Barragan, 2008)

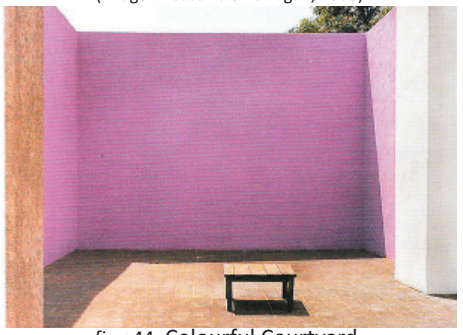


fig p44. Colourful Courtyard.
Barragan’s Own House & Studio, Mexico.
(Image in Rispa, 1996: 123)

The *Chapel for the Capuchinas Sacramentarias del Pirismo Corazon de Maria* (often simply referred to as *Tlalpan Chapel*), located in a market town on the suburban fringe of Mexico City, was completed in 1955, after 7 years of designing and building. Barragan was so passionate about the project that he partially funded it himself. (Design Museum, 2006; McKenzie, 2008; Rispa, 1996: 139)

This chapel is considered by some to be the epitome of Barragan's mastery of light and colour, Mexican artistic traditions, his religious and personal beliefs, and minimalist restraint. (McKenzie, 2008)

Again, this building appears as a non-descript, rendered wall from the street. Once inside, it consists of a long, narrow cloister with the convent spaces, sacristy, transept and chapel arranged around it. The interiors throw back to medieval monasteries and consist of a series of "quiet and deeply personal spaces of varying textures that are bathed in divine natural light". (McKenzie, 2008)

In the chapel itself, light is used as an architectural element (Rispa, 1996: 147), showcasing its mystical inner beauty. (McKenzie, 2008) It is filtered through stained glass *(fig p45)* and lattices *(fig p46)*, and is sieved and coloured to create and enhance spaces with an "insurmountable degree of lyricism and refinement". (Rispa, 1996: 147)

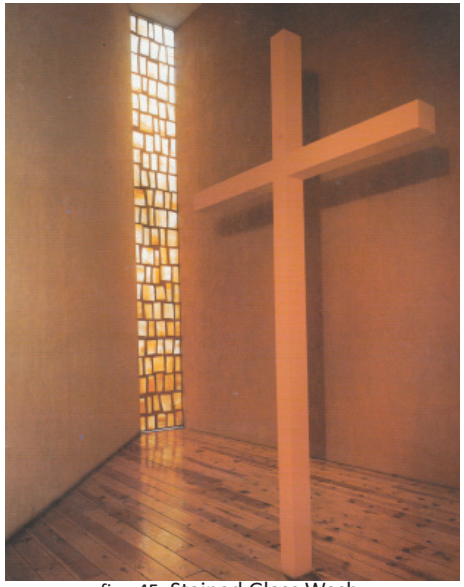


fig p45. Stained Glass Wash.
Recessed Window, Tlalpan, Mexico.
(Image in Rispa, 1996: 152)

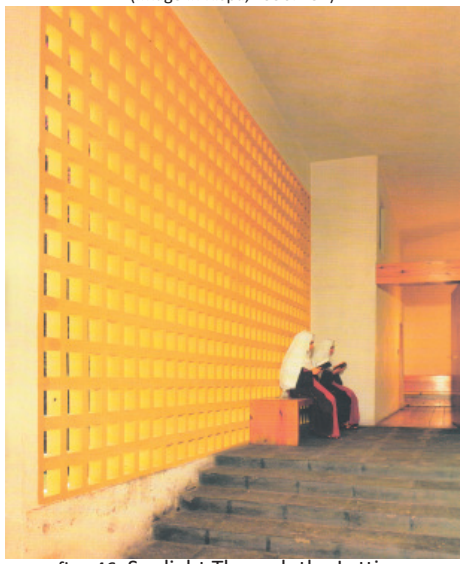


fig p46. Sunlight Through the Lattice.
Light and Shadow, Tlalpan, Mexico.
(Image in Rispa, 1996: 156)

Heureka Finnish Science Centre, Vantaa, Finland (1986-1988).
Heikkinen & Komonen Architects

"The design of the science center [sic] refers to the contradictory dynamics of nature itself, forces seeking order and balance countered by disruptive and chaotic tendencies."
-Heikkinen & Komonen, Finnish Architects.
(Heikkinen et al, 2009b: 1)

Finland's longest, and busiest, railway line (995km) starts in Kolari, in western Lapland, and ends in Helsinki Railway station. In Vantaa, at the junction of this railway line and the Kerava River, sits *Heureka*. (Heikkinen et al, 2009b: 1; Koskinen, 2008) The region has a rich cultural history, dating back to the Bronze Age and this may be one of the reasons for the choice of site when the Science Centre Design was put out for competition. (Heikkinen et al, 2009b: 1)

The centre incorporates various spaces for both permanent and temporary exhibitions, as well as a 220 seat auditorium, a 220 seat planetarium, a restaurant, offices and workshops. *(fig p50, following page)* An appropriate structural system was developed for each architectural element holding different functions. *(fig p47)* The structural materials included concrete, steel and timber. (Heikkinen et al, 2009b: 1)

Dominating the entryway is a stone garden *(fig p48)*. Stones were brought in from all over Finland to recreate Finland's geological map on a smaller scale. This garden reflects the long cycle of nature and reminds visitors of their position in Finland and its position in the world. (Heikkinenet al, 2009b: 1) Alongside this is a sculpture by Anssi Asunta of four illusionistic cubes *(fig p49)*, changing shape and appearance depending on the viewer's perspective. This is meant to remind the viewer not to rely only on their own eyes. (Heikkinen et al, 2009b: 1)

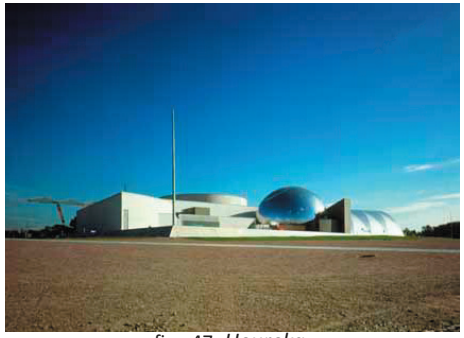


fig p47. *Heureka*.
Mirror-like Planetarium Dome Visible.
(Image in Heikkinen et al, 2009)



fig p48. *Heureka*.
Stone Garden in the Foreground.
(Image in Heikkinen et al, 2009)



fig p49. Illusionistic Cubes.
Anssi Asunta's Sculpture.
(Image in Heikkinen et al, 2009)

The original designs for the centre had included a pedestrian bridge over the railway. This would have been the main entrance and visitors would have first viewed the building from the railway side. They would have then entered at first floor level and down a winding ramp inside. In this way, they would catch a glimpse of all the museum had to offer before even buying their ticket. However, for financial reasons, the bridge was abandoned and this arrival sequence was lost. However, for interest, the stump of the proposed bridge still protrudes from the building's facade at first floor level *(fig p51)*. It provides a good viewpoint to survey the buildings most significant feature, its great sloped glass facade. (Koskinen, 2008)

The railway facing side of the building is dominated by this reflective glass facade. It is designed as an acoustic shield, protecting the interior spaces (mostly offices on this side) from the noise of passing trains. Its steel structure is coloured in the spectrum of visible light. *(fig p51)* This provides the dynamic view seen from passing trains. As trains pass at speed, the structural members in their many colours blend together in a blur of rainbow colours. A spectacular view designed for passengers in motion. (Heikkinen, 2009b: 1)



fig p50. *Heureka* interior.
Main Hallway Space.
(Image in Heikkinen et al, 2009)



fig p51. Rainbow Facade.
The Slanted Glass Facade & Bridge Stub.
(Image in Heikkinen et al, 2009)

Legorreta & Barragan teach us that
we need not be afraid of using vibrant colour.
(In sunny climates,
the sunlight washes them out
somewhat anyway)



Consider the **perspective of the viewer**,
this can produce dynamic results.
- not often the views that appear
on flat, elevational drawings.
(consider Heureka,
designed to be seen from a moving train)

Colours may be bright on the outside,
or understated outside and bright within,
a surprising, **bright explosion** contained
within rooms and courtyards.



Colours may be **external & exposed**,
they may **blend** with the context
(sky? shaded to match context changes),
or designed to be in
stark contrast to surroundings.

Water and light can have
dramatic & **dynamic** results
-
play of light and reflections
are hard to create any other way.



Moulding of light and shadow adds to
experiencing colour in a space

- colour **variation through space and over time**

light can be **flooded, dappled,**
channelled, patterned or **coloured**
in a multitude of ways

See coloured courtyards and light patterns
implemented in various spaces in the project.

Desert Design

The buildings of Will Bruder,
American Architect, Arizona Desert.

"Bruder understood that the desert was tough and fragile, and he developed an appropriate vocabulary of earth-hugging forms, durable materials, and strategies for capturing and filtering natural light."
-Michael Webb, Journalist.
(Webb, 2002: 26)

Will Bruder first moved to Phoenix in 1967 from Wisconsin (the home state of renowned architect, Frank Lloyd Wright). (Webb, 2002: 26) He has since become well known for his desert works that blend with and enhance their unique natural settings. (Webb, 2002: 36)

Bruder's *Byrne Residence* (1998) in Scottsdale, Arizona (just under 100 kilometres north of Phoenix) is situated on a rocky desert hillside with views to the south and west. (Melhuish, 2000: 196; Pearson, 1999: 99) The design concept was that of a sculptural gesture emerging from the hillside and geological metaphors are incorporated throughout the house, embodying ideas of 'stratification' and 'layering'. (Melhuish, 2000: 196; Pearson, 1999: 99; Webb, 2002: 36) *(fig p52)*

The house is embedded into the natural slope of the hill on the north east corner of the site. It has two levels with access on the upper floor while the lower floor is mostly buried in the hill with south west views. *(fig p53)* The angular orientation of the building is parallel to the site contours, this enhances the land/building relationship and allows for spectacular south west views from most of the living spaces. *(fig p54)* (Webb, 2002: 36) It has a sense of weight and permanence in the landscape, rather than something light and transitory. (Melhuish, 2000: 196)

The house plan has an angular geometry driving it *(fig p53)*, and many of the sandblasted concrete block walls are tilted at varying angles (Melhuish, 2000: 198), yet the house never appears unbalanced, the whole creates a sense both of illusion and anchoring. This is probably due to the fact that all the angles are structural and not just created for effect. (Pearson, 1999: 104; Webb, 2002: 36)



fig p52. *Byrne Residence*.
Scottsdale, Arizona.
(Image in Melhuish, 2000: 196)

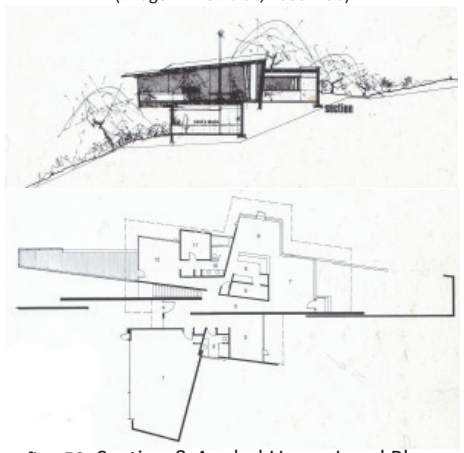


fig p53. Section & Angled Upper Level Plan.
Glazed facade and views at top of plan.
(Image in Webb, 2002: 39)

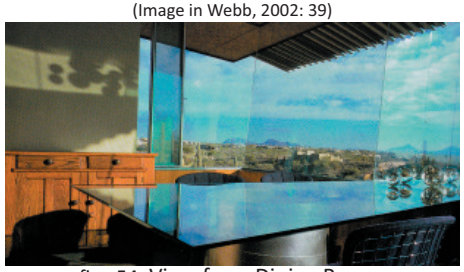


fig p54. View from Dining Room.
(Image in Pearson, 1999: 104)

Tilted concrete block walls mimic cliff faces of western mesas, the blocks inch out from the vertical as they rise but are also laid at an angle to the floor evoking shifted rock strata. This is the treatment of the main spine wall *(fig p55)* running the length of the house. (Melhuish, 2000: 198; Pearson, 1999: 99) A cantilevered, steel frame roof covers the main spaces. The roof is separated from the spine wall by seven steel brackets, opening a 100mm gap that is covered by glass, creating a slit skylight that washes the wall with sunlight and creates the illusion of a heavy element floating in space. (Melhuish, 2000: 198; Pearson, 1999: 99; Webb, 2002: 26)

The house presents a solid face to the direction of arrival. The facade materials include concrete block, rusting steel, blue/blackened copper cladding and acid-etched galvanised metal. (Pearson, 1999: 99; Webb, 2002: 36) A visitor would enter this 'cliff face' through a glass and metal 'seam' between the copper-clad garage and the bulk of the house. *(fig p56)* (Pearson, 1999: 99)

Bruder also creates 'canyons' by making narrow walkways run between high parallel concrete walls. The interior of the house is articulated by two such 'canyons', one running along the main floor spine, and the other down the access route to the lower level via a wedge-shaped stairway with fibreglass treads. Both passageways have thick, heavy walls along the sides and glass ends drawing sight and movement along the route. (Pearson, 1999: 99; Webb, 2002: 26)

The lower level is more private and much cooler. Buried in the hill, the light and views are experienced through narrow strip windows. (Melhuish, 2000: 198) On both levels, the back of the house, oriented towards the landscape, is enclosed by an angled screen of mitred glass, some clear and some non-reflective 'solex' glass. (Melhuish, 2000: 198; Webb, 2002: 26) Whereas the front of the house was a cliff, the back can be compared to a "crystalline formation breaking free of the earth". (Pearson, 1999: 99)

The play of light is important in the design, both inside and out. Dramatic effects are created inside through clerestoreys, narrow skylights and irregularly placed openings. The contrast of light and shadow defines different spaces. (Pearson, 1999: 99) Outside, the leaning walls and differing textures are emphasised by the daily and seasonal variations of sunlight. (Webb, 2002: 36)

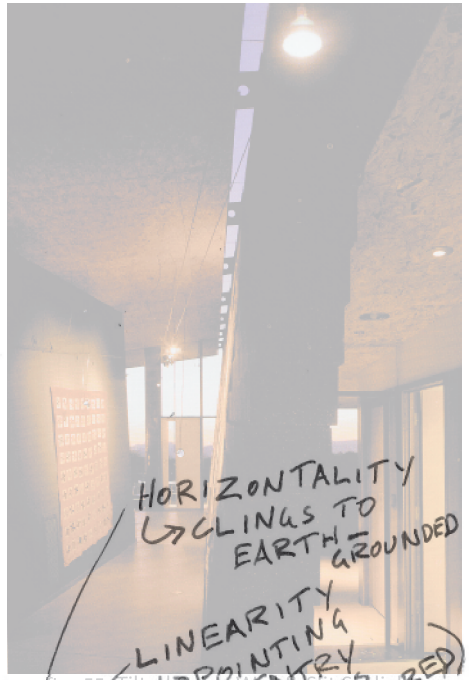


fig p55. Tilted Spine Wall and slit skylight.
Interior view towards entrance.
(Image in Pearson, 1999: 105)

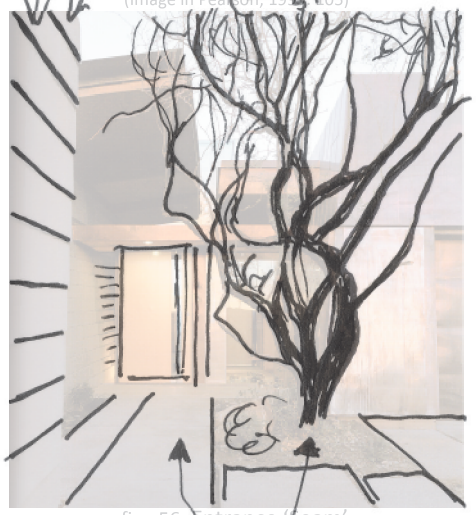


fig p56. Entrance 'Seam'.
Spine Wall and main house bulk to the left.
(Image in Pearson, 1999: 99)

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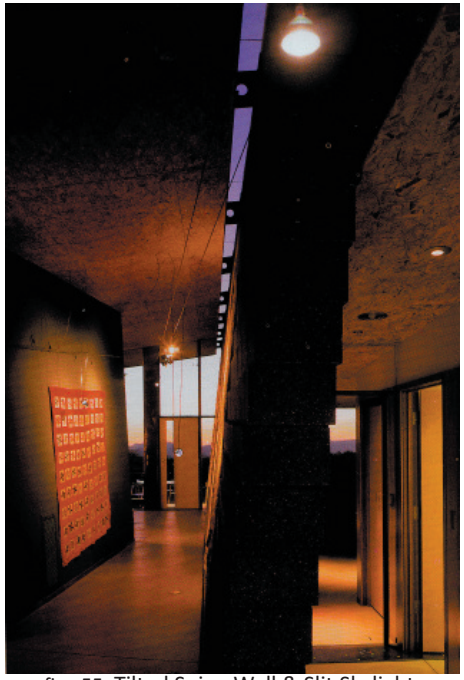


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Interior view towards entrance.
(Image in Pearson, 1999: 105)

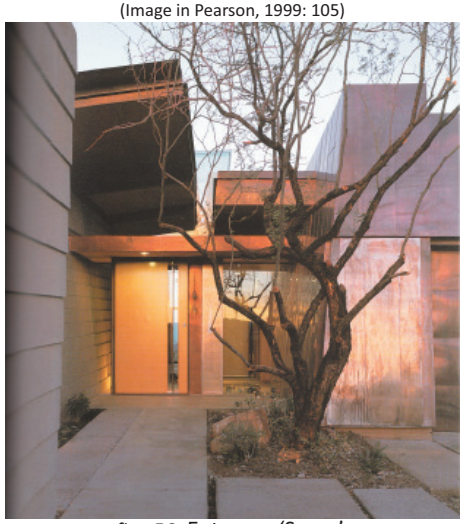


fig p56. Entrance 'Seam'.
Spine Wall and main house bulk to the left.
(Image in Melhuish, 2000: 199)

The *Deer Valley Rock Art Centre* sits in the Arizona hills near Phoenix *(fig p57)*. This 650 square metre building nestles at the end of a dam wall which was built to protect the neighbouring suburbs from flooding when water gushes off the high plateaus in spring. The building is a cultural and natural exhibition space that introduces visitors to rock art painted by the Hohokam Native Americans. (Betsky, 2002: 86; Betsky, 1995: 64)

A curved road along the dam wall brings visitors to the centre itself, allowing people to view the dam before being brought inside to learn about the art through exhibits and classroom-based lectures. *(fig p58)* (Betsky, 2002: 87; Betsky, 1995: 66)

Bruder once again sought to blend the landscape and building technology, both in form and materiality. (Betsky, 1995: 66) The building, which bridges a ravine *(fig p59)*, is built of tilt-up concrete panels which are covered with a stone aggregate left over from the local mining industry. This stone helps to blend the building with its surroundings. Slots and windows break the monotony of the walls and also allow selected views from within. Black steel which has been allowed to rust links the educational pavilions out to the rock art site itself. *(fig p60)* (Betsky, 1995: 66)



fig p57. *Deer Valley Rock Art Centre*.
In context against the dam wall.
(Image in Betsky, 2002: 87)

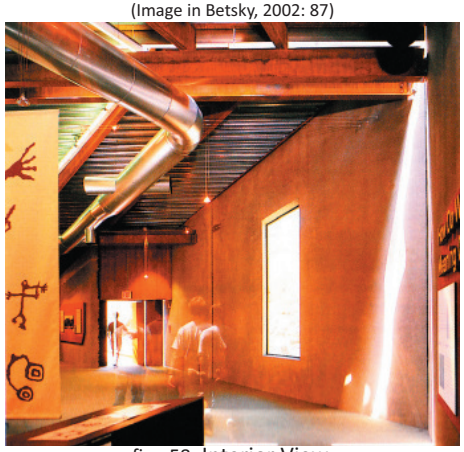


fig p58. Interior View.
Main building for museum & classrooms.
(Image in Betsky, 2002: 86)

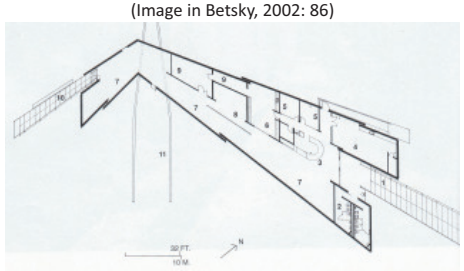


fig p59. Plan.
Walkways to left & right, ravine shown below.
(Image in Betsky, 1995: 68)

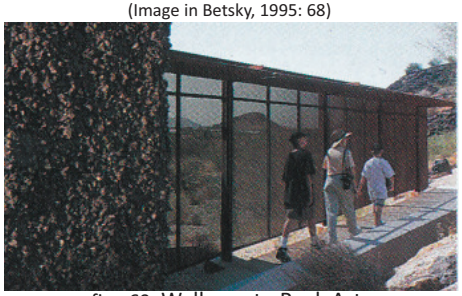


fig p60. Walkway to Rock Art.
Aggregate wall in front, rusty screens behind.
(Image in Betsky, 1995: 66)

The buildings of Rick Joy,
American Architect, Arizona Desert.

"...the simplest of his [Rick Joy's] buildings are infused with a passion for space and light."
-Michael Webb, Journalist.
(Webb, 2002: 28)

Rick Joy, originally from Maine, has lived and worked in Tucson, Arizona (near the Mexican border) since the mid 80s. (Rick Joy, 2009; Slessor, 2002: 68) He too was captivated by the desert's landscape and light. He creates forms that enter into a dialogue with their natural surroundings, often using natural, local building materials like rammed earth. (Rick Joy, 2009; Slessor, 2002: 68; Webb, 2002: 28)

Casa Jax, a house in Tucson, consists of three boxes *(fig p61 alongside and p64, following page)* on raised platforms, minimising the impact on the local vegetation. They are clad in rough, steel plates and nestle in a natural bowl in the landscape. (Slessor, 2002: 68; Webb, 2002: 66) Each box houses a different function –living area, bedroom, and den- this separation of functions heightens the sense of isolation. The functions are connected by gravel walkways between the structures. *(fig p62)* (Slessor, 2002: 68) The walkways emphasise the fragility of the site, and the building's connection to it. (Webb, 2002: 66) A small carport is hidden in a depression in the hill above the house, removing cars from the visible site. (Slessor, 2002: 70)

Each box is oriented to frame a particular chosen view and capture natural light. *(fig p63)* The living space box sees the setting sun highlighting a particular rocky outcrop and, after sunset, looks towards the distant city lights of Tucson. The bedroom has a spectacular morning view when the desert flora is backlit as the rising sun illuminates a rock face at the top of the mountains to the south west. (Slessor, 2002: 68-70; Webb, 2002: 66) The boxes are each capped by a flush timber deck allowing outdoor sleeping on warm summer evenings. (Slessor, 2002: 70)

The boxes, framed and clad in steel sheets, have been allowed to rust. The rusted colour blends with the natural desert colours. The applied nature of the metal is emphasised by the panel articulation and by the exposed fixings. A ventilated cavity behind the steel cladding allows heat to escape, keeping the interiors cool. (Slessor, 2002: 70)



Fig p61 Desert Boxes.
Casa Jax, Tucson, Arizona.
(Image in Slessor, 2002: 71)



Fig p62 View Between Boxes
Casa Jax, Tucson, Arizona.
(Image in Slessor, 2002: 71)

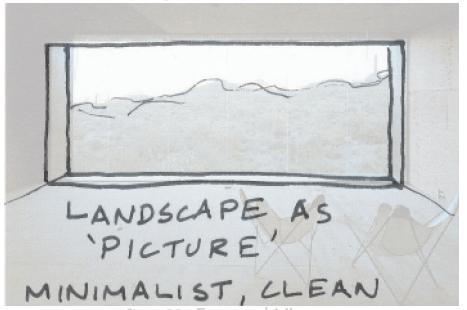


Fig p63 Framed Views
Casa Jax, Tucson, Arizona.
(Image in Slessor, 2002: 70)

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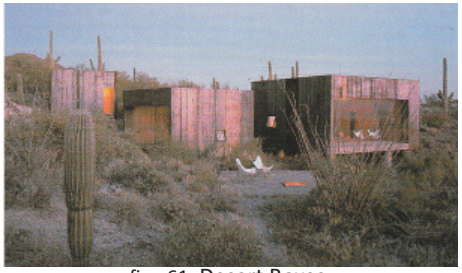


fig p61. Desert Boxes.
Casa Jax, Tucson, Arizona.
(Image in Slessor, 2002: 70)

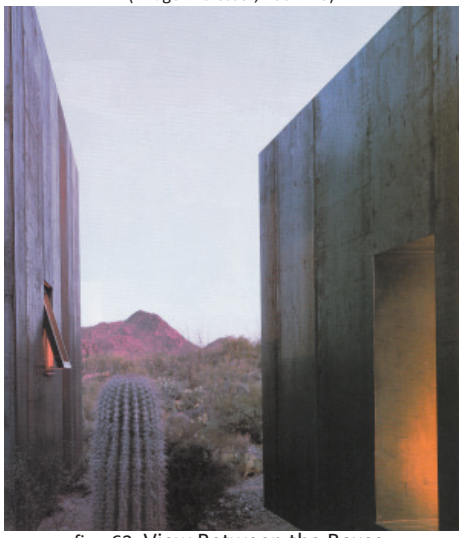


fig p62. View Between the Boxes.
Casa Jax, Tucson, Arizona.
(Image in Slessor, 2002: 71)

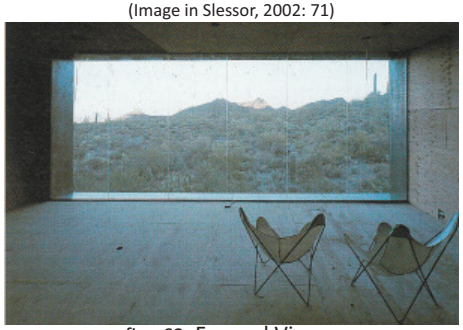


fig p63. Framed Views.
Casa Jax, Tucson, Arizona.
(Image in Slessor, 2002: 70)

The interiors are clad in a maple veneer, contrasting with the rough exteriors. The clear glass openings and translucent glass internal screens magnify light, link the interior to the vast landscape, and show a fragility which contrasts with the harsh environment. (Slessor, 2002: 70)

Another *Arizona House (fig p65)*, located close to the Mexican border, sits in a region where "landscape and sky collide in an exhilarating rush of space and light" (Slessor, 2001: 46) It is also an area known for its very clear night skies, and it is home to several astronomical observatories. That was part of the reason for the choice of site for this retired couple's home as the husband is a former radio astronomer. (Slessor, 2001: 46)

The site, on the side of a hill, slopes towards the south. *(fig p66)* The house sits on a level shelf, carved into the hillside. Two U-shaped retaining walls, skewed towards one another hold the hill at bay and cap the ends of two shed-like buildings. One is the main house, the other is a smaller guest house. A linear courtyard sits between the structures. (Slessor, 2001: 46)

Scrub and native trees are retained on the site wherever possible and views include snow-capped mountain peaks on the horizon. (Slessor, 2001: 46)

From the approach road, only the two glazed ends of the building are visible, at night they are glowing blocks. Entry to the house is via a cactus flanked gravel walkway and down a stairway between the retaining walls, emerging in the courtyard. The controlled form of this space emphasises a sense of the man-made against the natural. (Slessor, 2001: 46 & 69)

External and internal spaces meld fluidly, both in terms of the house and courtyard and the house and landscape. The courtyard itself ends in an infinity pool, extending the vista out to distant views. The living space in the main house takes the form of a long bar with a covered porch overlooking the pool, while the more private spaces, bedroom, bathroom and twin studies, face the main courtyard but open onto a private patio and pool area. (Slessor, 2001: 49)



fig p64. Section and Plan.
Casa Jax, Tucson, Arizona.
(Image in Webb, 2002: 70)

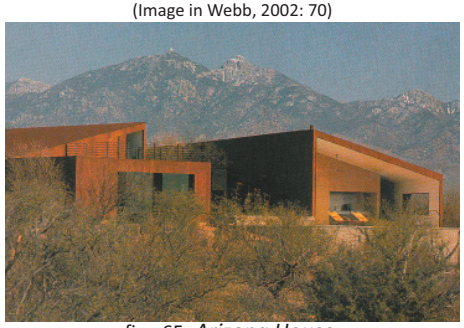


fig p65. *Arizona House*.
Tucson, Arizona.
(Image in Slessor, 2001: 46)



fig p66. Section and Plan
Arizona House, Tucson, Arizona.
(Image in Slessor, 2001: 48)

The smaller guest wing also links to the main courtyard, and it houses the garage and a telescope platform. All the windows, in both buildings, are designed to frame specific views and they take the form of flush glazing, box-like projections, and even unglazed cut-outs. Sliding glass panels connect the inside and outside and also help with cross-ventilation *(fig p67)*. (Slessor, 2001: 49)

Most of the house is clad in rusted steel panels. The dry desert climate allows the steel to weather quickly without actually rusting all the way through. Steel as a building material is common in the local vernacular of farm buildings. The rusted colour also blends with the desert hues. (Slessor, 2001: 49) The interiors are simple and understated, with white plaster walls and black, polished concrete floors, and elements of pale maple, stainless steel and sandblasted glass. (Slessor, 2001: 49)

In a similar vein, the *Tucson Mountain House* *(fig p68)* nestles in a valley that is alive with desert flora and fauna, and surrounded by protected ridges. The house has massive earthen walls crowned with a butterfly roof. (Webb, 2002: 72)

Car parking is hidden from view and a simple footpath leads from there to the entrance at the western end of the central valley. The walls of this valley slope from a height of about 3.3metres at the front door to about 2.4 metres at the fireplace mass to the east. This area divides the house into two with the main house functions on one side and the guest wing and porch on the other. In typical Joy fashion, all the openings are designed to frame specific views or catch solar events through the day *(fig p69)*. (Webb, 2002: 72)



fig p67. Terrace and Pool
Arizona House, Tucson, Arizona.
(Image in Slessor, 2001: 49)



fig p68. *Tucson Mountain House*.
Tucson, Arizona.
(Image in Webb, 2002: 72-73)

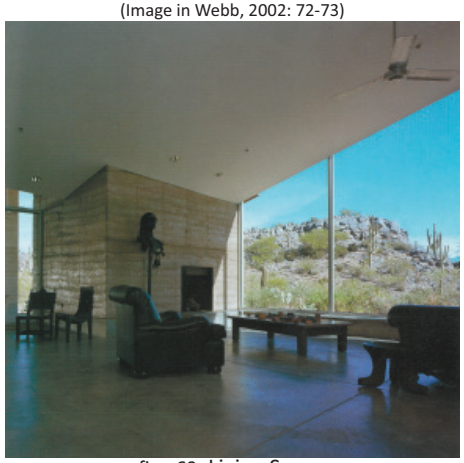
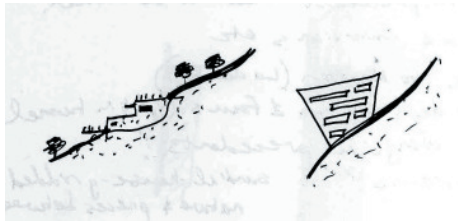


fig p69. Living Space
Visual connections to the landscape.
(Image in Webb, 2002: 75)

Arizona is a similar context to the Karoo:
-extremes of heat & cold-
-Vast, open, bright landscapes-
-Scrub-like flora-



Both Bruder and Joy choose to blend in with the natural surroundings (**sensitivity to site**)

Solid & grounded, '**growing' out of the earth**, following contours,
rather than standing as an icon in the landscape

(alternatively, Casa Jax -
floats above the landscape, subscribing to
the ethos of "touch the ground lightly")

View framing -
controlling what parts of
the landscape get seen & when

Emphasise isolation & site sensitivity -
-**hide cars and roads** from view
-allow **natural flora** to extend right
up to the building



Clean, simple lines seem to be successful.

Linear geometry contrasts with landscape, emphasising the man-made without seeming incongruous

Simplicity also serves to draw the eye
and emphasise vistas

Simple Palette
+
Uncomplicated Design
=
Beautiful & Sensitive structure



Materials:
-Natural - stone & earth (blend)
-Man-made - Sand-blasted concrete block, rusted metal
(colour blend, not incongruous)

Glass connects inside & outside
& expresses vast space

Thermal massing (thick walls and buried structures) help to regulate temperatures

Deep eaves & limited windows **prevent heat gain**

See materiality section on pages 143 & 144
for how the building will relate to its environment externally.

Innovation & Sensitivity with Light & Colour

'Skyspaces'
-Installation Art by James Turrell

"If the color [sic] is in the paint on the wall, then in making a structure and allowing light to enter it, the color [sic] will tend to ride on the walls. But if the color [sic] of the wall is white, which in one way is a non color [sic], then the color [sic] is allowed to enter the space riding on the light, and that color [sic] has the possibility of inhabiting the space and holding the volume rather than being on the wall."
-Julia Brown, Art Writer
(Brown, 1985: 25)

James Turrell is known for his 'light sculptures'. Many of his installations in galleries consist of surreal spaces with almost tangible light. They use light to create disconcerting optical illusions. *(fig p70)* Many of these are confined to the realm of art galleries. One of his specialities, however, could be considered an architectural element. His 'skyspaces' use light and time to create dramatic effects. *(fig p71)*

A 'skyspace' is essentially a very ordinary room with a very ordinary skylight that, with light, transforms a space over time. Usually the room used is sparsely furnished, with either cushions on the floor or simple chairs arranged around the periphery of the room. The walls are painted plain white. The roof (usually high or double volume) has a simple opening or skylight in it, framing a patch of sky beyond. Artificial lighting in the room, usually tungsten bulbs or fluorescent tubes, is hidden from direct view. It is usually recessed in the wall near the floor, or occasionally behind built in chair backs up to two metres off the ground. That essentially is all that is needed. (Adcock, 1990: 117-124; Brown, 1985: 64)

The performances that can be observed from such a simple construction have been described by many as spectacular yet subtle events. (Brown, 1985: 53 & 64)

Light, colour and space are closely linked. This is never so evident than at dusk, the most ambiguous time of day. In the short time between sundown and darkness, all the changes in light occur. (Brown, 1985: 56) This is the time when 'skyspaces' perform.

