

The Phenomenological Interrogation of Light as Material Weight in the Visual Perception of Architectural Space

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I confirm that the word count of this thesis is less than 100,000 words.

Light within this thesis, refers to the interval of daylight between two nights.

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For P who gave me values in life, and for O who gave me life with value

Abstract

This thesis sets out to explore notions of an inherited memory of light upon the human perceptual interpretation of architectural space. These considerations are based upon literature review and practice exploration which indicate human visual perceptions ability to read the manifestation of form and visual weighting in light and shadow. These concepts are explored through the consideration of painted shadow in work by William Blake, Fra Angelico, the drawn representation of light in architectural design by Peter Zumthor and Vitruvius and installation works which investigate the interstice of passing time and light by Olafur Eliasson and Sian Bowen. Each chapter seeks to build consideration of the momentary impermanence in perception of changing light, based within the bounds of the diurnal sequence. The thesis is written from the point of view that observance of shadow light in coalescence with architectural form, engenders a response to space which is wholly based upon our biological relationship to light. Models in practice are used as measuring devices and tools for drawing attention to the detail of shadow form and the visual weight of light over an extended period. This practice emerged through thesis consideration of the painted depiction of light as a moment in time held static. As such it provided extensive opportunity to study the visual representation of light alongside its associated visual weight as clues and manifests which drive the perceptual appearance of architectural space.

Access to Contents

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Introduction

How light manifests within human visual perception arguably informs the perception of architectural space. This thesis's findings suggest an ecological reading of light by the body does inform our existential experience of space subject to light. The basis for this argumentation emerges from the notion that every architectural space, subject to light, includes cues which fundamentally influence how we respond to the space we experience. This response, I will argue, is in part influenced by the form filled manifestation of light in perception and by the biological relationship our bodies have with time in relation to the diurnal sequence.

Practice underpins the literature review using models as an interpretive tool. Individual models contain constructed elements which recreate as closely as possible, details of shadow light for consideration and reflection. Light in architectural space is in constant flux due to the diurnal sequence, and as such can be difficult to study because of this constant change. Practice models seek to recreate elements of shadow light but do so in a way in which they remain constant and largely unchanging. They are used to explore readings of light which can create a familiarity with the detail of light. This route has provided an ongoing interpretive resource within my current teaching of undergraduate architectural students. It has been successful in providing students with the opportunity to explore and become familiar with the perceptual differences of light. It has become an invaluable learning resource which provides students with an ability to recognise and evaluate how the nuances of light transform architectural space perception. This learning outcome within teaching broadens and matures how students approach their individual relationship with light through design.

My text situates itself within a phenomenological point of view suggesting that we make an understanding of light in the context of architectural space through our visual measurement of light's attributes. Testing and measuring these attributes through models by architects and artists has been an important historical tool for providing qualitative measuring theories and potentialities of architectural space. The architect's model measures our response to what we see. It can be both a theoretical measuring device for potentialities, but also an empirical measuring device for experience. It is important to iterate that this thesis's contribution to knowledge comes from

examination of the detail of shadow light edge which transposes as a fundamental contributor to the whole experience of space.

Chapter One considers literature which evaluates research from a number of different perspectives and points of view. The review intends to support my emerging argumentation that man encounters light in architectural space as a fundamental part of our boundedness to biological past and evolutionary history. The literature supports my claim that when man experiences architectural space subject to light and respond in a way in which cannot name but, nevertheless sense a change in our relationship to that space, our experience becomes phenomenological. This phenomenological response, I will argue, is based upon our inherited knowledge and entrainment to light. What man observes in architectural space is biological memory. Man, this thesis claims, has boundedness to light which intrinsically influences every moment of our experience of architectural space.

The architects Peter Zumthor and Louis Kahn have used words such as 'atmospheres' (Zumthor, 2006, p. 11) and 'presences' (Kahn, 2013, p. 26) as descriptive devices which seek to describe an intangible experience of space. A feeling generated from space experience. My literature review incorporates research from current biology, perceptual psychology, psycholinguistics, cognitive science, archaeology, consciousness and culture, neuroscience, neurobiology, experimental psychology amongst others which deepen our understanding of what these architects may be referring to. My rationale for choosing this method of approach as opposed to review of singularly architectural literature is based upon architectural literatures vagueness. The aforementioned terms have become all encompassing, hinting at pure phenomenological thought, without seeking to investigate what leads toward phenomenology.

In Chapter Two I will consider the visual representation of light through its painted form, I have titled this chapter '*Concentrated*'. This title comes from my point of view which considers light - in relation to the paintings discussed - to be evaluated as a moment in time: static and meditated upon. Chapter Two will consider one work by William Blake and two by Fra Angelico alongside writing by Cennino d'Andrea Cennini. The discussion within this chapter will be balanced and counterpointed with consideration of perceptual psychology research.

Through analysis of 'A Vision, The Inspiration of the Poet' by William Black painted circa 1819 – 1820, Chapter Two further introduces the suggestion that our visual perception of the world has been, and continues to be, an evolving instinct through biological evolution. This suggests that what we perceive, and what we experience through perception is governed and formulated by the way in which we see and experience light. This notion introduces the connection between our perception of space and that of our biology, i.e. how way we make sense of the spaces we encounter, and our experience of space, is tempered by how we have evolved a sense of the world over time.

The rationale for looking at paintings by Blake and Fra Angelico is to introduce a method of analysis which deconstructs how we initially read a painting. I explore how visual cues within a painting can confuse our inherited biological response to what has been painted. The reason for this is that it provides a vehicle which allows the chapter to introduce notions regarding how we experience space, and how this constructed experience is based upon the signature made by light against object form in space.

In Chapter Three I will build upon and develop my arguments from Chapter One and Chapter Two. The text does this by considering six drawings which connect conditions of light with space. The drawings relate to two projects some two thousand years apart. The principles considered by the drawings, however, contain similar, if not the same understanding of our relationship with light. These works were chosen as published documentation which present understandings of light which I suggest are based upon our known experience of how light can be in architectural space.

The drawings use mark making as suggestion of known experience. This claim is made in the first instance, upon analysis of the illustrative plan and section drawings for a Roman bath house proposal by Vitruvius within his 'Ten Books on Architecture'. The second project is considered through its design development drawings of the Therme, Vals by Peter Zumthor. The similarity in nature of these works is useful to my argumentation because the drawings inform us about the visual representation of light. The representation of the confluence between the darkness's of light as an imperative aspect how we potentially experience these spaces, and that of brightness.

The representation of these spaces builds upon an established relationship man has with what I have coined the ecologies of light. The ecologies of

light as a proposal are representative of the nature in light and the layering of subsequent constituents of light. The drawings provide visual cues to light as an imaginative and conceptual framework. They illustrate how we construct responses of inherited knowledge of light by evoking our biological memory of light. Through this evocation, we create images as context. These develop as architectural proposition which acknowledge light as its activator.

Chapter Four will explore work by two contemporary artists who introduce light and artificial brightness as material within their work. The first work I consider is 'Your Strange Certainty Still Kept' 1996 by Olafur Eliasson followed by 'Shift' 2006, by Sian Bowen. Each artists work, I will argue tests the interstitial experience of time, particularly the interstice between perception and experience. I will argue that the interstice of our response to light is located through the passing of time and our experience interlocked within the change of these moments. Through our experience of these works, the interstice of light informs the memory we create.

My focus upon the interstice of light is important for a number of reasons. Firstly, light is an ever-changing material. What we think we perceive as static or constant, is in fact always in flux. This flux is due to the diurnal sequence. We may not register this flux, however our perception of light does. Our visual perception is always adjusting to qualities of light, to brightness and darkness, which is natural and normal, but nevertheless it constantly informs, and updates our response to light. Therefore, when light changes during the diurnal sequence, the experience we have of light which we perceive and register of that architectural space informs our memory of the space.

It is through this chapter's considerations of the work of Olafur Eliasson that we can consider interstitial of change. His work creates a metaphor for the occurrence of change, unrealised, unseen but known. It encapsulates and draws attention to the relationship between that of brightness, darkness and passing time. When the chapter explores Sian Bowen's work it does so by recognising that the published images of 'Shift' utilise the flux of light in space as an aspect of the work itself. It has shaped its future memory through the communication exchange between it and the interstitial. It has situated light as a fundamental appropriator. As Eliasson projects the extended recognition of a characteristic moment and thereby extends this perception indefinitely, Bowen fixes the interstice to her work thereby facilitating the continuation of a moment beyond its happening.

During Chapter Five I reflect in part upon my Practice work exhibition at PLACE Gallery, Belfast, Fig. 1.1, 1.2 & 1.3, where I tested my arguments regarding the visual cues light creates within individual perceptual experience. The exhibition entitled 'The Value of Darkness', provided an opportunity for visitors to the gallery to spend time looking into the models and if they wished to, write down what they perceived. The exhibition contained 12 practice models located at different positions within the space, each facing different directions so the light entering the model space utilised both direct and indirect light.

the exhibition lasted for four weeks in May 2016, to correspond with a month-long arts festival in this part of the city. While the exhibition formed an important task for this research in placing my research models within a public context, it did not seek to develop any lines of enquiry from the exhibition. The photographic images and drawings of these models are illustrated at the end of this thesis.

This chapter also provides consideration of possible ways in the which visual qualities of perception have become instrumental in forming subjective responses to visual gradients and weighting. This chapter deepens our understanding of weights of light as naturally occurring visual qualities which present perceptual cues from which subjective visual presentation arises - the subjectivity of our spatial response. During this chapter I will explore the importance of our biological connection to light through the diurnal system and visual perception synchronising our circadian rhythm.

These arguments seek to draw attention to the innate functioning we individually and collectively have as mammals for the unconscious reading of the visual weighting of light. I will argue that we make sense of the visual world of light, through an impression of dimensionality which is sensed by the process of reading gradients of light. This awareness provides the shape and form which we experience. My text further builds upon the suggestion that we construct a phenomenological experience of architectural space through our innate and imbued visual consciousness of ecological light cues. These may contribute to our constructed space experience and the suggestion of visual cues being used to determine a response to light.

Considerations such as primary shape, environmental conditions, gradients and the interstices of light are, I argue, principal sources within our constructed response to the experience of light in architectural space. This

key observation is based primarily, though not exclusively upon interpretation made through practice investigations. The notion that light has a visual weight provides opportunity to consider the weight of light as an intrinsic, informative, and a natural consequence of why space appears perceptually as it does to us.

ONE

Bounded: A Literature Review

'For the rest of my life I will reflect on what light is'

Albert Einstein C. 1917 (Ghatak and Lokanathan, 2004, p. 31)

There are five key pieces of literature which underpin this thesis, and as such they form the framework from which the main body of the text my practice and the literature review has been extrapolated.

The first two works are, Zumthor, P. (2006) and Kahn, L. (2013) which provide the basis of the question from which the whole thesis emerges. What informs and drives our perceptual response to architectural space, and what are we responding to are key questions derived from Zumthor and Khan.

In order to begin making sense of how light is, the third book, Cennini, C. A. (1960) becomes important literature for beginning to understand how the painter can learn to represent light. In doing so this book interprets light with great sophistication and insight. Arguably for the first time a methodology of light interpreted its visual manifest from darkness to brightness.

Intuitive insight of light by man is suggested by my fourth key text, (Costa-Mattioli, 2008) as a memory of light. The notion that man has a biological coupling to light, therefore informs all interpretation and interpretive analysis we make of light without exception. This literature suggests an inherent knowledge which defines not only how we function in relation to light but also how we make sense of and are influenced by how light appears to us perceptually.

The thesis is written from a phenomenological point of view which sees the body, through an interpretation by (Merleau-Ponty, 2004) as the conduit or tool through which man filters and creates a reading of experiences and environments. In the case of this text the environment is architectural space. These five key texts as companions and reflectors of the body of literature consulted, have provided the framework for the body of text.

Literature revue seeks to demonstrate that 'atmospheres' (Zumthor, 2006, p. 11) and 'presences' (Kahn, 2013, p. 26) are used as evidence words to encapsulate perceptual experience by the architects who use them. As such it suggests that the biological coupling of man to light is strong, this thesis seeks to explore the notion that these words refer to the perceptual manifest of man's coupling to light in space.

The following literature review suggests that these evidence words are used to encapsulate a notion of perceptual evidence within linguistic holding, representative of an endowed human relationship to light. This endowment suggests that man's visual perception, having developed biologically in

coalescence with light, maybe informative to human spatial 'eidetic memory' (Costa-Mattioli, 2008, p. 875) as part of a 'long-term memory made from an experience' (Costa-Mattioli, 2008, p. 875) [See *Chapters 2,3 & 4*]

Key literature within Chapter Two begins with (Costa-Mattioli, 2008) in their consideration of a perceptual memory of light, this relates formally with (Ni, 2004) consideration of perceptions use of shadow cues, (Ramachan, 2008) (Casati, 2008) which can be observed to be shadow form. (Foster and Hankins, 2007) explore the unconscious use of shadow cues within perception, which reflects with startling clarity Cennino Cennini's thesis how to paint light. These points of view are related to (Baudrillard, 1996) and the texts understanding of the structural form of atmosphere, viewed consideration of (Colonnese et al, 2010) that light is our first perceptual cue. (Gadamer, 1985) and (Merleau-Ponty, 1964a) present light to be found within man's collective perceptual history, which (Wilson, 2000) binds to objective reality through perception, and which (Bonfiglioli, 2004) suggests is informative in the way shadow enlightens spatial recognition.