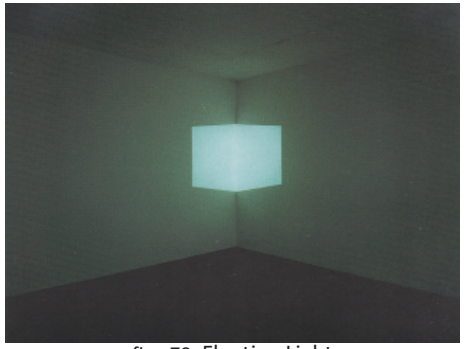


fig p70. Floating Light
Afrum-Proto (1966) - James Turrell
(Image in Adcock, 1990: 141)

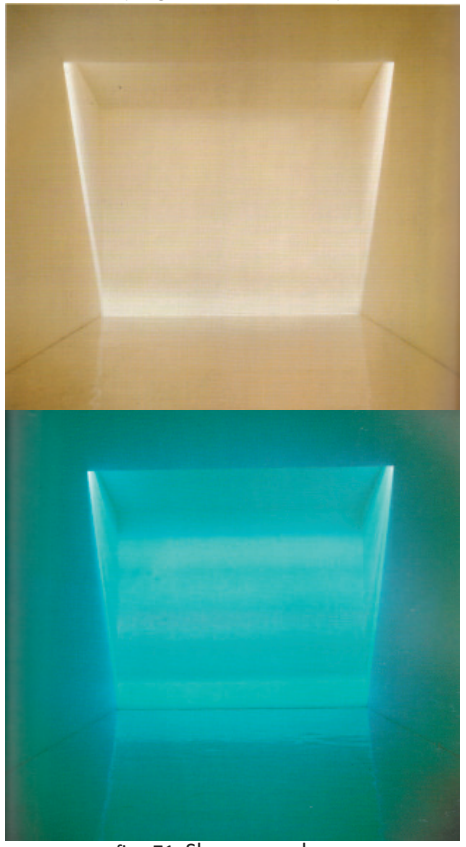


fig p71. Skyspace colours
Virga (1974) by day and night
(Image in Brown, 1985: 78 & 79)

Observers sitting in the space just before sunset would, typically, first be in a room flooded with natural light, barely aware of the hidden artificial lights in the room. The sky viewed through the skylight would first be a solid blue. Over time, the blue becomes darker and richer and the border inside the skylight would appear to recede. The sky soon fades to a paler blue and then goes through a series of colours quite quickly, red, orange, gold, yellow and violet. Finally the black arrives and becomes permanent, indicating that night has come. *(fig p72)* (Adcock, 1990: 118 & 126; Brown, 1985: 64)

At dawn, the light and colour performance would happen in a similar way but roughly opposite in its order. (Adcock, 1990: 123-124) In perceptual psychology terms, the margin around the opening is an 'inducing field'. The contrast between this and the space to the sky modifies the 'target colour' of the sky.
(Adcock, 1990: 118)

"In addition to forming light, the skyspaces seem to form time." (Adcock, 1990: 124) They seem to reinforce the significance of the progression of day to night and back to day, something that is already deeply rooted in human experience. (Adcock, 1990: 124)

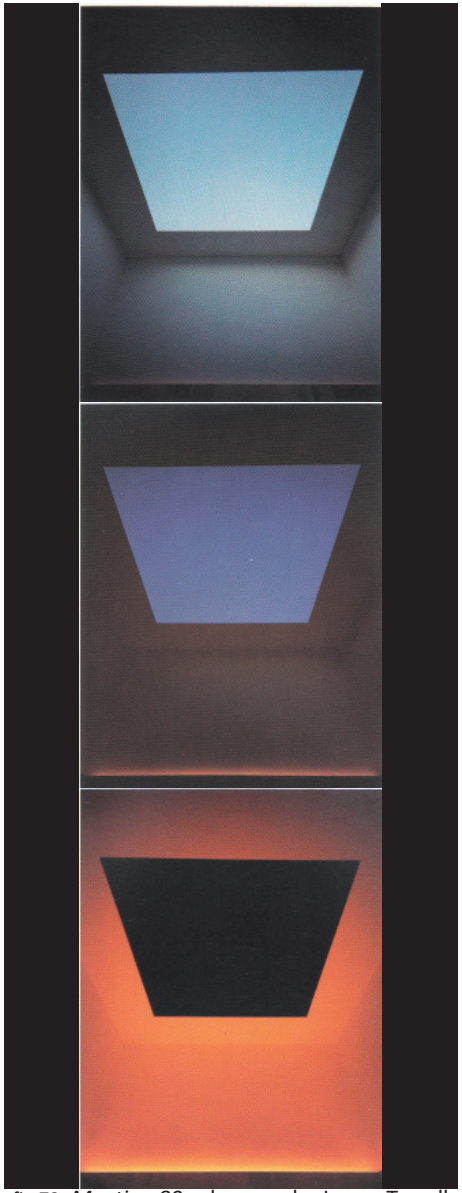


fig 72. *Meeting 80* - skyspace by James Turrell
Photographed in daylight, at dusk, & at night.
(Image in Adcock, 1990: 146 & 147)

Cambridge Crystallographic Data Centre, England
-Erik Sørensen

"Sørensen limits his palette of materials so that every move in the plane of the wall tells."
-Nicholas Ray, Architectural Journalist
(Ray, 1992: 31)

The Cambridge Crystallographic Data Centre *(fig p73)* houses a computerised database containing comprehensive information for the study of the crystal structures of biological molecules. (Ray, 1992: 24)

The building sits on a complex site in an early nineteenth century extension to the south of Cambridge. Its neighbours include a brick parking garage, a large brick university building, and a bungalow-style school. (Ray, 1992: 24 & 26)

This discussion will be limited to specific features of the building that are most relevant to this paper. The palette of materials, particularly externally, is intentionally limited to allow changes in the wall plane of the facade to be easily read. The building is steel framed with masonry infill and cladding. The facade is face-brick with uneven plaster lines due to slightly irregular brick shapes. (Ray, 1992: 30 & 31)

Natural light has been used in various ways within the building to create interesting and dynamic spaces. A large, south-facing light scoop pulls light down into a galleried main space within the building. It washes down a white-painted wall and illuminates the whole interior. *(fig p74)*(Ray, 1992: 39)

A fountain on the first floor trickles into a crystal bath in the middle of the office space. The bottom of the bath is visible from the floor below as a translucent circle in the ceiling where light shines through the water above. *(fig p74)*(Ray, 1992: 30)



fig p73. Limited Materials.
Cambridge Crystallographic Data Centre
(Image in Ray, 1992: 26)



fig p74. Wall flooded with light and water pool from above and below (insert)
(Image in Ray, 1992: 33 & 32)

The design deliberately allows lower light levels into the work space than are generally accepted. These levels are better for viewing computer screens (individuals have task lights that they can control individually in their work spaces). (Ray, 1992: 40) Most of the windows are lined with granite which provides a texture contrast to the brickwork and gently reflects light in the windows. (Ray, 1992: 31)

A two-storey high vertical slit up the building facade holds a narrow window with a mirror reveal. A sliver of light enters the window and is reflected off the mirror and across the interior space "projecting surprising patches of sunlight into the space as the seasons progress." *(fig p75 & p76)*(Ray, 1992: 40) In this way, light is used to provide interest and excitement (and a reference to the crystals being studied in the building) and also to trace the movement of time through the day and the year, placing the inhabitants firmly in their time context.

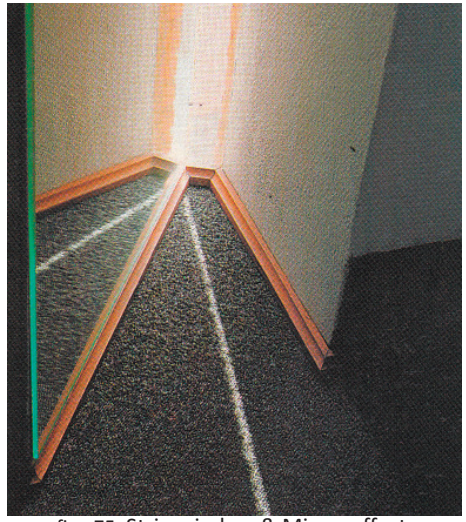


fig p75. Strip window & Mirror effect.
Cambridge Crystallographic Data Centre
(Image in Ray, 1992: 34)

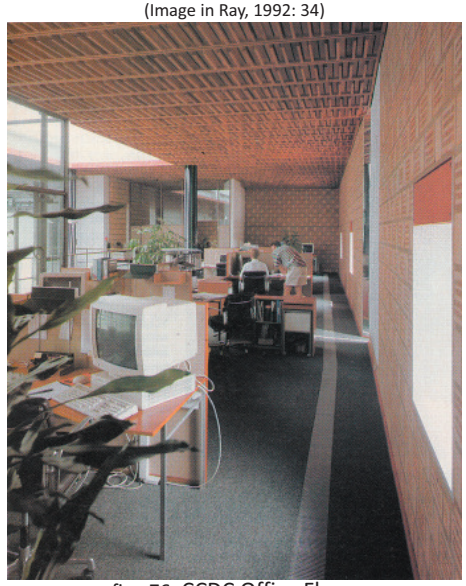


fig p76. CCDC Office Floor.
Light strips on the floor from mirror reflection
(Image in Ray, 1992: 40)

Hill House, Helensburgh, Scotland
-Charles Rennie Mackintosh

" Indeed all round the house tiny accents are made by touches of colour, of glass, of ceramic, of mosaic, used like lipstick or ear-rings, only in the places you are close enough to touch."
-John McKean, Architectural Writer
(Mckean, 1998: 42)

Hill House has been described as "Mackintosh's domestic masterpiece" built around 1904. (Mckean, 1998: 39) Externally, it is a large mansion with many different shapes tied together visually with a surface treatment of 'harling', a traditional scottish technique of plastering with a slurry of stone chips and gravel in a lime base. *(fig p77)*The inside of the house is like a different world. The entrance does not appear to offer a sense of transition between the two, but rather a strong boundary, a place to penetrate the thick wall into the realm beyond. (Crawford, 1995: 103)

The visitor enters through an understated black door, pierced with small squares of clear glass. *(fig p78)* (Crawford, 1995: 120; Mckean, 1998: 39) Just inside the door, on the right as you enter the hallway is the black door through which the visitor enters the library, this was the client, Walter Blackie's study. It is furnished with dark stained bookshelves and other dark furniture with simple, Arts and Crafts detailing. There are four long, purple inserts of handmade glass in the door, and a tiny detail of white enamel and purple-blue glass in other parts of the room. (Crawford, 1995: 120; Mckean, 1998: 39-40)

The room is almost entirely rectilinear with the occasional curves that seem to contradict the square order. It is a masculine room, the realm of the man of the house. (Crawford, 1995: 120) As we will see as we explore the house further, Mackintosh uses colour, light and detailing to define masculine and feminine spaces throughout the house. The glass inlays in doors are used often as a hint at what lies within. For the more masculine domain, he always uses dark shades of blue and deep purple. For the feminine spaces, he uses pale shades of pink, mauve and white. This sets up a subtle ordering through colour. *(fig p79)*
(Crawford, 1995: 123)


fig p77. South Facade of Hill House.
Walls finished with harling, slate roof.
(Photo by Author)


fig p78. Entrance Hall.
Looking back towards the entrance.
(Image in Crawford, 1995: 120)


fig p79. Colour and Light in Detail.
Fireplace mosaic at Hill House.
(Image in Mckean, 1998: 48)

As we climb the four steps from the entrance hall to the main lobby we begin to experience the contrast from the hard exterior to the soft interior. The heart of the house is a soft white. The lobby and stairs are an intermediate space between the black and the white, between the masculine and feminine worlds. (Mckean, 1998: 40-41)

Solid and void uprights divide the hall space and tiny pieces of pink and purple glass are embedded in wood panels and reflect light and catch the eye. Organic motifs are stencilled on the wall between the timber uprights in shades of blue, pink, purple and green. *(fig p83)* There is a shadowy, hidden seat beneath the upper stair, a nook to escape into but still survey the comings and goings at the front door. (Crawford, 1995: 120; Mckean, 1998: 41) The house has many of these 'edge spaces' or rooms within rooms. (Mckean, 1998: 44)

From the north-lit hallway, a dark door with glowing, opal white squares of glass inset onto it, opens into the drawing room. *(fig p82)* Directly ahead is a rectangular bay with seating in it. It is glazed and the view through the windows crosses the garden and looks out to the distant view of the water of the Firth of Clyde. (Mckean, 1998: 46)

This room was designed to work in three ways. It is a music space, a place for sitting in the sun, and a warm place in winter. (Crawford, 1995: 122) The main rectangle of the room is held together by a low cornice encircling the room at the height of the ceiling of the music room alcove and the bay window (the main ceiling is higher). It is a feminine space, with white and cream walls and carpets. Below the cornice is a stencilled trellis of white and silvery stripes that gently reflect light, covered in pink roses and green foliage. (Mckean, 1998: 47)

The main bedroom *(fig p80 & p81)*, up the bright stair barrel off the hall, is a similarly feminine haven. On the outside, the door is dark with six small squares of glowing glass, on the inside, the door is white and the glass is enamelled pink. Inside the room there is a sleekness and a lack of the Arts and Crafts type workmanship seen in the library. Lines are curvaceous and sinewy and all the furniture is thickly lacquered in ivory white paint. (Mckean, 1998: 42)

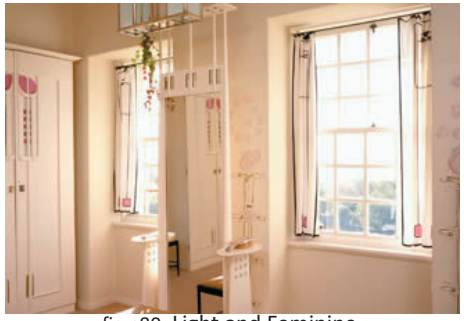


fig p80. Light and Feminine.
The main bedroom at Hill House.
(Image in *The Hill House*, 2009: 1)

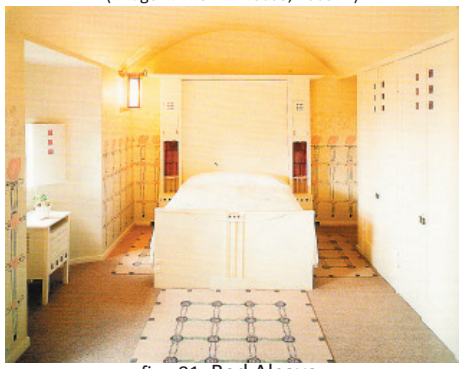


fig p81. Bed Alcove.
The main bedroom.
(Image in *The Hill House*, 2009: 1)



fig p82. The Drawing Room.
Another feminine domain.
(Image in Crawford, 1995: 124)

The ivory walls are, again, delicately stencilled with mauve and green rose motifs. The decoration is all sensual, feminine and uninhibited. (Mckean, 1998: 43) Contrasting to this is Walter Blackie's dressing room next door. This room is sober and masculine, in a similar language to the library. It is panelled and furnished in dark wood with simple, dark purple highlights. (Mckean, 1998: 43 & 44)

The house is "full of alterations and gradations of light which reinforce the masculine/feminine scheme of meanings: gloom in the vestibule, half-light in the hall *(fig p83)*, bright light beckoning us on the stairs and welcoming us in the drawing room *(fig p84)* and bedroom" and "when the sun comes out, the whole house responds to it." (Crawford, 1995: 123) The combination of light, natural and coloured through glass, and the ordered yet subtle arrangement of colour throughout the house creates emotive and comforting spaces, each different yet all a part of a whole.



fig p83. Transition Zone.
The hallway.
(Image in Mckean, 1998: 38)

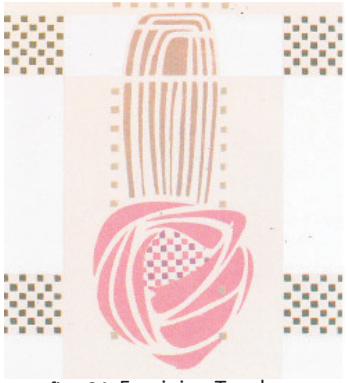


fig p84. Feminine Touches.
Mosaic detail from the drawing room.
(Image in Mckean, 1998: 46)

Chapel of Notre Dame du Haut, Ronchamp, France (1955)
-Le Corbusier

“architecture is the masterly, correct and magnificent play of forms in light.”
-Le Corbusier, architect
(Plummer,2003: 236)

In this chapel, Le Corbusier uses a simple material palette in order to accentuate his use of colour and light inside. The walls are finished in textured white stucco and the upturned curve forming the roof is concrete. *(fig p85)* Inside, he becomes a “magician with light”. (Plummer, 2003: 236)

The interior is dominated by the south wall *(fig p86)*, with angled apertures carved through the thick wall. Each void is splayed and tapered, either wider on the inside or the outside of the wall, specially designed to channel and trap light. Each one is unique in size and shape and fitted with a coloured glass window so that every void glows in colour. *(fig p87)*(Plummer, 2003: 236)

These openings, with their differing orientations, capture different light at different times of day. They are lit or shaded at different times and the chapel is washed with a dynamic arrangement of colours. They also have seasonal variation, the high summer sun is scarcely allowed inside, while the lower winter sun penetrates the entire width of the church. (Plummer, 2003: 238)

In other places, the rough white walls are painted in vivid colours. The rough walls always accentuated by the play of light and shadow that falls across them. (Plummer, 2003: 236)

Three small chapels rise out of the building like periscopes facing different directions, designed to catch the specific light of certain times of day and channel it to the altars below. *(fig p88 following page)* This light bounces off coloured walls, appearing to have absorbed the vivid hues by the time it reaches the floor. *(fig p89 & p90 following page)*(Plummer, 2003: 236)



fig p85. White Stucco and Concrete.
External view of the church.
(Image in Plummer, 2003: 241)

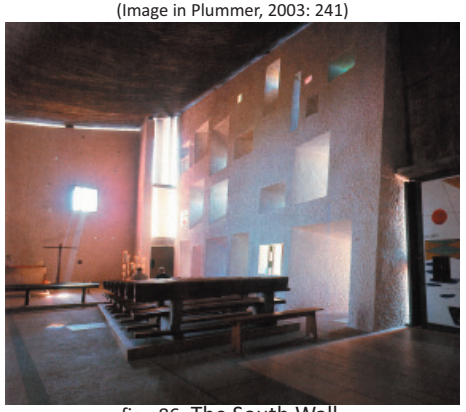


fig p86. The South Wall.
The main sanctuary.
(Image in Plummer, 2003: 242)

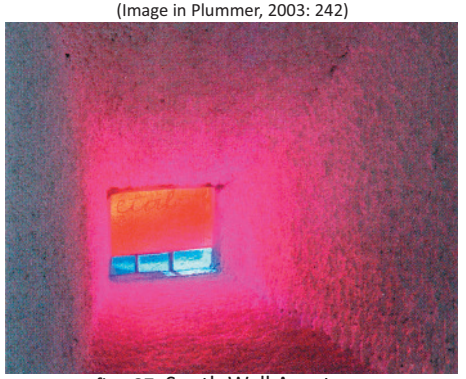


fig p87. South Wall Aperture.
Colour floods the slanted reveal.
(Image in Plummer, 2003: 243)

The corrosive force of light is also explored at Ronchamp. Slot windows allow direct, bright sunlight in on either side of the main door, and in a space between the south wall and the roof. This makes it seem as if the roof is floating. A similar effect seems to dissolve columns almost completely when there is bright light from behind. (Plummer, 2003: 238)

At dawn, it is the east wall that becomes animated. Tiny holes in the wall glow like stars as the sun catches them, and a single ray of bright morning light is directed into the chapel. This is just one of the ways in which a “totality of light in motion” is achieved as the various elements change through time and space.
(Plummer, 2003: 238)

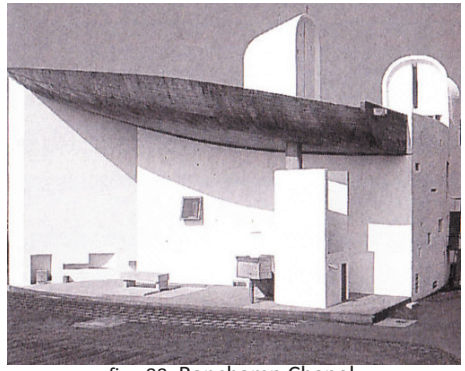


fig p88. Ronchamp Chapel.
Chapel ‘periscopes’ above the concrete roof.
(Image in Plummer, 2003: 236)

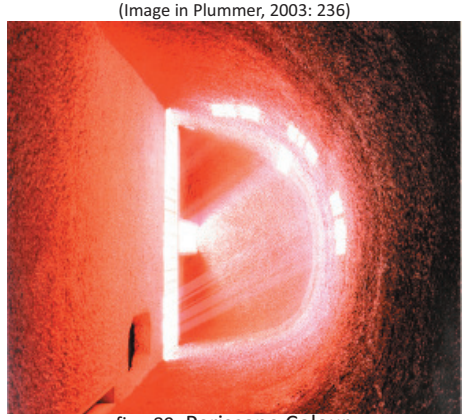


fig p89. Periscope Colour.
View up the red chapel light well.
(Image in Plummer, 2003: 245)



fig p90. Red Alter.
Coloured light floods one of the chapels.
(Image in Plummer, 2003: 244)

This ‘light tower’ concept is implemented in towers in the project. See page 156.

Monastery of Sainte-Marie-de-la-Tourette, France (1960)
-Le Corbusier

"More impressive than the shapes of light within the church is their orchestration through time and space, producing one of the great kinetic achievements of modern architecture."
-Henry Plummer, Architectural writer
(Plummer, 2003: 148)

In this Dominican monastery near Lyons *(fig p91)*, Le Corbusier again uses a very limited palette, claiming that a single material allows many different constructed forms and varying atmospheres that are still always the same. In this case the entire building is constructed of concrete, mostly unfinished but occasionally plastered. (Plummer, 2003: 246)

The hallways are based on repetitive rhythms of light and shade with views into pristine gardens, and each monastic space in the building is defined by its own variations of light and shadow. (Plummer, 2003: 246) The levels of the building are defined by the different ways that light is handled. The upper two living floors have horizontal ribbon windows at eye level. The floor below has a chequerboard arrangement of windows. The lowest, most communal floor, has an arrangement of concrete columns with slender, vertical panes. *(fig p91)* (Plummer, 2003: 246)

Form is defined by the shadows that fall across it. Simple, primary shapes like cubes, cones, spheres, cylinders and pyramid are revealed by light to their best advantage. (Plummer, 2003: 246)

An eerie, dark tunnel ramps down to the church itself. *(fig p92)* This emphasises the bright, mystical light at the destination. The church is full of light and colour. An angled, horizontal slit window provides glare-free reading light for the seated monks. It is slightly tinted by the reflected colour from the window reveals. *(fig p93)* (Plummer, 2003: 248)

Other tubes and funnels channel light into the building. Each tube is angled to capture a specific light at a single time of day or specific time of year. They are often painted bright colours so that the light glows in different colours. *(fig p93)*(Plummer, 2003: 248)



fig p91. External view.
Notice the variation in window arrangements.
(Image in Plummer, 2003: 250)

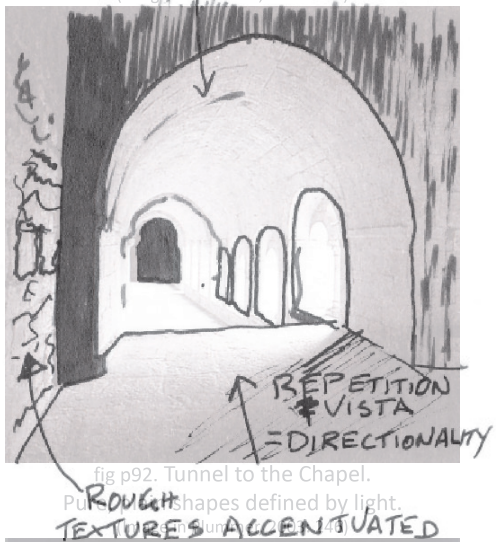


fig p92. Tunnel to the Chapel.
Pure shapes defined by light.
(Image in Plummer, 2003: 251)


fig p93. Main Chapel.
Coloured light from slits and tubes.
(Image in Le Corbusier, 1971: 34 & 35)

Simple vault structures will provide similar shadow play in the building. See images on pages 148 & 150.

Monastery of Sainte-Marie-de-la-Tourette, France (1960)
-Le Corbusier

"More impressive than the shapes of light within the church is their orchestration through time and space, producing one of the great kinetic achievements of modern architecture."
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fig p91. External View.
Notice the variation in window arrangements.
(Image in Plummer, 2003: 250)



fig p92. Tunnel to the Chapel.
Pure, plain shapes defined by light.
(Image in Plummer, 2003: 246)



fig p93. Main Chapel.
Coloured light from slits and tubes.
(Image in Le Corbusier, 1971: 34 & 35)

Simple vault structures will provide similar shadow play in the building. See images on pages 148 & 150.

Colouring and channeling natural light

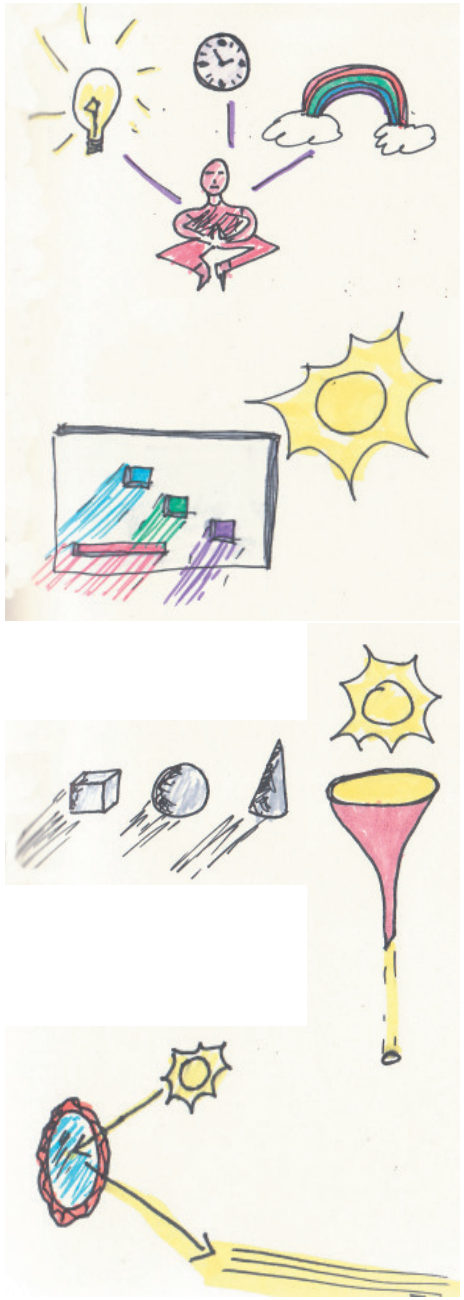
Varying types of windows, openings and apertures to allow light in differently

Colour and light to create **varied or themed** spaces (eg masculine & feminine)

Limited materials palette to emphasise light and shadow

Pure, simple shapes, emphasising shapes through shadows

Inclusion of mirror and other **reflective surfaces**, particularly at openings and windows



Spaces to **appreciate light, time & colour** (Skyspaces)

Using the **sun to track** things/patterns/graphs

Colour and light directionality
=
space changes over time

Funnelling light to emphasis or highlight

Varying bright, corrosive light and soft, **accentuating washes**

Views of and through **water** (and its affect on light)

Local Trends

Clanwilliam Living Landscape Project, Clanwilliam, South Africa
-Hilton Judin & Nina Cohen

"Key to the project is its concept of landscape – one that encompasses not only scenery and panorama, but also the people who produce, work, and live within it"
-'Karen' from the University of Chicago, Student Travel Blogger
(Unknown, 2006: 1)

The Living Landscape Project in Clanwilliam is a community based job creation and education project. The area around Clanwilliam is full of fossils, artefacts, natural features, San rock art *(fig p96)* and ruined structures. All of these point to the passing of time, and this is one of the main focuses of the museum/education centre. (*Living Landscape Project*, 2008: 1)

The project started as a simple museum when the archaeology department from the University of Cape Town bought some old buildings in Clanwilliam (a school and some houses). An extension to connect and convert these buildings to house exhibitions and workshops was built. Beyond this, the concept of museum was inverted. Instead of artefacts being collected together inside a building, the museum was taken to the exhibits as the minimal structures were dispersed throughout the surrounding landscape. *(fig p95)*
(Judin, 2009: 1)

Each 'building' was seen as a 'folly in the landscape'. They are situated near to artefacts (such as, for example, a cave, housing significant San cave paintings). The structures themselves were designed to be 'closed' or minimal elements in the landscape when not in use. *(fig p94)* When they are in use, they are opened up or added to. *(fig p95)* Students, locals and tourists interact at these points. Elements and materials that are brought to the site by users, or created on the site in workshops *(fig p97 following page)*, are intended to remain as part of the building, making it a dynamic, growing element in the landscape. (Judin, 2009: 1)



fig p94. Follies in the Landscape.
All that remains when the place is unused.
(Photo by Paul Kotze)

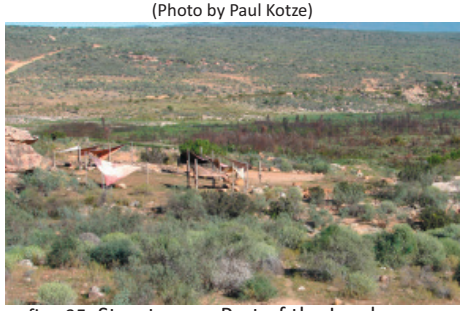


fig p95. Structure as Part of the Landscape.
The meeting space with sail roofs erected.
(Photo by Paul Kotze)

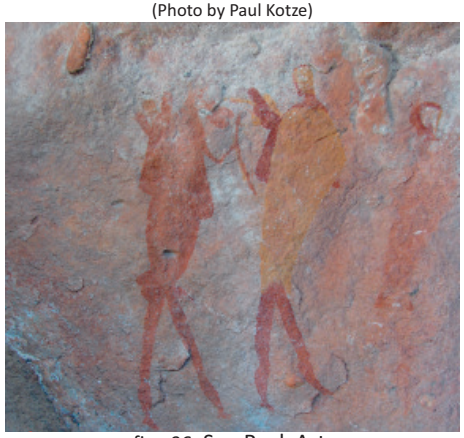


fig p96. San Rock Art.
The reason and inspiration for the project.
(Photo by Paul Kotze)

Andrew Lindsay, a well known South African artist, worked with students on one such later addition. They produced a shading structure for one of the meeting points in the landscape. When not in use, all that is visible on the site is a grouping of metal poles *(fig p94 previous page)*, looking as if they remain from some ancient structure. Lindsay's addition is a temporary shade structure, reminiscent of boat sails strung up between the poles. *(fig p95 previous page)* (Judin, 2009: 1) The colours in the 'sails' are derived from the surrounding landscape. As a result, they blend into the surroundings. Inspiration for the speckled paintwork on the fabric clearly comes from local lichen on rocks in the area. *(fig p98 & p99)*



fig p97. Weather Vane as Street Art.
A series of pieces are inspired by rock art.
(Photo by Paul Kotze)

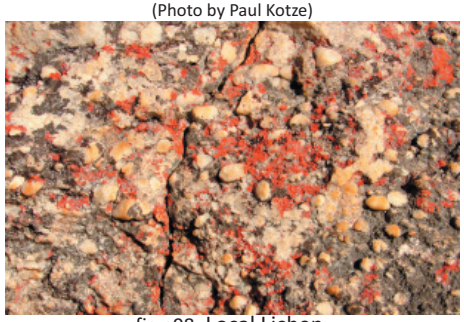


fig p98. Local Lichen.
Inspiration for the sail fabric patterns.
(Photo by Paul Kotze)

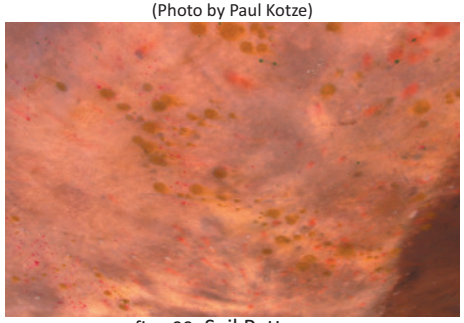


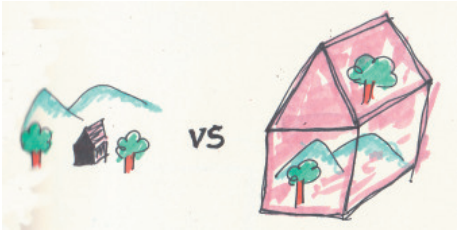
fig p99. Sail Patterns.
Inspired by local colour and lichen.
(Photo by Paul Kotze)

Additions through **use and time**
-**dynamic** nature of a building over time



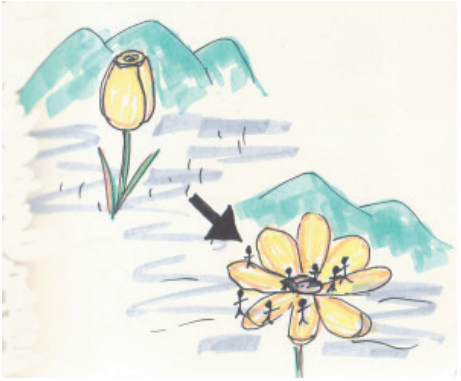
Involvement of locals, students and artists to leave their own mark on a building or landscape

Building IN a landscape
vs
Landscape IN a building



Dispersal across a landscape

Dynamic Nature of:
Open - Closed
In Use - Dormant
Alert - Asleep



Inspiration from **local landscapes, artefacts, colours and textures**

See ideas for artist and user input in the built complex on page 155.

Site Analysis

Where? and Why?

I needed a site where I could best explore the possibilities of colour and light in architecture, particularly in an African context. Initial investigations led to the Karoo, the semi-desert region that spreads over most of the South African interior and the western part of the country. The area is already known for its wide open spaces and clarity of light *(fig s1)*. The clear, dry atmosphere, free from the pollution or humidity of other regions, already draws artists and photographers who try to capture the landscape views in their work.

The next question lay in what you could build in the Karoo and who would use it. This vast area is peppered with small towns and lone farmsteads with long distances in between. One town in particular caught my attention as it already had something of its own claim to fame. It also has its own connections to light, and its position is closely linked to the cosmos.

Sutherland

Sutherland, a town with a population of just over 2000 people (around 3650 if you include the surrounding farm areas) (Wagener, 2004: 1) , is located in the Northern Cape, just north of the border with the Western Cape, about 340 kilometres from Cape Town. *(fig s2 & s3)* The town was established in 1855 on the farm, De List, and named after Henry Sutherland, a clergyman from Worcester who used to have a church service in the region once a year. (Wagener, 2004: 1) The area was found to have a reasonable supply of underground water (hence the many windmills), though the rainfall is only around 250mm per year, spread throughout the year. (Wagener, 2004: 1)

The Japanese discovered the Sutherland region to be one of the quietest in the world in terms of seismic activity. It sits at a height of about 1550 metres above sea level, and has approximately 80% cloudless skies at night. (Wagener, 2004: 1) It is these latter two facts that led the South African Astronomical Observatory (SAAO) to be set up here in 1973. Observation conditions in the main cities (particularly the primary observatory in Cape Town) were becoming impossible by the 1960s due to the increase in city lights polluting the atmosphere. (Warner, 2009: 53)



fig s1. The Vast Karoo.
View of the Karoo Landscape near Sutherland.
(Photo by Author)

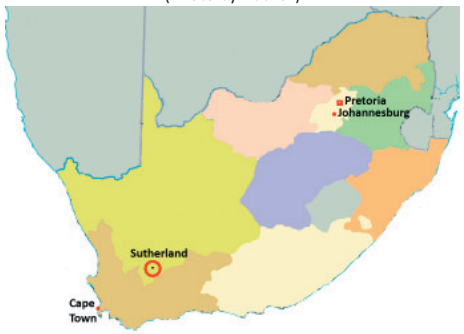


fig s2. Sutherland in Context.
Map of South Africa. Sutherland is Circled.
(Image by Author)



fig s3. Welcome to Sutherland.
Road sign on arrival at Sutherland.
(Photo by Author)

The SAAO

The Sutherland branch of the SAAO (the Cape Town branch still exists but is primarily an administration centre) was started with three telescopes, transported from Cape Town, Johannesburg, and Pretoria. Since then, other telescopes have been added to the grouping on the SAAO ridge. *(fig s4)* They are owned by various countries and institutions including the UK, Japan, Korea, and Germany, and have different functions and are mostly controlled remotely. (Warner, 2009: 53; SAAOb, 2008)

SALT

The most significant addition to the SAAO ridge is the Southern African Large Telescope (SALT). *(fig s5)* Opened in 2005, SALT is one of the two largest optical telescopes in the world. Its twin, in Fort Davis, Texas, surveys the Northern Hemisphere skies. The 11 metre diameter mirror is, in fact, made up of 91 hexagonal mirror segments, each 1 metre across. Modern technology allows the mirrors to be mechanically aligned on their individual mountings in order to be able to work together as one single mirror. This telescope is so powerful that it would be able to see a single candle flame on the moon. South Africa owns one third of SALT. The balance of the US$32 million it cost to build was paid for by partners (mostly universities) in Germany, India, New Zealand, Poland, United Kingdom and the United States of America. Astronomers from all over the world use the facilities on a rotation basis throughout the year. (SAAO, 2008b; Strydom, 2009)



fig s4. SAAO Telescope Domes.
The Earth's Shadow (blue part) Rising Behind.
(Image in Koorts, 2008)



fig s5. Southern African Large Telescope.
(SALT).
(Photo by Author)

Sutherland Extremes

Sutherland is certainly a place where extremes come together. The town's other claim to fame is that of being the coldest place in South Africa in winter. It gets frost an average of 88 nights a year and has an average yearly minimum temperature of 3°C. The town usually gets at least one fall of snow each winter. *(fig s6)* (Wagener, 2004: 1) A weather observation station was first set up in 1879 and carried on until 1896. The service started up again in 1927 and continues to the present. The coldest recorded temperature was -16°C, on 12 July 2003, though it felt colder due to the wind chill factor. (Wagener, 2004: 34; Karoo Hoogland Municipality, 2009)

Being inland and a semi-desert region means that temperature differences between day and night can be extreme, as are the differences between winter and summer. The average maximum temperature is 20-25°C (Wagener, 2004: 1) , but summer maximums can be well into the 30s. So the hot, dry summers *(fig s7)* are a contrast to the cold, snowy winters.

Another extreme that meets in the town is that of technology. Juxtaposed with the astronomical technology at SAAO, that makes South Africa a leader in the field *(fig s9, following page)* {{151 Warner, Brian. 2009/s53;}}, is the quiet town itself. Sutherland certainly doesn't look as if it is the home of some of the world's most high-tech scientific equipment. *(fig s8)* The main road running North-South through the town, and the road that meets it from the Observatory to the East, are the only tarred roads around with the rest being graded sand and gravel. There is one fuel station with rather limited opening hours. There are no supermarkets or department stores, only a co-op and a small cafe. There are three high end restaurants (two with bars) and two coffee shops. Broadband internet appears to be virtually unheard of and there is only consistent cellular phone service within a small radius of the town.



fig s6. Sutherland Snow.
Snow in June 2007, at SAAO.
(Image in Koorts, 2007)



fig s7. Summer Sutherland.
Hot and dry in March 2009.
(Photo by Author)



fig s8. Plein Street, Sutherland.
Rural townscape.
(Photo by Author)

It is apparent that there is a high degree of segregation, on many levels, between the people of the town. The colour line, a remnant of South Africa's turbulent past, is evident in the physical divide between the predominantly white 'old town' and the predominantly 'coloured' township region, with a tract of open land in between.

Beyond that, there are other definite divides. The Afrikaans speaking white population and the far smaller English speaking population seem to keep to themselves, while the Scientists and Astronomers based at the Observatory, many of whom are international visitors for limited contract periods, don't seem to have much interaction with the town or its inhabitants.

Apart from the obvious links to the sky, and its nickname, the *Gateway to the Universe*, Sutherland is rooted in an interesting region geologically. To the west of the town is the Roggeveldberg mountain range, and beyond that, the Tanqua Karoo. This sedimentary basin seems to attract attention from geologists internationally, particularly in analysing the water content of deep reservoirs in the 450 metre thick sandstone fan complex making up the region's geology. (Statoilhydro, 2008)

To the South East of the town is Salpeterkop *(fig s10)*, believed to have been the last active volcano on the continent, south of the equator. It last erupted some 66 million years ago. (Kok, year unknown) Until recently, the top of this hill was a popular walking destination for the spectacular views of the area, but it has now been closed to the public by the owner of the private land on which it sits.