Within Chapter Three (Zumthor, 2011) provides the basis through which the drawn representation of light in design is explored within the considerations of (Casati, 2014) and (Kleffner and Ramachandran, 1992) regarding visual perceptions inherent understanding that light comes from above the horizon, and that architecture (Pallasmaa, 2009) and (Zeki, 2009) is evidential of light as aestheticized within human perception.

Pertinent literature within Chapter Four considers how consciousness considers the phenomenal within space, (Brentano, 1995), along with (Merleau-Ponty, 2004) and (Viola, 2003) in discussion of the role to which the body as the tool through which our perceptual experiences of light are manifest and through which we begin awareness of our perceptual response to light, counterbalanced by (Bowen, 2007) through discursive observation of the potential for our linguistic interpretation of text.

Key Literature in Chapter Five which provides the structure for argumentation begins with (Taylor, B. N. 2008) regarding our interpretation of weight aligned with (Cutting, Millard, 1984) interpretation of light through gradient. The discussion that darkness can be understood to be light is explored through (Kahn, 1967) and (Nandakumar, Torralba and Malik, 2011) in consideration of the perception of form in shading, tempered with (Merleau-Ponty, 1962) and (Sartre, 1973) in discussion of the pre-determination of perception, which links the text back to (Costa-Mattioli, 2008).

Our memories of light in relation to form are encapsulated within these ecologies of light. The context of light in architecture, is the binding relationship between light and object. This relationship, therefore, utilises and draws out man's descriptive nature. The phenomenological perception of architectural space may suggest a derivative of, and existence through biological endowment. This endowment is held within linguistic terms and is characterised within such fields of experience as perception, stereopsis, shadow and shadow edge recognition, left bias, depth perception, amodal completion, ecology of shadow, painted shadow and illuminated shadow.

In consideration of these ways of experiencing architectural space, it suggests that terms, such as 'atmospheres' (Zumthor, 2006) and 'presences' (Kahn, 2013) describe eidetic biological memory, a coupling one might say between man, light and perception. It is useful to differentiate at the beginning of this chapter the relationship which my practice research has with light and most of the literature reviewed. In this thesis I have only engage with light, whereas a high volume of the following scientific literature, explores light and shadow perception using computer generated image scenarios. Results and conclusions observed are using digital monitors, my research project only considered images made from the observation of light and recorded digitally. I have felt it pertinent to counterpoint scientific considerations with those coming from the arts, to counterbalance and temper points of view with similar subject matter. (Morganstern, Murray, and Harris, 2011) in their paper 'The human visual system's assumption that light comes from above is weak', advocate that, 'every biological or artificial visual system faces the problem that images are highly ambiguous, in the sense that every image depicts an infinite number of possible 3D arrangements of shapes, surface, colours, and light sources' (Morganstern, Murray, and Harris, 2011, p. 12551). To make sense of this, vision developed in man with a reliance on the assumption that 'light shines from overhead' (Morganstern, Murray, and Harris, 2011, p. 12551). This could be interpreted as a representation of the sun, therefore entailing light will always be perceived to come from above the horizon to man which they describe as a 'prior' (Morganstern, Murray, and Harris, 2011, p. 12551). (Morganstern, Murray, and Harris, 2011) further argue that 'the visual system combines light-from-above prior with visual lighting cues [projected shadow and conclude that] where, on average, light comes from overhead... there are large variations in lighting direction that are reliably cued by shading and shadows' (Morganstern, Murray, and Harris, 2011, p. 12551).

This can be interpreted as meaning that our perception of light also contains reflected and refracted light.

Architectural spaces often have numerous directional lighting propositions where light enters from different directions and provide 'variations in lighting directions' (Morganstern, Murray, and Harris, 2011). It has been established by (Ramachandran, 1988b) that the 'perception of shape from shading' is intrinsic to human vision and demonstrates 'that the human visual system has a top-down lighting bias in its perception of 3D shape' (Ramachandran, 1988b, p. 258). In addition to this (Nandakumar, Torralba and Malik, 2011) submit that 'the bottom-up perspective that focuses on texture, shading and contour' (Nandakumar, Torralba and Malik, 2011, p. 257) implies that the perception of shapes within our visual field relies upon very reduced information in order to formulate and understand shape and in addition suggest that 'humans can use contour alone to accurately perceive the shape of a selected artificial stimulus' (Nandakumar, Torralba and Malik, 2011, p. 257).

This suggestion correlates with previously proposed hypothesis by (Gerardin, de Montalembert and Mamassian, 2007) which 'proved that there is a left-lit bias in addition to a top-down one [bias]' (Gerardin, de Montalembert, and Mamassian, 2007, p. 258). The 'left-lit bias' (Gerardin, de Montalembert, and Mamassian, 2007) is a reference to the perceived course of the sun across the sky as the earth rotates – sunrise being in the East and sunset in the West. This hypothesis directly connects the evolution of vision to climatic conditions.

One might argue that as a natural consequence of this inherent knowledge it can be seen to influence how relationships to the world are then presented. For instance, (Chen, 1999) in the paper entitled, 'The Temple of Guanyin: A Chinese Shadow Play', introduces the historic relevance of the left-hand side of the stage within Chinese classical theatre. (Chen, 1999) describes that 'in classical Chinese theatre... the left side of the stage to the audience represented the entrance from the outside, and the right side represented either the exit or the door... thus most of the shadow figures moved from left to right' (Chen, 1999, p. 64). It's reasonable to argue that these entrances and exits are a reference to sunrise and sunset, and as such one might reasonably suggest that within Caravaggio's 'The Calling of St Mathew' 1593 – 1610, the time is sunset.

(Cutting, Millard, 1984) provide consideration of the perception of angled gradients within human vision. The visual perceptions of angles, according to this research, are determined by shadow shape made in relation to object form. They contend, that shadow 'gradients are the sources of information that grade, or change, with visual angle as one looks from one's feet upward to the horizon... [and provide] the phenomenal impression of flat and curved surfaces' (Cutting, Millard, 1984, p. 198).

Stereopsis, relates to the visual perception of the depth of field within human vision, (Trombley, 1996) uses this term to describe what he refers to as 'Stereo Prints' (Trombley, 1996, p. 310) in which shadow is projected upon a wall. He describes the use of tubes, within the eyes biology, for each eye to observe. Through the process of looking with relaxed vision at shadow, (Trombley, 1996) suggests that, 'the shadow takes on solidity by seemingly occupying a spatial position beyond any other object' (Trombley, 1996, p. 310). I suggest, that this signifies that the form which shadow naturally carries, has the capacity to be seen as an aspect, separate from the wall, and as an entity in itself.

As such, shadow characterises an important category with visual perception. What is not said, however, within this paper, is that the use of the term 'Stereo Print' misleads. This is because the two prints used as examples within the paper were different from each other. The images possibly signify the rotation of the earth, demonstrating the object representation made by shadow, change position in relation to the sun. This incremental change, and the difference between the images, suggests the manifestation of new 'spatial position[s]' (Trombley, 1996, p. 310).

One/One Interpretive Shadow

Exploring 'The Shadow Only: Shadow and Silhouette in Late Nineteenth Century Paris', (Forgione, 1999) considers the notion of shadow 'inconsistency' (Forgione, 1999, p. 490) by artists. The use of interpretive shadow within painting, suggests 'that shadow had become an element to manipulate at will, for purposes other than illusionism' (Forgione, 1999, p. 490). In analysis of its use, the instances in which shadow leads to 'silhouette' (Forgione, 1999, p. 491) is where shadow becomes another surface, an object, if you like, in its own right - not the projection of another object in light. This idea is exemplified for (Forgione, 1999) in Seurat's 'Night Stroll' 1887-1888. Within this painting the author suggests, that the 'palpable quality of the atmosphere that surrounds her [the figure in the work] seems

to thicken and slow both her progress and our perception of the image' (Forgione, 1999, p. 505). This use of shadow by Seurat demonstrates our innate response to, and inextricable consciousness of, the role which shadow plays in our response to the visual environment being formally representative of eidetic memory.

The importance of Stereopsis depth perception is considered further by (Bacon and Mamassian, 2002) in relation to binocular vision, which is found in animals which have two eyes. This research posits the notion that it is thought to be through the mechanism of this vision that the perception of 'depth' (Bacon, Mamassian, 2002, p.1037) within an environment can be seen. Their research suggests, however that 'there is more to stereopsis than point-by-point matching' (Bacon, Mamassian, 2002, p.1037) and that depth perception can 'be assigned in the absence of binocular correspondence, namely amodal completion' (Bacon, Mamassian, 2002, p.1037).

Amodal completion refers to the ability of visual perception to complete aspects of a visual scene that 'is partially occluded by another' (Bacon, Mamassian, 2002, p.1037). An example of this would be our visual perceptions ability to complete depth perception of an architectural space. In practice this would occur when aspects of the scene we are experiencing are occluded behind another object. The role amodal completion plays is that it allows the perceptual generation of the depth of this space to be constructed cognitively without our vision being aware of every part of every form within the space. In this process we make an educated guess based upon our past experiences. Amodal completion is the term used for the process used to complete our visual processing of objects in space. (Bacon and Mamassian, 2002) suggest that this can be 'achieved monocularly' (Bacon, Mamassian, 2002, p.1037) and conclude that 'surface interpolation, like figure-ground processing, is a fast, first stage, low level process that is not dependant on direct binocular matching' (Bacon, Mamassian, 2002, p.1044) advocating that the process is not reliant on stereopsis. This suggests that over time we become accustomed to reading the manifestation of a scene and the signs of light therein.

Within the proposition of amodal completion, 'shadow correspondence' (Mamassian, 2004 p. 1279), is the consideration of the how images are processed within our visual system. (Mamassian, 2004) considers the importance of both the 'gradual luminance ramp' (Mamassian, 2004 p. 1279), which is how we see the change from brightness into darkness and

the gradual gradient of change within shadow itself. The 'gradual luminance ramp' signifies the 'light source position' (Mamassian, 2004 p. 1279) which is the perceived direction within an image of space, which provides an indication of where the light is coming from. It is usually and most often indicated by reading the direction of shadows in the image. Through this we make a judgement as to where light appears to be coming from. 'Impossible shadows' (Mamassian, 2004) present a representation of light which is suggested by shadow form direction from an object whose shadow does not logically correspond to the object form. (Mamassian, 2004) highlights the surrealist painting 'Indefinite Divisibility' by Yves Tanguy as well as his own graphics to demonstrate that 'impossible shadow' (Mamassian, 2004) scenarios are 'inconsistent with a unified light source' (Mamassian, 2004, p.1288).

This inherent functioning in how visual perception makes sense and therefore provides meaning to what and how we see, allows us to connect the nature of how vision functions in relation to what is *of* nature - light. This means that our biological connection to light, through which we have learnt to see, makes sense of the environmental conditions we experience.

According to (Bauer, 1987) 'Experimental Shadow Casting and the Early History of Perspective' presented particularly in relation to the Baroque architect Biagio Pelacani, who was a resident in 14th Century Parma, was the first practitioner to trace 'the shadow cast by an irregular body in order to trace its perspective' (Bauer, 1987, p. 214). This is particularly interesting as it's a further development from Pliny the Elder, during the 1st Century AD who, within Natural History, introduces the notion of the outer edge of the shadow cast by man being drawn around, which became the first representation of man, made by man. Biagio Pelacani's work leads to the tracing of objects in light, by man, which have been constructed by man. Stereographic projection of an 'irregular body' (Bauer, 1987) relied upon an understanding and consciousness of the differing angles and projections of the many points made along the edge of a drawn object. This is opposed to the simplicity of straight edged objects. The representation of the human body, although also in perspective, was made through shadow projection without the layering of angles. However, Bauer uses a description by Benvenuto Cellini of shadow casting using a life model which touches upon the subtlety and importance of shadow edge experience. In the words of Cellini, 'we set a light, neither too high, nor too low, nor too close, but with that discretion which revealed to us what was most beautiful and most true... we quickly outlined the shadow' (Bauer, 1987, p. 215). Bauer also presents

the dilemma of shadow edge clarity that Cellini purports to. He would have undoubtedly discovered this while investigating shadow clarity. Shadow clarity is determined by the proximity of light to said object, and/or object to projection surface. Bauer continues his discussion,

'drawing from shadow proves difficult for two major reasons: the incompleteness of the image and its quality. A shadow provides only a silhouette; it corresponds to what Alberti calls circumscription, but fails to indicate, as Cellini aptly notes, the division of the parts within the outline. More critical perhaps is the nature of the image produced by shadow casting. Instead of being sharply defined and easily traced, the edges of shadows are often indistinct or confused, and it can be difficult to determine exactly where the penumbra ends, and the umbra begins' (Bauer, 1987, p. 215).