There is something poetic about the way Sutherland sits at the point of encounter between the Earth and the Sky. *(fig s11)*



fig s9. Cut-away view of SALT, showing mirror.
Model on show at the SAAO Visitor Centre.
(Photo by Author)



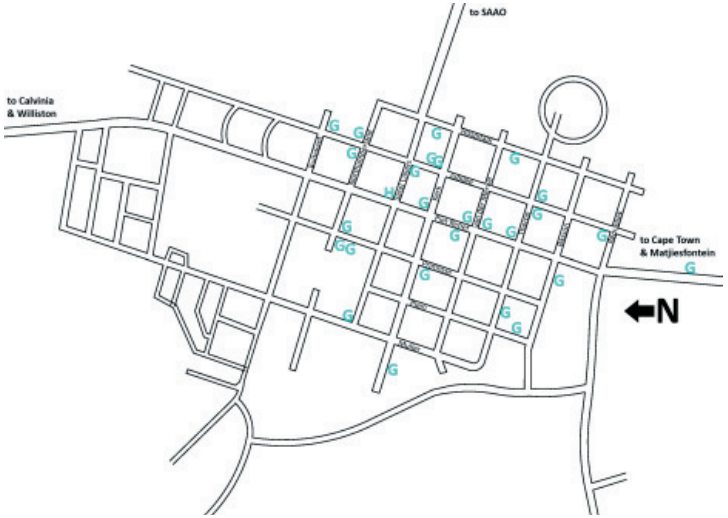
fig s10. Salpeterkop.
View from The Observatory ridge.
(Photo by Author)



fig s11. Encounter.
What happens where Earth meets Sky?
(Image by Author; Photos in Statoilhydro, 2008; ASSA, 2009)



Mapping of Residential Land Use



Mapping of Guest Houses & Hotels



Mapping of Restaurants, Coffee Shops & Bars



Mapping of Services and Community Facilities



fig s12. Sutherland High School.
(Services & Community Facilities)
(Photo by Author)



fig s13. Sutherland Police Station.
(Services & Community Facilities)
(Photo by Author)

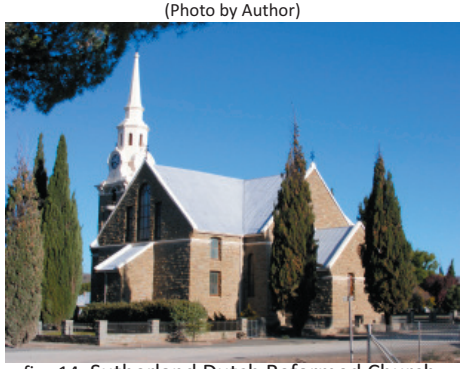


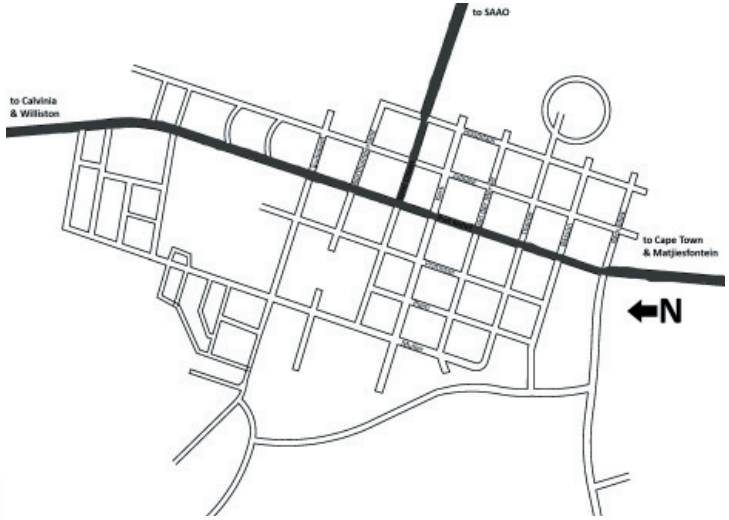
fig s14. Sutherland Dutch Reformed Church.
(Services & Community Facilities)
(Photo by Author)



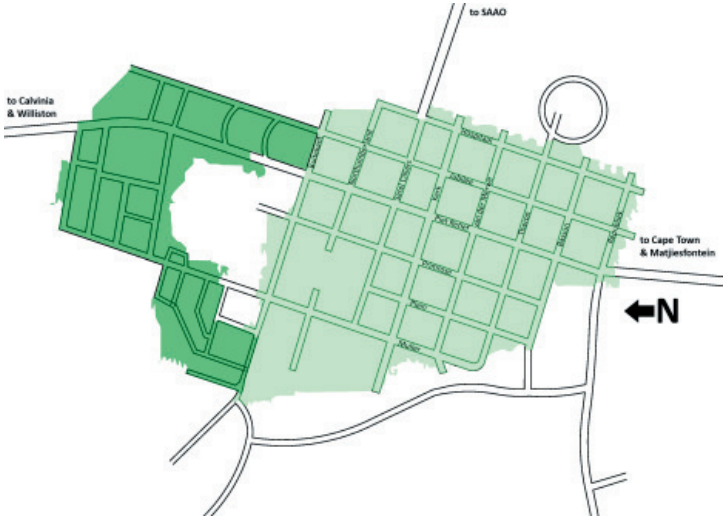
Mapping of Retail & Industrial Land Use



Mapping of Sports Facilities & Open Land



Mapping of Road Surfaces
(Dark Grey indicates the only tarred surface)



Area Segregation - A Remnant From the Past
Predominantly White South & 'Coloured' North
(Generalised, Perceived. Not Enforced)



fig s15. Disused Public Pool.
(Sports Facilities & Open Land)
(Photo by Author)



fig s16. Playground, Locked & Unused.
(Services & Community Facilities)
(Photo by Author)



fig s17. Standard Government Housing.
(Area Segregation)
(Photo by Author)



Composite Mapping of Land Use in Sutherland

Key

- R -Residential
- G -Guest House
- H -Hotel
- Rt -Restaurant
- C -Coffee Shop
- Ba -Bar
- K -Church
- B -Bank
- Sc -School
- L -Library
- Ho -Hospital
- Dr -Doctor
- TL -Telkom
- PL -Police & Magistrate
- M -Municipality
- Po -Post Office
- V -Visitor Centre
- E -Electric Substation
- We -Weather Station
- Ms -Museum
- W -Work/Job creation
- OA -Old Age Home
- CM -Cemetary
- S -Shops
- I -Industry/Warehouse
- F -Sports Fields
- T -Tennis Courts
- P -Public Pool
- PL -Playground
- O -Open Land



fig s18. Sutherland Post Office.
Map position 1.
(Photo by Author)



fig s19. *Kambrokind* Guest House.
Map position 2.
(Photo by Author)

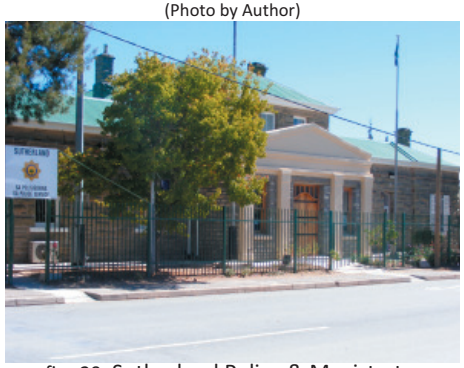


fig s20. Sutherland Police & Magistrate.
Map position 3.
(Photo by Author)

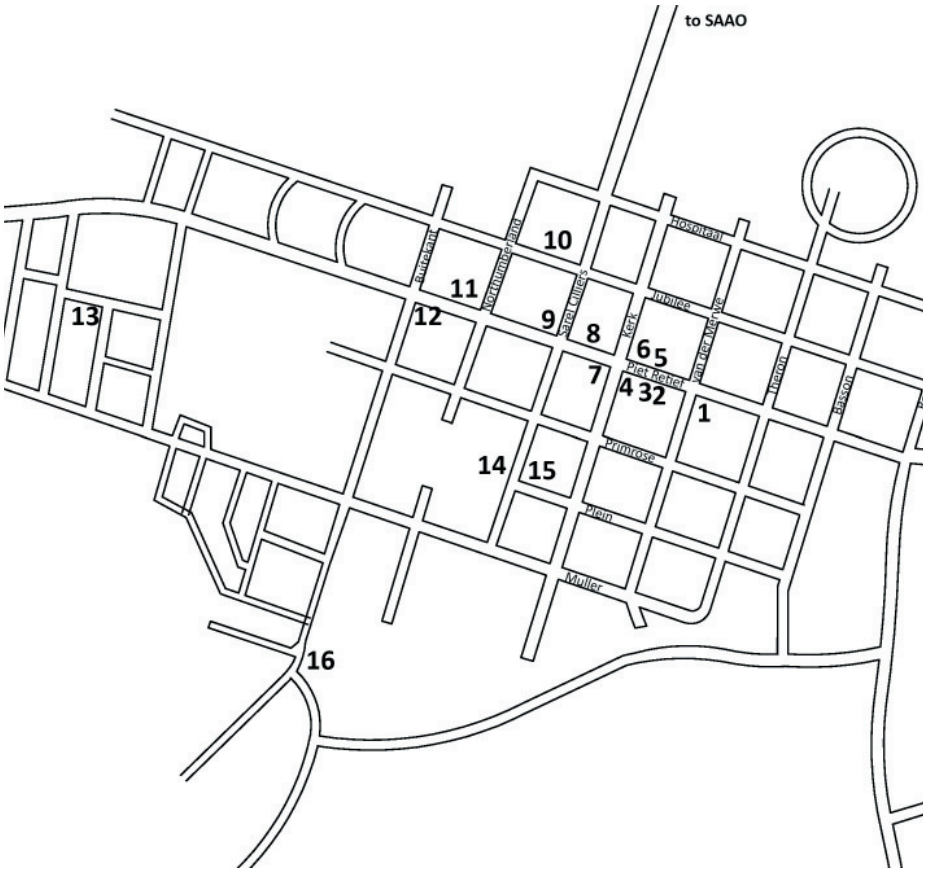




fig s21. Karoo Hoogland Municipality.
Map position 4.
(Photo by Author)



fig s22. Standard Bank.
Map position 5.
(Photo by Author)



fig s23. *Foodzone* Co-op.
Map position 6.
(Photo by Author)

Significant and Typical Sutherland Buildings.



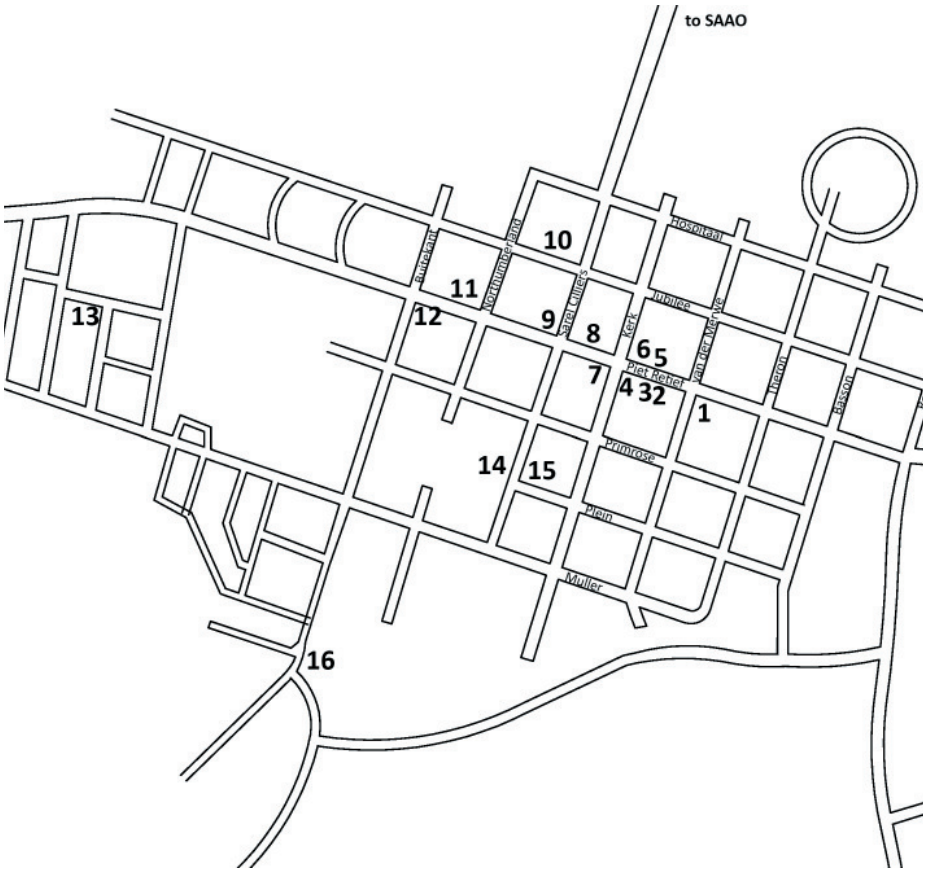
fig s24. Church Hall, Dutch Reformed Church.
Map position 7.
(Photo by Author)



fig s25. *Die Trommel,* Gift & Souvenir Shop.
Map position 8.
(Photo by Author)



fig s26. Sutherland Hotel.
Map position 9.
(Photo by Author)



Significant and Typical Sutherland Buildings.



fig s27. Old Lawyer's House. Now a Gallery.
Map position 10.
(Photo by Author)



fig s28. *Perlman* Restaurant.
Map position 11.
(Photo by Author)



fig s29. *Andre's Kafee*.
Map position 12.
(Photo by Author)



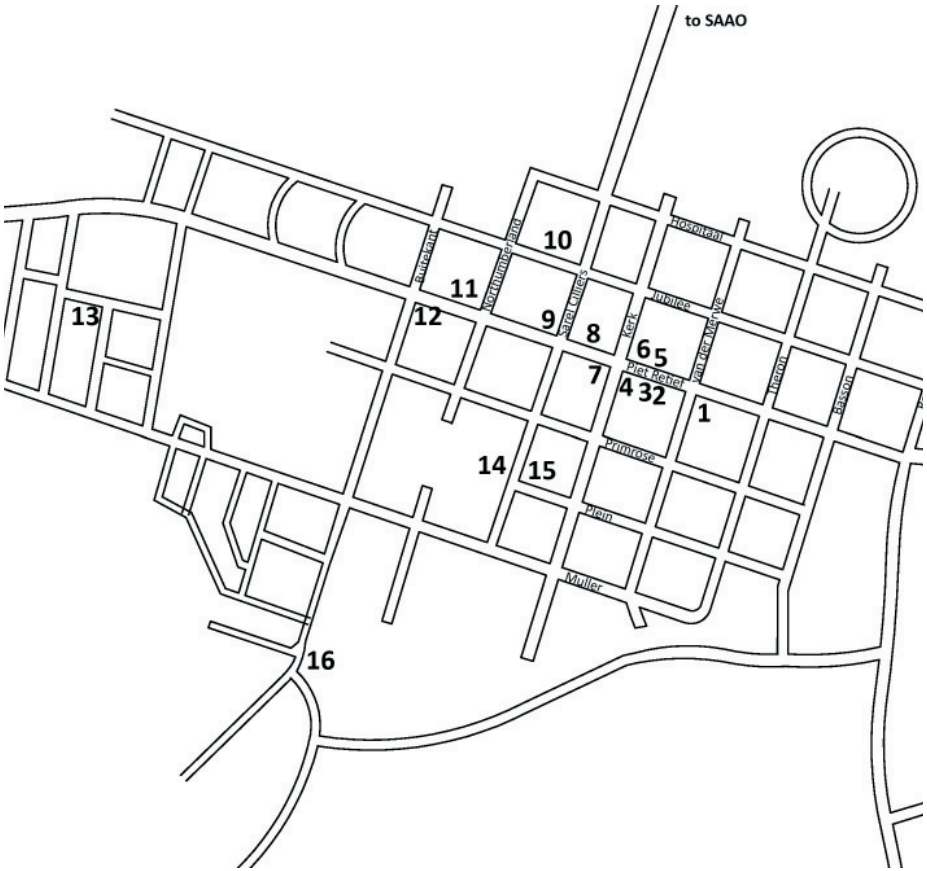
fig s30. Church.
Map position 13.
(Photo by Author)



fig s31. Library.
Map position 14.
(Photo by Author)



fig s32. Old People's Home.
Map position 15.
(Photo by Author)



Significant and Typical Sutherland Buildings.



fig s33. *De List*, School Hostel.
Map position 16.
(Photo by Author)



fig s34. Old Mill Building. .
Currently for Sale as a House.
(Photo by Author)



fig s35. Typical Sutherland Stone House.
Sometimes the Stone has been Painted.
(Photo by Author)

Choosing a programme

Before my first visit to Sutherland I had been toying with various ideas for a built project in the town. One I had not considered was any sort of Astronomical Observatory. I assumed that, with the SAAO already operating outside the town, there was no need for anything more along those lines.

However, as I met and discussed options with amateur astronomers in the town, I discovered there was something lacking. The SAAO is purely scientific in nature. Many of the telescopes are robotic and unmanned, the others are not available for use by the public. Most of the scientific data being recorded is about tracking and measuring whereas amateur astronomers are about looking and sometimes photographing. *(fig s36)*

A number of amateur astronomers tend to travel to Sutherland regularly, bringing their own equipment with them and setting it up in fields, on the roadside out of town, or on the properties of guest houses (one I spoke to drives from Stellenbosch every New Moon-ie. Monthly-for a few days). There would seem to be a demand for facilities to set-up telescopes and equipment and to securely store it on site, possibly with basic accommodation alongside. These findings were further confirmed by an engineer at SALT, Ockert Strydom, who concurred that the Amateur Astronomy field was an untapped market. (Strydom, 2009)

An Observatory is an exciting and unusual building typology to work with, but I felt there needed to be another aspect to the programme. I didn't want a building that would only ever be viewed in the dark. A building with a day/night multi-use type of programme seemed to provide an interesting design challenge.

I was already aware that two artists, Marcus Neustetter and Bronwyn Lace, had been involved in some art-based community development programmes earlier in the year. *(fig s37)* I knew that an off-shoot of that was a possibility to bring artists and scientists (astronomers) together in some way, possibly in a studio format (a particular guest house had been suggested as a venue). Artist studios seemed to be a possibility to work alongside my observatory. Later this was confirmed as a useful and exciting possibility by Marcus Neustetter. (Neustetter, 2009a) He elaborated on his vision for having artists and scientists collaborate on ideas in workshop type settings. He stressed the importance of giving back to Sutherland itself, possibly displaying astronomy related works IN the town (as opposed to 18 kilometres away at the SAAO). He also mentioned that there are artist residences and communes all over the world, where artists stay for a few days and have the use of simple accommodation and a studio. (Neustetter, 2009a)

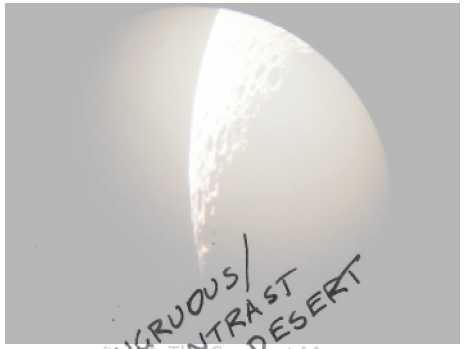


fig s36. The Crescent Moon.
Photographed through a telescope.
(Photo by Author)

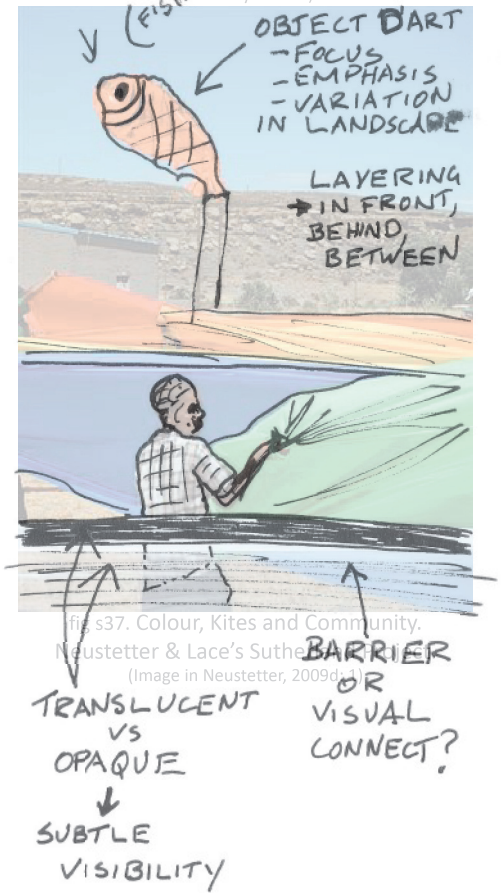


fig s37. Colour, Kites and Community.
Neustetter & Lace's Sutherland Project.
(Image in Neustetter, 2009d, p.1)

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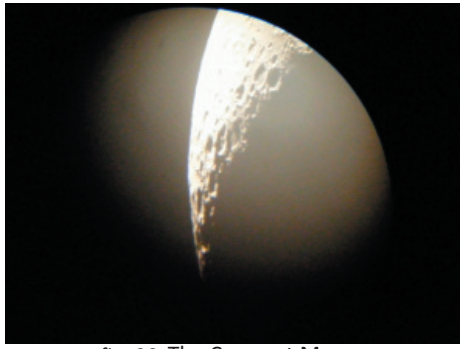


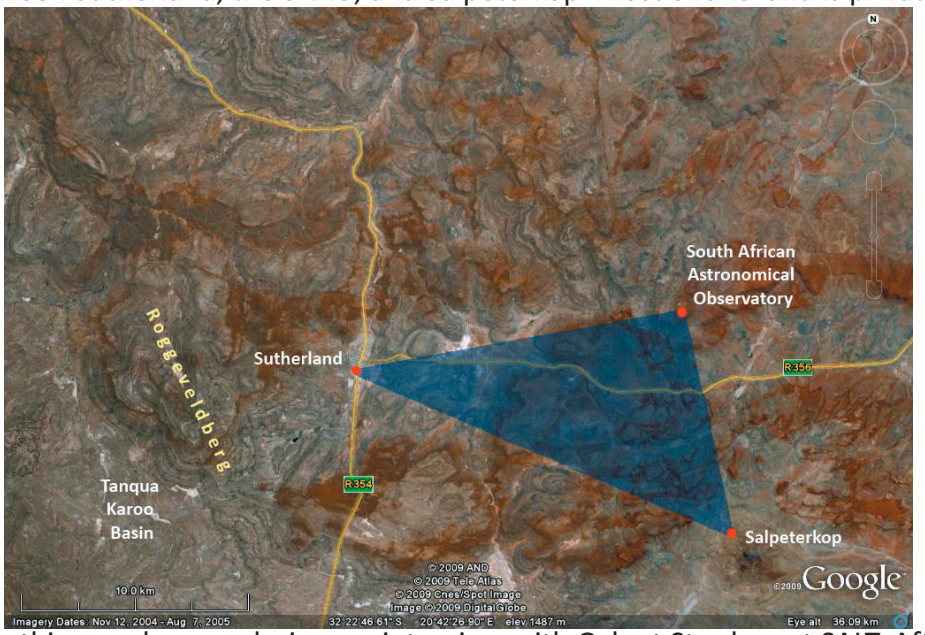
fig s36. The Crescent Moon.
Photographed through a telescope.
(Photo by Author)



fig s37. Colour, Kites and Community.
Neustetter & Lace's Sutherland Project.
(Image in Neustetter, 2009d: 1)

Selecting a site

Initially I had in mind to find a suitable site between Sutherland and the entrance to the SAAO. The discovery of the volcano, Salpeterkop, seemed to provide another point of interest. So I started to narrow down my search to the triangle between Sutherland, the SAAO, and Salpeterkop. Most of this land is privately owned.



A significant turn in this search came during my interview with Ockert Strydom at SALT. After confirming the need for an Amateur Astronomers' Observatory, he took me outside SALT and pointed across a valley to a ridge to the North West. He said he thought that ridge may be a perfect spot as it was a similar height to the SAAO ridge and so would have similar air flow patterns, conducive to observations. The visual link between the two observatories would also be poetic. (Strydom, 2009)

Back inside SALT, we consulted a map and discovered that the ridge was called Skurweklipkop *(fig s38 & s39)* and that it was on a farm called Ezelfontein. (Strydom, 2009) On my way home I eventually managed to locate Ezelfontein, and met the farm's caretakers (the owners of a neighbouring farm oversee Ezelfontein for the owners who currently reside in Cape Town). Hester and Willem Obermayer confirmed that the hill was on the property and Willem, drove me up to look at the hill. It seemed I'd found my site. It falls North of the triangle *(fig s40)*, but the access road is off the main road between Sutherland and the SAAO.



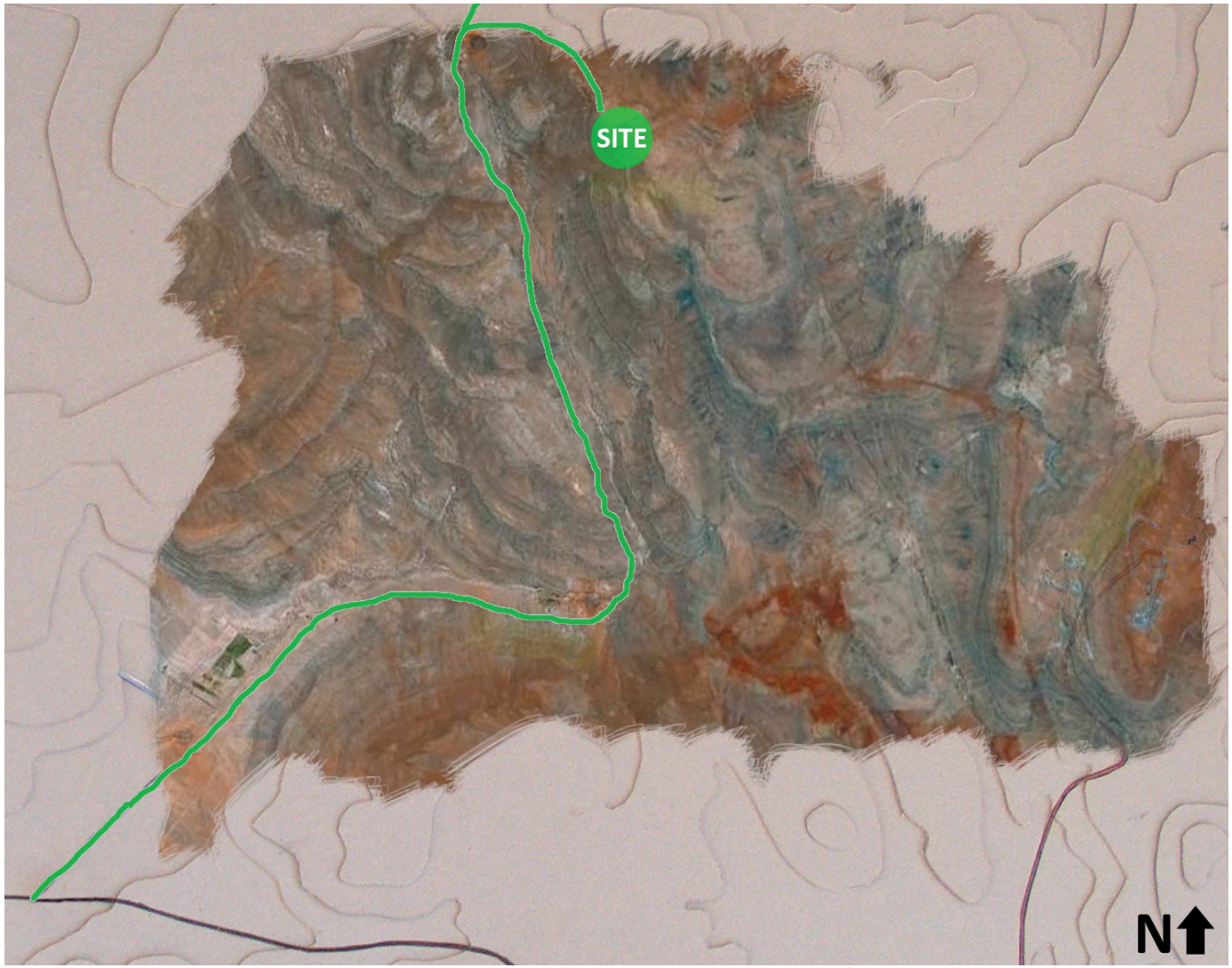
fig s38. Skurweklipkop.
As Viewed from outside SALT.
(Photo by Author)



fig s39. Skurweklipkop.
View to the Top from its Lower Reaches.
(Photo by Author)



fig s40. Skurweklipkop in Context.
The hill's Position in relation to 'The Triangle'.
(Image by Author; Photo from Google Earth)



Site Access:
Dirt track from the main road between
Sutherland & the SAAO



fig s41. Skurweklipkop.
Rocky Landscape.
(Photo by Author)



fig s42. Skurweklipkop.
Karoo Under Foot.
(Photo by Author)

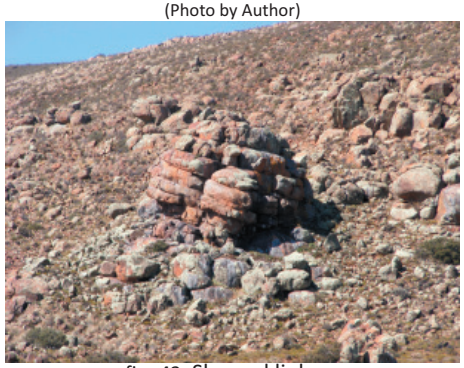
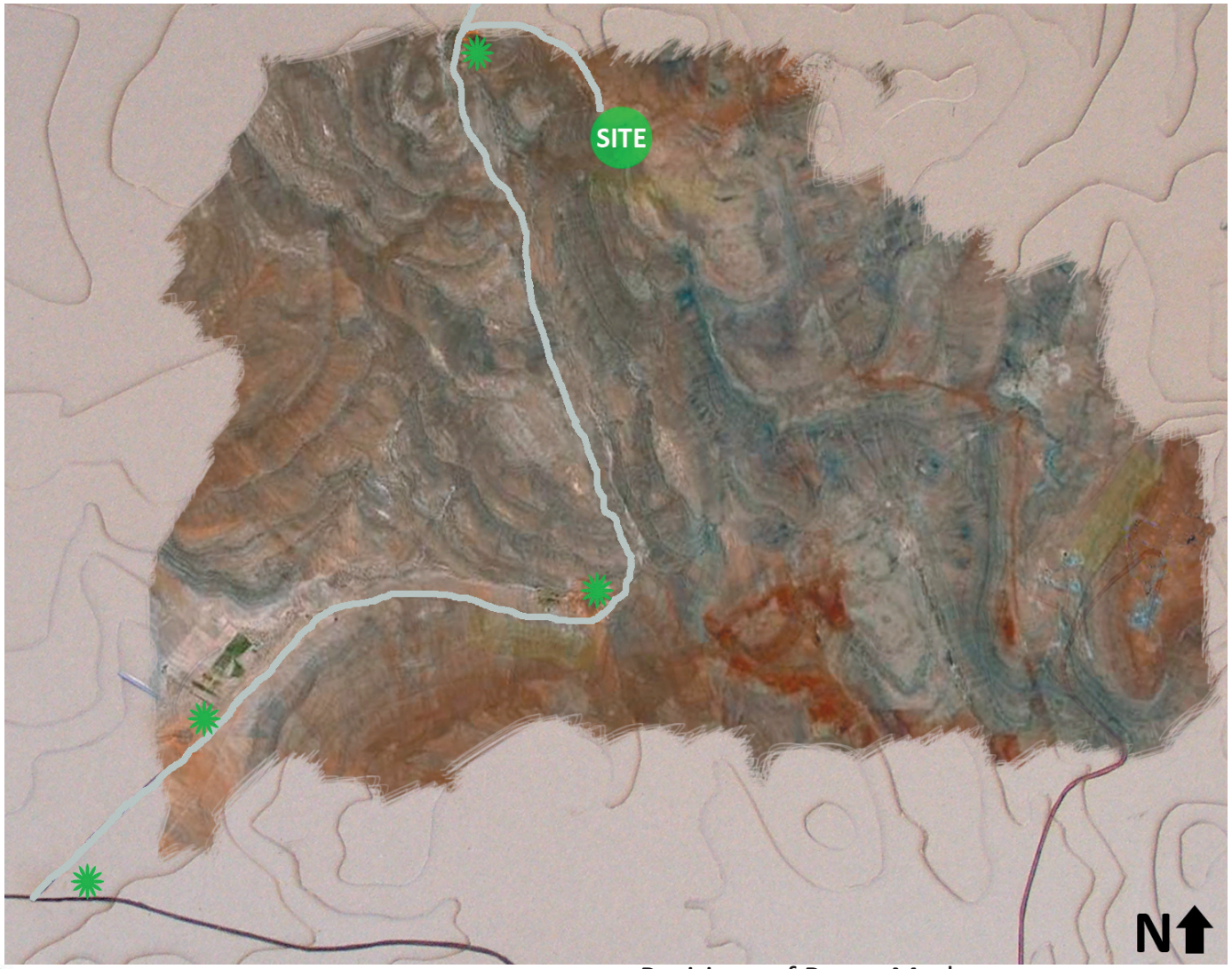


fig s43. Skurweklipkop.
Rocky Features Around the Hill.
(Photo by Author)



Positions of Route Markers:
Interventions at key route points or turnings.
Possibly in the form of land art or sculpture. *(fig s44, s45 & s46)*



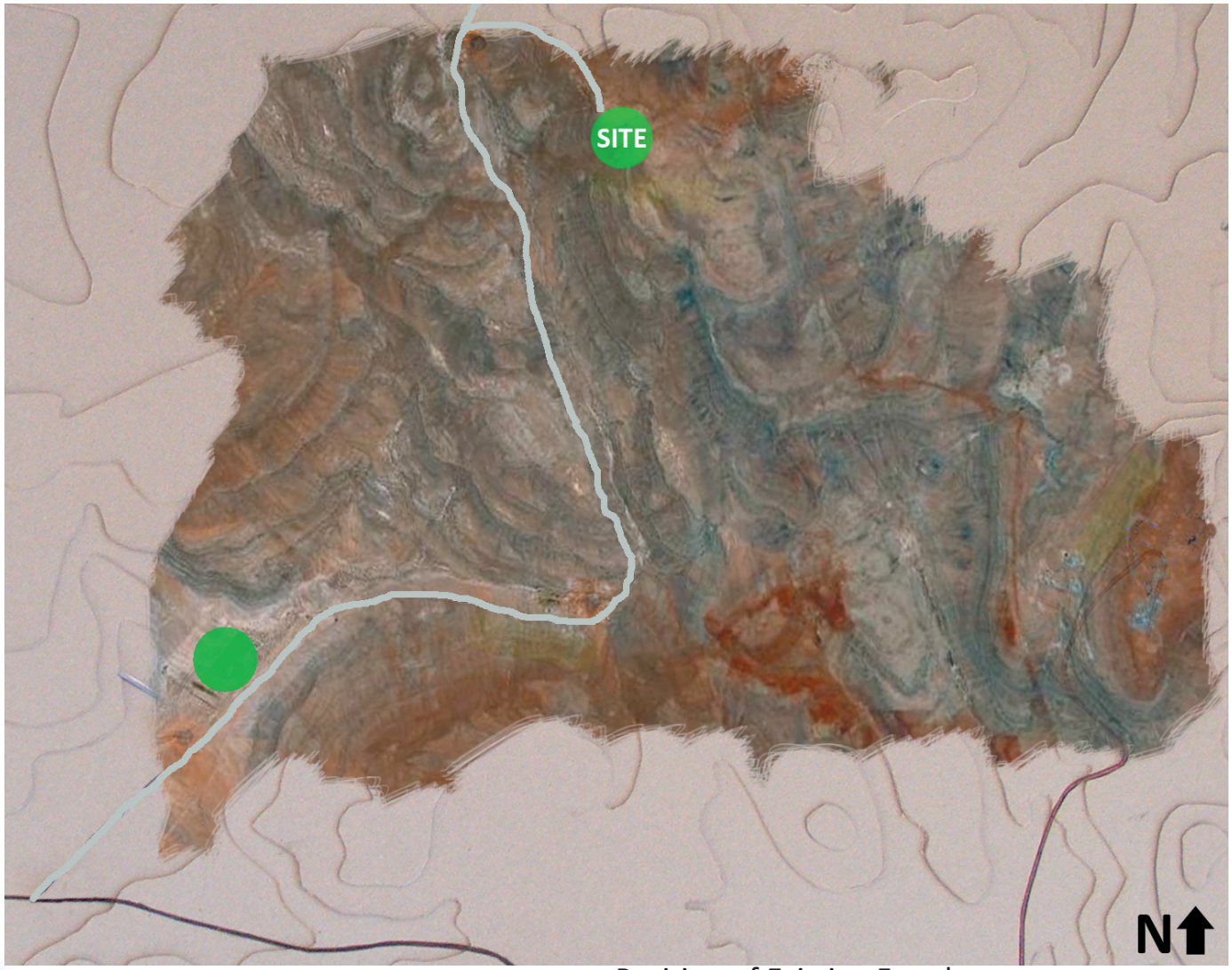
fig s44. Painted Monolith.
Land Art by Strijdom van Der Merwe.
(Image in van der Merwe, 2009)



fig s45. Stacked Stones.
Land Art by Strijdom van der Merwe.
(Image in van der Merwe, 2009)



fig s46. Painted Boulder.
Land Art by Strijdom van der Merwe.
(Image in van der Merwe, 2009)