Bauer's analysis of shadow leaves out an important fact within shadow analysis, which is time. In chapter three, I shall discuss the interstice of time in relation to shadow light in detail. The 'circumscription' (Bauer, 1987) reflects (Chen, 1999) discussion regarding the relationship shadow light has with presentation seen within shadow plays. Immortals, according to Chen, were carried by a cloud, 'the patterns on this cloud cast a beautiful shadow that changed in size and clarity, depending on the distance of the piece [the cloud] to the light and the screen' (Chen, 1999, p. 66). This demonstrates knowledge of the relationship between light, object and shadow as Cellini describes, our vision interprets the relationships through these manifests. The meaning of these presentations comes through our experience of light in time. In 'The Perception and Recognition of Natural Object Shape from Deforming and Static Shadows' (Norman, Dawson and Raines, 2000) introduces the concept of the 'informativeness of shadows for the perception of object shape [where] observers viewed shadows cast by a set of natural solid objects' (Norman, Dawson and Raines, 2000, p. 135). In making this observation they observed that,

'there are many variations in the in the specific 2D shape of a cast shadow that depend on a wide variety of factors independent of the object itself' [the paper seeks to consider a fundamental question] 'is the human perception and recognition of shape invariant over such complex transformations as induced by movements of environmental light sources'. (Norman, Dawson and Raines, 2000, p. 137-138)

Architectural space undoubtedly contains 'complex transformations' (Norman, Dawson and Raines, 2000) of shadow, which are wholly connected to the diurnal sequence. Enquires into the relationships man generates in perception can be, 'induced' (Norman, Dawson and Raines, 2000) by the changing climatic conditions and its resonance with our experience of architectural space. Indeed, this paper concludes by questioning how does this impact upon human experience, and asserts that 'the orientation of the light source casting the shadows was also varied [time] leading to further alterations in the shape of the shadows' (Norman, Dawson and Raines, 2000, p. 135).

As the source of light changes position the complexity of the manifest relationship between object and source also changes. This sequence will deform, stretch, elongate, shorten, vary the angles and density of percept. In recognising this, the paper acknowledges the 'measure [to which the] human observer's ability to discriminate and recognise naturally shaped objects from their shadows [and is able to] examine in more detail the perceptual effects of [these] changes in the position of light sources to compare discrimination and recognition performance for static and deforming shadows' (Norman, Dawson and Raines, p. 138) This consideration of how shadows deform and change recognises the directional change of light laterally, and our innate perception of this change.

Published in the journal *Perception*, (Casati, 2007) considered what he states to be the 'basic rule of the ecology of shadows [is] that that the cast shadow of object A cannot be hidden by another object B covering the shadow of A' (Casati, 2007, p. 1849). This observation made of a children's play park slide which had a frosted shadow represented as object B. The occluding shadow of Casati's body, presented as object A. The visual perception of his shadow 'appear[ed] to pass under object B' (Casati, 2007, p. 1850). His observation of the frosted texture of the slides shadow appeared to have a different surface texture because of the previous night's freeze and therefore appeared different to that of his own shadow on the frosted ground. What Casati presents in this paper is an interesting consideration of the nature of shadow texture and therefore its recognition by our vision. (Casati, 2012) is a paper entitled 'Some varieties of Shadow Illusion: Split Shadows, Occluded Shadows, Stolen Shadows and Shadows of Shadows'. This paper provided consideration of the juxtaposition between shadow in relation to the object from which it manifests and suggested that shadows are subject to 'preference rules for segmenting the visual scene' (Casati, 2012, p. 357). They amounted to the notion that shadows are

subject to convention, and that convention is connected to the physical world - to the objects from which the shadows are made.

Shadows, (Casati, 2012) contests, 'are asymmetrically related to the concrete objects that cast them' (Casati, 2012 p. 359). More radical, is the suggestion of 'shadows of shadows' (Casati, 2012, p. 359). This phenomenon, relates to an understanding of how light is, and is arguably the classification of shadow as light, reflectance or indeed of possibly an expectation of a 'filled' (Casati, Sorenson, 2012, p. 1276) shadow body, a reconsideration of (Kleffner and Ramachandran, 1992). The hypothesis by Casati, that the visual perception of objects is based upon two primary summations, such as 'uniqueness of the light source and light from above' (Casati, 2014, p. 351) was reconsidered. The question this raises is, why the visual system can make a functional understanding of the scenario presented?

In the case of this discussion, a re-evaluated consideration of (Kleffner and Ramachandran, 1992) illustration of round convex and concave inversions is made. The (Casati, 2014) suggests that the visual system can tolerate the absence of cast shadows within situations where they ought to be present, based upon an inherent understanding that light comes from above. Casati suggests that 'cast and self-shadows' (Casati, 2014, p. 351) are processed separately within the visual system, therefore leading to this understanding of shape from shading. However, I would argue that Casati has developed his consideration of these round inversions through the presentation of them as very shallow shapes not capable of making a projected shadow. Therefore, in this situation, only self-shadow can be present. This may explain why they present as they do, strengthening the merit of (Kleffner and Ramachandran, 1992) regarding our ecological response to light. In relation to this question I suggest it requires further investigation using ecological light and physical form as opposed to computer generated imagery.

One/Two Judgement

In (Braunstein and Andersen, 2004) the suggestion that 'observers can judge the position of an object in a scene that is not resting on the ground if there are intermediate objects between the one being judged and the ground surface' (Braunstein, Andersen, 2004, p. 1305). This presents a very important consideration. It highlights the importance with which shadow form is utilised within the visual interpretation of objects, and the objectivity which perception of shadow plays in the human visualisation of objects in space.

The research bases itself within the framework of ‘common motion between the object and the shadow’ (Braunstein, Andersen, 2004, p. 1307). This motion means that the source of the light moves independently from the object. This movement occurs within the diurnal sequence – the mechanism of primary light. (Braunstein, Andersen, 2004) conclude that,

‘if a shadow is to determine the perceived position of an object within a scene, the observer must associate the object with the shadow [these] results indicate that the motion of the shadow is more important than the correspondence between the size of the object and the size of the shadow in determining the perceived position of an object’ (Braunstein, Andersen, 2004, p. 1317).

How architectural space appears within human perception, may be conditioned by the modality of light to which the space is subject. (Pont and te Pas, 2008) explore the uncertainty with which visual cues inform object recognition and investigate the notion that ‘the appearance of objects depends on their material, shape, and on the illumination conditions’ (Pont, te Pas, 2006, p. 1331) at the time of perception, which means that ‘object appearance provides us with cues about the illumination and the material’ (Pont, te Pas, 2006, p. 1331). This is an important observation because it explores the duality with which visual mechanisms provide detail and interpret reliance’s within perception which overlap exposing the dilemma of percept. (Pont, te Pas, 2006) surmise that it may be ‘probable that the shadow edge location is used as a cue to the illumination direction [and that] shadow edge position was used as a cue to perceived illumination direction’ (Pont, te Pas, 2006, p. 1343). The ‘ecological circumstances [of] shape-from-shadow’ (Kennedy, Bai, 2004, p. 664) through which mammalian vision has evolved, implies the notion that ‘a border-polarity hypothesis about a black line at a shadow’s border’ (Kennedy, Bai, 2004, p. 664) exists. This existence provides the ability for human perception to recognise the image of a face made through the combination of ‘illuminated regions’ (Kennedy, Bai, 2004, p. 653) and ‘dark parts [which] depict shadow’ (Kennedy, Bai, 2004, p. 653).

This action correlates with what (Baxandall, 1995) termed within ‘Shadows and Enlightenment’, as ‘local [or] relative deficiency’ (Baxandall, 1995, p. 2). Further to this, (Kennedy and Bai, 2004) suggest that the ‘luminance contour is the shadow’s border’ (Kennedy, Bai, 2004, p. 653) which visual perception uses to make sense of what it perceives. This ‘border’, which is seen within shadow is made through ‘collimated and hemispherical diffuse illumination’

(Pont, te Pas, 2006, p. 1334). As such it provides the values between shadows in architectural space, which is an important point as shadows provide us with key processing sequences within space.

These ecologies are 'spatially separate signals [that] are integrated by the visual system' (Gilchrist, Delman and Jacobson 1983, p. 248). This suggests to me that our unconscious processing of spatial layouts, must consider 'border polarity' (Kennedy, Bai, 2004, p. 653), and the edge of shadows. Doing so enables 'shape-from-shadow perception' (Kennedy, Bai, 2004, p. 653), to further influence our experience of space, as a fundamental in shaping experience.

'Emmert's law [according to Bross, 2000] states that a retinal image is proportional in size to the distance of the surface it is projected upon' (Bross, 2000, p. 1385). As such, all visual perception produces retinal images. Retinal after images, are the recognition of previously observed objects which have been projected on to the retina during vision. These are seen as colour shapes or form when we close our eyes or experience zero light conditions quickly after experiencing the visual perception. However, retinal after images are also naturally present during vision, and as such are constantly overlapping and changing as a natural consequence of what perceptions we encounter. We often only become aware of them when we close our eyes. Because of this (Bross, 2000) has proposed that there is a 'close connection between the visual and tactile modalities' (Bross, 2000, p. 1385) of the characteristics of what we experience, which he aligns with the work of George Berkeley. Berkeley suggested 'that visual space and object perception our derived from our ability to relate to and manipulate things manually' (Bross, 2000, p. 1385). Therefore, we 'relate' (Bross, 2000) to the spaces which we experience through visual perception, and we 'manipulate things manually' (Bross, 2000) through Emmert's law as an unconscious, but fundamental evolutionary consequence of the experienced retinal image.

In advancing the suggestion that part of the human visual perception and motor system, (the mechanism of sight) both rely on shadow as instrumental influencers of this. Their study used the 'congruent condition [and] incongruent condition' (Bonfiglioli, Pavani and Castiello, 2004, p. 1291) of the cast shadows of objects. This research achieved a distinction between the two notions by suggesting that the 'congruent condition' (Bonfiglioli, Pavani and Castiello, 2004) used objects 'with their own natural cast shadow' (Bonfiglioli, Pavani and Castiello, 2004, p. 1291) and 'incongruent condition' (Bonfiglioli, Pavani and Castiello, 2004) when objects used 'the

cast shadow of a different object' (Bonfiglioli, Pavani and Castiello, 2004, p. 1291). Participants in this research had to identify individual objects as an exercise in perception and also to reach for and seize the objects as a motor system exercise. The study concluded that 'cast shadows did not influence identification of 3D objects, but affected movement kinematics, producing distractor-like interference, particularly on movement trajectory [within] incongruent' conditions (Bonfiglioli, Pavani and Castiello, 2004, p. 1291). This indicates that shadow perception influences our analysis of depth judgements of objects we see. Further to this their work acknowledges that our,

'visual system has evolved in order to be able to recognise objects irrespective of the features of their variable, unstable, cast shadows, and for this reason is immune to them. In contrast [to this] shadows are potentially informative as to the spatial layout of the scene' (Bonfiglioli, Pavani and Castiello, 2004, p. 1302).

This interposes and further strengthens the role to which an eidetic memory (Costa-Mattioli, 2008, p. 875) of light influences our complex relation to the experience of light in architectural space. In (Kingdom, Beauce and Hunter, 2004) the consideration that shadow does not have colour, but rather that it lifts the chroma (the purity measurement of colour value, according to the Munsell Colour System) out of existing colour as a 'potential cue for distinguishing shadows from reflectance variations is colour [and] that the visual system exploits inbuilt assumptions about the relationships between colour and luminance in the natural visual world' (Kingdom, Beauce, and Hunter, 2004, p. 907). Further to this they suggested that, 'one of the visual cues used by the visual system to identify shadows is colour [which is] consistent with the idea that the human visual system has inbuilt assumptions about the origin of colour luminance relationships' (Kingdom, Beauce, and Hunter, 2004, p. 913).

This notion that the chromatic change in colour of objects, with part coverage by shadow, enables the visual system to recognise the chromatic change as the signifier of shadow, is significant. This is because it suggests 'that colour vision... evolved primarily to help animals discern shadow... with regard to the primary advantage of making chromatic distinctions' (Kingdom, Beauce, and Hunter, 2004, p. 913). This paper has significance and is particularly important to this research, because the visual perception of everything that we see is being determined through an evolutionary link.

This is the link between shadow, made by objects occluding light, and our human vision. This vision is determined by a process of reading the cues made through these occlusions, which is part of our experience of space. An aspect of this evolutionary process of chromatic distinction may have been for the benefit of numerous survival outcomes, but as part of an interpretive process, which we use to explore our response to space, must also be pertinent.

As an interpretive process, the Herman Grid observed to be a black grid over a white background, characterised by (Vergeer and Van Lier, 2010), to 'exhibit lightness differences at the intersections... where crossing white bars on a black background show dark patches at the crossings' (Vergeer and van Lier, 2010 p. 1565), explores the possibility that peripheral vision is the mechanism through which we visualise these occurrences. Their research suggests that 'the dark spots are best seen in peripheral vision' (Vergeer and van Lier, 2010, pp. 1575-1576), because of 'radiating edge hypothesis' (Vergeer and van Lier, 2010, p. 1576). This hypothesis by (Vergeer and van Lier, 2010) relates to a consideration that the 'Herman Grid is caused by radiation from dark/light edges between the squares and the intermediate bars [and that the] black edges radiate darkness on their dark side and lightness on their light side' (Vergeer and van Lier, 2010. P. 1576). The characterisation of the Herman Grid as a function of experiencing vision is similarly discussed by (Colonnese et al, 2010).

Their work provides developing understanding of the connection between light responses in [the] retina...[which] increase... the number and strength of synaptic connections and change in neuron excitability required for the generation of mature [and] spontaneous signal processing... these developmental changes interact to shape sensory responses' (Colonnese et al, 2010, p. 480). The relationship between the functional experience of light, by new born babies is inferred as the explicit instigator and primary building block in the development of visual sensory processing. It establishes light and its relationship with the object world, as a critically fundamental element in the processing of human experience. This observation of the manifestation of light against object is the mechanism through which insight can be gained.

In contrast to (Kingdom, Beauce, and Hunter, 2004), James Turrell, the American artist speculates that shadow can be encapsulated within light. In an extract for his photographic work 'Music for Mendota' (1970-71), in which he provides citations, almost like the line to a play which accompany each

individual photograph, he speculates that 'the grain (of light) inside shadow becomes lushly coloured' (Clark, R. 2013, p.91). Through the action of closing the openings which have allowed the light into the spaces of these photographs, Turrell suggests that 'soft darkness envelops' (Clark, R. 2013, p.91).

Turrell has 'embraced light as a medium' (Clark, R. 2013, p.91) through which light has become physical having a totality which is all encompassing. Turrell expands upon this, 'We generally use light to illuminate things, but I was interested in the thingness of light, as a physicality...I want to have a work that is light, so you are looking at light, not something light illuminates. Light itself becomes the revelation. (Clark, R. 2013, p.91) Referring to Turrell's work known generically as a 'skyspace', Clarke describes how these works 'change with light and weather conditions throughout a given day and are most dramatic around sunrise and sunset' (Clark, R. 2013, p.93). Turrell expands upon this thinking while referring to his work 'Music for Mendota', suggesting 'the piece is performed by events that occur in the sky' (Clark, R. 2013, p.93). While using light as a medium the skyspace is the frame for the work only, the artist seeks no control or manipulation beyond its setting, the motion of its subtlety is outside or beyond being fixed.

Similarly, (Weis, 2012) describes shadow as, 'the cut that light makes of the surroundings' (Weiss, 2012, p. 86), questioning the meaning of shadow and its uniquely esoteric role with society. He expands further, questioning, 'does the shadow only exist with respect to the light, as an unobtrusive effect of the conjunction of things. Does the night cause all the shadows to disappear, or does it transform everything into shadow?' (Weiss, 2012, p. 87). These distinctly philosophical and to an extent rhetorical questions seek to penetrate how shadow is to man. Weiss touches upon the preciseness with which light can facilitate or purport to facilitate how things really are, or are at least perceived to be.

The conditions to which we experience the contextualisation of materiality in relation to light, is suggested as best observed at different times and in different light conditions. (Weis, 2012) continues, 'in order to appreciate the colour of a particular piece of celadon, you need to view it at ten o'clock in the morning on a beautiful sunny day in the autumn, oriented toward the north, and scrutinized by the light penetrating through a solitary window covered with paper [possibly shoji paper]' (Weiss, 2012, p. 88). The choice of material being referred to in this example may not be critical, however it presents a careful and considered appreciation of the role in which objects;

time, climatic conditions, season, orientation, window aperture, space and the manipulation of the source light all coalesce within a single percept. This attention and recognition of how light is and that it can be subject to change in relation to materiality informs our understanding of experience. In this experience, shadow perception is a physical alteration of the body to the conditions of light in space. (Da Costa Kaufmann, 1975) considers the changes in the action of the eye to the apprehended scene by describing how,

'the eye adjusts to the brightest light in the field of vision by dilating or contracting the pupil, in very bright daylight it may contract the pupil to a level where enough light is let in to see, but not enough to produce a perceivable contrast of light in what is observed to notice a difference in light and shadow' (Da Costa Kaufmann, 1975, p. 259).

Da Costa Kaufmann additionally links the writing of Cennino D'Andrea Cennini and his contention that the artist should, when painting spaces, seek to 'give relief to your figures... according to the arrangement of the windows which you find in these places, for they give you the lighting... whichever side it comes from, apply your relief and shadow according to this system' (Da Costa Kaufmann, 1975, pp. 259 - 260). This recommendation to the artist may seem intuitive to us today, however, in relation to making sense of what we perceive, in relation to the space we are in, the text of Cennini highlights the necessary amalgam of learnt, reasoned and formulaic process which have arguably developed into key ways of analysis.

One/Three Embodied

As such these points of view have influence, so it may be useful to consider several points of view from outside the natural sciences. Following on from this early consideration by Cennini, (Miwa, Itai, Watanabe and Nishi, 2011) express consideration of the nature of the body of shadow being created within theatre. They suggest that within the nature of space, an 'important element of shadow is that they are always connected to bodies. A body always casts a shadow, yet we are often unaware of our own shadow... [s]hadows are incomplete embodied media' (Miwa, Itai, Watanabe and Nishi, 2011 p. 325). In this evaluation of the projection of the shadow body within the context of theatre, using artificial light, the assumption that shadows are 'incomplete media' (Miwa, Itai, Watanabe and Nishi, 2011) highlights the papers narrow narrative perspective. (Farago, 1991) on the other hand, presents reflection on 'Leonardo's extensive writings on chiaro e

scuro, [authors inference] and other writings that treated the appearance of light, colour and atmosphere, would have met the need for qualitative (rather than strictly quantitative) treatment of rilievo [authors inference]'(Farago, 1991, p. 67). This analysis highlighted by (Farago, 1991) draws attention to an early expression of a phenomenological understanding of visual perception which Leonardo embedded within a scientific rationale of light and its relation to perspective. This form of understanding of experiences was also being developed at this time by Cennini as we have seen above and Alberti.

How to make sense of what is seen and be able to describe the elements of its nature is complex and difficult. (Fiorani, 2008) observes that 'Mary's drapery is shadowed with intense dark blues that match in modelling the dark red shadows of Gabriel's robe' (Fiorani, 2008). This analysis links closely with (Kingdon et al, 2004) thesis that shadow does not have colour within its body but lifts the chroma in existing colour to indicate its presence. (Fiorani, 2008) description of the 'intense dark blue [and] dark red' (Fiorani, 2008) are indications that this chromatic change was occurring, and Leonardo was able to recognise that the visual cues of shadow on coloured cloth indicated shadow.

This is a profound and liberating concept. Leonardo according to (Fiorani, 2008) was able to develop painting techniques which made the representation of values of light possible. In 'depicting the instability of shadows... he learnt how to dilute colours [to] differentiate opaque pigments (corpi), semi-transparent colours (mezzi-corpi) and varnishes, and apply colours in multiple layers, which he also knew how to vary incrementally in tone and thickness' (Fiorani, 2008, p. 273). This developing knowledge which Leonardo brought to painting allowed him, arguably to paint light and shadow with the enhanced understanding which he did. Being able to demonstrate understanding of visual perception through making work provided opportunity for others to grasp a sense of something apprehended, but not easily described.

This was something which Junichiro Tanizaki managed through written form, not painted. (Chilver, 2007) reflects upon Junichiro Tanizaki's, book 'In Praise of Shadows' where he suggests that 'the interiors of [some] Japanese restaurants and houses have been calibrated to maximise the play of affective resources – light and dark, texture, taste and scent... dovetails into a unity of effect' (Chilver, 2007, p. 38). He is suggesting that it is these elements which have been carefully considered and purposely and

positively designed into the spaces, are the factors which 'calibrate' these spaces into a system to which we are attuned to. We connect to them, as we connect to the elements from which they are made. As (Chilvers, 2007) suggests, 'what is nightfall but the earth casting its own shadow on half of itself' (Chilver, 2007, p. 41). To this our bodies and the phenomenon of our intuition are connected. How spaces change and adapt to the flux of light are always part of this process.

The artist Heinz Mack in conversation with Sarah Gold and Karlyn de Jong sought to question 'Mack's diverse investigations into the perception of light, space and colour' (Gold, de Jong, Nov 2013, p. 39), as Mack works primarily with light and seeks to test this material using highly reflective substrates, which he wears, Mack makes himself an object in the work. In consideration of the architectural space, Mack is clear on the impact which light has and he suggests that 'the particular space and the various positions within that space [which] influence perception... effect the visibility of objects within that space. Every space has its own light, its own dimension, and its own time' (Gold, de Jong, Nov 2013, p 44). This point of view connects us with Tanizaki, Cennini and Leonardo.

(Steidle, Werth, 2013), suggest that 'darkness changes a room's visual message and the concomitant behaviour and processing style' (Steidle, Werth, 2013, p. 76). Their discussion considers the role of darkness in relation to creativity. The phrase 'concomitant behaviour and processing style' (Steidle, Werth, 2013) relates specifically to the changes which darkness seems to provide within a creative environment. The study found that 'darkness increases freedom from constraints' (Steidle, Werth, 2013, p .76). This research relates to the context of a situation where the limit and circumstances of the creative process were known, and within a controlled environment. Nonetheless the study found that 'darkness [within an architectural space] elicits a feeling of freedom, self-determination, and reduced inhibition' (Steidle, Werth, 2013, p .76). The study suggests that the 'findings demonstrate that general subjective perceptions, such as freedom and autonomy, do not depend on social constraints alone, but emerge from the social and physical world surrounding each individual' (Steidle, Werth, 2013, p .77). The suggestion by (Steidle, Werth, 2013) that man is influenced by elements which are purely social, but which originate upon the environmental influence, is important.

Although these experiments were conducted using artificial light within controlled conditions, there is reason to believe that the characteristics of

the influences observed may also transfer to light conditions experienced through the diurnal sequence. The way in which man encounters spatial locations, leading to the process in which our relation to that environment is made through cognitive reasoning, may be because 'each of us has an elaborate mammalian inheritance of spatial perception and processors (Levinson, 1998, p. 10). This paper entitled 'Studying Spatial Conceptualisation Across Cultures: Anthropology and Cognitive Science' considers different or differing cultural or linguistic cultures and the cognitive process within each.

They go on to suggest that these inform the making of understanding of the environment we each experience. This route to experience may be as different as the languages we speak and the architectural space we experience. I would argue that this is another way of referring to, or suggesting connection to our 'eidetic memory' (Costa-Mattioli, 2008). Expanding upon this notion and also relating it to the previously described rational of Amodal Completion, Levinson further suggests to us that the 'visual system isolates objects from their background, reconstructs their three-dimensional shape, gives us estimates of depth and size and so utilising specialised neural networks with processing underway long before the signals even reach the brain' (Levinson, 1998, p. 10) which suggests that parts of the brain have evolved functioning, primarily designed to facilitate our cognitive experience of the world. How we visually navigate that world, suggests that, 'some parts of the brain, like the hippocampus, seem to be primarily dedicated to spatial memory' (Levinson, 1998, p. 11).

This shapes the argument that spatial memory is based upon the remembered form of cognitive recollection. This recollection may likely be connected to a memory of light. Levinson continues stating that 'there is little room for doubt that all this forms part of our common culture-independent biological endowment... [and] it is important to appreciate the biological underpinnings to our sense of space' (Levinson, 1998, p. 11) In consideration of Levinson's suggestion it's useful to consider what (Haun et al, 2011) have theorized in relation to the fact that 'cultural diversity goes hand in hand with cognitive diversity' (Haun et al 2011, p. 79). This cultural diversity can relate to language differences, which in turn are the subject of numerous cognitive approaches to similar scenarios such as environmental conditions and spatial awareness. (Haun et al, 2011) continues with this consideration in suggesting that the 'remarkable fact about cultural regimentation is that on the one hand it generates variant performance from a biologically common cognitive foundation and on the other within a culture

it engenders the common output essential to communication and cooperation' (Haun et al 2011, p. 80).

The cultural question regarding the cognitive form of perceptual experience and recognition of light is fundamentally attached it would seem to what (Haun et al, 2011) posits a 'common cognitive foundation' (Haun et al, 2011) from which derives cultural diversity. However, it's worth considering that within this diversity there may be 'common' perceptual experiences through which we are able to direct common cultural experiences which differ from what (Haun et al, 2011) present. This is an element for consideration when constructing a hypothesis based upon the role of shadow in our percept of space. It is worth considering that 'this combination between group variability and group consistency lies at the heart of the human capacity for culture, as the special mode of adaption that is the hallmark of the species' (Haun et al, 2011, p. 80). As such within (Haun, Call, Janzen and Levinson, 2006) this very point is made.

It has become possible through anthropological analysis to 'trace the evolution of human cognitive abilities and tendencies' (Haun, Call, Janzen and Levinson, 2006, p. 1736). Suggesting that such 'mode[s] of adaption' (Haun et al, 2011) found within different communities have the unifying element and relevance as to the possible recognition of why light becomes inextricable to experiencing space. One might arguably correlate that light, becomes the 'featural specificity' (Haun, Call, Janzen and Levinson, 2006, p. 1738) from which an understanding of space is derived. The words 'atmospheres' (Zumthor, 2006, p. 11) and 'presences' (Kahn, 2013, p. 26) one might argue present notions of ideas or qualities.