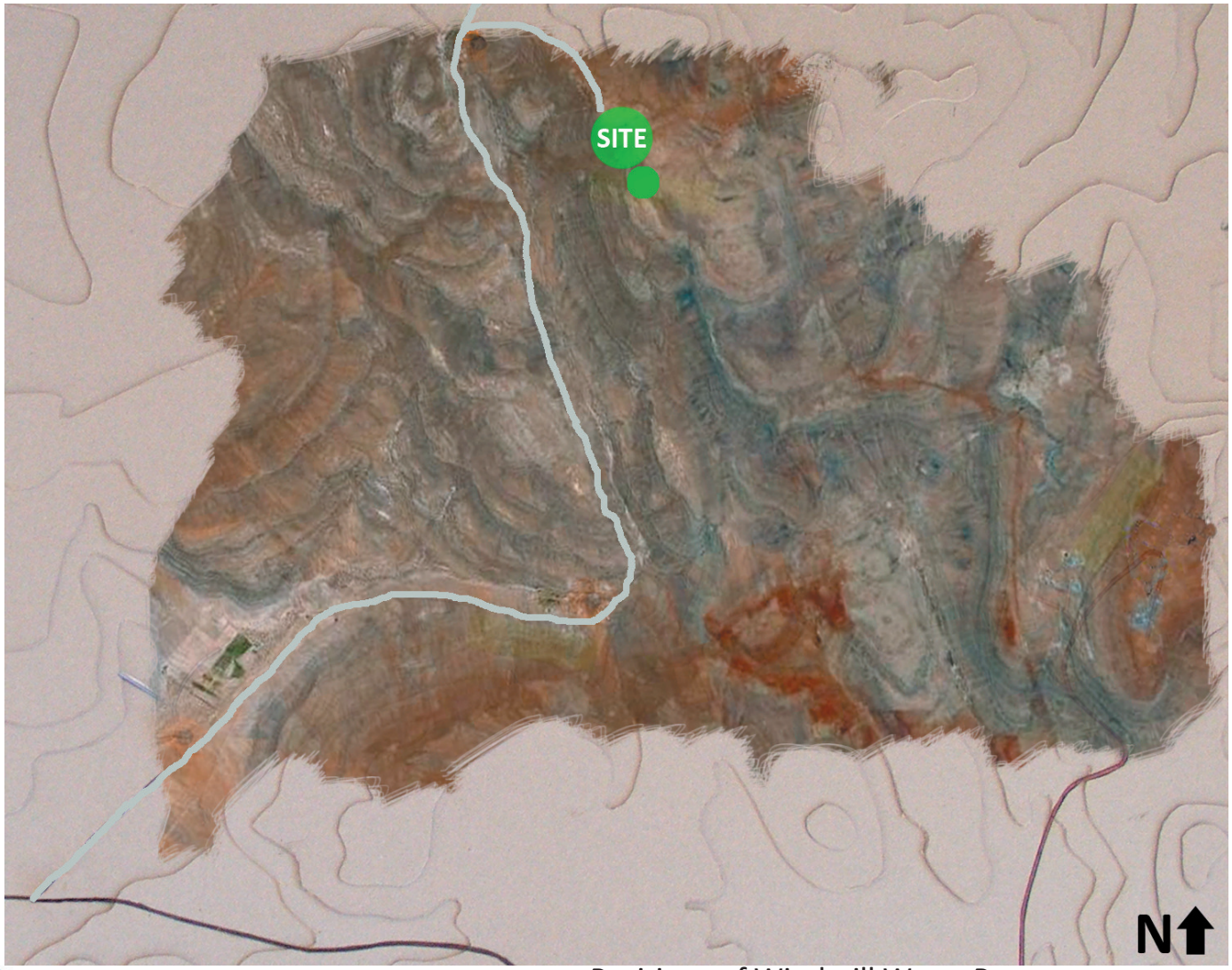
Position of Existing Farmhouse:
Main Llama and Alpaca herds (and shearing sheds)
will remain housed here. *(fig s47 & s48)*



fig s47. Alpacas.
Small Alpaca herd already at Ezelfontein.
(Photo by Author)



fig s48. An Alpaca.
South American native - at home in the Karoo.
(Photo by Author)



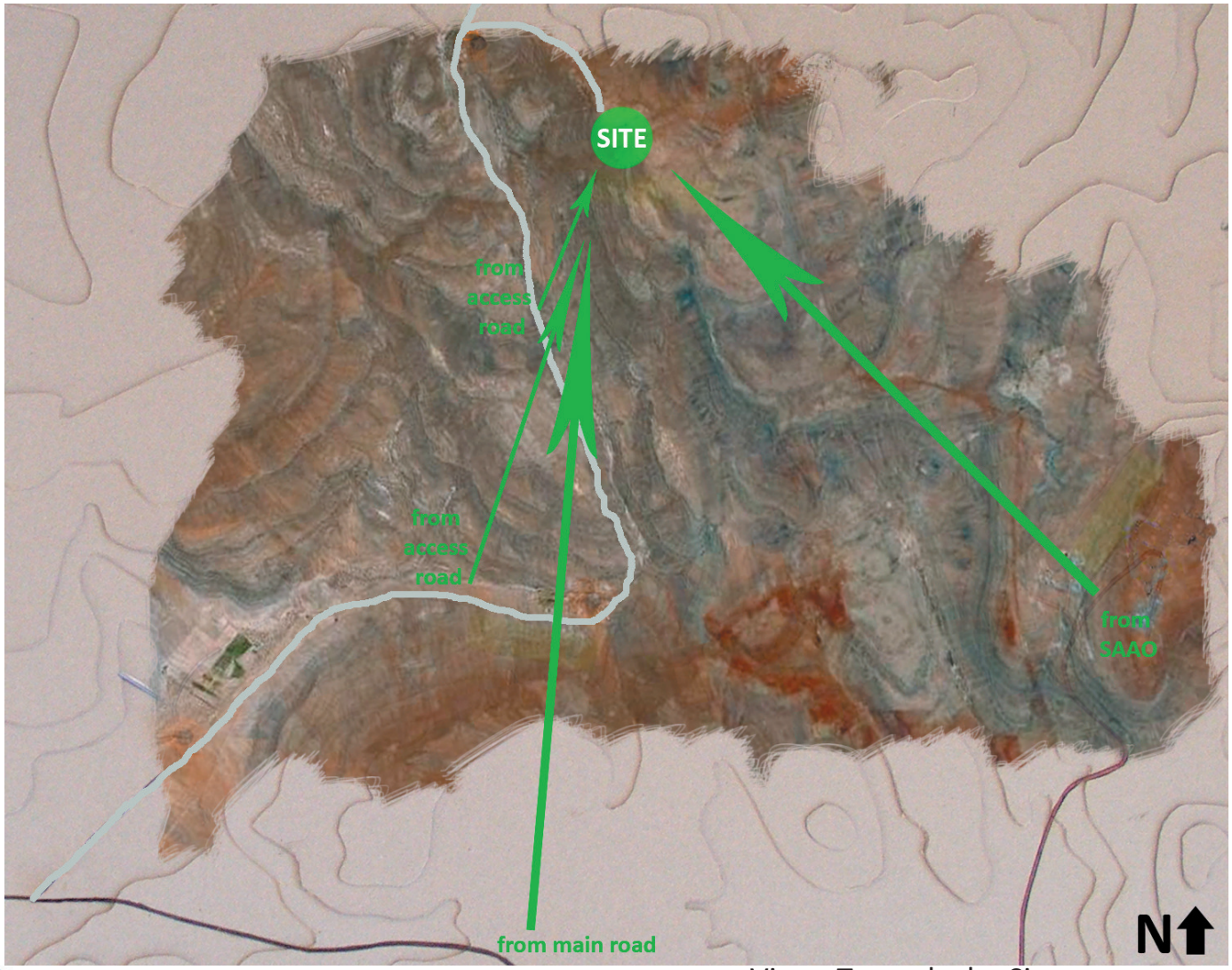
Positions of Windmill Water Pump:
Borehole water will supply the new buildings
(fig s49 & s50)



fig s49. Windmill on site.
One of the areas many windmills.
(Photo by Author)



fig s50. sutherland Windmill.
A common site about town.
(Sketch by Author)



Views Towards the Site:
Significant views TO the site, from the main road, the access road, and SAAO.



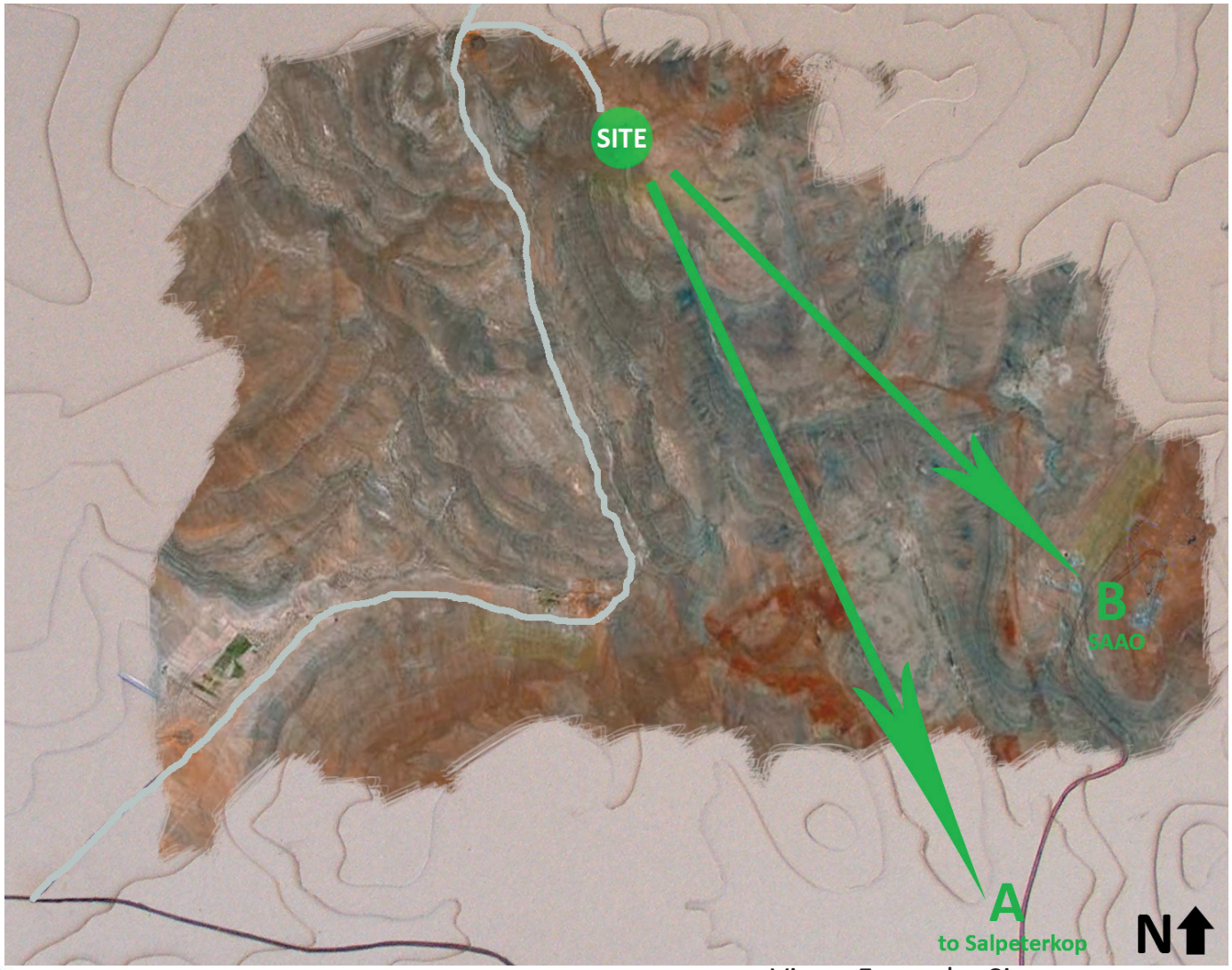
fig s51. Skurweklipkop.
Karoo Under Foot.
(Photo by Author)



fig s52. Skurweklipkop.
Rocky Ground.
(Photo by Author)



fig s53. Local Fauna.
Springbok Roam on Adjacent SAAO Property.
(Photo by Author)



Views From the Site:
Significant views FROM the site towards Salpeterkop Volcano and the SAAO.



fig s54. View A.
Skurweklipkop towards Salpeterkop Volcano.
(Photo by Author)



fig s55. View B.
Skurweklipkop towards the SAAO Ridge.
(Photo by Author)

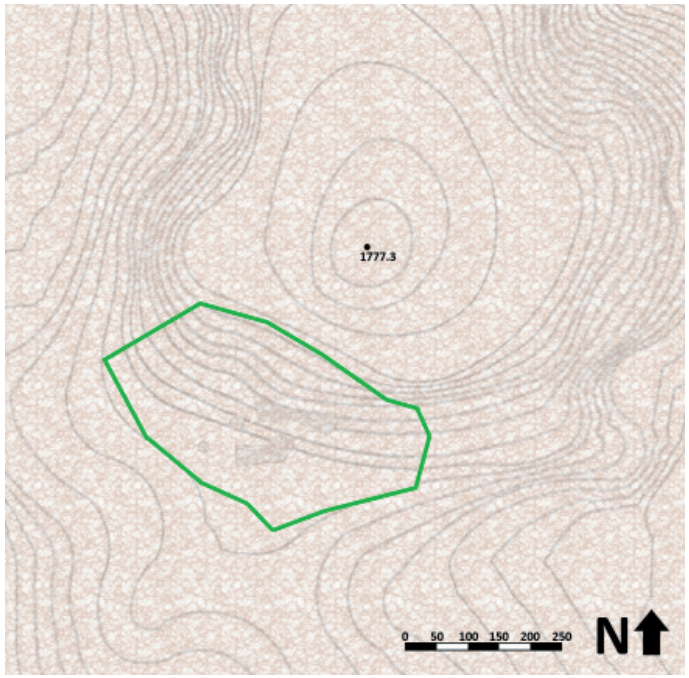


fig s56. View B (enlarged).
SAAO Ridge View Enlarged.
(Photo by Author)

Solar Studies

As the building will be situated on an undefined site on a large Karoo farm, the general region that has been selected is roughly shown here in green. Simple massed objects have been placed on the site to see the effects of shadows. These are varied in shape and size but are not intended to represent design intent for the project.

Sun movement and resultant shadows have been mapped for three days of the year and three times each day (8am, noon & 5pm). 21 December (summer solstice) will show the hottest time of year with the least shade and how this impacts the site. 21 June (winter solstice) will show the coldest time of the year, with the least hours of sunlight. 1 September, 'Spring Day' in South Africa, is also the day on which, in 2000, ground was broken for the building of SALT. In 2005, 1 September was the opening ceremony or 'First Light' of SALT. This day, while significant for these reasons, is also a day between solstice and equinox. This means the sun scenarios depicted on this day will occur more than just once (solstice) or twice (equinox) and will be a more useful indication of site conditions.



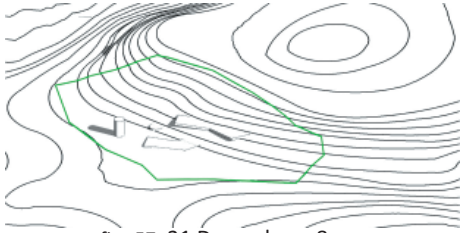


fig s57. 21 December - 8am.
Sun already fairly high, little shadow.
(Image by Author)

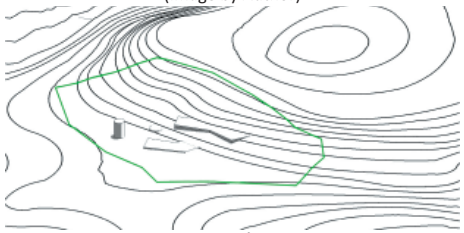


fig s58. 21 December - 12 noon.
Sun overhead, Almost no shadow.
(Image by Author)

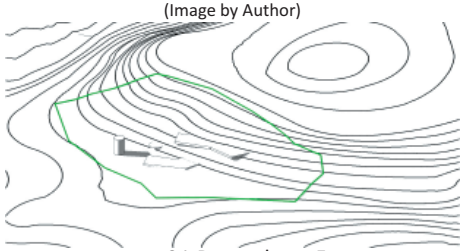
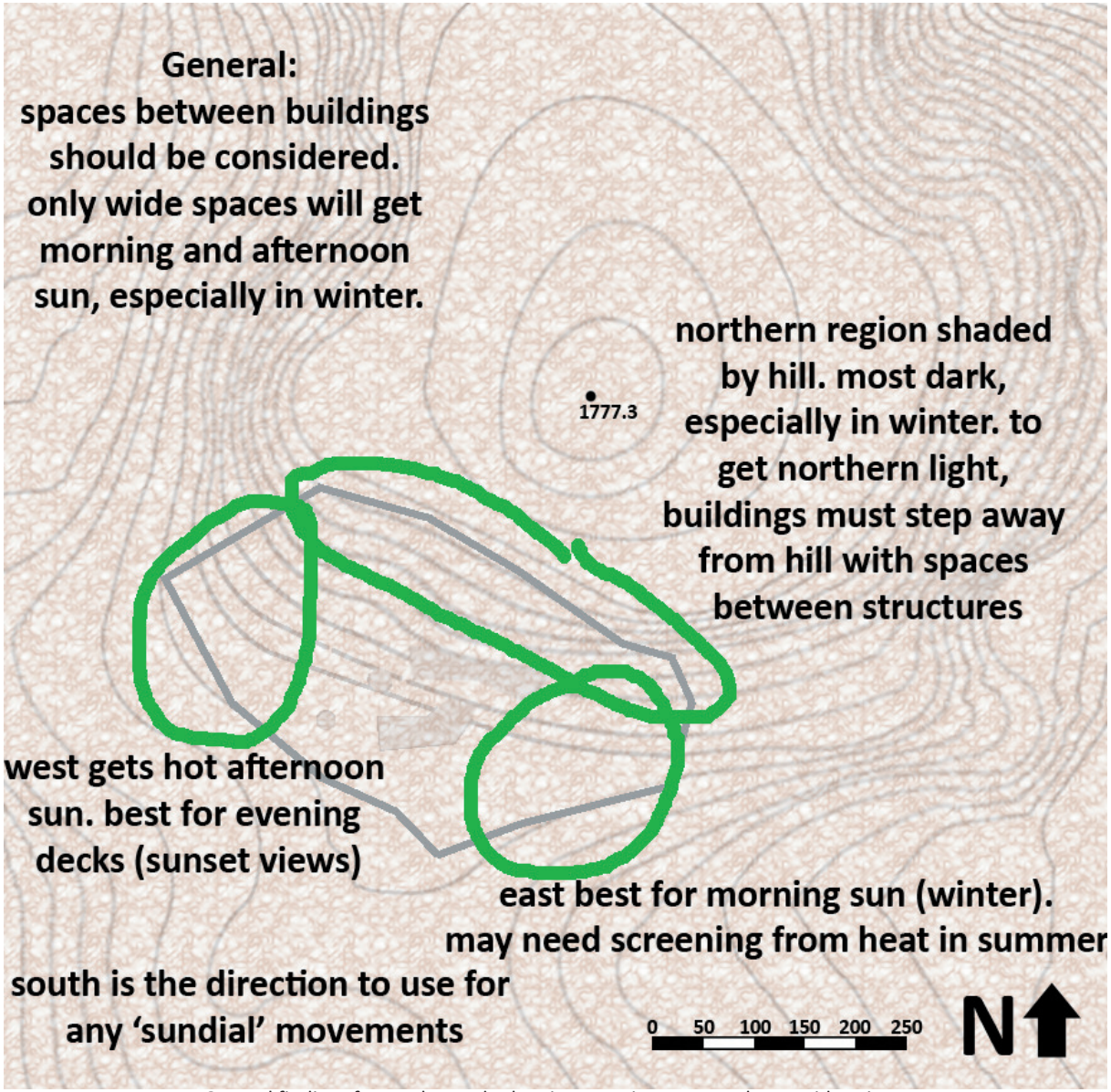


fig s59. 21 December - 5pm.
Sun still fairly high, little shadow.
(Image by Author)



General findings from solar study showing most important solar considerations.

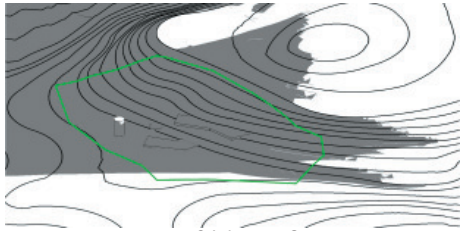


fig s60. 21 June - 8am.
Sun barely touching site, total shadow.
(Image by Author)

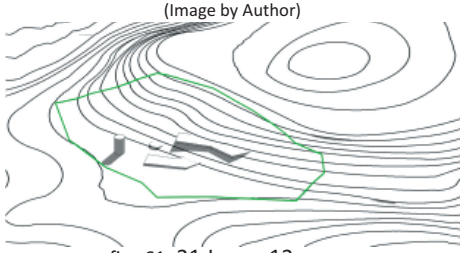


fig s61. 21 June - 12 noon.
Sun at highest, southern shadows cast.
(Image by Author)

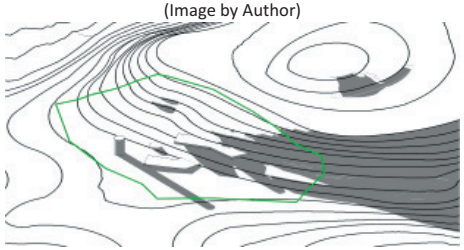
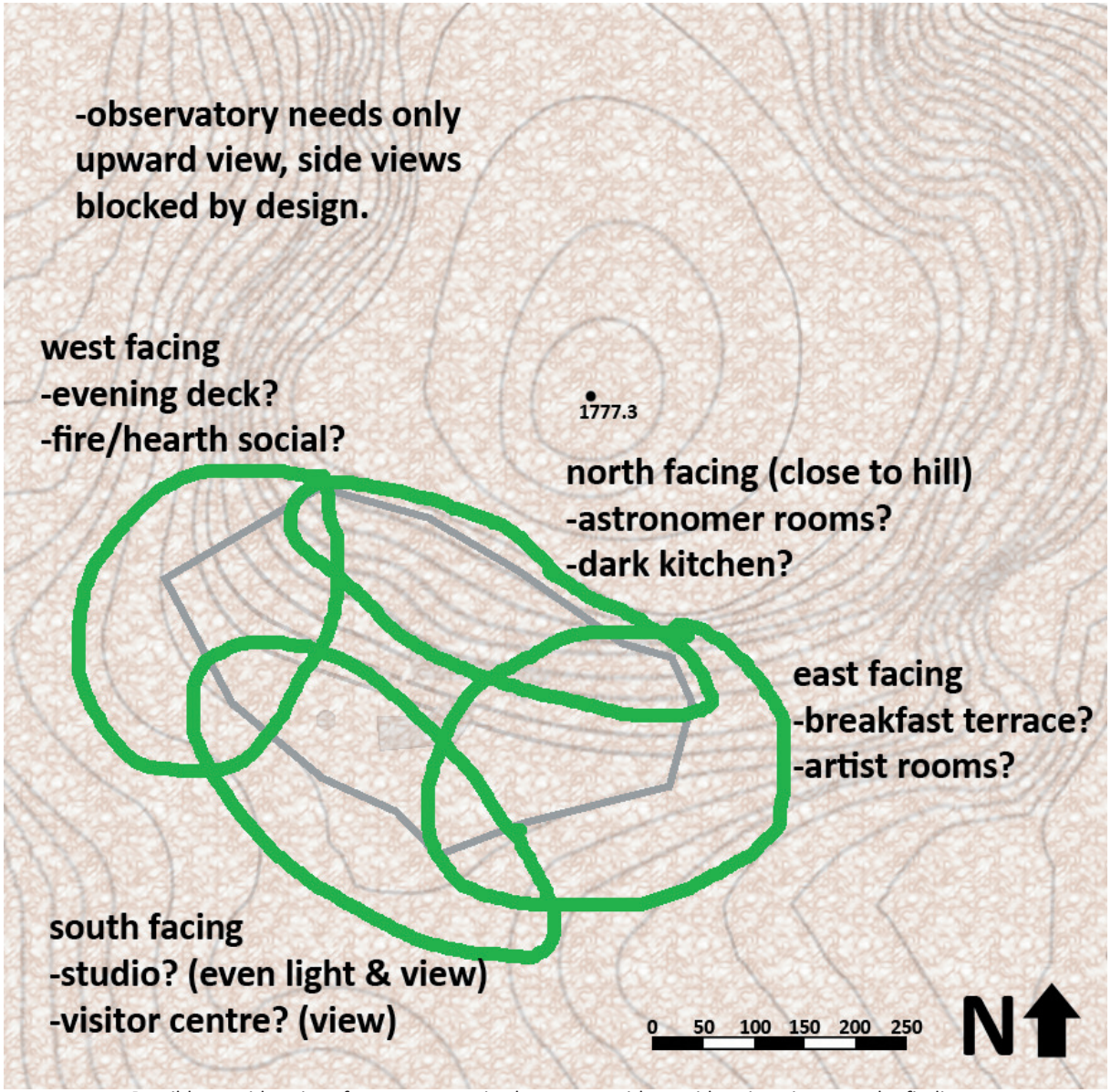


fig s62. 21 June - 5pm.
Long shadows, east of site in shade.
(Image by Author)



Possible considerations for programmatic placements with consideration given to solar findings.

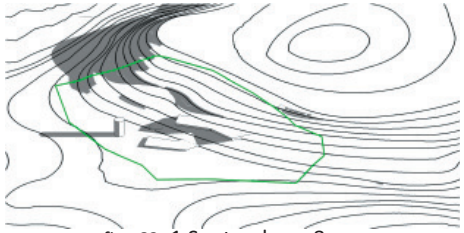


fig s63. 1 September - 8am.
Low sun, long south western shadows.
(Image by Author)

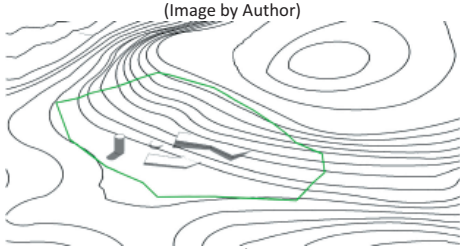


fig s64. 1 September - 12 noon.
Sun at highest, short southern shadows.
(Image by Author)

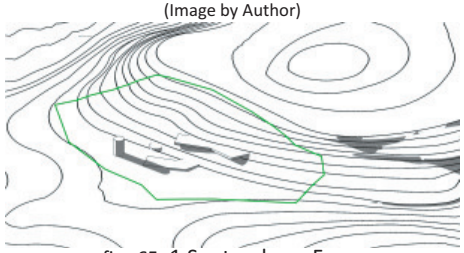


fig s65. 1 September - 5pm.
Low sun, long eastern shadows.
(Image by Author)

Adding to the programme

Finding a site added new possibilities to the programme. Lynne Emery, the owner of Ezelfontein, has a few of her own ideas of what to do with her farm. Though they are long-term plans, she has already started in one way. She has imported a small herd of Alpacas and a pair of Llamas from South America. Her intention is to breed them and develop the herds. The Llamas can be used as pack animals for walking trails in the area while the Alpacas are bred for their wool.

Lynne would like to start a small weavery on the farm. A place where a few of the local people (from the township area) could be trained in the art of weaving and where products like rugs and textiles could be made and sold. The wool would be from the sheep and Alpacas already on the farm.

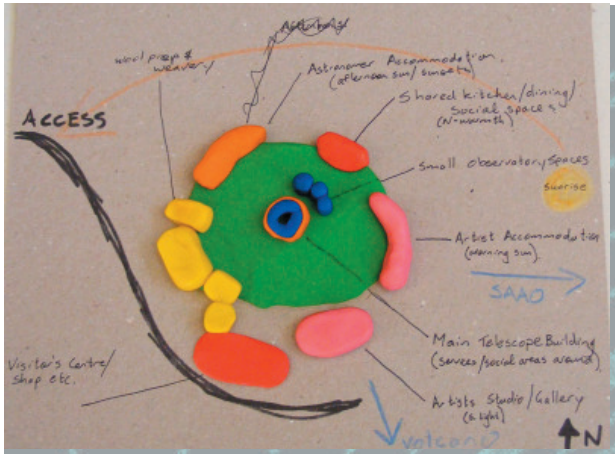
The weavery aspect seemed to tie in quite well with my existing programme. Weaving is not far removed from the art component. The idea of the colouring and weaving of the wool ties nicely into my subjects of colour and light. It will also provide some more training and employment for the community, as well as a permanent activity in the complex (as opposed to artists who may come and go). It also has the potential to bring in an income, both by attracting interested visitors, and from the sale of woven goods. Already having Alpacas on the farm provides a unique point of interest that can be utilised.



fig s66. Weaving Loom.
Fez Medina, Morocco.
(Photo by Author)



fig s67. Unique Woven Rug.
made at *Weavers Nest*, Namibia.
(Berner, 2007: 1))

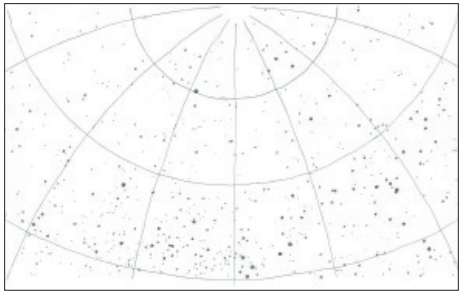


Concepts & Design Development

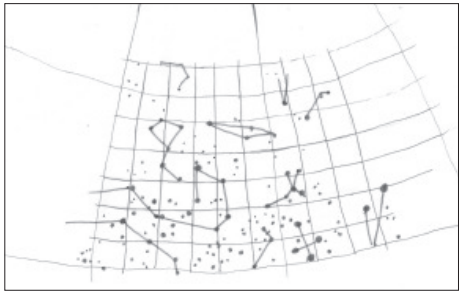
Early concept explorations included dabbling with the idea of orbits, the centrality of one object, space, or building with others arranged around it.

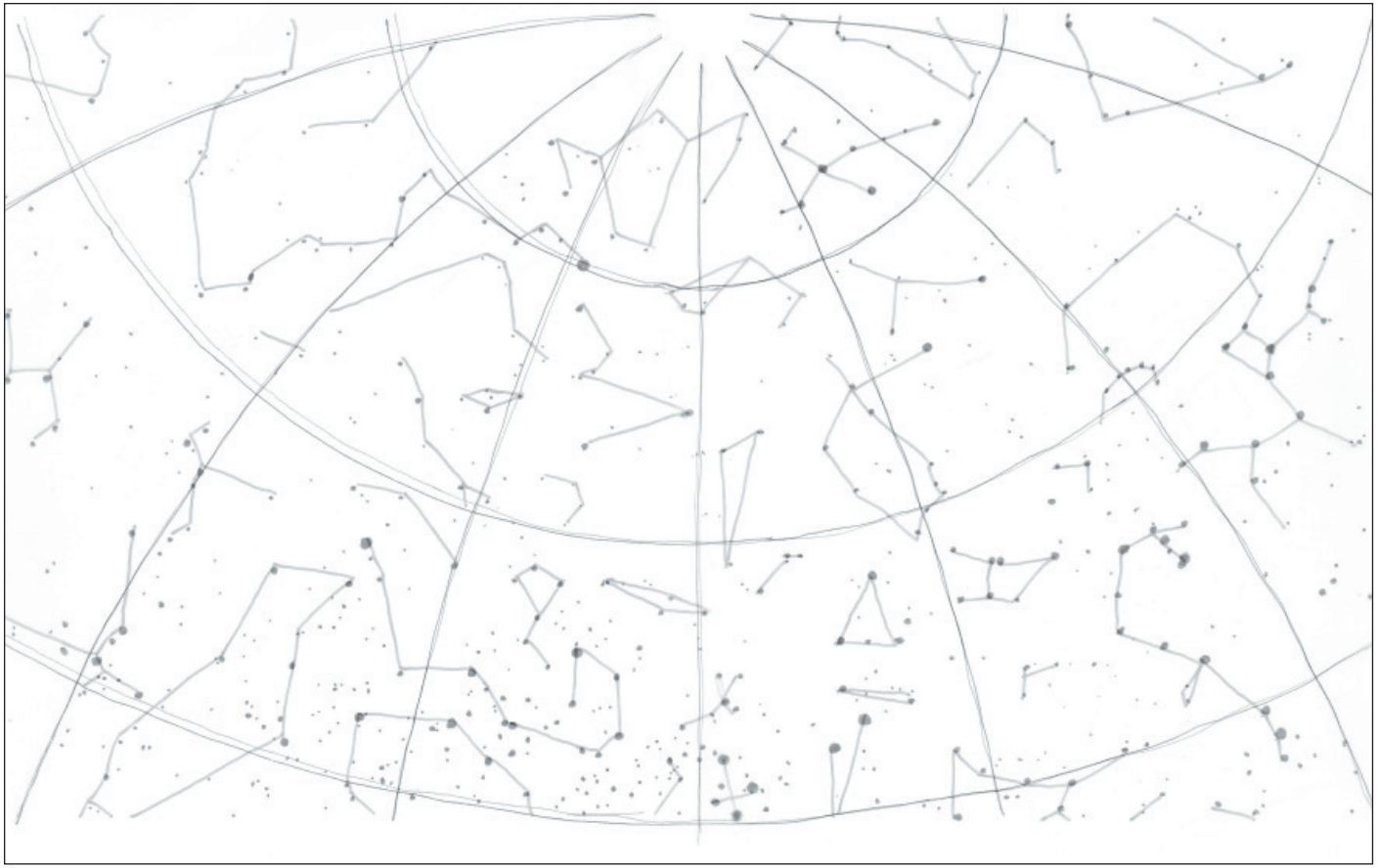
This phase was short lived. At this point, my research took me to the more modern understanding of the Universe, post Copernicus.

Modern scientific discoveries show us that, while our own solar system may be heliocentric, the Universe at large is a lot more random.







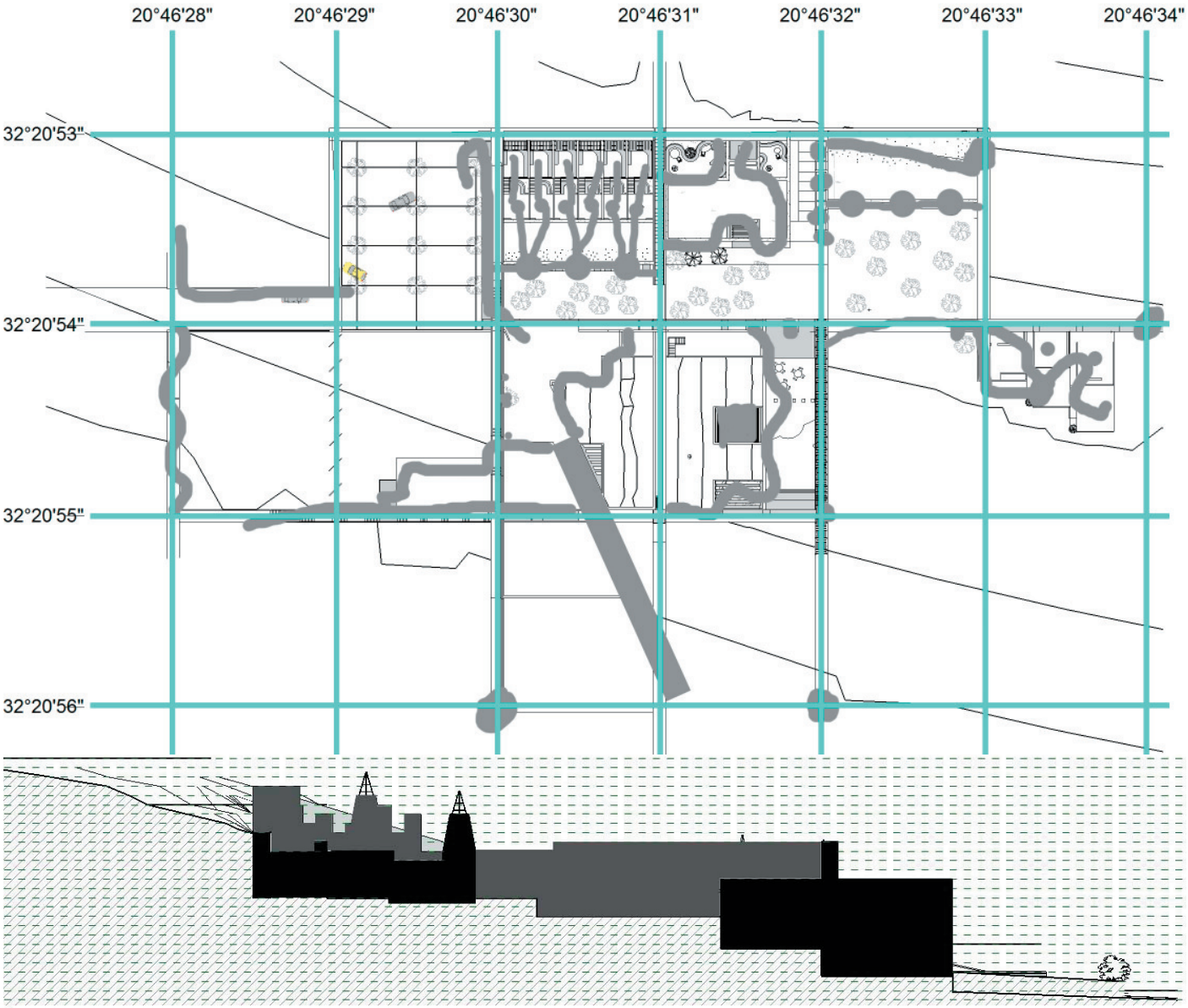


The images alongside show a trace of a ‘star map’. A grid, devised by astronomers to enable the mapping and logging of stars, appears as a rigid structure with stars randomly scattered around it.

Lines can be overlaid to represent established constellations, a kind of cosmic dot-to-dot.

The main image shows these drawings superimposed, resulting in a regular grid with dots and shapes scattered around it. (The image on the top right shows a portion of this grid enlarged with sub-grids added).

What would this arrangement look like if it were brought down to earth?



On the ground, the grid and objects concept translates into a grid derived from the seconds of latitude and longitude.