Through language, the experience of light and its meaning can be investigated and considered. In (Levinson, Gray, 2012) the notion that differences between cultures and their individual responses to experience derived through the language they use to denote these experiences can be understood as 'variation is signal' (Levinson, Gray, 2012, p. 167). In this understanding the variety of responses to similar experience naturally 'over evolutionary time [develop] variation within species become[ing] variation between species' (Levinson, Gray, 2012, p. 167) The differences within the same, become the differences which change. The complexity of 'variation' instigates differences to alter sufficiently to make a new, new. The written and spoken form of dialects in language continues to evolve and change, each individual dialect having the capacity to be one whole. As this paper explains 'language reflects the cultural uses to which they are put... e.g. with

colour words reflecting the technology of dye and paint' (Levinson, Gray, 2012, p 167). If we use this notion to reflect upon our own society the uses of hue; saturation; greyscale and RGB, all relate to the technological process of reproducing or categorising the colours which visual perception presents. We describe the visual world through the language of how to make a record or response to what we see or experience, (Levinson, Gray, 2012) continue,

'phylogenetic reconstructions of language history seem to be able to reach right back to the beginning of the Holocene or 10,000 years ago, before the development of agriculture, pottery or metallurgy. These deep reconstructions rely on the selection of features that change only slowly – such as the kin terms, or some body parts, words for the sun, moon, fire and the lower numerals' (Levinson, Gray, 2012, p.170).

Making 'words for the sun, moon, fire' (Levinson, Gray, 2012) means in part making words which represent what these elements do. The sun is the light giver; the moon is the reflector of the light from the sun and fire, not only providing heat like the sun, but it is also the light in the darkness, the light when the sun is gone.

One/Four Memory

Within language memory is inherent. (Costa-Mattioli, 2008). The consideration of the relationship between short term and long-term memory, and the dependency in which neurons (brain cells) in the brain rely on the processing of proteins to generate new brain cells and enable the making of these memories be-they short term or long term. However, what memories are and how they are stored remains hypothesised. It is however believed that protein improves the synaptic connections between neurons. As such (Costa-Mattioli, 2008) suggests that there may be a link between our 'ability' (Costa-Mattioli, 2008, p. 874) and the generation of more proteins and 'extraordinarily long-lasting memories' (Costa-Mattioli, 2008, p. 874). This hypothesis suggests that 'the activity of protein eIF2 α , 'decides' whether a long-term memory is made from an experience' (Costa-Mattioli, 2008, p. 875). This notion is particularly interesting to the point of view of this research, as it may be possible that, 'these genes underlie eidetic and other enhanced forms of memory' (Costa-Mattioli, 2008, p. 875). If this is the case then it strengthens the proposition being made here between our response to light in architectural space, and eidetic memory (Costa-Mattioli, 2008) of experience of the light.

Being able to make judgements and contrasts in relation to light is complex. (Soranzo, Agostini, 2006b) have concerned themselves with the 'articulation of the visual field' (Soranzo, Agostini, 2006b, p. 102) and as such have explored these notions. Using an artificial light, they have considered how our visual system is able to differentiate between objects which are illuminated which creates lightness on these objects and how the luminance of these objects is discerned within our field of vision. (Soranzo, Agostini, 2006b) have suggested that, 'the intensity of the light rays is the product of the intensity of the incident light and the reflectance of surfaces. When the intensity of light falling on surfaces changes, the amount of light reaching the retina, (i.e., the luminance) is correspondingly modified'. (Soranzo, Agostini, 2006b, p. 102)

Light in architectural space is 'incident light' (Soranzo, Agostini, 2006b). The walls and other objects within space are the 'reflectance surfaces' (Soranzo, Agostini, 2006b). Climatic conditions influence the 'incident light' (Soranzo, Agostini, 2006b) which in turn influences the 'reflectance surfaces' (Soranzo, Agostini, 2006b). What this means is that the space becomes brighter or darker, and the elements within this space in turn alter luminance becoming brighter or darker. The space illumination and luminance values alter, and with this so does our visual perception of that space. In consideration of the luminance of surfaces, and the degree to which these surfaces can alter and differentiate between one another by the form of their shadow is particularly relevant. (Soranzo, Agostini, 2006a) designed their experiments using 'a simulation of... light/shadow display' (Soranzo, Agostini, 2006b, p. 103) where patches of light ranging from '56cd [candela to] 5.6cd' [candela] (Soranzo, Agostini, 2006a, p. 187) arranged beside one another suggested that surfaces reach a point when visual perception cannot make a differentiation between them. They conclude, therefore that 'we believe the visual system evolved with this physical constraint taken into account and uses this limit as a point of reference for inferring the intensity of the illumination' (Soranzo, Agostini, 2006b, p. 111). Their conclusion proposes that we have an evolved biological connection to light which guides and informs our decisions about the life world we experience. (Soranzo, Agostini, 2006b) continue and suggest that 'the entrances of caves and holes are good examples of regions in which the luminance could be zero ... the best illumination intensity estimation of a shadowed field, and consequently the best degree of lightness constancy, should be obtained in cases in which there is a region having zero luminance' (Soranzo, Agostini, 2006b. P.111).

This light-dark relationship forms the structural framework from which our visual perception functions. Therefore, it informs the context through which we experience our environment, and the degree to which diminishing light until 'zero luminance' (Soranzo, Agostini, 2006b) becomes pivotal in generating how we judge the context of the spaces which surround us.

Within current biology it's recognised, as (Collett, 2009) suggests that there are parallels between how insects navigate and their memory of light as a means through which they place themselves individually and/or collectively within an environment. Memory it is suggested, 'enhance[s] the efficiency with which animals can exploit their resources' (Collett, 2009, p. 1103) These memories of an environment, 'Spatial Memories [one might say] encode relationships between features in an environment, or an individual's path through the environment' (Collett, 2009, p. 1103). It is common practice to make memories of environments we experience. We may make these memories for different reasons consciously or unconsciously, but they are evident. They become fundamental to the process of living and through which we become reliant. (Collett, 2009) proposes that, 'spatial memories are thus of great ecological importance, and they make possible many of the conditions that lead to social behaviour' (Collett, 2009, p. 1103). However, the condition of 'spatial memories' (Collett, 2009) are a shared feature among species, and this shared feature provides an insight into the linkages between how we make memories of spaces and how light is a part of this feature.

In response to this thinking, (Collett, 2009) goes on to suggest that 'it is striking how much their organising principles [that of insects] have in common with our own' (Collett, 2009, p. 1103). The honey bee uses a 'polarisation compass' (Collett, 2009, p. 1104) for navigation which exploits the properties of 'light scattered across the sky' (Collett, 2009, p. 1103). It uses this mechanism as a locator of the sun in the sky which can calculate the rotation of the earth, its movement, and the position of the sun as a triangulation navigation tool. The bee is able to 'combine inputs from its polarisation detectors with its circadian clock [the human circadian clock will be discussed later in this chapter] to determine the earth-based directions' (Collett, 2009, p. 1103). For (Collett, 2009) 'understanding better how insects use spatial memories... may help explain the evolution of our larger and more complex brains' (Collett, 2009, p. 1108). Man may have evolved to a point where he uses tools which derive navigational needs, without the necessity of relying on in-built 'polarisation compass', (Collett, 2009) but it

could be argued having considered (Collett, 2009) as a primer, that man has still retained connection to light, but uses lexicographical means to navigate understanding derived by the signs of light experienced.

This use of language to consider or develop an understanding of light or to develop consideration of what interpretation is made through the experience of light is further considered by Ernst Gombrich. In his book 'Topics of Our Time: Twentieth-Century Issues in Learning and in Art', Gombrich attests in relation to Abraham van Beyeren's painting 'Still Life' circa 1667 that, 'simply to enjoy the feast of the eye is to miss the message of the painting' (Gombrich, 1991, p. 57) In referring to van Beyeren, who painted 'Still Life' during the mid-1600's, Gombrich interjects an association to the allegorical conversation. He constructs the idea of two people viewing the work and commenting on, 'how Van Beyeren enjoyed the sparkle of light on these precious vessels' (Gombrich, 1991, p. 57). In doing this Gombrich is considering the act of interpretation he, touches upon the consideration that the viewer is not the artist and as such is detached from any understanding of the work which the artist may have had. As such the viewer is not able to comment with certainty on what the artist may have thought while making the work. The viewer, Gombrich suggests, is able to make their own subjective comments, based upon their own sensory perception and interpretation of that which they see, but they have no certainty of the artists intentions. He further suggests that the, 'the strength of subjective convictions is no safeguard against errors' (Gombrich, 1991, pp. 56-57).

It is through the interpretation of what is seen or believed to have been seen that we construct understanding. These forms of understanding are personal to us. Gombrich makes no fundamental connection to the light in the painting as we might expect, rather it is seen within the nature of the articles upon the table which becomes a subjective reading of light. On the basis of Gombrich's 1995 publication 'Shadows; The Depiction of Cast Shadows in Western Art' he makes the descriptive reference to 'misty atmosphere' (Gombrich, 1995, p. 20) with reference to the healing shadow within Masaccio's 'St Peter's Shadow Healing' 1425, which has been interpreted as 'observed paucity' by (Jacobson, and Werner, 2004, p. 1369) as an analysis of shadow form. I have not been able to locate Gombrich's reference in his publication to the 'surprising paucity of cast-shadow' (Jacobson, and Werner, 2004, p. 1370), however it is a very communicative phrase, well utilised within their own consideration of the 'pictorial cues' (Jacobson, and Werner, 2004, p. 1369) of shadow in painting. They

postulated that 'artwork perceptual cues' (Jacobson, and Werner, 2004, p. 1370) can be divided into two compelling categories, that of 'essential [and] expendable' (Jacobson, and Werner, 2004, p. 1370).

This categorisation was based upon the evaluation of 89 works contained within 'Janson's Story of Painting' (Jacobson, and Werner, 2004, p. 1370), published in 1984. Their research is grounded in the questioning of why 'the visual system, which has evolved under natural light conditions [would not be] sensitive to singularities' (Jacobson, and Werner, 2004, p. 1371). This sensitivity relates to visual perception not being overly sensitive to 'shadow orientation' (Jacobson, and Werner, 2004, p. 1371) within the perception of cast shadow. They concluded that the 'visual search for inconsistencies in cast shadows is not efficient and probably relies on high level-controlled processes' (Jacobson, and Werner, 2004, p. 1377). This inefficiency is based upon the visual perception of static images. Further to this, (Jacobsen and Werner, 2004) conclude that 'cast shadows unlike static shadows, are primarily conveyors of transient or temporal information' (Jacobson, and Werner, 2004, p. 1382) suggesting that human evolved visual perception developed in relation to the movement of light and not to static light cues.

The notion of 'sunlight without shadows' (Gauguin, Bernard, 1954, p. 63) becomes an anathema, when we consider the tracery, movement and difference in shadow in relation to climate, the two are intertwined inextricably. If we reconsider what Gold and de Jong suggested, that 'every space has its own light, its own dimension, and its own time' (Gold, de Jong, Nov 2013, p 44) which suggests an individual constructed experience of space in thought. The importance of the artist is that they can record a point of view, a remembrance of space. This can be demonstrated in Paul Gauguin's correspondence when he suggests in his letter to Emile Bernard that,

'I will get as far away as possible from that which gives the illusion of a thing, and since shadows are the trompe l'oeil of the sun, I am inclined to do away with them. If in your composition [Gauguin referring to Bernard's work] shadow enters as a necessary form, it's a completely different thing' (Gauguin, Bernard, 1954, p. 63-64)

Consideration of literature which emphasises biological coupling between man and light is fundamental and inextricable within cognitive science and evolutionary psychology (Chaplin, 2005). Evidence, that the perceptual construction of shape and form within our visual acuity suggests 'there is a

universal biological basis for these phenomena... which is fundamentally rooted in sense perception' (Chaplin, 2005, p. 20). (Bowmaker, 2008) extend this point by suggesting that 'vision provides an animal with the ability to detect, almost instantaneously, the environment around it' (Bowmaker, 2008, p. 2022). This capacity then provides visual perception with ability to make sensorial judgements about the conditions of that environment. These judgements are made because 'animals have evolved their visual sensitivity to match aspects of their photic environment and it is likely that the primary adaptive selective pressure is the spectral range and intensity of daylight' (Bowmaker, 2008, p. 2024).

If we recall, (Haun, Call, Janzen and Levinson 2006) and the suggested importance which 'featural specificity' (Haun, Call, Janzen and Levinson 2006, p. 1738) plays in the construction of our recognition of place, their research advocates that 'there are two main strategies for remembering object location: the use of object features and the use of place features as defined by a spatial frame of reference' (Haun, Call, Janzen and Levinson 2006, p. 1737). Light, one can reasonably argue, based upon previous suggestions, contributes fundamentally to 'featural specificity' (Haun, Call, Janzen and Levinson 2006) and provides some framework for understanding the 'anthropologies of consciousness' (Winkelman, 2010, p. 125) which tests how we come to join with, and know experience.