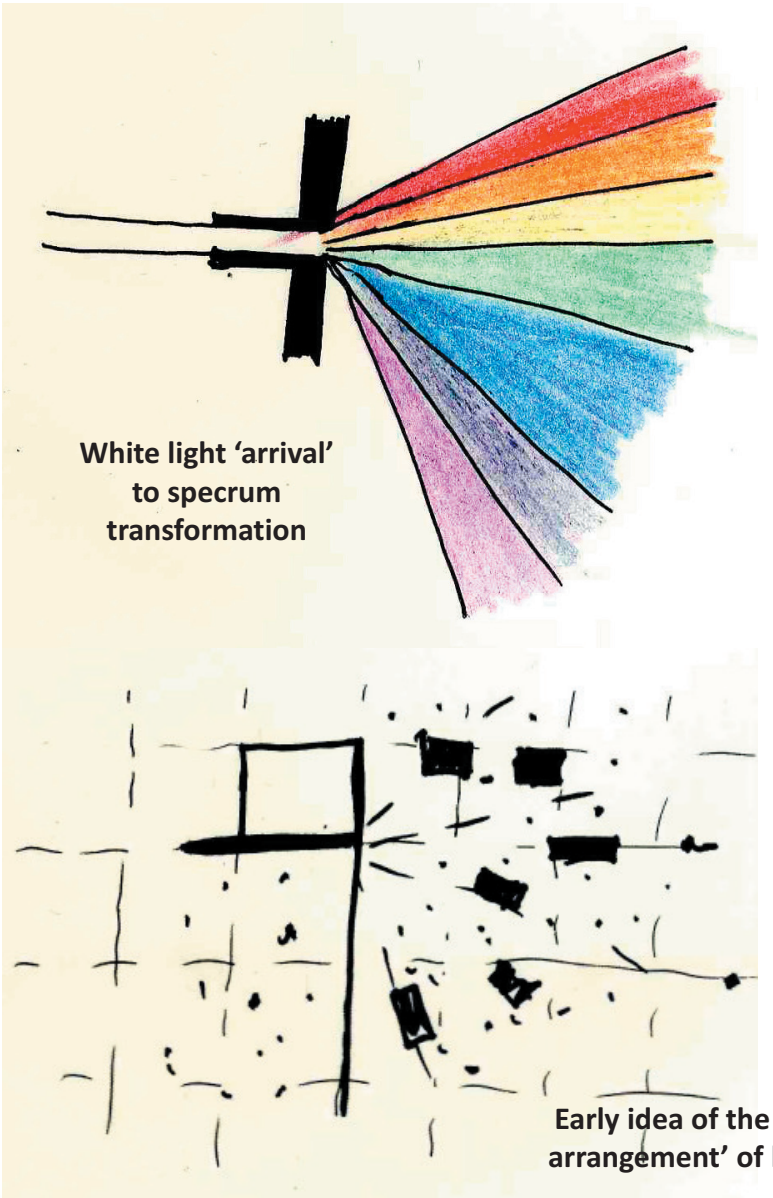
Built form surrounds the grid, sometimes clinging to it or feeding off it, sometimes leaving it.

The grid will be readable, often as a two metre wide line acting as a pathway, watercourse or wall. They will read strongly in some places and fade into the landscape in others.

From the air, the cutting , scraping or building in the landscape will be evident as grid, similar to large scale land art, photographed from above.

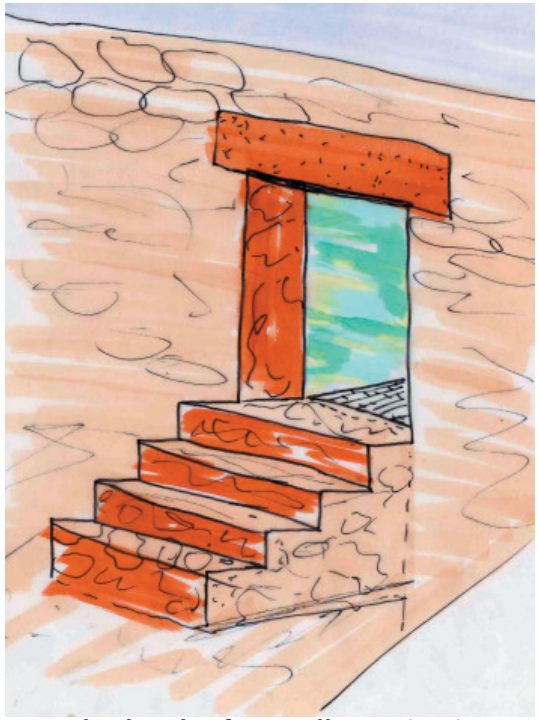
From the ground, spaces will not be grid related boxes. The grid will only read in parts in terms of alignments or vistas.

In section, a similar grid can be created by extending the contour lines into horizontal guides. These lines define levels and heights.



White light ‘arrival’ to specrum transformation

Early idea of the ‘spectrum arrangement’ of built forms

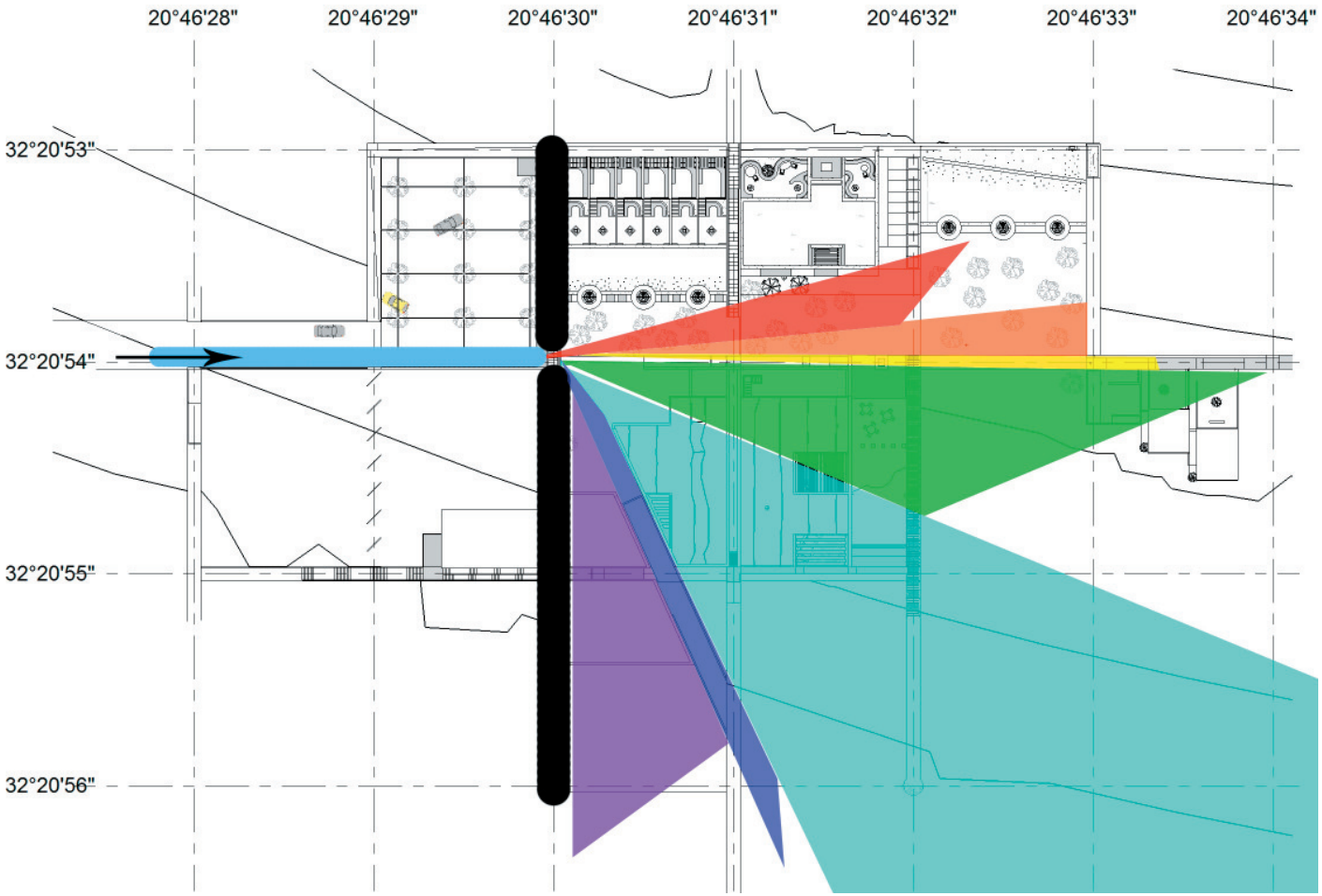


Early sketch of a small opening in a thick, stone wall with colours just visible beyond

A second conceptual element is the idea of the spectroscope, or prism. White light, passing through a small aperture (and prism) is split into the spectrum.

Translated into built form, a visitor, unaffected and unaware of what to expect from a building is led through a small aperture in a blank or nondescript wall.

Once across that threshold, the world trasforms into a spectrum of colour. This ‘colour’ is both literal colour and metaphorical in the form of views, space and variety.

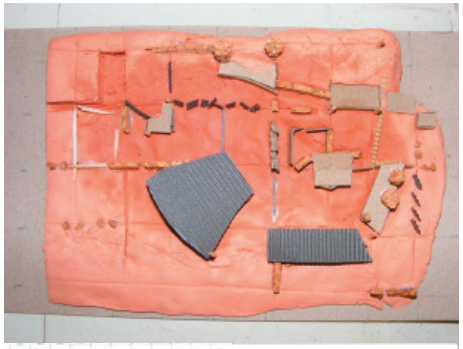


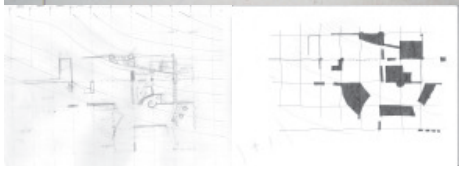
Apart from some stone walls and fences, the complex is largely hidden from view on the approach along the winding farm track.

After parking in a sunken parking areas, visitors will walk up a long ramp to a small opening in the monolithic stone wall that cuts through the complex.

Up to this point the visitor is unaware and unaffected by the realm beyond the wall, the metaphorical *white light*.

On crossing this threshold, the visitor emerges into another world. The spectrum, represented by planting, views, space and colours, is suddenly evident and transforms the visitor's experience.





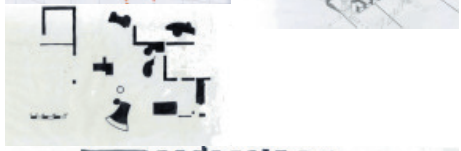
Early explorations of the star grid concept resulted in a very spread out plan with pavilion-type buildings connected by rigid walkways along the grid-lines.

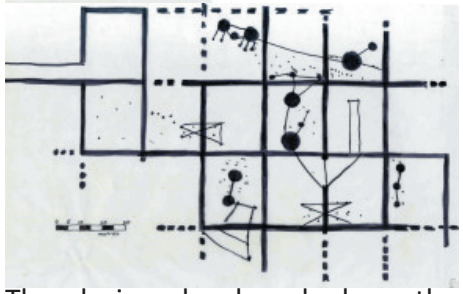
The Visitors' Centre (the largest roof on the model) was intended to be a beacon or marker, visible from the approach route.

Parking had already been sunken (hiding the cars in the landscape) and the astronomers' accommodation was buried in the hill. Small spaces (bathrooms) were pulled up to become tall spaces.



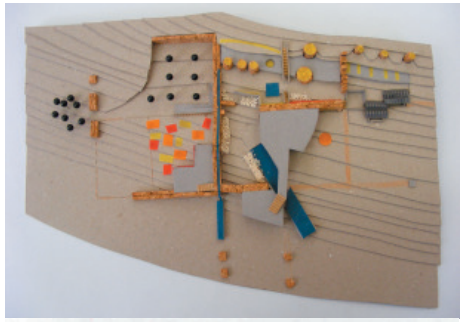


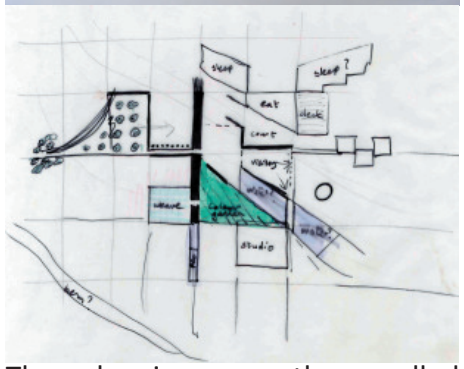




The design developed along the same lines as the previous one. It soon became evident that the distances were just too vast and the separated buildings didn't work.

The restrictive walkways and confusing planning also didn't help with way-finding or enjoyment.





The planning was then pulled together in a more cohesive arrangement and the Visitors' Centre was made more central and the first stop on arrival.

This is the point at which the *spectrum concept* was incorporated, resulting in the thick wall, hidden buildings and then the opening out towards the main views.

The grid became less rigid.

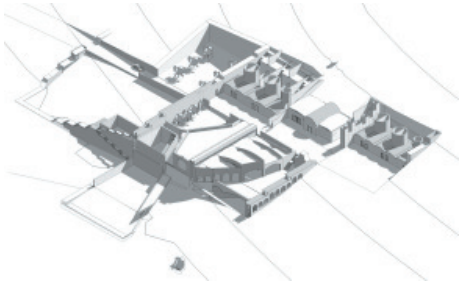




By this point, a structural system had started to develop (earth brick vaults). The Visitors' Centre was still undecided, but the vaults suited the bedrooms. Spans, heights and vault types were many and varied.

Indigenous Karoo trees and bushes were to be planted throughout, densifying the existing flora. Most of the roofs are planted and accessible, blending in with landscape.

The Weavery, originally on the west side of the big wall, was pulled in to interact with the Visitors' Centre (only the wash/dye shed remained behind). The big wall became a walkway (inside & on top).

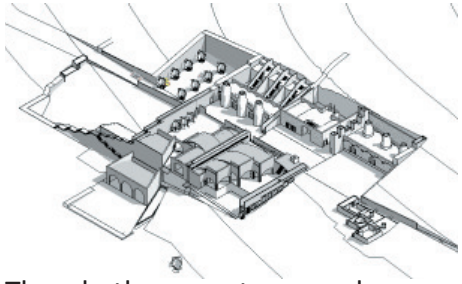


Structural explorations dominated the next stage of development. Keeping brick vaults throughout seemed logical. Combinations of brick and beams (to keep the large span roofs fairly flat) failed for various reasons.

At this point, varied height and curvatures were used for variety and clerestory windows. The eastern walkway became a heavier element to 'hold' the courtyard.

The rooms were straightened up and rear courtyards added.

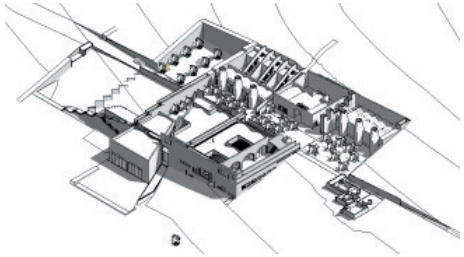
Arches span the large openings (by default of structure). There is a struggle to keep the openness in the Visitors' Centre space as the structure gets heavier.
(image above is missing the observatory and studio elements)

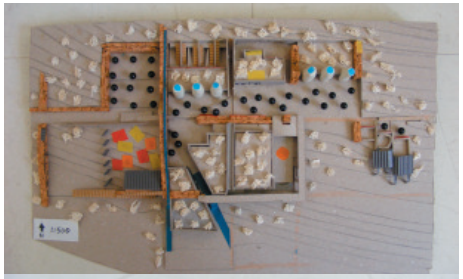


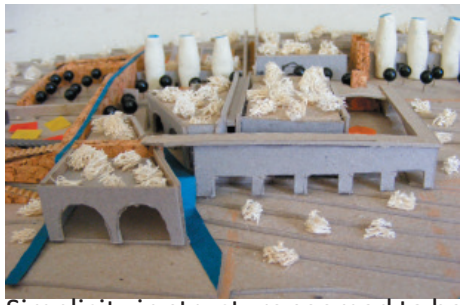
The bathroom towers became more slender (a shared layout inside allowed this).

The Visitors' Centre roof changed slightly, becoming mirrored. The walls on the eastern courtyard side were squared off. This allowed for interesting variation within where the glass weather-line could curve within a square structure. Outside, covered spaces could be developed.

The Observatory section was moved away from the building slightly (to achieve better sight lines). The layout was changed to allow for interesting connections between the spaces as well as related courtyard spaces.







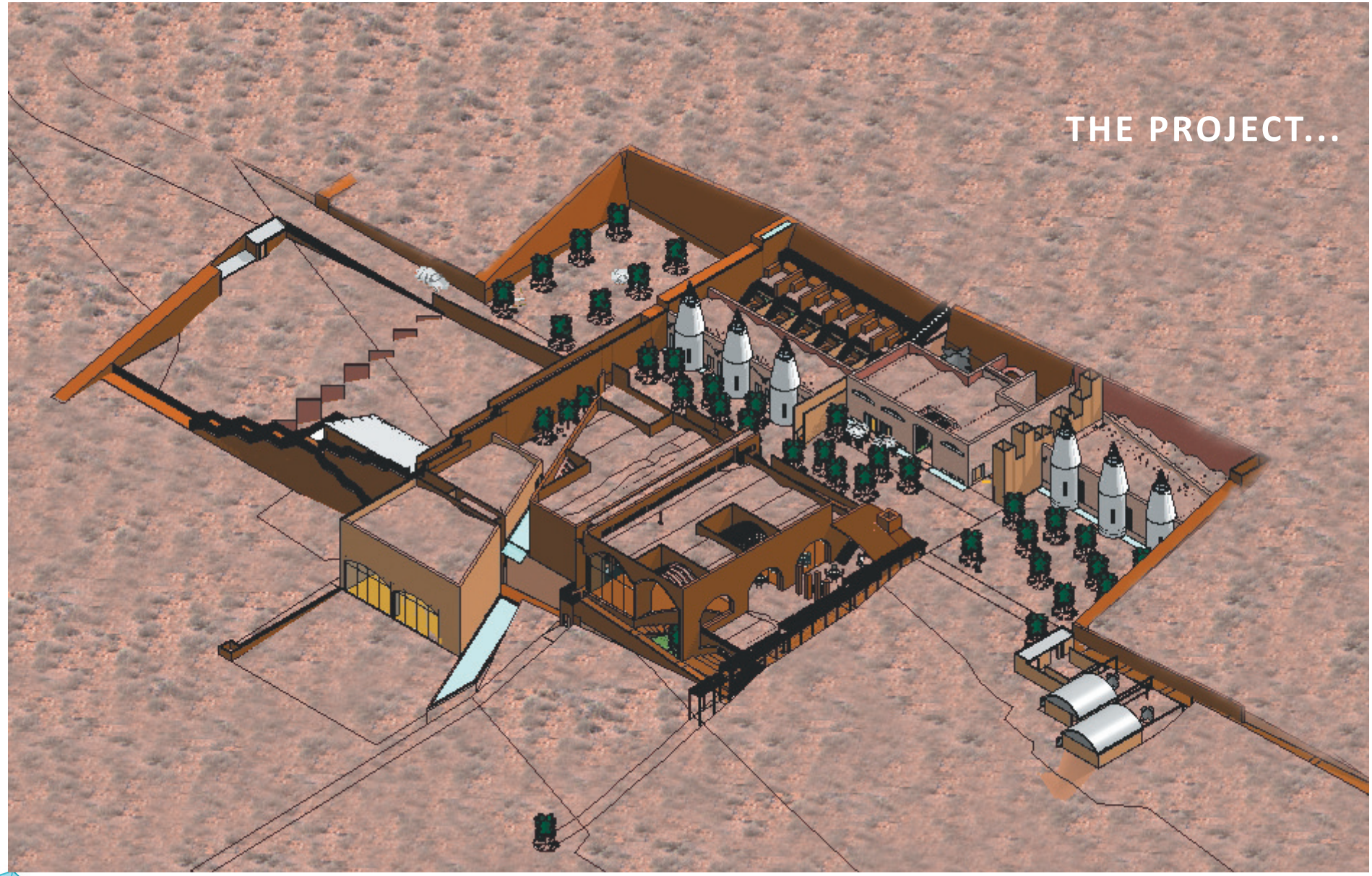


Simplicity in structure seemed to be the answer to some of the problems of disjuncture. ALL the roofs were made into barrel vaults orientated North-South. The Bathroom light towers were moved to the front facades, providing variation and, with the rear courtyard additions, allowing more North light into the artists' rooms.

The spaces in front of the accommodation buildings became gardens (dense Karoo trees), differentiated from the courtyards at the rear.

The East and South walkways around the Visitors' Centre are very solid. These were later removed. A simple walkway with a lightweight pergola is sufficient to mark the line, without becoming monolithic and dark.

Sleeping decks behind the artists' rooms were, at this point, raised by over 5 metres from the courtyard below. While this provided great views, they weren't easy enough to get to. These were later dropped and made into slightly raised sleeping decks or day beds.


THE PROJECT...



Artists' Accommodation:
Simple, self-catering rooms for individuals.



Astronomers' Accommodation:
Simple, self-catering rooms for individuals.

Cooking & Eating:
Kitchen & dining facilities to be shared by artists and astronomers.





Visitors' Centre:
Central information and social hub, ties all other functions together.



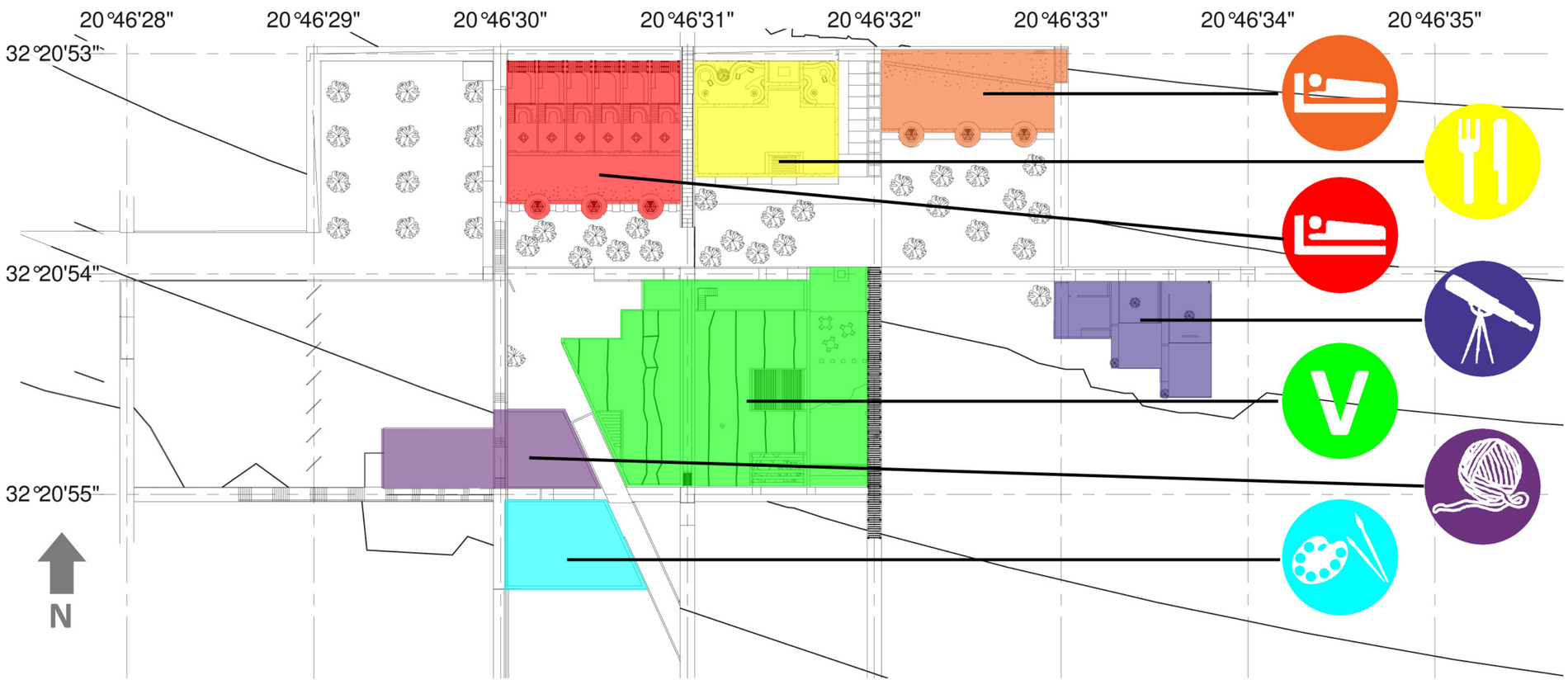
Artists' Studio:
Adaptable or divisible space for the use of artists.

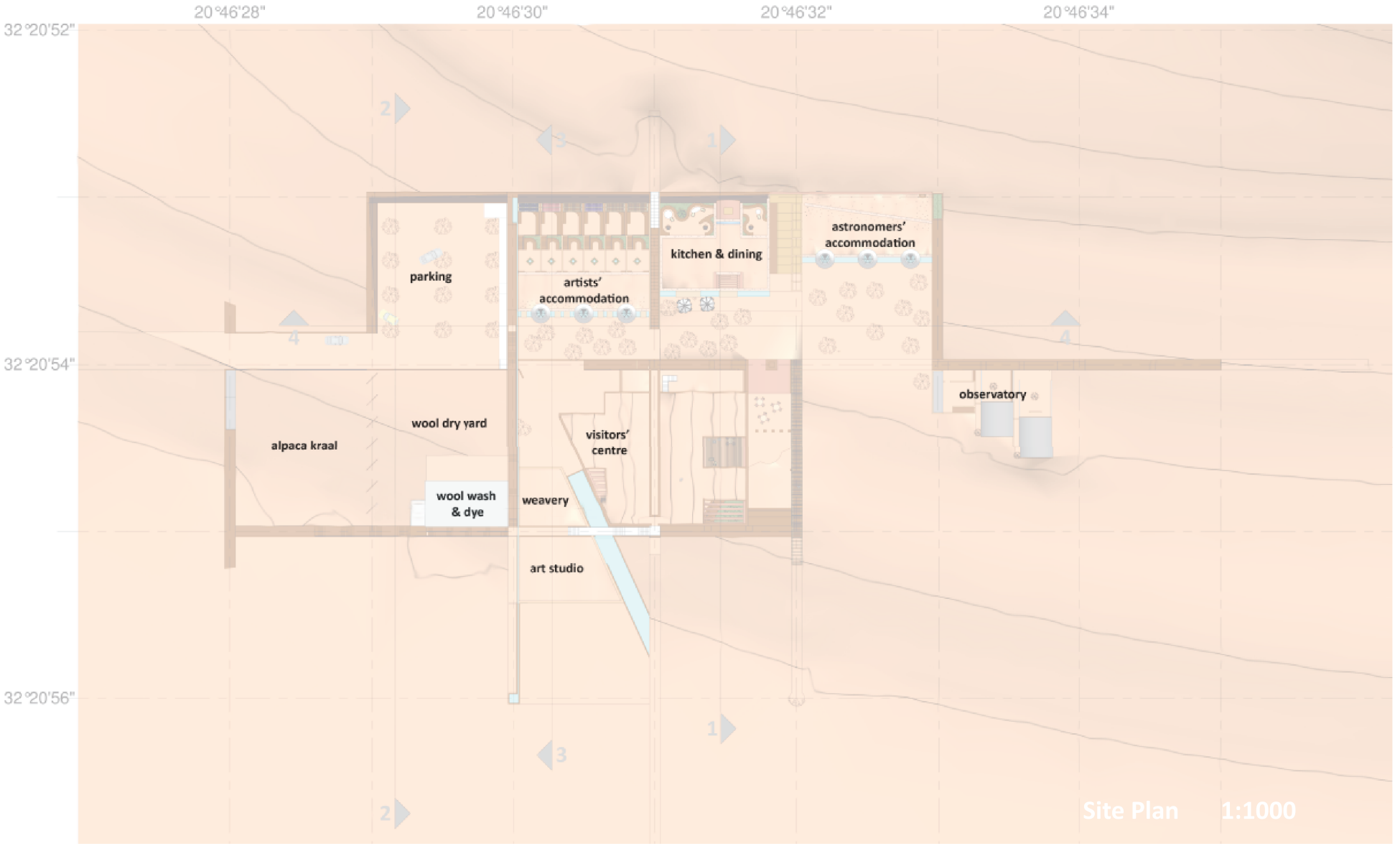


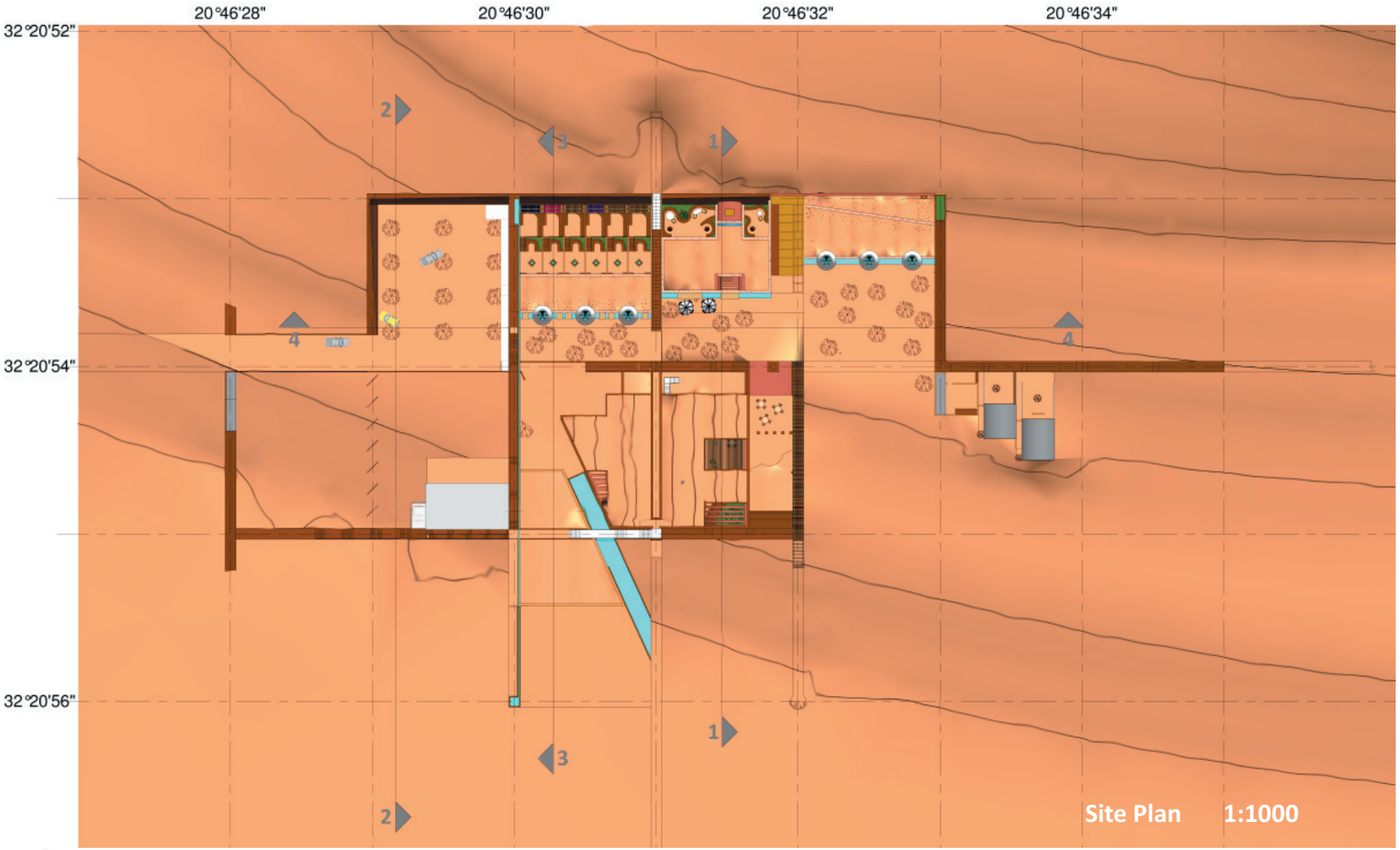
Observatory:
Spaces for telescopes, both permanent and temporary (private).

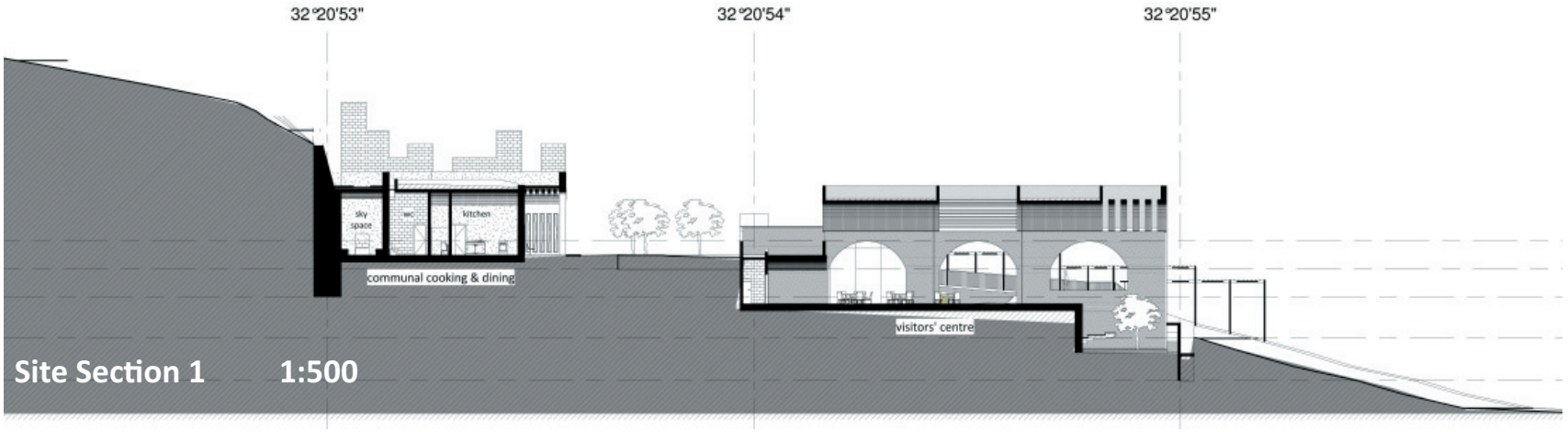


Weavery:
Space for processes of wool preparation and of weaving (& training)

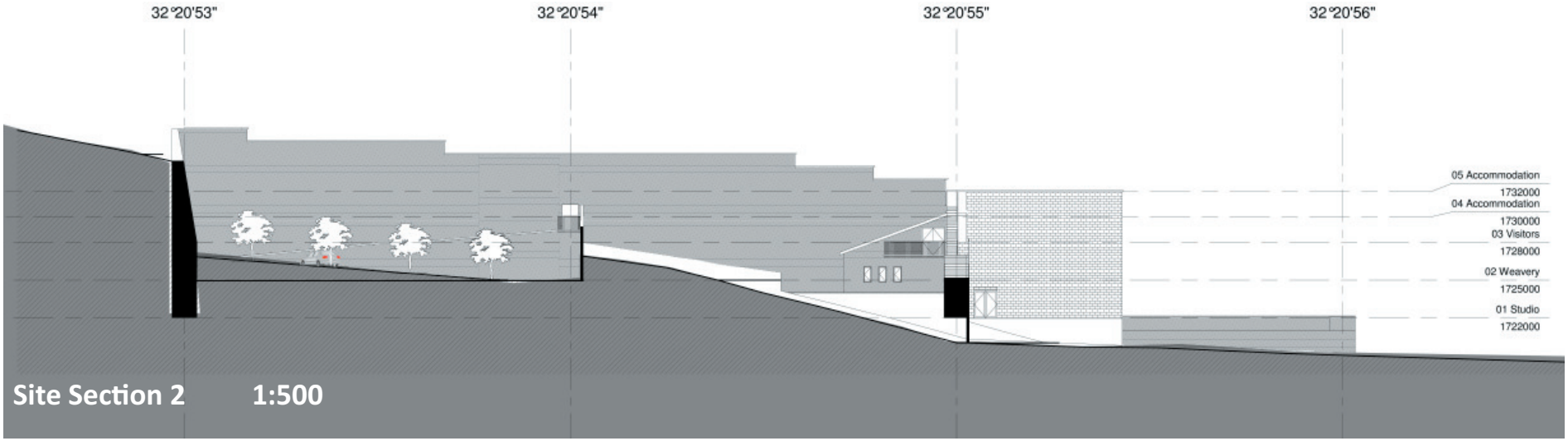

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20°46'29"
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20°46'28"
20°46'30"
20°46'32"
20°46'34"
32°20'52"
32°20'54"
32°20'56"
parking
artists' accommodation
kitchen & dining
astronomers' accommodation
observatory
alpaca kraal
wool dry yard
visitors' centre
wool wash & dye
weavery
art studio
Site Plan 1:1000

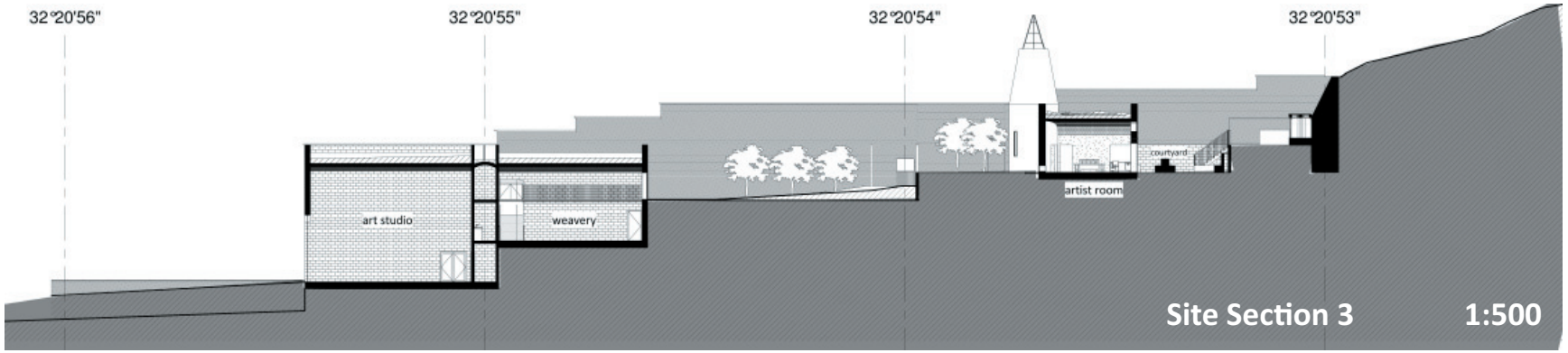

20°46'28"
20°46'30"
20°46'32"
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32°20'54"
32°20'56"
1
2
3
4
Site Plan 1:1000



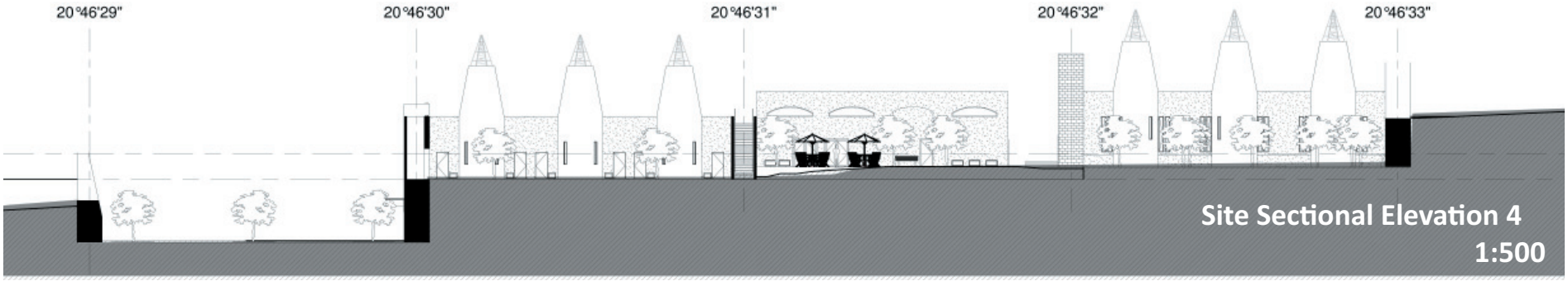
Site Section 1 1:500



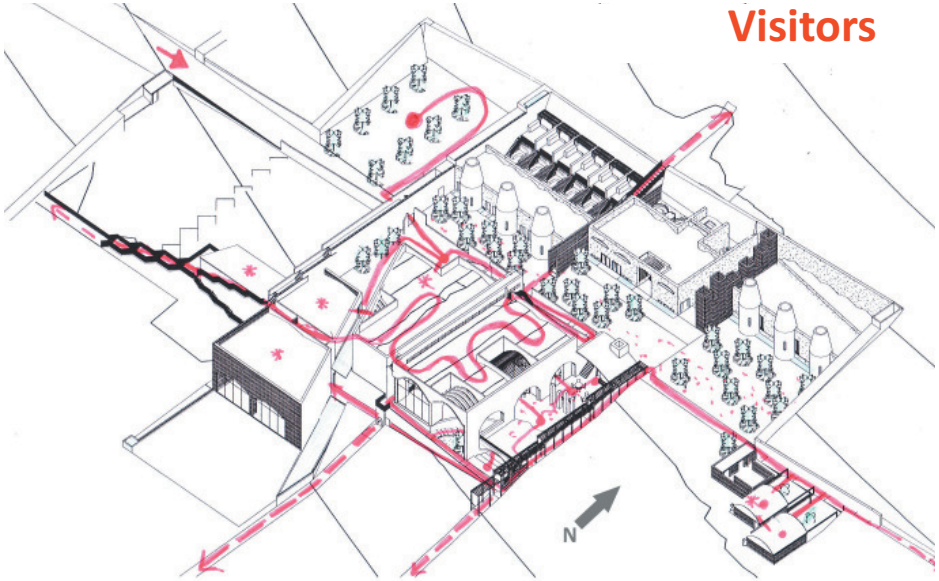
Site Section 2 1:500

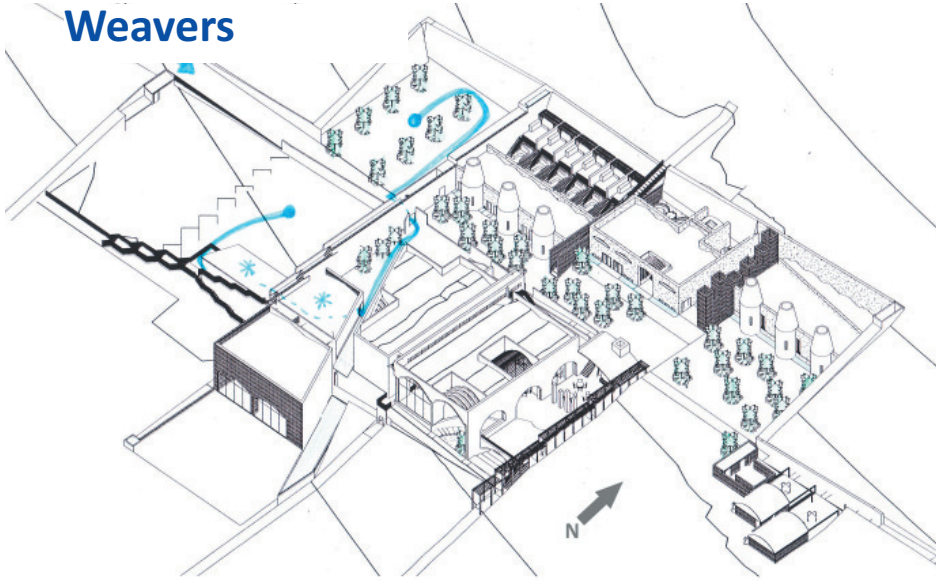


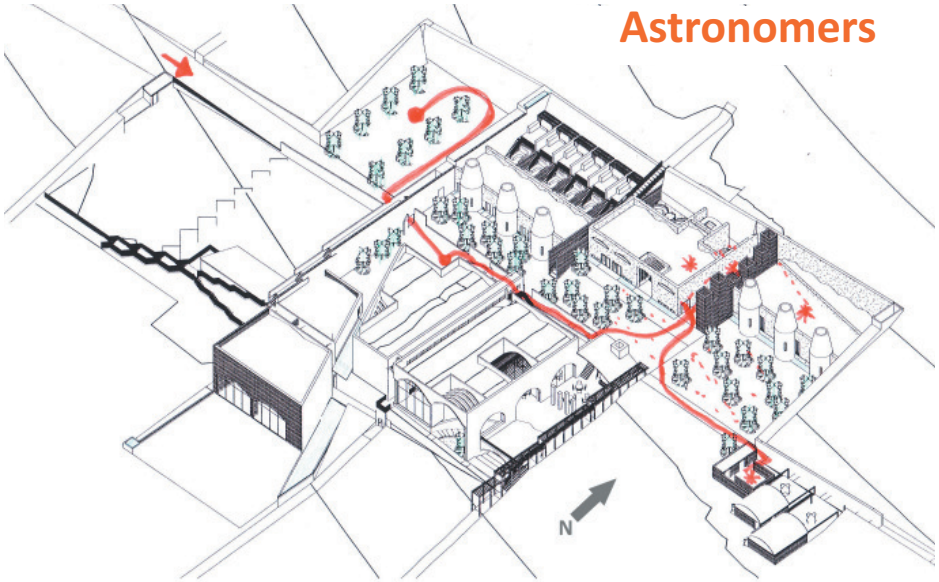
Site Section 3 1:500

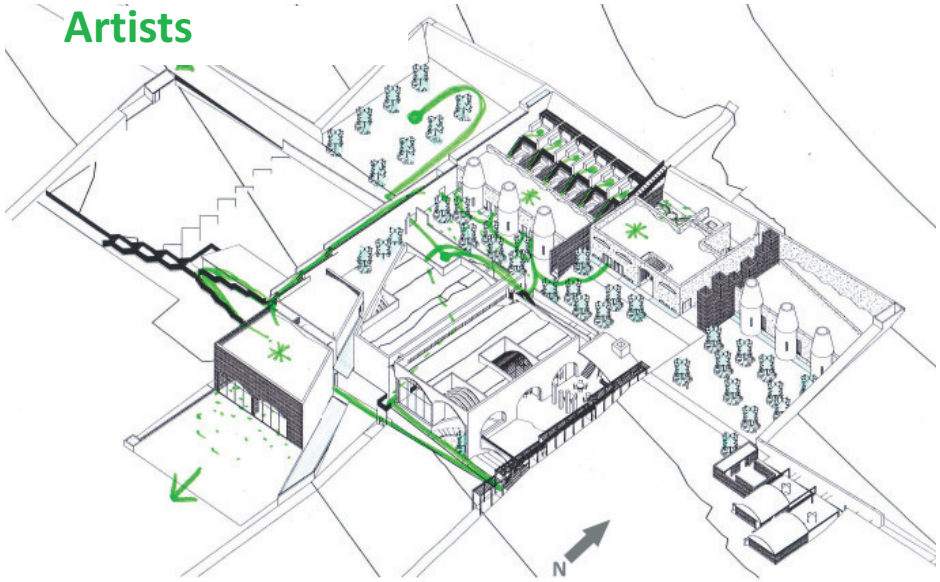


Site Sectional Elevation 4
1:500









Circulation

Very few parts of the complex are entirely private and visitors are encouraged to wander around and discover 'special' spaces in the built form or in the landscape. These diagrams show the most commonly used routes for some of the main groups of users.

Materiality and Structure

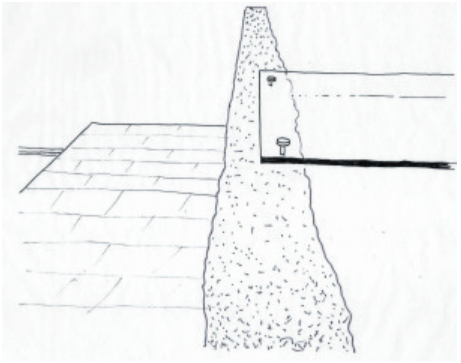
"The more tactile and monotone a surface finish, the more colors [sic] of daylight can push and pull optically to liberate an atmosphere from its scaffold behind. Facets receiving direct sun turn a warm hue between yellow and red, while those in shade are tinged complementary hues from violet to greenish-blue."
-Henry Plummer, Architectural Writer
(Plummer, 2003: 80)

Materials chosen for this building are predominantly natural ones. Natural materials express their age and their history. They tell the story of their origins and development over time. They also allude to historical use of specific materials by man. This adds the elements of time, history and grounding into the very structure of a building. (Pallasmaa, 2005b: 21)

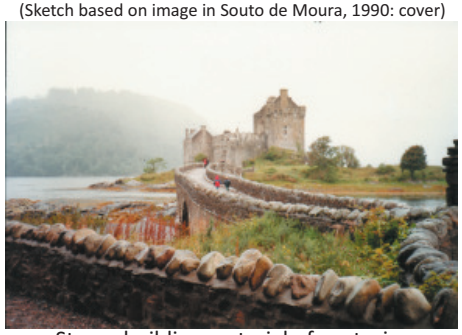
Architecture can be said to be about finding the balance between stability and movement, mass and void, opacity and transparency, and shadow and light. (Pallasmaa, 2005a: 202) This building attempts to achieve this balance, in part, through the use of contrasting materials. Contrasts of colour, juxtapositions of rough and smooth, or matt and reflective, will be accentuated by the play of light and shadow on surfaces.

J. Bronowski, author of *The Ascent of Man*, makes a distinction between the architecture of moulding, and the architecture of assembled parts. He sees the differences, in the context of man's development, as being intellectual ones rather than simple technical ones. Rolling clay into a ball, or scooping a shelter out of a hillside may, at first, appear to be revealing nature's shape. In effect, it is only revealing the action of man's hand. (1973: 94) Conversely, when man, now with a tool in his hand, splits a piece of wood or stone, he is on a voyage of discovery. In this way he reveals nature, laying bare the shapes and patterns created over time. (1973: 95)

Both these material treatments are utilised in this building. The ground will be scraped and carved, and the resulting rocks will be constructed into stone walls. Raw earth will be compacted into walls and moulded into bricks to create the vaulted structure of the roofs. These natural elements will be used alongside concrete blocks, sandblasted and brown (rather than grey) to match the landscape, and glass.



Contrasting materials & textures
Waterway by Eduardo Souto de Moura
(Sketch based on image in Souto de Moura, 1990: cover)



Stone: building material of centuries
Eilean Donan Castle, Scotland
(Photo by Author)



Stone, brick, steel & glass
Esposito entry by Eduardo Souto de Moura
(Sketch based on image in Souto de Moura, 1990: 14)

Stone

Stone, an element of earth, but moulded in the earth through fire, speaks of the organic rather than mechanical. It comes from the earth and relates back to the earth through its colour, texture and solidity. (Franck, 2000: 58) In this case, stone is used directly from the site, emphasising the buildings grounding in its immediate context. It also reminds us of of its history and use, in various ways all over the world. It is a material that has been with man for his whole existence.

Local stone has been used around the Sutherland area for decades. The dry packed stone walls that run through the farms have stood for generations. The carefully dressed grey-blue stone, used for many of the older houses, has become part of the town's identity.



Natural stone on the site
Skurweklipkop, near Sutherland
(Photo by Author)



Stone's many faces
Raw stone, dry packed wall, dressed stone
(Photos by Author)

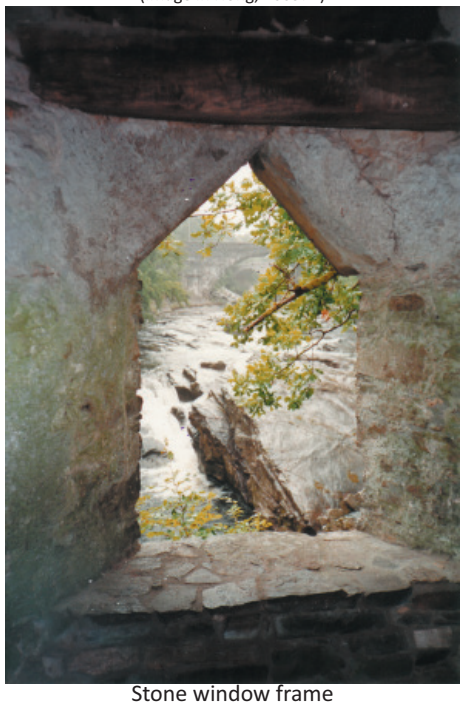


Ancient Stone
Balnuran Cairns, Scotland
(Photo by Author)

Highly polished, granite will be used in details in the form of tiles. This, maybe more than other stone, speaks of preciousness and eternity alongside the solidity and stability. Its patterning celebrates the slow and violent changes that the earth has undergone. (Franck, 2000: 59) Used in the reveals of doors or windows, this element will celebrate that place of connection between inside and outside, and it will reflect light in a different way to the rough textures around it.



Reflective stone
Granite Tile
(Image in Hong, 2009: 1)



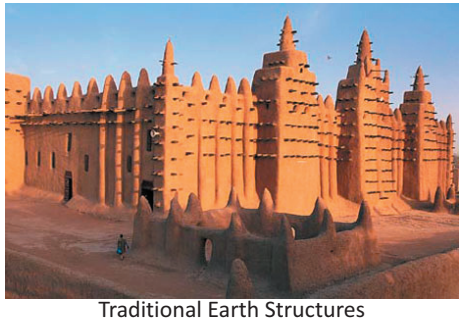
Stone window frame
Near Glen Morrison, Scotland
(Photo by Author)

Rammed Earth and Earth Bricks

Falling firmly in the category of earth, and with water in its creation, this material has also been used in various ways in traditional construction for centuries, on all five continents. (Minke, 2000: 56) This is the moulding of shapes to form space. Space, in the Karoo, is not at a premium, so the thickness required in walls of this nature is not a problem.

Conversely, the thickness, and the ease with which the walls can be carved into after ramming, can contribute to variation in spaces as openings, recesses and niches are cut.

Vaulted earth brick structures, with careful planning and engineer input, can be constructed with little or no formwork, and will have the required stability to support the weight of earth and local flora on the roofs.



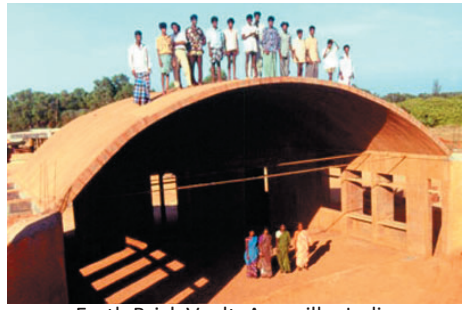
Traditional Earth Structures
Djenne, Mali
(Image in Mok, 2007: 1)



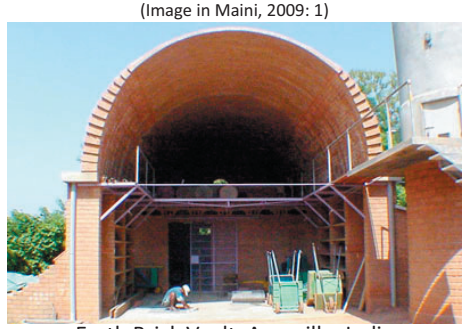
Traditional Earth Structures
Kasbah Ait Ben Haddou, Morocco
(Photo by Author)

The brick will be made on site with a forming machine. Suitably clay rich soil will have to sourced outside of the immediate vicinity (the site is too sandy and not suited to brick-making). The bricks and rammed earth will be cement reinforced for extra stability.

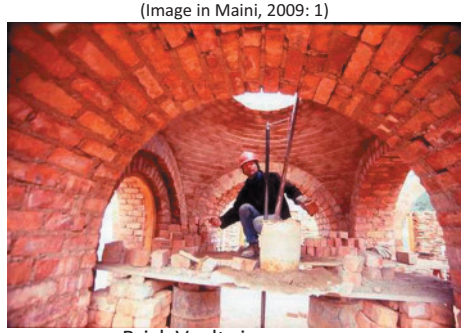
These techniques are fairly labour intensive, but, apart from some basic training, also do not require much in the way of technical knowledge or mechanical equipment. This is suitable for the region as many people living in the township region are either unemployed or under-employed.



Earth Brick Vault, Auroville, India
10.35m span. Built free spanning in 3 weeks
(Image in Maini, 2009: 1)



Earth Brick Vault, Auroville, India
6m span. Built free spanning in 6 weeks
(Image in Maini, 2009: 1)



Brick Vaults in progress
Morris gallery, Barrydale
(Image in Horn, 2009: 1)

Glass

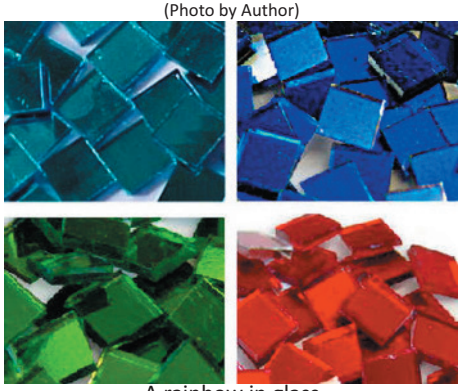
"Glass material curiously unifies the four ancient elements by being born of earth and fire and resembling air and water. (Pallasmaa, 2005a: 209) Glass is most often used as the connector between the inside and outside, allowing views out and light in. Variety in window arrangements can be used to great effect in producing a play of light and shadow.

The lightness of glass contrasts with the heaviness of the earth and stone, helping to open up spaces to the light and the landscape.

Glass will also be used to tint or colour light in places (refer to *Ronchamp Chapel* on page 96).



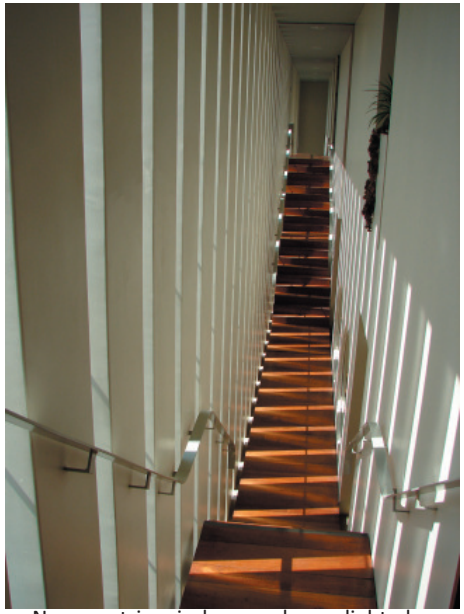
Lightness of glass, like air or water
British Museum, London
(Photo by Author)



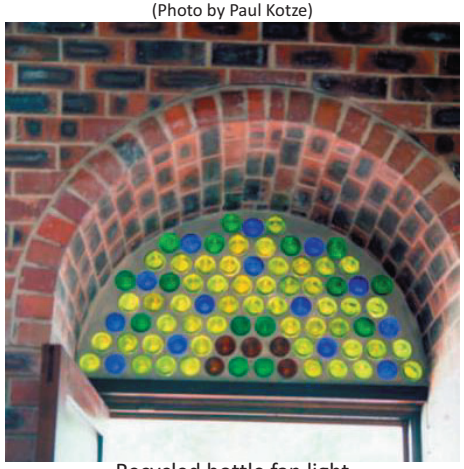
A rainbow in glass
Coloured mirror mosaic tiles
(Image in Wozniak, 2009: 1)

Recycled or re-used glass will be used in the form of windows and skylights made out of old glass bottles. Not only is this a sustainable way to re-use old materials, but it can provide colour and pattern variations in windows, as well as a 'starry sky' effect when used in the roof. The structure of the walls and roofs are perfectly suited to be able to include such elements. For the roofs, bottles will be used on the ends of PVC pipes in order to reach through the structure and the planted roof.

Glass mosaic (along with ceramic tiles) will be used in smaller details in water features. They will reflect light and colour, especially with the added dynamic of the play of light on water. They will also provide interest and light reflectivity if water features are dry.



Narrow strip windows make sunlight play
Dutch Embassy, Maputo, Mozambique
(Photo by Paul Kotze)



Recycled bottle fan light
House Lijnes, Noordhoek, Western Cape
(Image in Horn, 2009: 1)

Concrete Blocks

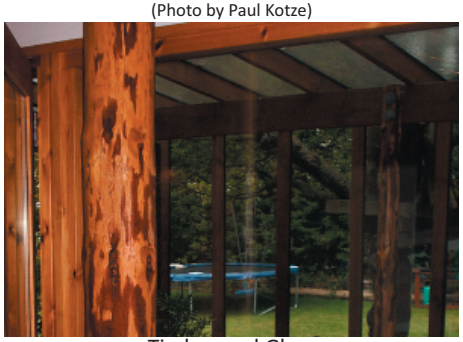
Due to the inaccessibility of the site, it was decided that concrete would be kept to a minimum in the building (no large poured concrete slabs etc.). However, small, precast elements will be incorporated. Concrete blocks will blend into the desert setting (refer to *Desert Design* section on page 80) as well as contrasting, in its regularity, to the stone walls. In some cases, especially internalised rooms or courtyards, it will be plastered and painted.

Timber

Wood is not prolific in the region and would have to be brought in to the site from elsewhere. Timber also talks of nature and time. The pattern within is nature revealed. Wood, too, has been used by man for centuries. In this setting, it will be used as a lighter contrast to the bulky stone, mostly for lightweight pergolas and sun shades, as well as for some door and window frames.



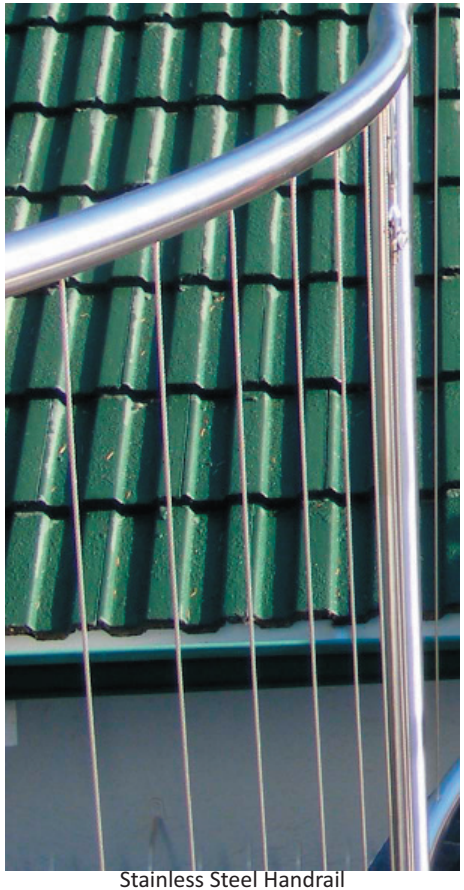
Wood and Steel
Getty Villa, California
(Photo by Paul Kotze)



Timber and Glass
House, London
(Photo by Author)

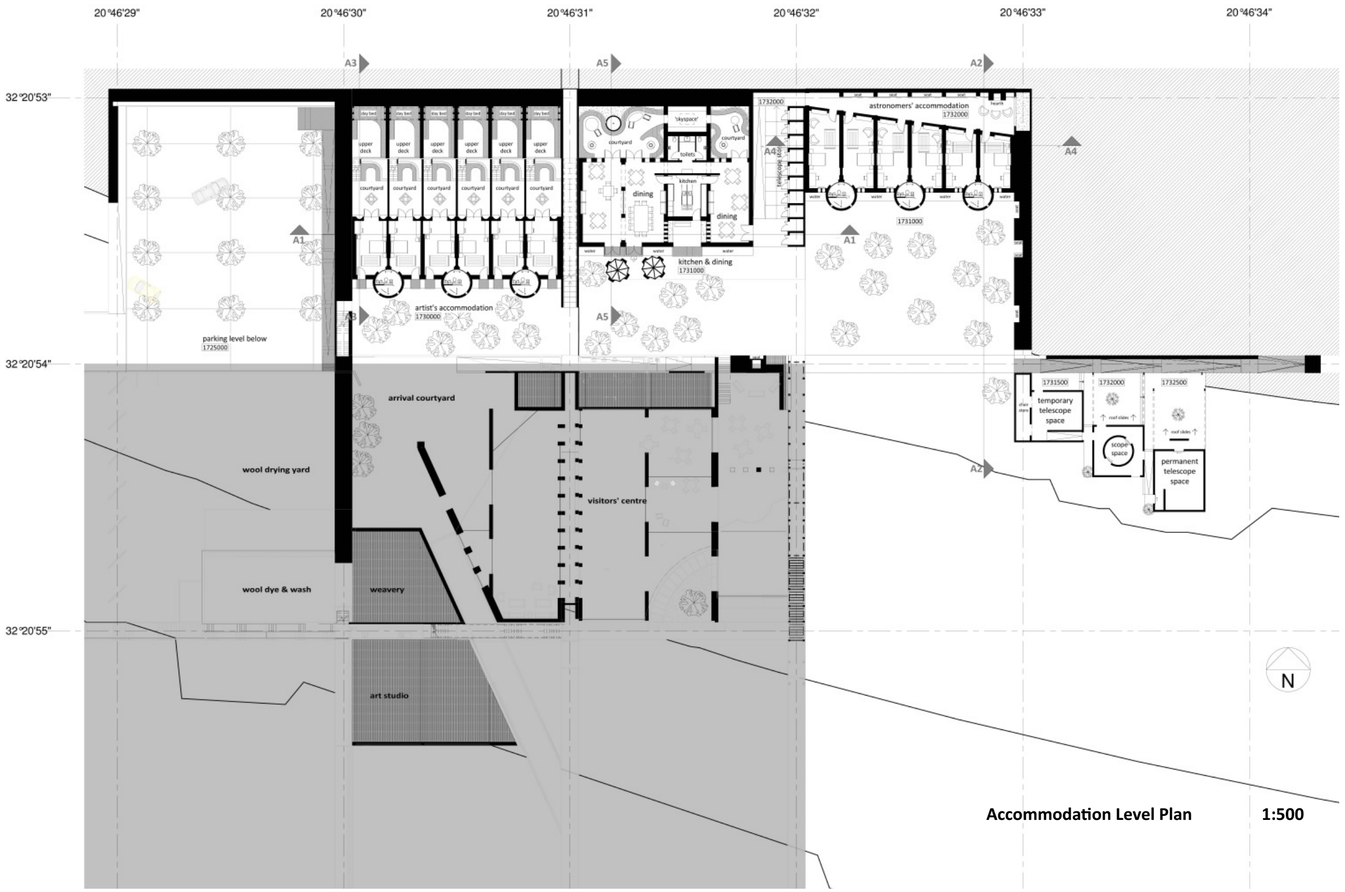
Metal

Steel and aluminium provide a man-made contrast to the materials used directly from the earth. These are elements of earth that have been transformed by fire. They will be used for slender framing elements for glass walls and sliding doors, as well as for handrails and gantry-type walkways.

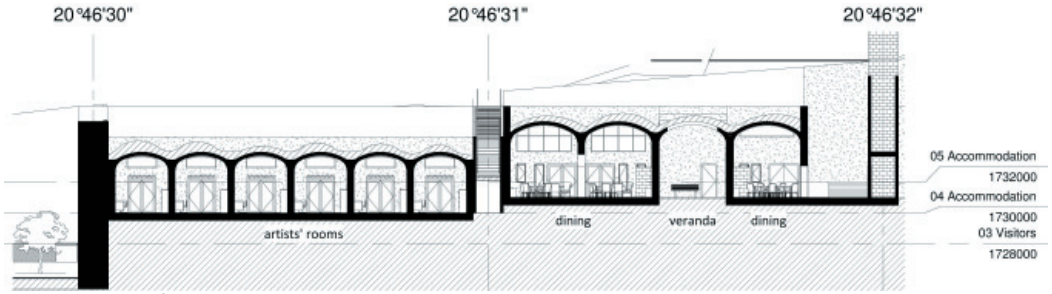


Stainless Steel Handrail
Lightweight and slender
(Photo by Author)