Our knowing of experience ranges from 'biologically based abilities, and interactional potentials for awareness, experience and learning... which create relationships with and understandings of the environments and [the] self' (Winkelman, 2010, p. 126). In the book 'Catching the Light: The Entwined History of Light and Mind', (Zajonc, 1993) considers the diffraction of light, as a manifestation within our visual perception, displayed as our recognition of shadow edge. Shadow edges contain the 'interactional potentials' (Winkelman, 2010) of both a dark and light line along its edge because of diffraction. Its obviousness to us is dependent upon the intensity of light, and the proximity of the occluding edge. One might notionally describe the formation of shadow and its constituent parts to include and to display 'the presence of any universal feature' (Levinson and Evans 2010, p. 2746) such as the sun. Through this structural process which can be seen to be both physiological and at the same time cognitive, light connects to the heart of our shared human being.

(Beau Lotto, Clarke, Corney, and Purves, 2002) suggest an approach to understanding the human concept of seeing colour within light, as one placed within an understanding which supports evidence that it is through a 'consequence of generating sensations of colour empirically' (Beau Lotto, Clarke, Corney, and Purves, 2002, p. 265). Through humans 'phylogenetic history (i.e., evolution)' (Beau Lotto, Clarke, Corney, and Purves, 2002, p. 265) suggest that seeing colour occurred. (Conway, 2009), suggests that colour vision is 'the ability to distinguish surfaces or lights on the basis of spectral distribution received by the eye' (Conway, 2009, p. 274) and that 'trichromatic colour vision [the basis of human vision] could have evolved following only one or two genetic mutations' (Conway, 2009, p. 278).

This closely connects the human mechanism of vision to the experience of hue and chroma as fundamentals within 'phenomenological colour experience' (Neitz, Neitz, 2008, p. 702). If it is the case, 'the visual system, which has evolved under natural lighting conditions' (Jacobson & Werner, 2004, p. 1371), suggests that cast shadows made by light 'are primarily conveyors of transient or temporal information' (Jacobson & Werner, 2004, p. 1382). This information informs the basis of our perceptual reading of light against that of object be it, consciously or unconsciously.

One/Five Experience

Our experience of space is centrally placed within this experiential composite. As a mammal, we are diurnal in nature, therefore subject to the naturally changing periods of light and dark throughout the course of a day, and to the circannual cycle seasonal changes throughout the year. Within this structural relationship, (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015), have suggested, that it is through this process of being 'entrained' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015, p. 2651), to light and dark ratios, that mammalian cells are influenced.

Research suggests that this influence leads to cellular changes in the hypothalamus which are driven by either 'a long or [a] short photoperiod' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015, p. 2651). The 'photoperiod' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015) in question is represented by the seasonal differential between different times of the year. For example, the period of time between the autumn equinox 23rd September, and the winter solstice 21st December, would be defined as 'short period photoperiod' (Wood, Christian,

Miedzinska, McNeilly, Burt and Loudon, 2015, p. 2652), where cells respond to the higher degree of darkness to that of light. Equally the period of time between winter solstice and the spring equinox 23rd March, would be defined as a 'long period photoperiod' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015, p. 2652). The hypothesis that cells respond to variances in darkness and light, indicates that this research has identified the potential relationship of light within the development cells. Closely related to this is protein within the body such as the 'opsin protein' (Foster, Hankins, 2007, p. 748) which is a neuron within the eye structure which is made of photo-sensory pigment with a,

'peak sensitivity in the 'blue' region of the spectrum near 480nm... it remains unclear what ecological advantage this wavelength might confer on such diverse species, one possibility is that [they are] tuned to the dominant wavelength of light at twilight. When the sun is close to the horizon there is relative enrichment of 'blue' light in the dome of the sky. (Foster, Hankins, 2007, p. 748)

The dome of the sky, which is being referred to, is the gradient of blue which can be observed around sunset, when the sky is cloudless. It represents the gradient of blue visible as light blue toward the horizon and a gradually darkening blue toward the centre of the visible sky. This may appear within visual perception to have the appearance of a dome shape made by the gradient of colour appearing in the sky. This shape in the sky appears through shading gradients, in much the same way as we see and experience architectural space as the perception of shading gradients.

Light is undoubtedly different within every room because the flux ingression of light through windows or doors will have differing determinant edge qualities over time. However, the evidence of an inherited biology which connects these natural changes to our perceptual experience is strong. The ratios of changing light conditions, throughout the year have been seen to influence and 'regulate... time annual changes in physiology' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015, p. 1). This reinforces the notion of a human response to ecologies of light. Man, functions in tune to 'biological time [which] remains synchronised to solar time' (Foster, Hankins, 2007, p. 747). The intrinsic relationship between photosensitive pigments within our eye, 'may relate to the complex task of twilight detection, or the adaptive responses of the eye to differing levels of environmental illumination' (Foster, Hankins, 2007, p. 750).

If this suggestion by (Foster, Hankins, 2007) has merit and one links this consideration to the notion of (Edensor, 2013) in relation darkness, which suggests that '[i]n the absence of light, other sensations of tactility, sound and smell were fore grounded, provoking an advanced awareness' (Edensor, 2013, pp. 446 – 7), it may give rise to a consideration that light levels instigate physiological response.

At the heart of his consideration, lies representation of how we see; the mechanics of what we see; how this seeing presents to us; how we interpret what we may see and why it presents in the way that it does. (Foster, Wulff, 2005) draw attention to the fact that 'the introduction of artificial lighting and the re-structuring of working hours has progressively detached our species from the 24-hour cycle of light and dark' (Foster, Wulff, 2005, p. 407). This introduction naturally conflicts with the way in which the body is tuned to light, and to which it has evolved over '120 million years' (Foster, Wulff, 2005, p. 409). These changes have influenced 'cognitive function... immune function [and] mental health' (Foster, Wulff, 2005, p. 409). The case that man is arguably coupled to light physiologically, psychologically and phenomenological becomes increasingly strong based on this evidence. As (Edensor, 2013) predicts, the possible necessities of 'sustainability' (Edensor, 2013, pp. 463), may reintroduce night-time darkness to the human experience of the world once more from which we have become increasingly distant from since the Industrial Revolution.

This leads to the necessity for a deeper more meaningful sustainable relationship with human physiology and with the world we encounter. The human evolved biological balance within the light / dark cycle, inevitably aligns our nature with nature. Evidence reasonably suggests that the notion of how we experience the darkness's of light can 'entrain' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015) our response to experienced light. This suggests the influence of light in space is natural and fundamental and an important aspect of our being. Therefore 'the light-dark cycle is the most reliable and strongest external signal that synchronises [entrains] biological rhythms within the environment. (Stokkan, Yamazaki, Tei, Sakaki and Menaker, 2001, p. 490), they continue, the 'SCN [suprachiasmatic nucleus] is entrained by the light cycle and, from its position at the top of the circadian hierarchy, drives or entrains peripheral rhythms in adaptive phase relations to the environment' (Stokkan, Yamazaki, Tei, Sakaki and Menaker, 2001, p. 491).

Our experience of the nature of light in space activates natural sequencing of how we have evolved to be in light. Richard Dawkins suggests with our 'remote sensing technology' (Dawkins, 1996, p. 126) the mechanism of living our circadian rhythm 'permits... the anticipation of daily environmental changes' (Brown, Kunz, Dumas, Westermark, Vanselow, Tilmann-Wahnschaffe, Herzel, and Kramer, 2008, p. 1602). This 'anticipation', (Brown, Kunz, Dumas, Westermark, Vanselow, Tilmann-Wahnschaffe, Herzel, and Kramer, 2008) relates to being 'entrained' (Wood, Christian, Miedzinska, McNeilly, Burt and Loudon, 2015) to light, which is naturally in flux. Our natural being in space is derived from the diurnal day length changes.

Being diurnal by nature reflects our evolved relationship to light, but the suggestion that human organs such as the Liver can be entrained by food strengthens this and is explored by (Lee-Phillips, 2009). This research emerged through analysis of night-shift workers eating when the body has evolved to sleep, which lead to both gastrointestinal and cardiac disease. This brings us back to man being diurnal as opposed to nocturnal in nature. They suggest that 'shift-work that involves circadian disruption is probably carcinogenic to humans' (Lee-Phillips, 2009, p. 142). Indeed (Rajaratnam, Arendt, 2001) places the physiological experience of 'the 24-h society [as] an environmental challenge that outstrips our biological adaption to the natural 24-h cycle of light and darkness' making life outside our biological heritage prone to inherent difficulty'. (Rajaratnam, Arendt, 2001, p.999).

With the ability to live outside of our natural cycle, man unlike any other mammal has been able to construct a way of being which is opposite to our evolutionary needs. (Lee-Phillips, 2009) suggests 'in nearly all organisms, patterns of biochemistry, physiology and behaviour oscillate with the daily cycles of light and dark, often with near perfection' (Lee-Phillips, 2009, p. 142). Light as a material within environments which have the capacity to restore and rebalance cognitive functioning is paramount. Research exploring the notion that 'exposure to restorative environments facilitates recovery from mental fatigue' (Berto, 2005, p. 249) was evaluated after participants completing tests designed to invoke mental fatigue. These tests involved exposure to images of different environments and found the natural environment to be 'high in restorativeness... [these were] lakes, rivers, seas, hills, woods, orchards, forests' (Berto, 2005, p. 251). Environments evaluated to be 'very low in restorativeness.. [were] city streets, industrial

zone, housing'. (Berto, 2005, p. 251). The division between the perception of a natural environment and that of a manmade environment on cognitive functioning is striking. They suggest that the rationale for this may be that 'natural environments are innately fascinating: they evoke a type of effortless attention or fascination, that allows directed attention to rest and restore' (Berto, 2005, p. 258). The experiences of manmade environments are suggested to carry 'very low restorativeness' (Berto, 2005, p. 252).

This notion creates the possibility that the darkness's of light within architectural space could be argued to contain the 'innately fascinating' (Berto, 2005, p. 258). When we discuss light in architectural space, we are developing our consideration of nature within an environment, the ecological within the man made. Within a wider context it is the construction of a dwelling place. The implication of this review, suggests light should be considered as a highly ecological and fundamental restorative element within the health and wellbeing of man.

The concern of this thesis is the experience of light within architectural space, which, (Berto, 2005) is suggesting is an environment low in restorativeness. However, I would argue that light is the single discernible element which inhabits both restorative and non-restorative environments. The implication of this, may imply that nouns such as 'atmospheres' (Zumthor, 2006, p. 11) and 'presences' (Kahn, 2013, p. 26) demonstrate and signify, the recognition of the restorative within the non-restorative.

TWO

Concentrated

'the act of painting... opens and refines consciousness by slowing down time as it focuses the eye. Vermeer, spending hours, days and weeks painting a small corner of a small room is an act of ritualistically informed meditation that leads to new possibilities of awareness and love. This concentrated process lets us view our attachments with detachment by rendering the illusion of reality as an illusion' (Sellars, 2003, p. 162)

The painting, 'A Vision: The Inspiration of the Poet', by William Blake circa 1819 – 20 Fig 1.0, is painted on paper measuring 244mm by 211mm. It is a work which although painted in the early 19th Century, suggests the depiction of light, from an abstract, postmodern point of view counterbalancing objective truth. Arguably it is one of the earliest works of this type representing architectural space, prescient today in the model for 'Subjective Experience of Architecture' 2008 by Antony Gormley and David Chipperfield for the KIVIK Art Centre, Österlen, Swenden. The model for this proposal clearly introduces a memory of the language and geometry of this work. My consideration of this watercolour by Blake in this chapter is pertinent, as the work presents a testing and uncertain painted portrayal of light and shadow. It is pertinent because it opens the possibility for this thesis to explore, consider and draw attention to light as concentrated time in painting.

The painted image of light, I believe can be used as an exemplar of analysis for how we perceive light in space and how we make sense of the space we see. The painted form of light within Blake's work is counter intuitive. It is counter intuitive, balanced by linear perspective. This counterpoint in the relationship tempers the viewer's visual acceptance of the reality of light as presented by the work. It also presents many fundamental questions relating to how we, the viewer of the work, ascertain how light is and how the light reads to us. Most telling, perhaps, is how we use visual cues to perceive the object form of architectural space.

The primary form at the heart of this work is an inverted rectangle containing a room within a flat plane. This work reflects, it could be suggested, knowledge of Albrecht Durer's 'Studies of Shadow Projection' circa 1525. These drawings explore primary shape and the shadows which they cast to consider form and depth, based upon the visual perception of light. Alongside this one might consider also, Antonello da Messina's 'St Jerome in his Study' circa 1460 – 5. In this work St Jerome reads at his desk within the confines of a church or cathedral. The work demonstrates knowledge of linear perspective and that of multiple shadow form within a single space projecting in differing directions with one moment of time.

Primary form in earlier works by Antony Gormley, also relate to Blake's work in which the cube and rectangle encase voided form such as 'Allotment II' and 'Still feeling'. Other works in close formal proximity to Blake's work by Donald Judd such as, 'No Title' 1974 and 'Untitled' 1980, explore the use of primary shape as apertures for the study of form in relation to light. Gianni Colombo 'Elastic Space' 1966-67, tests the volume of light and darkness

within the confines of rectangular expanded form, and the Iranian artist Shirazeh Houshiary, projects geometry and the division like linear perspective within the interior volume of primary shape. However, Blake's painting explores and tests our acceptance of the division and tapestry of overlapped shadow and introduces the darkness's of light (a phrase I have coined) as painted light. In consideration of these other works, it is reasonable to place 'A Vision: The inspiration of the Poet', alongside sculpture and painting which provide contemporary relevance as works which align comfortably within a post-modernist point of view regarding linear perspective. This manner of formal representation which has arguably become a well understood and accepted contrivance in making sense of environmental conditions, places Blake's work as radical and visionary.

It does this by projecting an understanding of shape and form through the medium of painted light in shading; these projections make no sense when considered in detail but read as intuitively correct. Where is the light coming from in this work? How are the shadows we see being produced? There are many tensions within this work pushing our perception in multiple and conflicting directions. The linear perspective being used by Blake understands that our visual perception will read it as the pivotal form making structure within the work. Linear perspective provides our capacity to sense the main internal voluminous space which appears to be moving away from our vision. This space appears to have been hewn out a larger solid. Within this central rectangular cavity is housed a second rectangular form which has a pitched roof. This form has the appearance of another room; it becomes the secondary space, a space within a space. There are two figures contained within, one seated at a table, the other standing to the right of the seated figure. The underneath of the table reflects the rectangular form of this space and that of the larger main space. This volume under the table becomes the third space within the work.

'A vision: The inspiration of the Poet', contains extremely unusual shadow placing and formation. This chapter's discussion is important as it introduces the notion of vision as an evolved way of accepting what we see. It allows us to make sense of what we perceive even if, upon analysis what we see is not functionally possible. My literature review in the previous chapter considered arguments which proposed an evolved relationship between vision and light and our perception. Through analysis of Blakes work, I seek to draw attention to and provide better understanding of my underlying argument which suggests we rely upon the ecologies of light to inform why light within contained space, appears to us as it does. When one looks at

this work without any deep insight or thought of its form, it will read as an incised rectangular shape recessed into a plane. Our visual perception is assuming depth. This assumption, I would suggest, is based upon an understanding of linear perspective projection, and not on a reading of the shadow formation. Perception based on shadow cues is a highly developed intrinsic action within the human visual system (Ni, 2004).

Linear perspective projections within the depth of field perception within this work conflict with the shadow form represented. Linear perspective is telling our perception one thing, while shadow form is telling us something else. These conflict with each other. The linear projection is telling our perception that this visual stimulus is an internal rectangle. The form of which is moving away from us. It also suggests that it is a hollow void with flat sides surrounded by a wider flat material area. The shadow representation, however tells us something else. It is confused and uncertain. Our visual perception, when reading Blake's work, is biased toward the perspective more than the shadow.

The structure of the perspective which is a learnt characteristic of vision, dominates our evolved reading of light based upon shadow. Vision uses both to make sense of our surroundings, but they are in conflict within this work. Our perception of the drawn perspective seeks to override the impossibility of the shadow. I suggest that the shadow presented in this work is ecologically impossible. This is because the shadow formation in relation to the linear perspective is incongruent. This incongruousness of the shadow may only have been possible if the work was illuminated from multiple directions rather than one direct light source, and I don't believe this to be the case. Using the outer edge of the painting as a lighting cue, the evidence for multiple light sources (where the work receives directional lighting from multiple angles) does not seem to be evident. On the outer frame of the work there is no dominant evidence of lighter or darker areas of surface gradient as one might expect when directional lighting overlaps on a seemingly flat surface. The outer edge of the painting displays a uniform mid tone which one would not expect if multiple light sources were being implemented.

The room in which the two figures are situated, displays a single light source. This light source appears to take the form of a lamp, possibly an oil or candle lamp. This lamp is placed directly above the seated figure on the central axis of the ceiling. A projected volume of light has been pushed forward, outwards into the main voluminous space in the direction of the

viewer. This light illuminates the ground space in front of the opening of the room as a wash of light manifest on to the floor of the main space. Its form reinforces and reflects the linear perspective projection of the lower area of the room; we can read its form and density light through the artists understanding of shadow edge and the gradient of lightness into shadow. The definition of this area of lightness, produced by this projected volume of light, is well defined. It has been so well defined, and directed, that it clearly shows that William Blake understood the principles of how to transpose areas of light and shadow. This reinforces our acknowledgement that Blake was able to transpose light into painted form competently. It also suggests that he was able to manipulate our understanding of how light can be, and how light can be manipulated by its material surroundings. Why then has Blake painted such incongruent shadow?

Starting with the flat border around the outside edge of the main space, as I have stated it does not appear to bear the signature of multiple light sources when one looks at the painting. However, if a square of white paper is placed over the incised rectangle so that only the outer frame is evident, seen in Fig 1.1, the frame looks different. Having covered this central area of the work one is able to see that the surrounding frame does indeed have a gradient of tonality which appears to run diagonally across the work from the bottom right to the top left of this border. This gradient across the painting when viewed in relation to the pronounced gradient on each of the four internal walls is creating an optical condition with which our visual perception is struggling to make sense.

On the one hand the very strong linear perspective draws us into the painting; this allows us to understand the depth of field within the work. Further to this it allows us to recognise that the internal form is moving away from us. However, this message is being conflicted by the incongruent gradient shadow form which is apparent in the descriptive lighting of each wall. This influences the form of each internal wall in a wholly different physical manner. The form of each internal wall, due to the gradient shadow, appears to curve, it has shape and it portrays form. This apparent curve is not delineated by the linear perspective, as the perspective presents a relationship between each wall junction as straight. It is the painted light which intimates the perception of curvedness.

This painting intimates, I suggest, a weight to the light perceived. The perceptual curve is seen to run diagonally across each wall, which adds another layer of incongruity to the perceptual cues which the viewer's

perceptual awareness must process. In practice I have tested the perceived qualities of shadow light to explore what we perceive when we look at architectural space and the painted presentation of space such as Blake's helps this analysis. This practice creates shape and form through manipulating the relationship light has with objects. By creating this form which is purely of light, allows me to fully appreciate and explore of the form of light being painted within *A Vision: The Inspiration of the Poet*'. This practice leads our understanding of what is being activated within our perceptual understanding of Blake's work. In Fig 1.2, 'Practice Model Three' I have manipulated light within 'Practice Model Three' to create the appearance of a curved surface. The shape and the form which can be seen within this model have been created by shadow edge. I have made this visual experience by placing objects within the model which light interacts with to create characteristics found within ecological shadow. This approach creates the possibility to become aware of the shape and form which is inherent in light. When we first look at Blake's work, we may not notice anything unusual about it. The linear perspective makes such a strong and visually forceful statement that it becomes dominant within the work.

However, the different mixture and over layering of visual cues, suggests to me based upon practice work, that while the influence of the perspective is dominant in the first instance, our evolved visual perception is so strong and fundamental, that it is translating the other assemblages of shadow gradient as conflicting with the dominance of the linear perspective. If this is the case, it's pertinent because it means that when we observe and experience the geometry of architectural space the over layering of shadows come in conflict with our visual perception. As such this influences the judgements we make.

If this were to be the case, it would be helpful to break down the conflicting elements of the painting into its constituent parts. These include the individual walls; the floor; and the room in which the figures are placed. In Fig 1.3, the ceiling marked A, begins with dark shadow on the top far left-hand edge. As this plane moves inward towards the back wall, the gradient of the shadow lightens. Its lightest point appears to be positioned at the midpoint between the front edge and the rear wall and runs diagonally from top right to bottom left. From this lightest point the gradient appears to darken into shadow once more terminating at the top right internal corner in dark shadow. The nature of this shadow formation, that is, how it presents to us through our visual perception, appears to us as a curved surface, see (Ramachan, 2008) (Casati, 2008).

The directional lighting of this surface is wholly individual to this surface to create the manner of shadow that it displays. Shadow gradients which merge across each internal wall, present the appearance of similar individually specific directional lighting. This suggests to me that the space has at least four conflicting light sources, each source addressing an internal wall, thereby creating impossible shadows. It suggests that these shadows are impossible because there is no common unity in the way in which they relate to each other or to the walls on which they appear. This notion is demonstrated by the shadow in the top left-hand corner of the painting, as a shadow it appears as a gradient running across the ceiling from left to right. This, I suggest, indicates a light source outside the space at top right, which would create a shadow on the inside left corner. However, the darkest edge of this shadow would almost certainly run for the entire length of the inside edge.

Two/One Character

Shadow has multiple perceptual degrees of visual density which can be perceived as being very dark even black, as well as being very bright. Within my consideration of the 'Weight of Light' in Chapter 5, this very dark shadow I suggest is representative of visual heaviness, as very bright shadow, is suggested to be representative of visual lightness. The characteristic of shadow presentation, characterised within the corner of a room, is demonstrated in Fig 5.2. The shadow in the top left-hand corner of Blake's painting does not display similar characteristics to those seen in Fig 5.2; this suggests that it is being under-lit from beneath. Light from the top right, would also cast shadow from the top right-hand corner, down the outer edge of the left side wall, this is not present. The lamp as a light source is making a projection onto the floor of the recessed space; it may also be the reflected light which is diminishing the shadow edges; however, it presents incongruities and difficulties in this role.

The light being projected manifests as a centrally placed area on the floor of the space. It can therefore, one would assume, reflect and dissipate, within the space with an equally central and even manner as the surfaces appear to be flat and smooth. The area in front of the room with the lamp is clear of any obstructions, so there will appear to be no possibility of the light being reflected towards the room or to the back wall of the space. Reflected light will always reflect and mirror at the angle to which it was produced if it is being received by a flat clear surface. Clearly at a macro level most surfaces have texture (Gibson, 1986), but in the case of this painting the walls appear

to be texture less. With this principle in mind the lamp light will have to be reflected toward the viewer out of the space. If one is to deduce this, then the wall area behind the room with the lamp should be the darkest part of the painting, however it does not appear to be the case.

The left-hand side wall behind this room seems more convincing in its shadow depiction than that of the right-hand side. The right side has a gradient of shadow which appears darkest close to this room which then gradients outwards, indicating that the corner closest to the room is in receipt of the least light. The area behind and to the right of this room displays a cast shadow on the floor, suggesting it was made from the form of the room with the lamp. This projected shadow runs on the floor diagonally to the right of this small room and finishes at the edge line of the back wall creating a small triangular shadow shape. This projected shadow will have to have been made by a light source at the top right of the painting. One would expect this because of the perceived depth of the main space. A top right light source outside of this space would not have an angle acute enough above the small room with the lamp, to have only made such a small a projected shadow. One would expect that more of the small room would have to have been projected against the back wall of the recessed space.

Together with these observations and combined with an uncertainty about the legitimacy of the light sources and directions within this painting by William Blake, the ambiguous lighting of the space presents no coherent explanation. What the light source scenarios in this painting do present nevertheless, is that our visual system seems to have the ability to make readings of a presented scenario and understand it from a space awareness point of view, but the visual cues which we use to make these readings are aware that the presented scene is not logical. Nevertheless, we can understand what we perceive. There appears to be no projected reason to this light; only the visual insight of vision which we supply. The experience presented within Blake's work in which different and differing scenarios of light describe a perception indicates that our visual system makes sense of conflicting light cues to present a coherent reference system.

By studying Blake's work, we can give consideration to judgement made upon the presentation of the light which we observe. This consideration allows us to then explore notions of visual perception based upon the nature of vision. This is particularly pertinent to consideration of how we experience the perception of architectural space. This is because consciously or

unconsciously the visual cues of light fundamentally inform our experience. Vision is based upon evolutionary development, and visual perception is beyond consciousness (Foster and Hankins, 2007).

Within David Hockney's thesis 'Secret Knowledge: Rediscovering the lost techniques of the Old Masters', he investigated the use of Optics, as a mechanism for the accurate transposition of the perceived scene. His research places the manipulative use and exploration of the qualities of light, in conjunction with the scientific evolution of the glass lens. Hockney presents an argument that the lens was to be found at the very heart of painted representation between the 15th and 17th century. He began by looking at the placing and arrangement of people and objects within paintings and their relationships to light. This notion originated when he noticed how Caravaggio and Velazquez made such careful use of light within many of their works. He became aware of how strong side lighting, usually from one source, created depth and accuracy of light upon walls, people or objects. Also, that careful arrangement of the subjects within the painting exploited inherent qualities in light, 'optics need strong lighting and strong lighting creates deep shadows' (Hockney, 2001, p. 13).

Hockney suggests that the use of optics provided for the first time the realisation of accurate painted shadow. Artists were able to spend time observing how light was seen to be, and how it manifested as a projection of a wall or a screen. This new way of working provided the beginnings of a realistic representation of life. Strong deep blackness became a common backdrop in portraits and still life painting for the first time. The character and unique nature of darkness was being explored for the first time. Within this representation the manner and structure of composition began to become important in understanding why subjects were the way we observed them to be. The character of light, its structure and form necessitated how an entire body of work over four centuries would develop and grow within European Art.