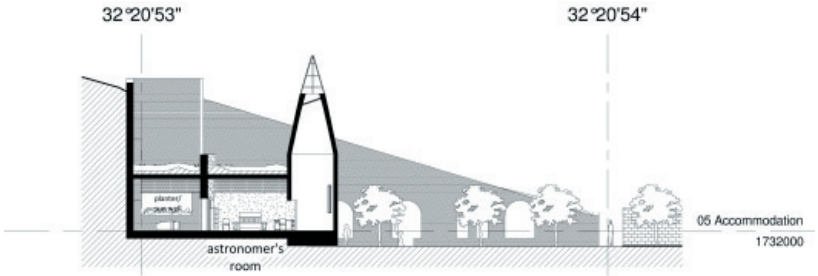
Accommodation Level



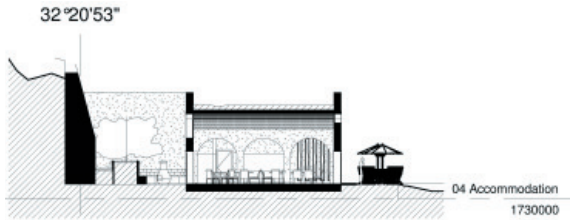
Accommodation Level Plan **1:500**



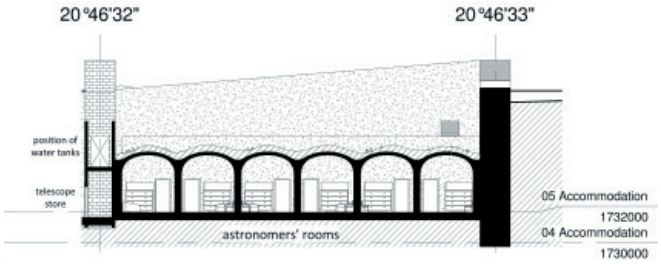
Section A1 1:500



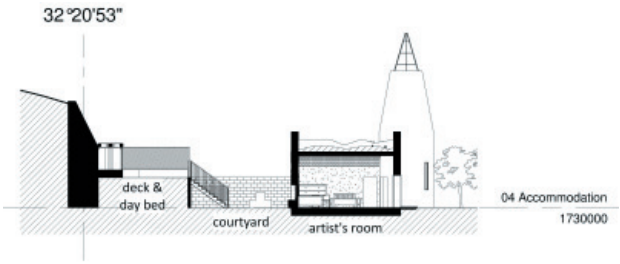
Section A2 1:500



Section A3 1:500



Section A4 1:500



Section A5 1:500



Artist's Room Interior



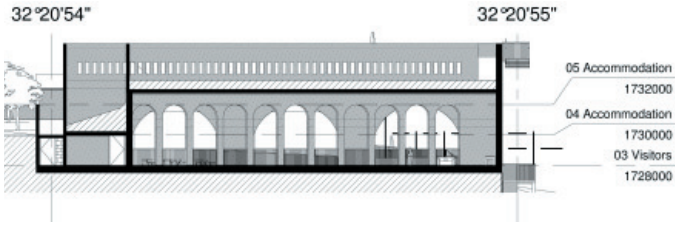
Dining Room Interior



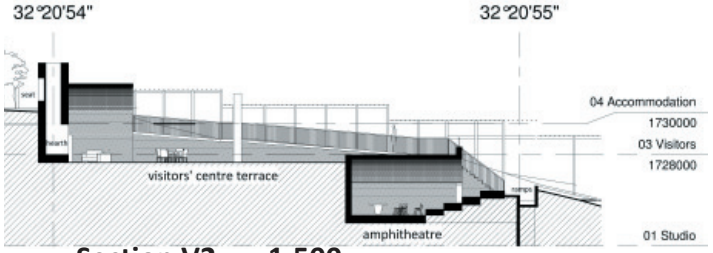
Dining Room Courtyard

Visitors' Centre Level

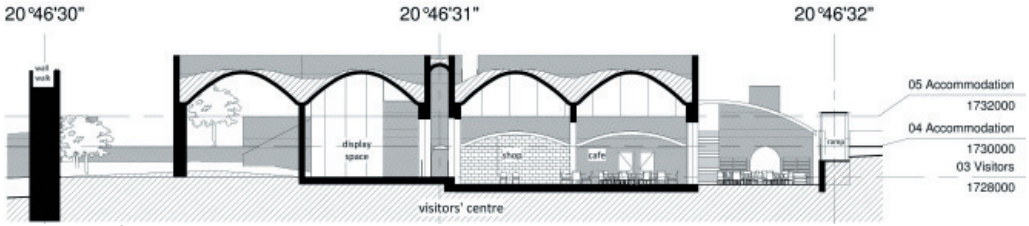




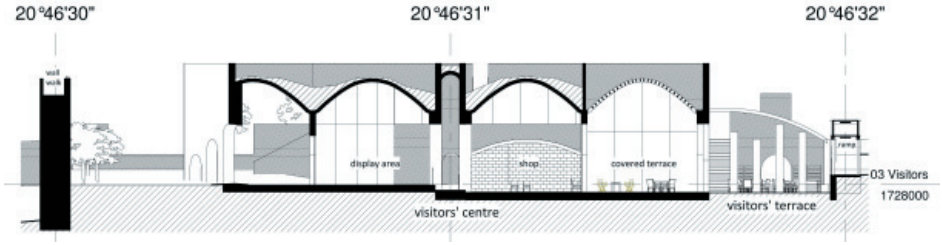
Section V1 1:500



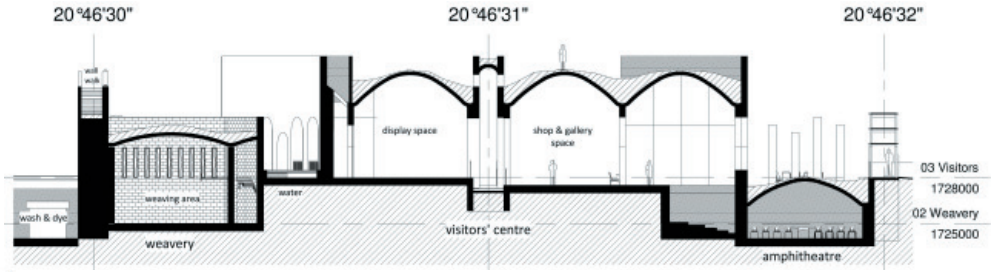
Section V2 1:500



Section V3 1:500



Section V4 1:500



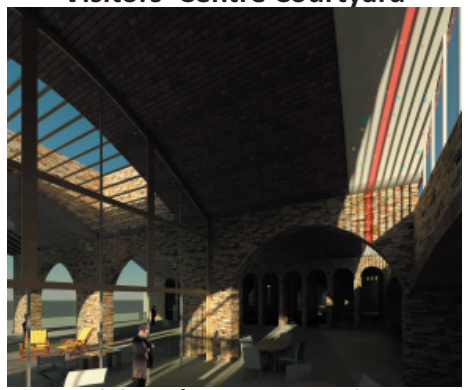
Section V5 1:500



Visitors' Centre Interior

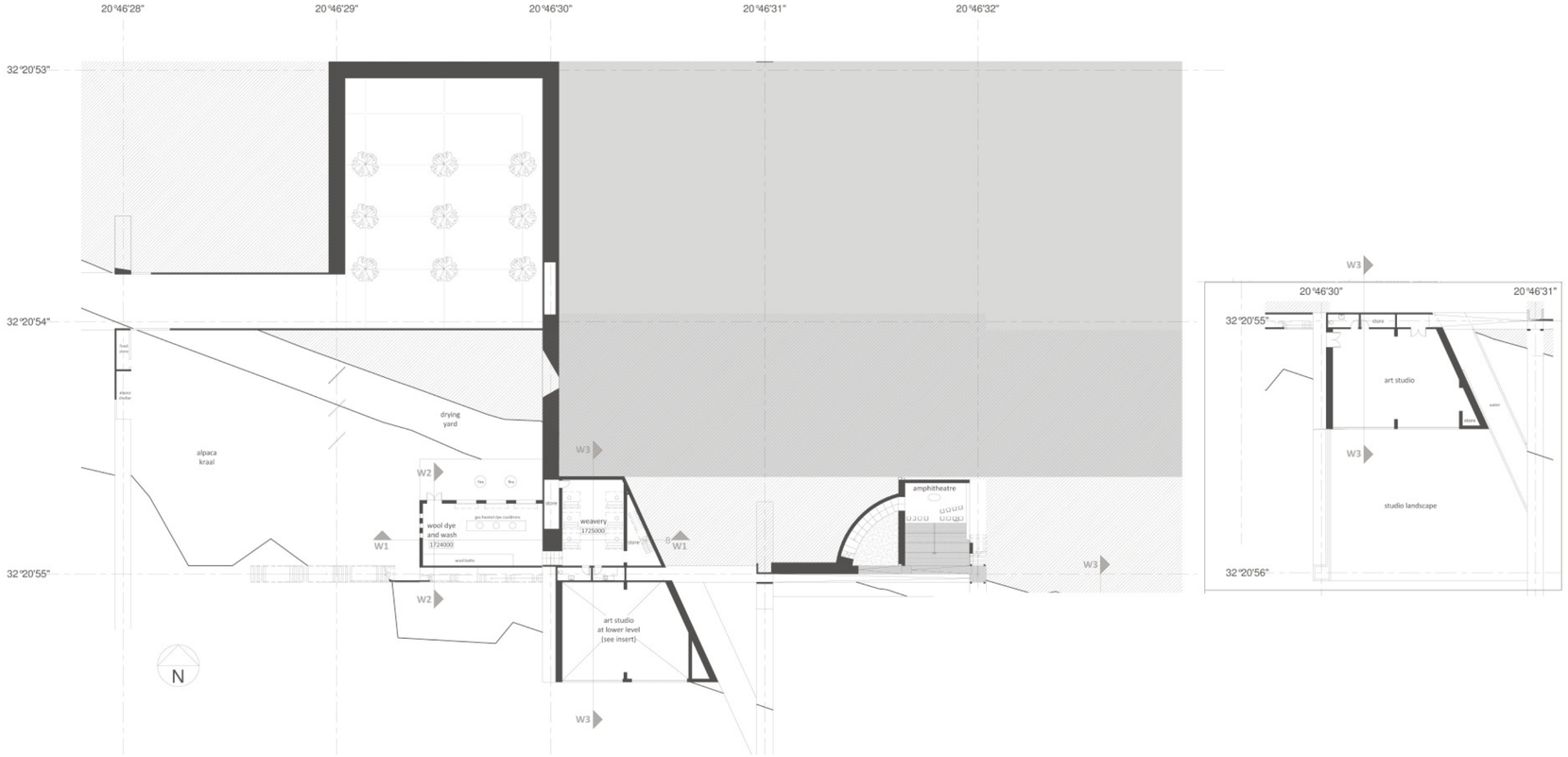


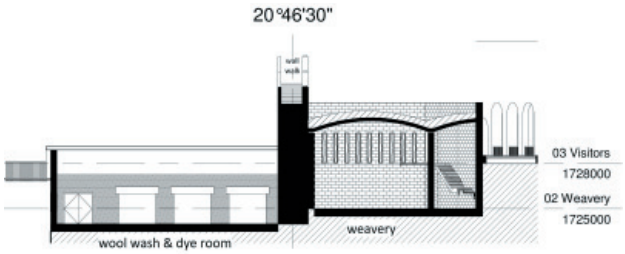
Visitors' Centre Courtyard



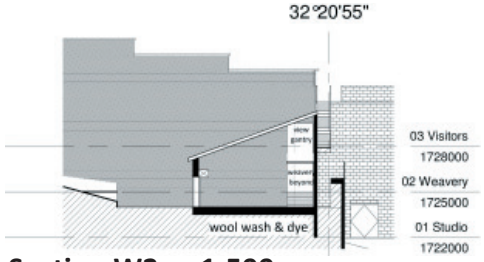
Visitors' Centre Interior

Weavery & Studio Levels

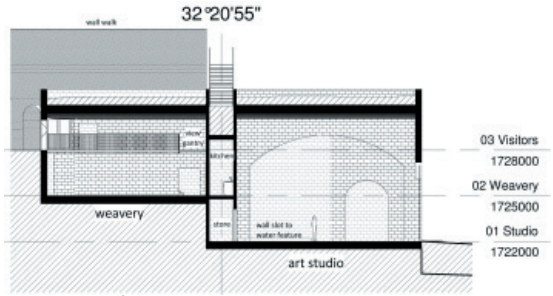




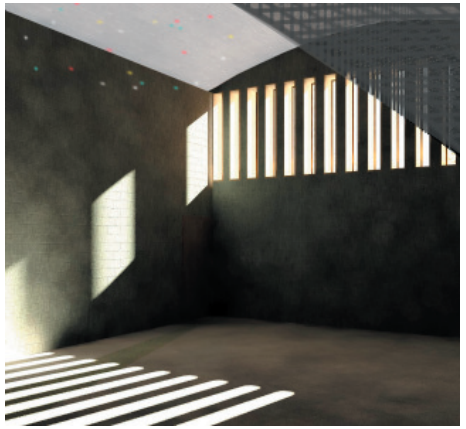
Section W1 1:500



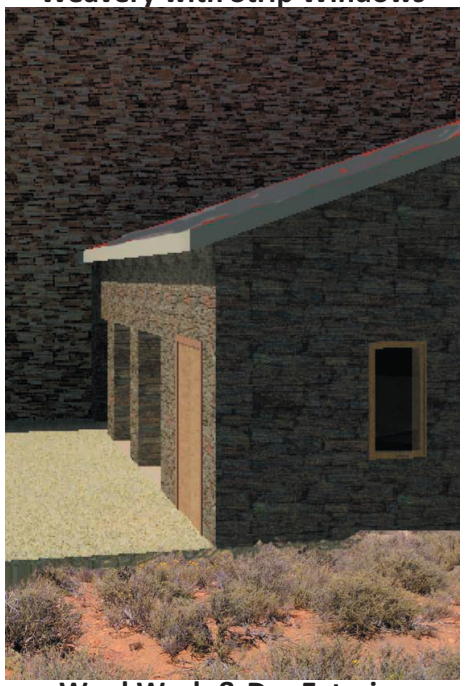
Section W2 1:500



Section W3 1:500



Weavery with Strip Windows

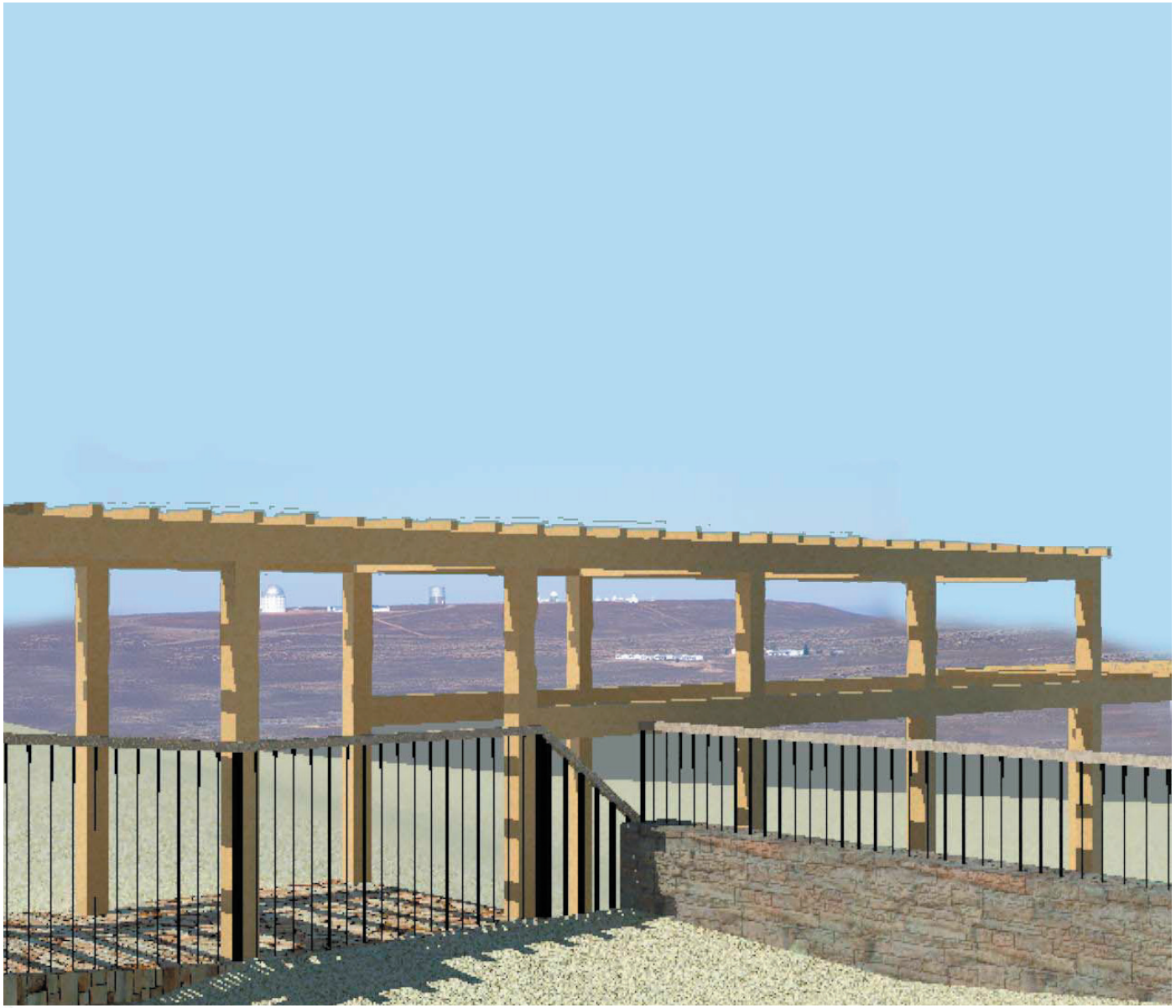


Wool Wash & Dry Exterior



Focussed Views

This is the first framed view encountered on crossing the arrival threshold. A shallow pool cuts through the building, pointing to the distant horizon, and the extinct volcano, Salpeterkop.



Focussed Views

The visual link between the scientific observatory (SAAO) and the new amateur observatory has been retained.

The SAAO ridge, initially only visible as snatched glimpses through the Visitors' Centre, gradually becomes clearer as the visitor moves through the Centre and onto the terrace. From there, the full panorama of the surrounding region is laid bare, including the SAAO and SALT across the valley.



Sketch of Planned Star Grid Structure
-Marcus Neustetter
(Image in Neustetter, 2009c: 1)



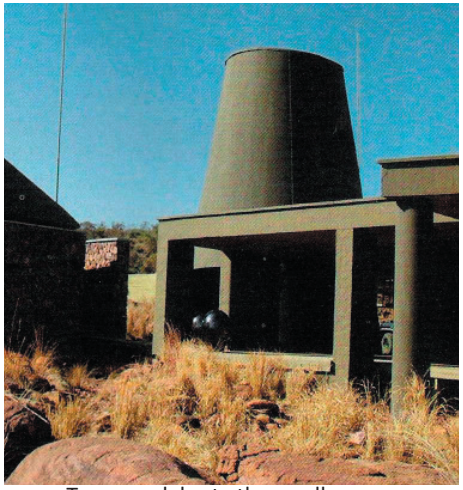
Model of Planned Star Grid Structure
-Marcus Neustetter
(Image in Neustetter, 2009b: 1)

Additive Art

Artists and visitors will be encouraged to leave their mark on the building and the landscape. Whether it is a structured piece of art or simply the moving of a stone to create a cairn, wall or seating area, each person will contribute to the dynamic and changing nature of a building in progress.

The work alongside, by artist, Marcus Neustetter, is a proposal for an installation piece at the SAAO in Sutherland. Based on an historical method of mapping stars by viewing them through a grid, this piece would be built as a folly in the landscape.

The sculptural shading devices on top of the bathroom towers (see the following page) would be another example of where artists would contribute to the development of the building.



Towers celebrate the small spaces
Lebala Lodge - Michael Scholes
(Image in Kotze, 2009: 15)



Karoo Scenes
A corbelled shed near Carnarvon
(Image in Fagan, 2008: 33)



The Towers

The smallest spaces in the project have become the tallest.

The bathrooms in the artists' and the astronomers' rooms have been stretched into tall, circular light wells. Initial inspiration came from similar bathroom towers in Michael Scholes' *Lebala Lodge*. It was adapted in order to speak of Karoo precedents.

The bathroom is often stuck away out of sight. It is, however, a space of ritual, a space that everybody regularly occupies. This space is celebrated here as an object in its own right.

Internally, it is an interesting space as it breaks from the rectilinear rooms. The top is closed by a coloured glass skylight, pulling natural light inside and washing the space with colour.

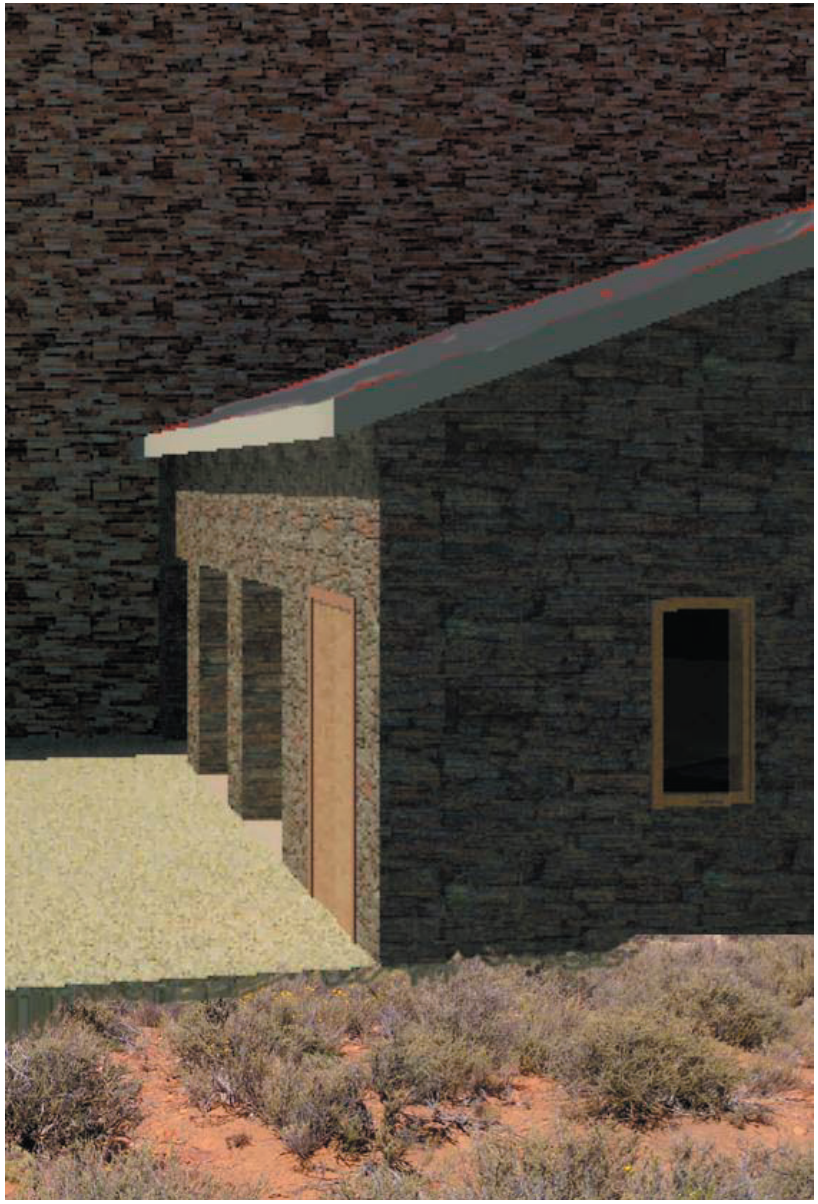
The top structure will be a unique, artist-created work of art, doubling as a sun shade.



Stone shed in the Karoo
Near the *Ouberg Pass*, outside Sutherland
(Photo by Author)



Bright Colours in the Dyers' Souq
Marrakech, Morocco
(Image in Verner, 2005: 36)



Wool Wash & Dye Shed
(and adjacent drying yard)

The Wool Wash and Dye Shed is one of the few built elements on the western side of the big wall (the side of approach and arrival). Intended to look like an old farm building, it is of rough stone from the site and has a corrugated iron roof, intended to rust over time.

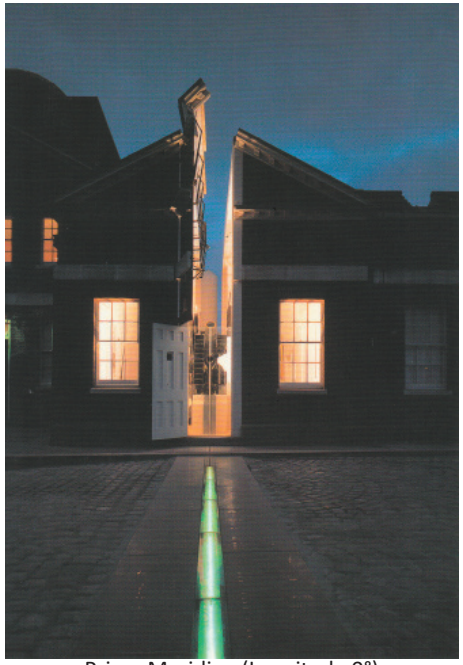
The drying yard will, mostly, be left in its natural state with simple racks and drying lines erected to allow the washed or dyed wool to dry in the sunshine. This, in itself, will be a burst of colour in the landscape. It will be hidden from view of the access route by a screen fence, so that the colour is only visible by a visitor having passed through the 'prism aperture entrance'. The best view will be from the wall walk overlooking it.





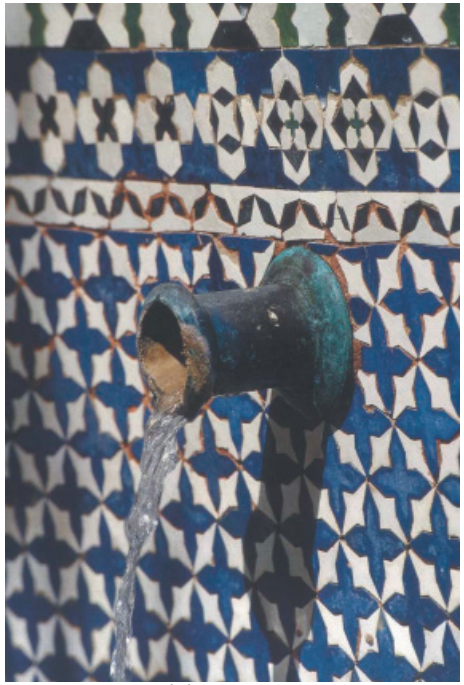
Catedral de Sevilla Courtyard
Seville, Spain
(Photo by Author)

The sunken parking area, surrounded by its heavy, stone retaining wall, will be planted with indigenous trees (Acacia Karoo). In a similar way to the above image, trees will be irrigated through narrow channels in the paved floor.



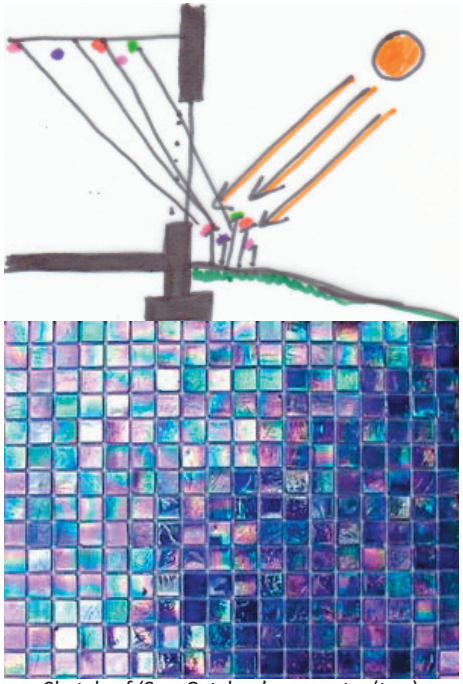
Prime Meridian (Longitude 0°)
The Royal Observatory, Greenwich, England.
(Image from postcard - ©National Maritime Museum)

The grid line in the project (the lines of latitude and longitude) will be marked in small ways along parts of their lengths, or at their ends. This will be a subtle indication, in the form of a line in the paving of a path, a stainless steel or mosaic strip along a wall, or a small artwork, hidden in the landscape at the termination of a line across the site.



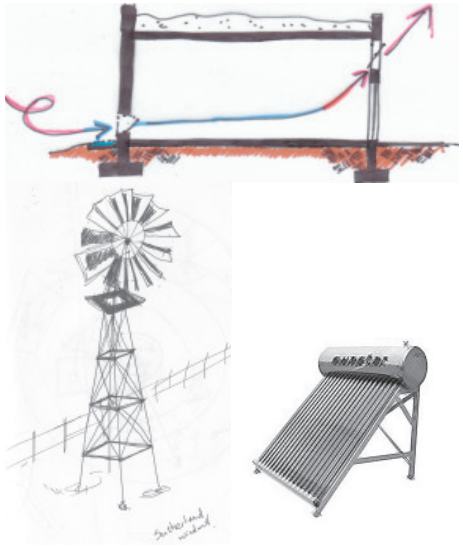
Celebrating Water
Jamai Palace courtyard, Fez, Morocco.
(Image in Verner, 2005: 65)

Water will be an important feature in the complex. In such a barren environment, it will be celebrated in the form of channels, shallow pools and fountains. They will usually not be more than a few centimetres deep, and may even dry up sometimes. Mirror and mosaic details will enhance the play of light on the water.



Sketch of 'Sun Catcher' concepts. (top)
Example of reflective glass tiles. (above)
(Tile Image in *Iridescent Glass Mosaic Tiles*, 2008: 1)

Coloured mirror glass, mounted on flexible wire will be arranged outside windows as sun catchers. Sunlight will reflect the coloured patterns through windows into the interiors of spaces. The patterns will change as the sun moves and as the wind blows the wires.



Cooling concept sketch (top)
Windmill sketch & Solar water cooler.(above)
(Images by Author)

Environmental considerations include:

-Water: There is already a windmill borehole pump adjacent to the site. Water will be pumped from there to storage tanks above the telescope store rooms.

-Power: Water will be heated by solar power, cooking will be done on gas, and solar cells will generate enough energy to power the rest of the building.

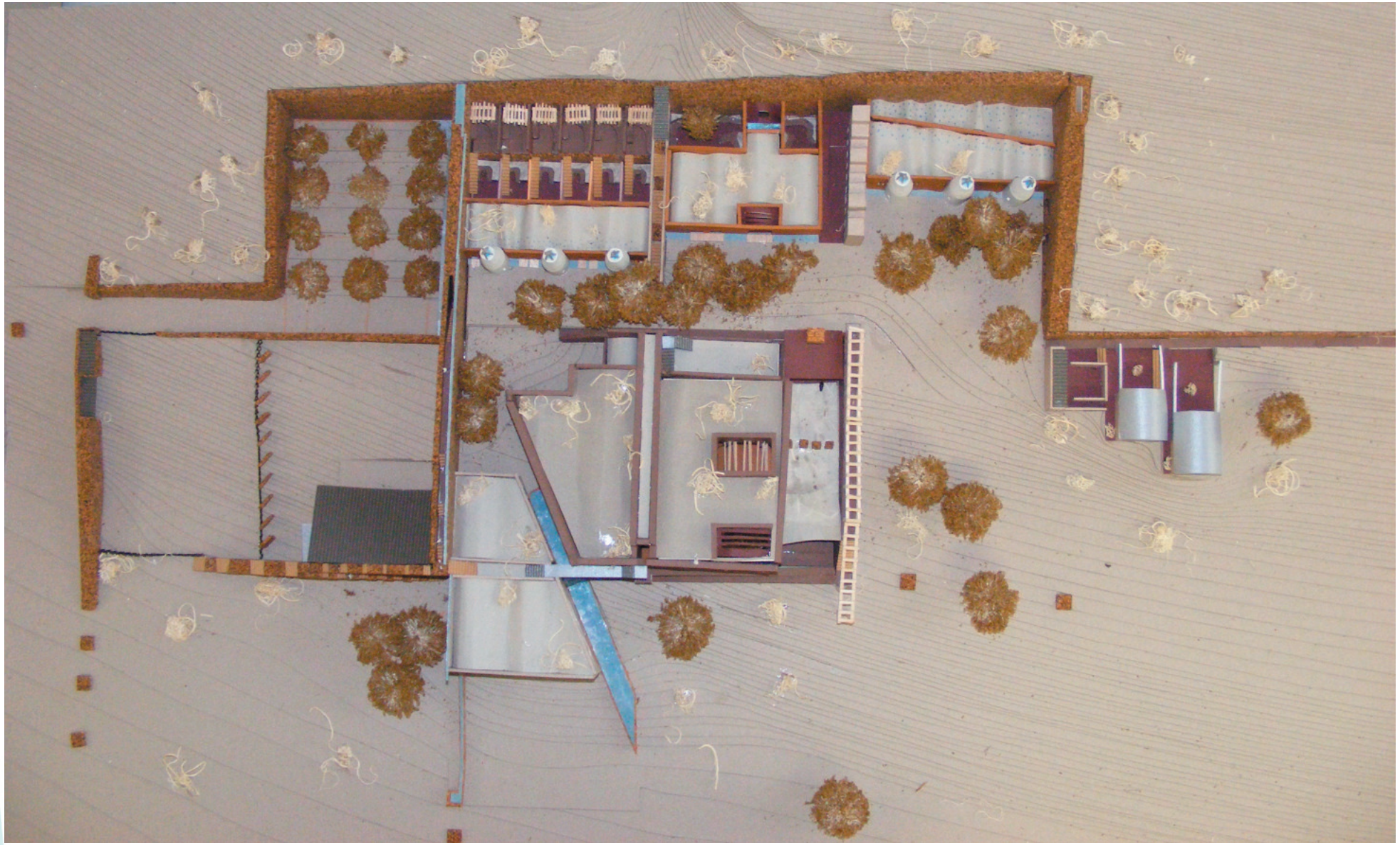
-Temperature: Air flowing over water will help to cool some spaces. (sketch above) Earth, stone and roof planting all contribute to a high thermal mass that will regulate internal temperatures.



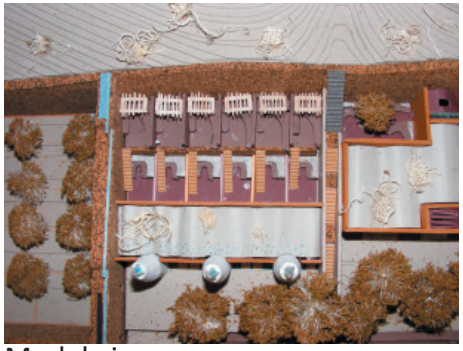
Karoo Flora
Natural, local colours
(Tree Information In Palgrave, 1977))

The landscape surrounding (and on the roof of) the building will be planted with indigenous, local flora. Open spaces in and around the building will be extensions of the surrounding. Vegetation will be denser on the site, an oasis in the desert. Trees, though not currently growing on the site, will be ones that are endemic to this region of the Karoo.

Many of the chosen varieties have bright coloured flowers (seasonally) and will add to the colour vibrancy within the bounds of the complex.



Aerial View of Final Model



Model view:
Artists' Accommodation



Model view:
Shared Cooking & Dining Area



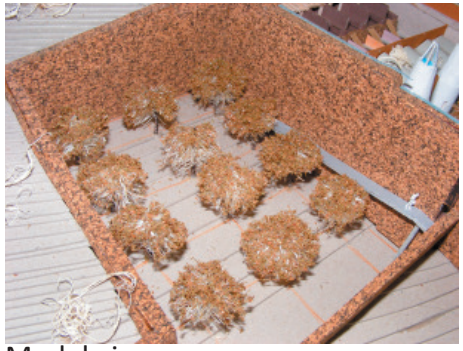
Model view:
Astronomers' Accommodation



Model view:
Bathroom Towers



Model view:
Looking north along Wall Walk



Model view:
Parking Area and Entry Ramp



Model view:
Wool Wash/Dye Shed & Dry Yard



Model view:
Visitors' Terrace & 'Sundial Pillars'



Cafe Area of the Visitors' Centre Terrace

Construction Details

Details included here focus on two main areas to try and show the main construction materials and methods used in the building.

Each section will start with an image, followed by a plan detail. The callout sections and details are referenced on the plan and will appear on the following pages, sometimes accompanied by sketches.

(Information used in this section is from :
Houben et al, 1994;
Keefe, 2005;
McHenry, 1984;
Walker et al, 2005;
Weismann et al, 2006,
as well as from consultations
with a structural engineer.)

20°46'32"

3542

32°20'54"

1600

STORE

200

'KOPPIE' STONE FIREPLACE

1000

1000

9000

COVERED
OUTDOOR LOUNGE
(STONE PAVED)

TUCK SHOP/CAFE
SERVERY
(EARTH/COB FLOOR)

4350

4250

1400

6200

400

ALUMINIUM FRAMED
GLASS FOLDING DOORS

TERRACE
(NATURAL GROUND)

RAMP
ABOVE

5600

A

A

STONE RAMP WITH
TIMBER PERGOLA

2400

1000mm STONE PAVED 'APRON' TO
DIRECT WATER RUN-OFF AWAY FROM BUILDING

B

B

800mm 'KOPPIE'
STONE WALL

500x500mm 'KOPPIE'
STONE 'SUNDIAL COLUMN'

ALUMINIUM FRAMED
GLASS FOLDING DOORS

1000

C

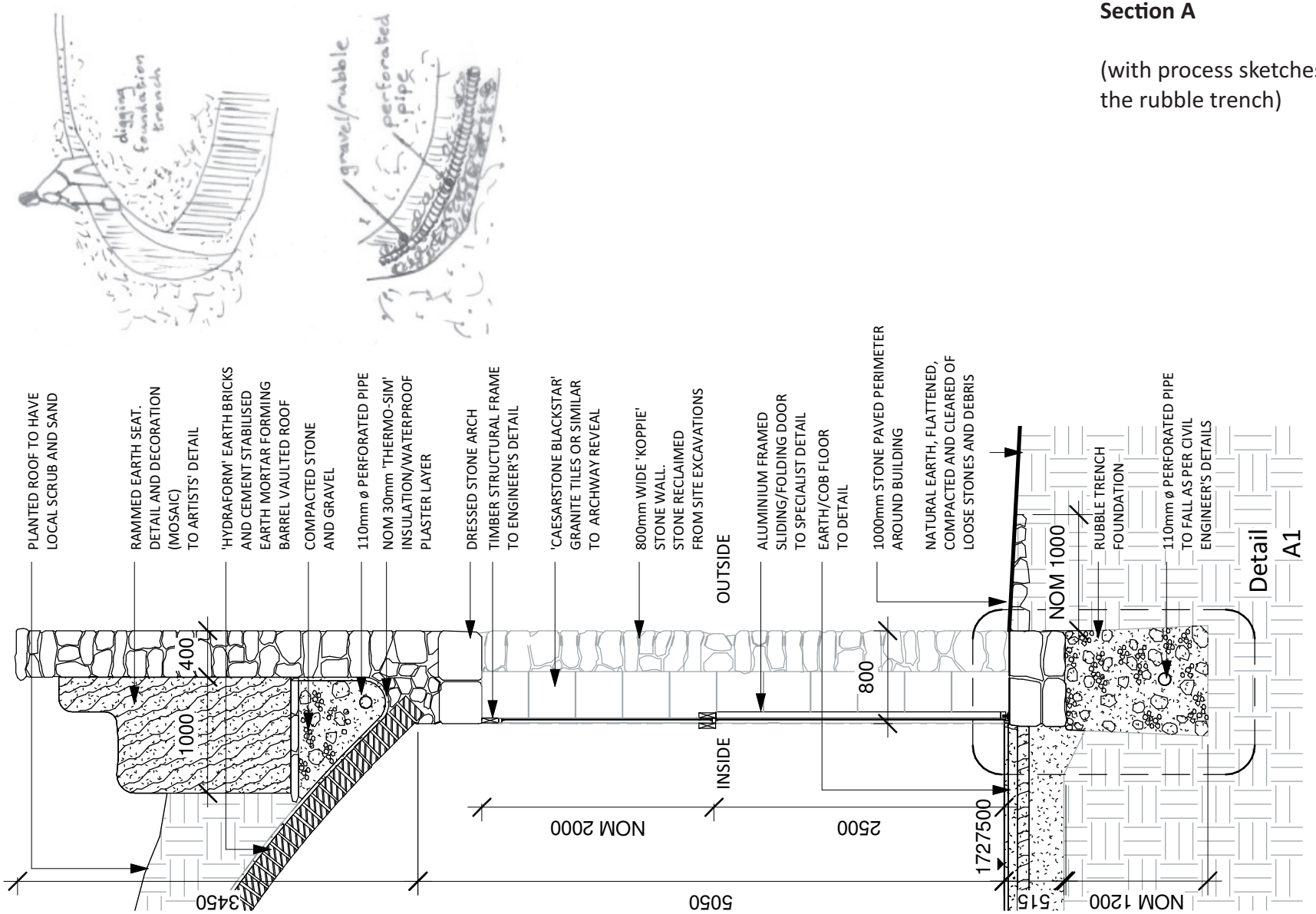
C

COVERED TERRACE
(EARTH FLOOR)

FIRE
PIT

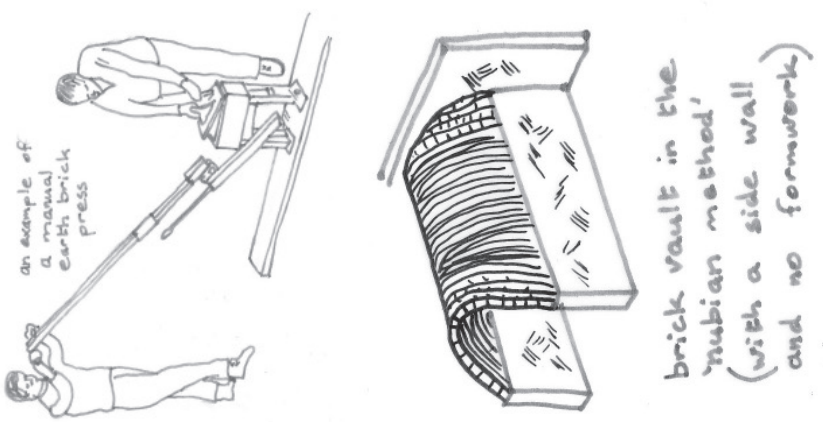
Section A

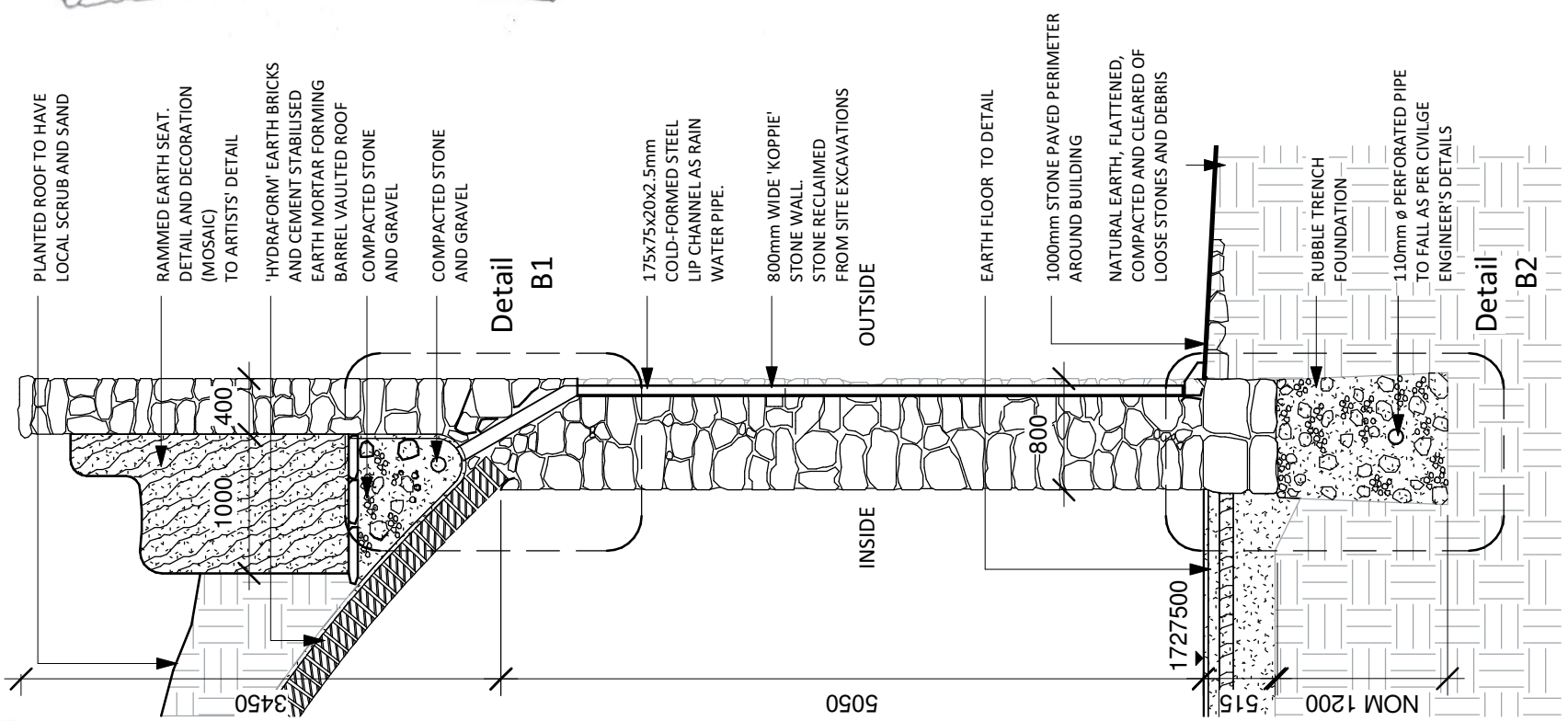
(with process sketches for the rubble trench)

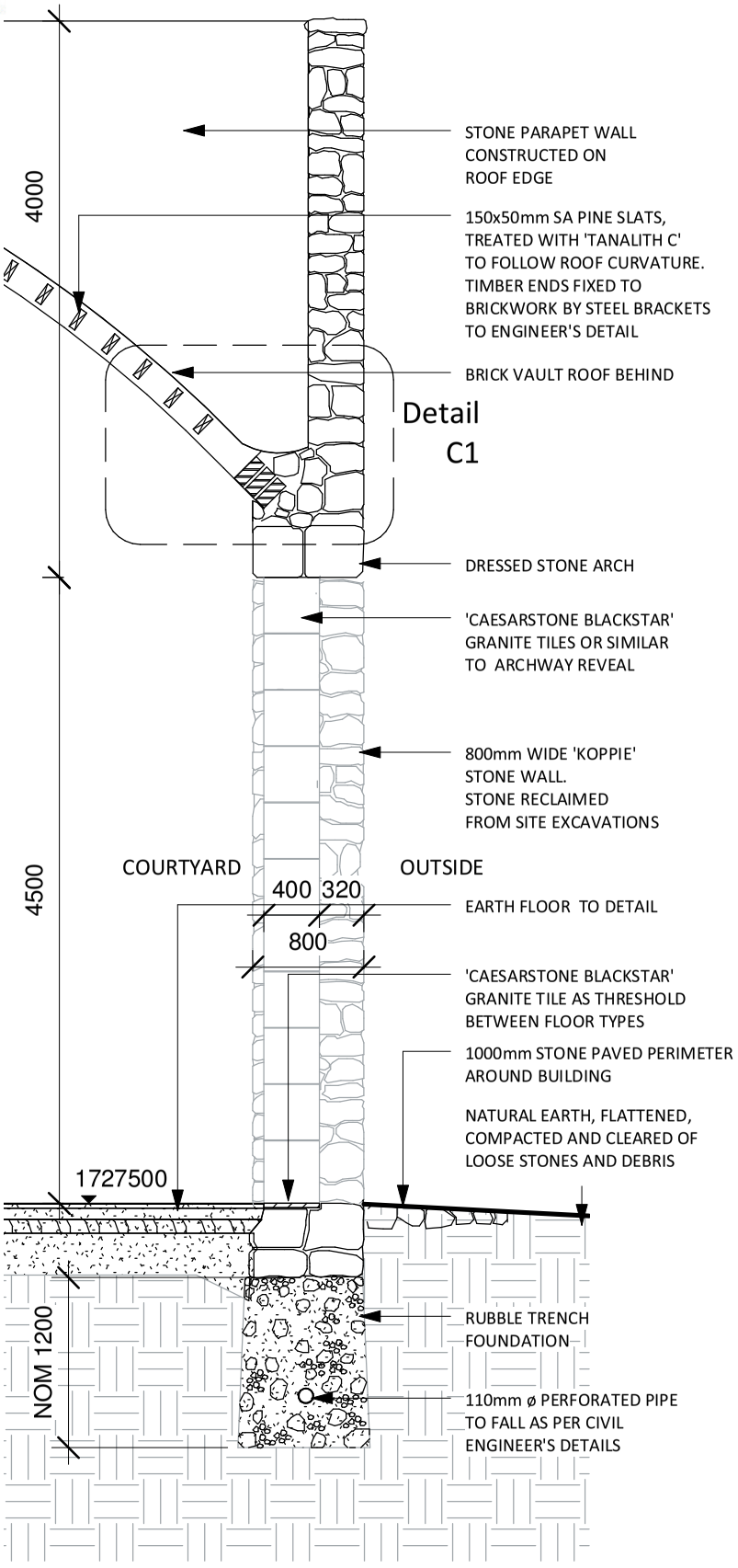


Section B

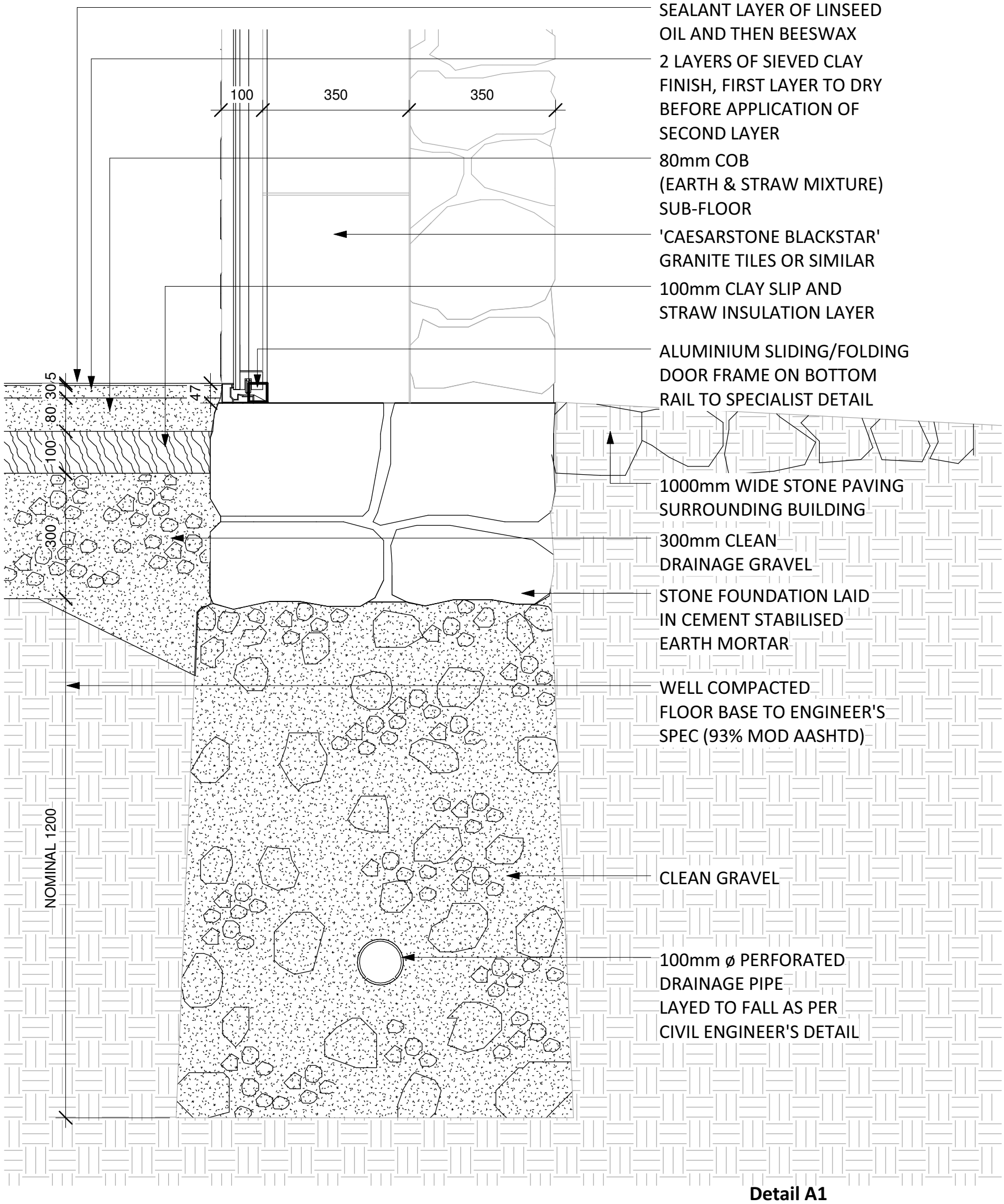
(with process sketches for earth bricks and brick vaults using the ‘nubian technique’)



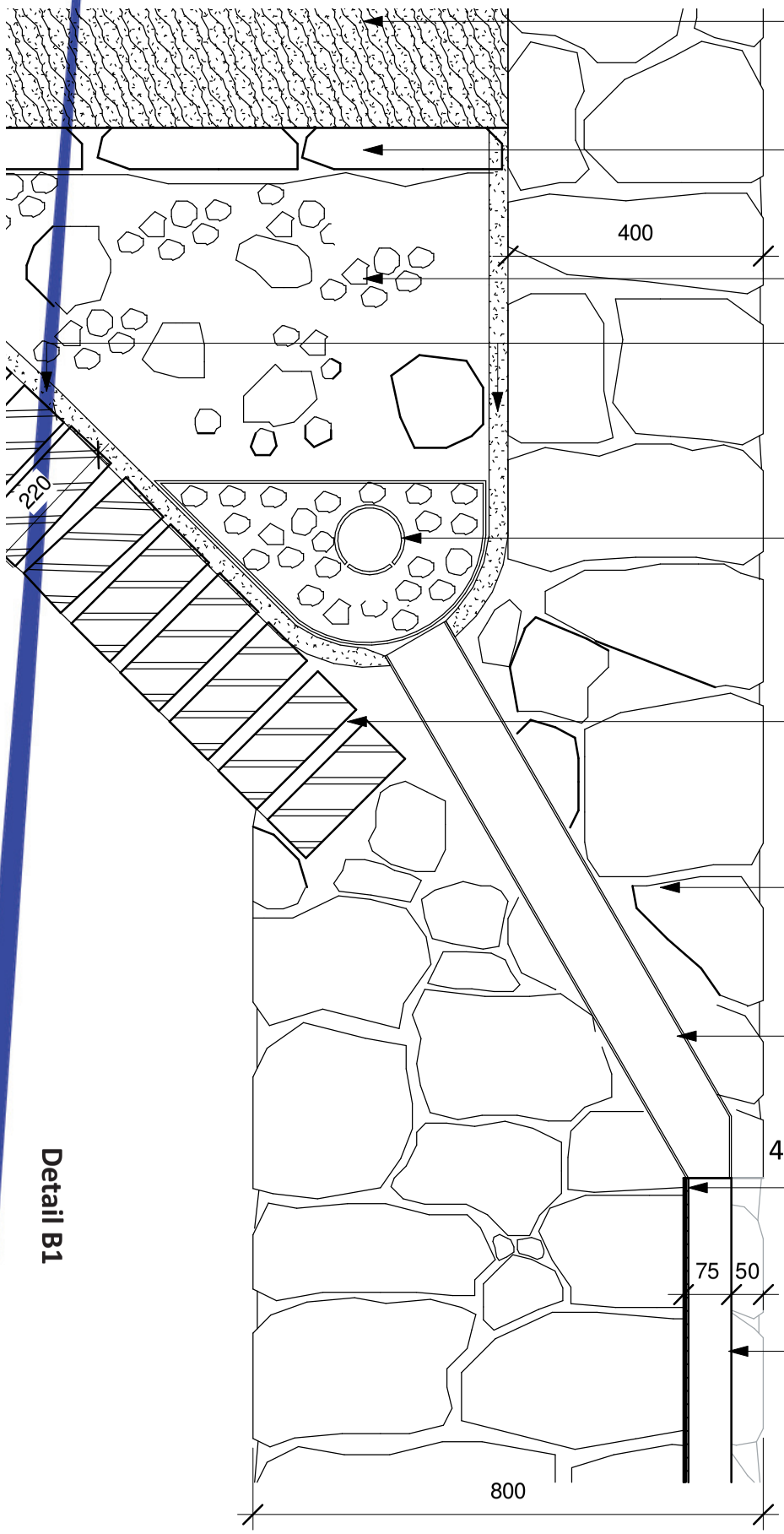



4000
4500
NOM 1200
1727500
STONE PARAPET WALL
CONSTRUCTED ON
ROOF EDGE
150x50mm SA PINE SLATS,
TREATED WITH 'TANALITH C'
TO FOLLOW ROOF CURVATURE.
TIMBER ENDS FIXED TO
BRICKWORK BY STEEL BRACKETS
TO ENGINEER'S DETAIL
BRICK VAULT ROOF BEHIND
Detail
C1
DRESSED STONE ARCH
'CAESARSTONE BLACKSTAR'
GRANITE TILES OR SIMILAR
TO ARCHWAY REVEAL
800mm WIDE 'KOPPIE'
STONE WALL.
STONE RECLAIMED
FROM SITE EXCAVATIONS
COURTYARD
OUTSIDE
400
320
800
EARTH FLOOR TO DETAIL
'CAESARSTONE BLACKSTAR'
GRANITE TILE AS THRESHOLD
BETWEEN FLOOR TYPES
1000mm STONE PAVED PERIMETER
AROUND BUILDING
NATURAL EARTH, FLATTENED,
COMPACTED AND CLEARED OF
LOOSE STONES AND DEBRIS
RUBBLE TRENCH
FOUNDATION
110mm ø PERFORATED PIPE
TO FALL AS PER CIVIL
ENGINEER'S DETAILS

Section C


SEALANT LAYER OF LINSEED OIL AND THEN BEESWAX
2 LAYERS OF SIEVED CLAY FINISH, FIRST LAYER TO DRY BEFORE APPLICATION OF SECOND LAYER
80mm COB (EARTH & STRAW MIXTURE) SUB-FLOOR
'CAESARSTONE BLACKSTAR' GRANITE TILES OR SIMILAR
100mm CLAY SLIP AND STRAW INSULATION LAYER
ALUMINIUM SLIDING/FOLDING DOOR FRAME ON BOTTOM RAIL TO SPECIALIST DETAIL
1000mm WIDE STONE PAVING SURROUNDING BUILDING
300mm CLEAN DRAINAGE GRAVEL
STONE FOUNDATION LAID IN CEMENT STABILISED EARTH MORTAR
WELL COMPACTED FLOOR BASE TO ENGINEER'S SPEC (93% MOD AASHTD)
CLEAN GRAVEL
100mm ø PERFORATED DRAINAGE PIPE LAYED TO FALL AS PER CIVIL ENGINEER'S DETAIL
100
350
350
5
30
47
80
100
300
NOMINAL 1200

Detail A1



RAMMED EARTH SEAT
TO ARTISTS' DESIGNS

STONE PLINTH LAID
IN CEMENT STABILISED
EARTH MORTAR

CLEAN DRAINAGE GRAVEL

+-30mm 'THERMO-SIM'
WATERPROOF/INSULATION
PLASTER

110 ø PERFORATED DRAINAGE
PIPE WITH 13mm STONE ALL
WRAPPED IN A4 BIDUM

'HYDRAFORM' EARTH BRICKS
AND CEMENT STABILISED
EARTH MORTAR FORMING
BARREL VAULTED ROOF

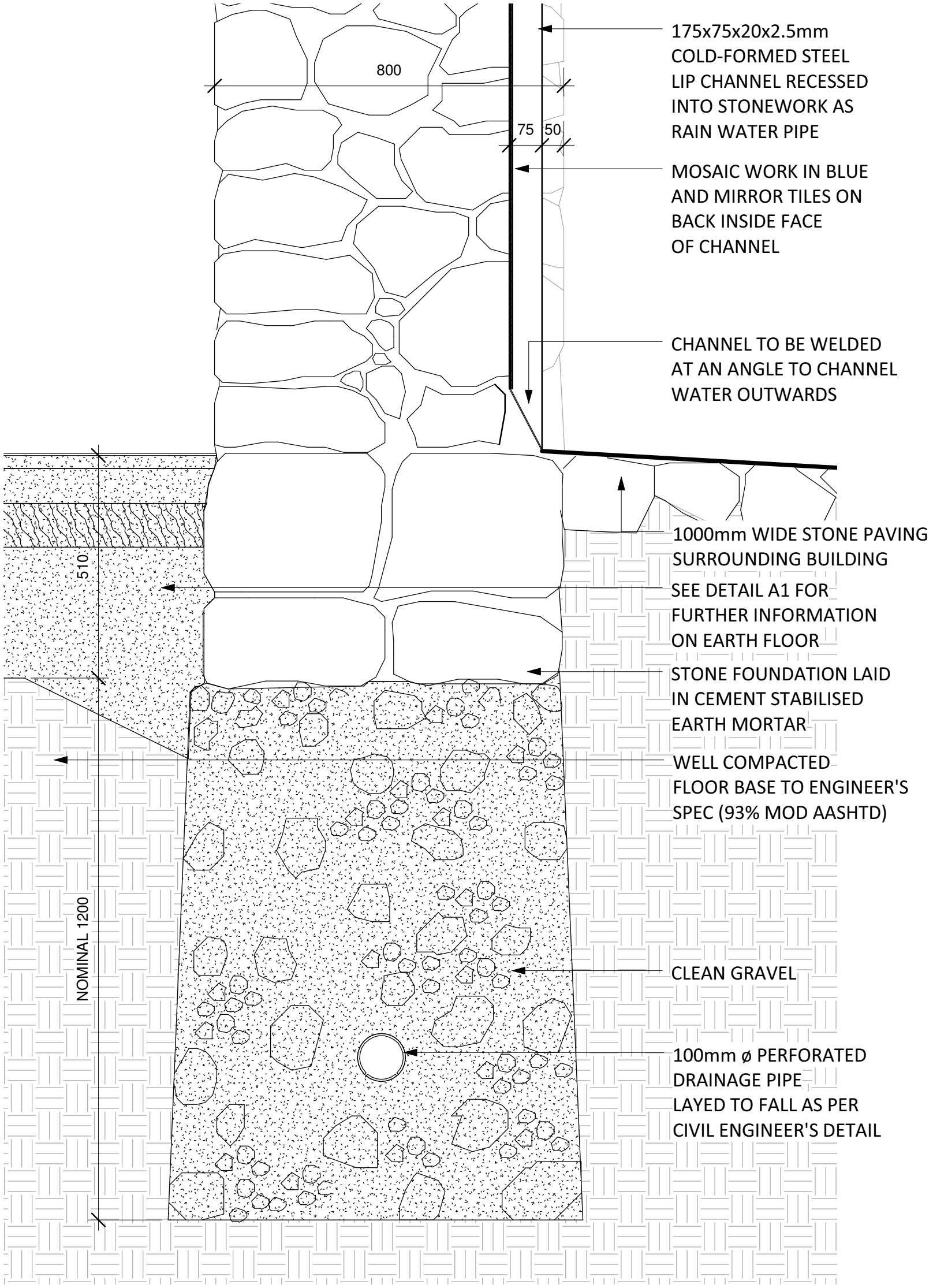
'KOPPIE' STONE WALL.
STONE RECLAIMED
FROM SITE EXCAVATIONS

110mm ø PVC
DRAINAGE PIPE BUILT
INTO STONEWORK

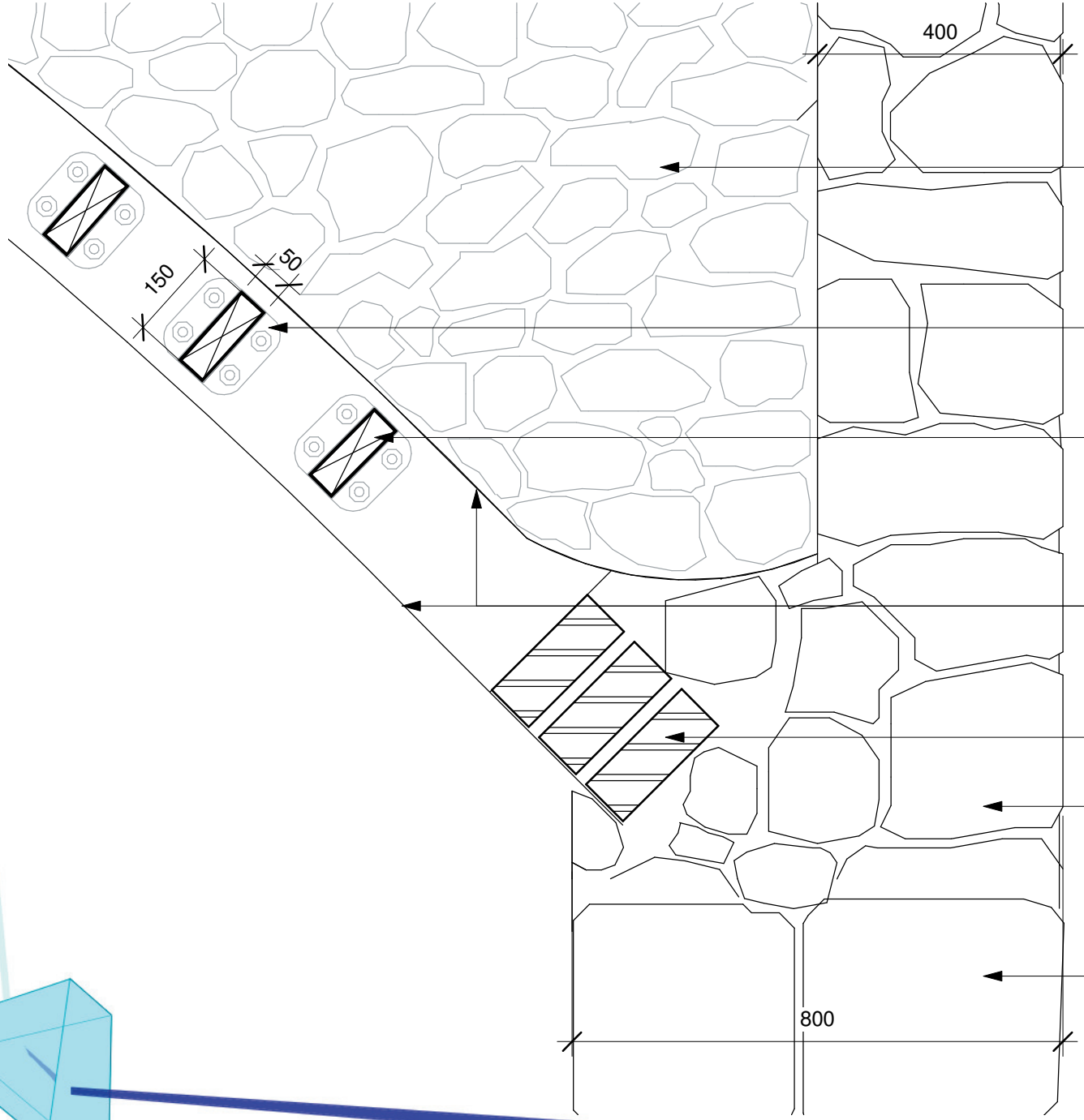
MOSAIC WORK IN BLUE
AND MIRROR TILES ON
BACK INSIDE FACE
OF CHANNEL

175x75x20x2.5mm
COLD-FORMED STEEL
LIP CHANNEL RECESSED
INTO STONEWORK AS
RAIN WATER PIPE

Detail B1


800
75
50
175x75x20x2.5mm
COLD-FORMED STEEL
LIP CHANNEL RECESSED
INTO STONEWORK AS
RAIN WATER PIPE
MOSAIC WORK IN BLUE
AND MIRROR TILES ON
BACK INSIDE FACE
OF CHANNEL
CHANNEL TO BE WELDED
AT AN ANGLE TO CHANNEL
WATER OUTWARDS
510
1000mm WIDE STONE PAVING
SURROUNDING BUILDING
SEE DETAIL A1 FOR
FURTHER INFORMATION
ON EARTH FLOOR
STONE FOUNDATION LAID
IN CEMENT STABILISED
EARTH MORTAR
WELL COMPACTED
FLOOR BASE TO ENGINEER'S
SPEC (93% MOD AASHTD)
NOMINAL 1200
CLEAN GRAVEL
100mm ø PERFORATED
DRAINAGE PIPE
LAYED TO FALL AS PER
CIVIL ENGINEER'S DETAIL

Detail B2



'KOPPIE' STONE PARAPET WALL. SUPPORTED ON ARCH BRICKWORK

STEEL FIXING BRACKETS TO ENGINEER'S DETAIL

150x50mm SA PINE SLATS, TREATED WITH 'TANALITH C' TO FOLLOW ROOF CURVATURE

LINE OF VAULT BEHIND

EARTH BRICK VAULT START

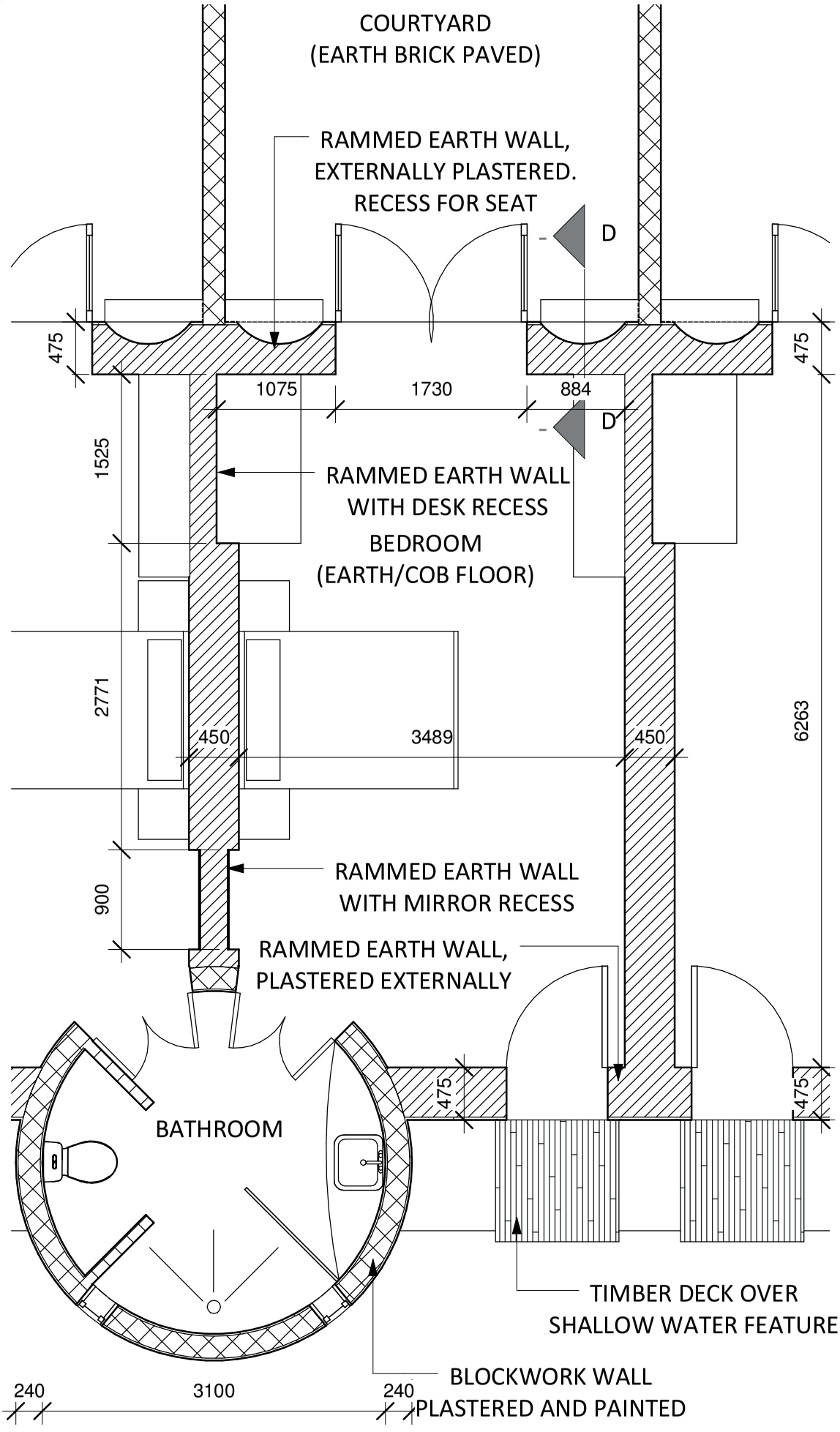
'KOPPIE' STONE WALL. STONE RECLAIMED FROM SITE EXCAVATIONS

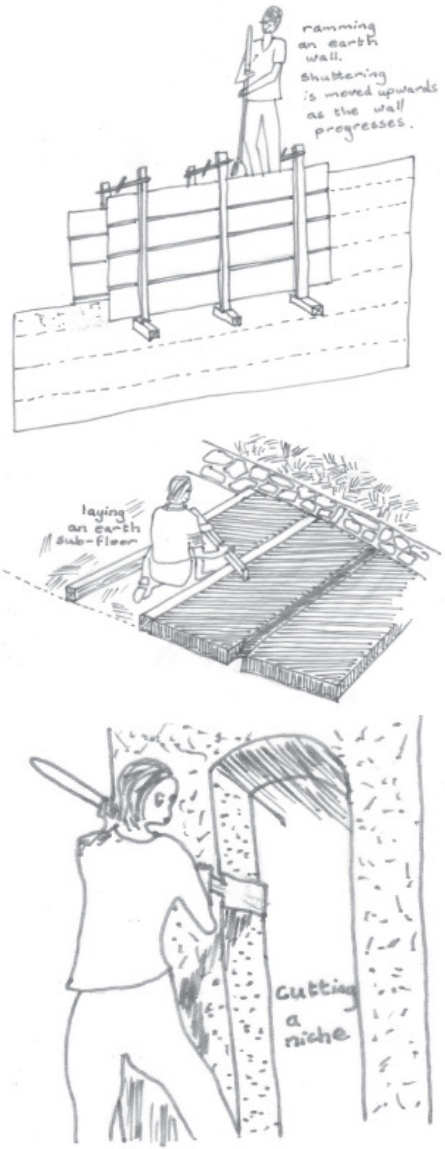
DRESSED STONE ARCH

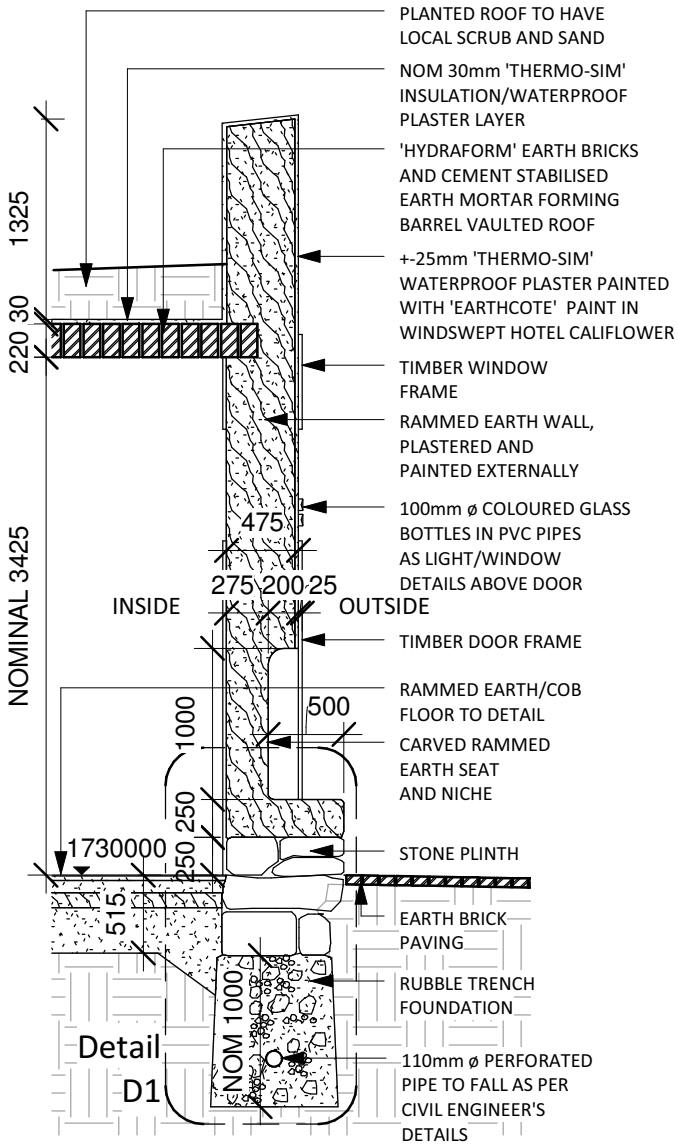
Detail C1



Private Courtyard behind Artists' Accommodation

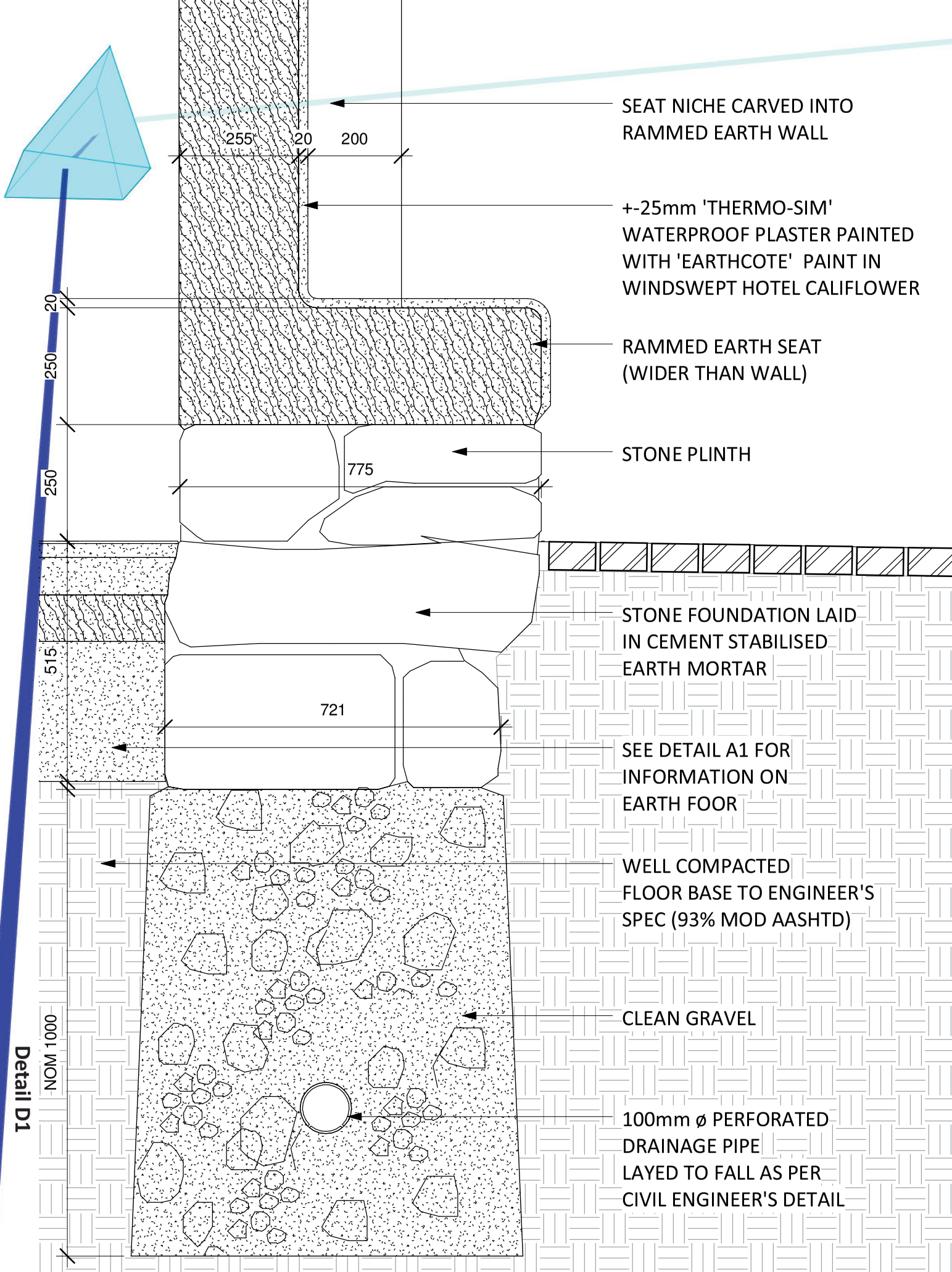

COURTYARD
(EARTH BRICK PAVED)
RAMMED EARTH WALL,
EXTERNALLY PLASTERED.
RECESS FOR SEAT
D
D
475
475
1075
1730
884
1525
RAMMED EARTH WALL
WITH DESK RECESS
BEDROOM
(EARTH/COB FLOOR)
2771
450
3489
450
6263
900
RAMMED EARTH WALL
WITH MIRROR RECESS
RAMMED EARTH WALL,
PLASTERED EXTERNALLY
BATHROOM
475
475
TIMBER DECK OVER
SHALLOW WATER FEATURE
BLOCKWORK WALL
PLASTERED AND PAINTED
240
3100
240





Section D

(with process sketches for building rammed earth walls, earth floors and for carving into rammed earth)


SEAT NICHE CARVED INTO RAMMED EARTH WALL
+-25mm 'THERMO-SIM' WATERPROOF PLASTER PAINTED WITH 'EARTHCOTE' PAINT IN WINDSWEPT HOTEL CALIFLOWER
RAMMED EARTH SEAT (WIDER THAN WALL)
STONE PLINTH
STONE FOUNDATION LAID IN CEMENT STABILISED EARTH MORTAR
SEE DETAIL A1 FOR INFORMATION ON EARTH FOOR
WELL COMPACTED FLOOR BASE TO ENGINEER'S SPEC (93% MOD AASHTD)
CLEAN GRAVEL
100mm ø PERFORATED DRAINAGE PIPE LAYED TO FALL AS PER CIVIL ENGINEER'S DETAIL
255
20
200
20
250
250
775
515
721
NOM 1000
Detail D1





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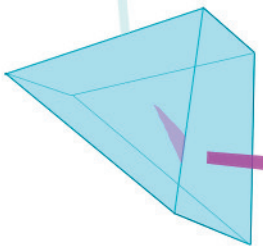
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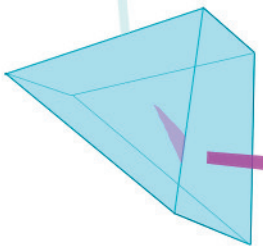
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