Seeing with the use of optics intensifies light, intensifies our experience of light and of darkness. It became clear for the first time to the artist, that brightness and darkness were the whole constituents of light. They were not a separate entity; these characteristics were within light. As colour was to be understood as light, darkness was being understood as light. Projected light has a character of enhanced hue and saturation. Optics can unlock the character of light. Light is colour and the colour we perceive in the apprehended environment is the light which falls upon the object of our

gaze. What the glass optic seems to do is partially unlock the colour intensity and vibrancy of light and make each colour more colourful, more rounded, more intense. Paintings belie a way of seeing which had not been recognised up until the use of the optic.

David Hockney is not being critical within his thesis, that in anyway seeks to diminish the work of these artists, rather he is clear that optics don't paint, it is the artist who make the mark. Hockney is drawing attention to the use of the optic as a cutting edge technological development to which artists found a use. From an historical point of view, optics have been the representative tool within scientific investigation. Astronomical and biological exploration began to develop great insight through the opportunities which the lens facilitated. Most notably among the scientists using optics were Galileo Galilei and Sir Isaac Newton. For Galileo the use of the lens in Venice during the 16th Century and subsequently his conflict with the dominance of theology at the time conflicted with his scientific observation of the celestial universe. Sir Isaac Newton's 'Experimentum Crucis' in 1665 where optics facilitated his discovery that light was colour, which led ultimately to our understanding that the colour which we perceive is in fact light reflecting different wavelengths to our retina which we perceive as a hue. The portrayal of light through the painted works of artists currently provides an enduring and continuing praxis.

The beginning of the representation of light through the painted form in works by Fra Angelico appear to have been made with consideration of the writings of Cennino d'Andrea Cennini in 'Il Libro dell' Arte'. They would have been contemporaries within 15th Century Florence, and this correlation provides insight to early renaissance thinking of the translation of light perception into light as a material interrogation. By considering that the practitioner, Fra Angelico, and writer of a methodology for painting, Cennini, both occurred in the same period and within the same city in northern Italy, provides a fascinating over layering of technical, manual and practical application.

Cennino provides the technical description for painting the representation of light, while Fra Angelico demonstrates how this practical manual may have been implemented. Both points of view, considered together, allow the origin of light as material interrogation, within the painted medium, to emerge in the early 15th Century Renaissance. One of the most fundamental points which arises from David Hockney's thesis is that artists who were working without optics or indeed with, such as Giotto and possibly Fra Angelico in

the 14th and 15th century had what one might argue a definite understanding of colour as light some two hundred years before Newton. This capacity to use colour as a way of representing light was at the beginning of a developing understanding of colour as light. Techniques for the representation of shadow through the medium of painting were being developed as renaissance tools, as such the 'Il Libro del Arte' was one. This artist's manual gave step by step advice on mixing one's own colour paint. It led the artist through processes from the raw mineral deposit taken from the earth to the technique of how to grind these minerals properly to provide the best possible quality pigment. It informed the artist on which mineral or substance to use and became a directory of materials to be considered for colour pigment ranging from yellow ochre clay, to burnt chicken bones to the soot of olive oil. This material colour index then recommended which pigment was best for which colour representation, through to which colour should be used for which purpose. 'Il Libro del Arte' provided a guide for the artist on how best to develop shading. The guide clearly explains the visual perception of light falling upon draped cloth. It characterises the difference in our visual perception between raised areas of cloth in clothing and the folds between these areas. Possibly for the first time within painting, guidance had been written which acknowledged light as a key element within object recognition. This guidance suggests to me that light is being acknowledged as the main instigator of how our experiences of the perception of object form in relation to light is formulated. That light is the foremost element within our visual perception. Without light, object recognition is not available

To develop the representation of light as a gradient in painting carries the logic that human visual perception accepts light as the key in understanding objects as visual form. This realisation, it suggests to me must have been made through extensive reflective observation. The knowledge that light upon form can be portrayed with a gradient of tone carried within a single colour is an astonishing conclusion to have been made. Cennino Cennini's observation must have developed through time observing light on objects and cloth or drapery before being able to formulate his thesis on painting.

Based upon single colour graduation, the depiction of shadow became a fundamental pre-requisite for the depiction of light. Light and shadow from this moment on were inextricably linked one might argue. Within this observation of how the artist began to paint the representation of light within a wider vocabulary of renaissance art emerged giving new meaning to light as material substance, to light and shadow as elements within the same material. Light and shadow are the key ingredients for making this new

understanding of light. An understanding of light simply as brightness is to misrepresent the elemental nature of its substance. This is because it depends wholly on the gradient from brightness to darkness to reach its full evolutionary connection to man. Cennini provided the renaissance painter with a formula for making the painted depiction of light. His manual writes a step by step account of how to portray light on clothing within a clear and methodical technique. Remarkably this reinforces the suggestion that by 1430 Cennino had developed an understanding or instinct that colour was integral to light more than 230 years before Newton. Cennini's understanding of light and how light is in many instances would lead in time to a radical painted representation of scenes in nature and architecture.

For instance, in 'The Annunciation' circa 1435 by Fra Angelico Fig 1.4 an understanding of the character of light demonstrates that the artist's sensibilities were tuned to the character of how light is or can seem to be. Part of the way we observe this work is to see the figures floating within the scene in which they are being depicted. The figures within many of Fra Angelico's works have the appearance of floating within the scene, rather than appearing to be located at the scene in the same way that the architecture is.

Two/Two Depiction

Our reading of many of his works suggests the depiction of projected shadow to be a developing concern. The depiction of shadow on clothing or in architectural detail develops more concertedly than the shadow of people. The painted depiction of projected shadow from a person onto secondary objects has not developed in tandem with that of the realism which Cennini taught for clothing. It's as if many of Fra Angelico's works have been painted within a soft dispersed light. The architectural form and landscape are painted softly and gently as forms which do not encounter light in the same manner as the people's clothes or faces. Clothes are shown with folds and ripples which don't always do what we expect. They often provide an attempt at an indication of the direction of the light source, and the angle of where light is suggested to be coming from. These help to provide depth and transition between people and provide an indication of their movement and how they are positioned and how their limbs are positioned beneath their clothes.

Shadow helps to differentiate between types of fabric and texture. It can be seen within the 'The Annunciation' that everyone gives the impression that

they have been painted separately and placed within the work. The feeling of transition from one side of the work to another and the differentiation between characters standing beside, behind or in front of each other don't carry the legacy of others shadow. Everyone is a separate identity within the whole, neither influences the other. Nobody gets in the light of another; nobody is in the shade of another. Though individually each shows the representation of ripples of light within the folds of their robes these representations of light remain the same whatever the context of the individual, whatever the apparent light conditions. Their body form is without the context of other individuals, hence the distinct lack of projected shadow by man on man.

The beginning of the representation of light has not developed at this point beyond the ripples in a robe. The artist is still learning the consequence of light and its representation by shadow. The recognition of shadow made by architecture, upon the form of architecture comes at a time when painters are beginning to evolve their ability to read place. What may be contributing to our reading of early renaissance representative painting by Giotto and Fra Angelico is the importance which colour has, and that darkness is largely absent within this representation. Darkness, deep shadow and shading are fundamental aspects of visual perception along with brightness. Cennini is beginning a dialogue that includes darkness and shadow.

The realisation that these elements are fundamentals of visual perception is a breakthrough. The question which Cennino must have been considering at the time was; what the painter would have to do to make the painted representation feel more like that of natural perception? What is missing from the painted form? What is our experience of the lived world and why does the lived world differ from the painted world? The insight needed to be able to differentiate and make a judgement that our lived world experience differed in some way from the painted one in the first instance takes considerable philosophical acuity. To consider writing a manual which tries to explain and deliver a method for understanding of how light is, becomes a significant intellectual challenge.

Cennini did this by breaking the content of the 'Libro dell' Arte' into a 'how to' manual. It starts with the individual entering the profession of an artist and beginning to draw. Cennini describes the making of the tools for various types of mark making, and the preparation of the medium onto which the artist will wish to draw. He describes the manner of shading using light as a metaphor in, 'how to put on lights and washes of white lead, just as you

shade with washes of ink' (Cennini, 1960, p. xxii). The craftsman's Handbook continues with chapters on the 'character' of colours in which the natural form of the pigment is described. The process for grinding materials, Cennini notes that each material has a different nature and therefore requires a different approach to preparation and grinding. The descriptive character of hue is described along with suggested uses for it within such things as foliage, flesh, hair or for costumes. The text provides clear direction for the artist in choosing which colour is best for which scenario.

Within this text Cennini is beginning to offer the artist a framework from which to look at the world they are painting. In doing so, he provides tacit framing of colour within different painted scenarios, which allows the artist to relate specific colour to specific form thereby inadvertently categorising colours to different uses. Within this rationalising of colour templates, it provides Cennini with the mechanism to suggest the manner to paint the shadow of light. This rationale for colour is explored by Baudrillard, who suggests within 'The System of Objects' that, 'tradition confines colours to its own parochial meanings and draws the strictest of boundary-lines about them' (Baudrillard, 1996, p. 31). Where Cennini recommends 'Cinabrese' (Cennini, 1960, p. 23) for flesh, 'Hematite' (Cennini, 1960, p. 25) for a cardinal's purple, or 'Ochre' (Cennini, 1960, p. 27) for flesh colours, draperies or mountains, the colours are given a prescriptive use. In this instance they act as a way finder for the new professional painter, but also as a frame from which these colours begin to have associations for use.

Baudrillard provides a measure or diagram through which colour has a perceived meaning and association. This association becomes so embedded within the understanding of colour and the societal meaning being placed upon it that the essence of the colour ceases to have meaning in its own being. That it exists as an object without free association. The colour of light is every tone and hue perceptible to the vision of the perceiver. Within Book Seven of Leon Battista Alberti's 'On the Art of Building within Ten Books', he notes that 'the art of building consists of different parts... which are common to all structures... [but which] will prove so valuable that not even painters, who are most exacting seekers of delight, will be without it' (Alberti, 1988, p. 189). How light is, for Alberti, is measured by the mechanism through which it arrives within the interior of the building. That is the apertures and breaks in the structure which facilitate the ingress of the light to enter the space. When Alberti uses the word 'delight' (Alberti, 1988). it suggests to me that he is referring to the character of the light - how the painter will interpret the visual perception of the manner

of the light being perceived. The character of the light is being informed by the 'different parts' (Alberti, 1988), that is the form of the building and the choices that have been made by the architect, who may or may not have considered how light will influence the contained space.

When Cennini describes the 'method and system for working on a wall... [or] way to paint a wall in secco' (Cennini, 1960, pp. 42-50), he is describing what Baudrillard calls, 'structure of atmosphere' (Baudrillard, 1996, p. 30). This structure makes relations between objects. These objects have value and categories of colour which Baudrillard implies have organisational structure within the environments of architecture we experience. This architecture may be our homes, places of work, worship or retail environments. For Baudrillard all encapsulate structural systems with meaning. These meanings are derived out of the use we make of colour. How we relate to these colours and how we derive our understanding of place is accompanied by light and as a complement of light. Baudrillard would suggest that, 'design is always accompanied by the cultural need for atmosphere' (Baudrillard, 1996, p. 30). The cultural need of any work of architecture is based within the significance of the needs for which the building has been designed. Light is one of the fundamentals of architecture which is embedded in the structure of building. The introduction of light is often wrapped within the need for the inside space to be connected to the outside environmental conditions. This relationship between inside and out, seen and unobserved, is an action of most works of architecture which we experience daily. Alberti considered lintels, thickness, jambs and voids, and wrote about the importance of building to understanding their function - to design what Baudrillard called the, 'structure of atmosphere' (Baudrillard, 1996, p. 30), for Alberti meant,

'the window openings of a temple should be paced high up, where they have a view of nothing but the sky... the awe that is naturally generated by darkness encourages a sense of veneration in the mind: and there is always some austerity about majesty' (Alberti, 1988, p. 223)

These apertures in the fabric of the structure are not windows for the inhabitants to view the outside environment; they are for the outside environmental conditions to influence the internal world of the inhabitants. If we have not experienced the situation at first hand, we may have seen pictures of light breaking through the upper air of large cathedral buildings, where the manifestation of light projects the shape of the window aperture

within the building. In the following chapter I will discuss the Therme Vals, by Peter Zumthor. The environmental conditions of this space are often characterised by water particulates in the air which provide the space a tracery of substance which creates lighted shapes travelling at angular unison with the sun throughout the interior space. This unison is being regulated and tempered by any passing clouds, changing the volumetric intensity of the beaming light, brighter or darker, waxing or waning as the exterior conditions regulate the interior experience.

Two/Three Window

Where windows have no view, where visual perception of the outside environment is not the key task and where the primary function of the window is as Alberti contends to 'view nothing but the sky' (Alberti, 1988) all allow these experiences to arise. This is where the methodology of the window as light changer begins. Windows becoming apertures in the building fabric, whose primary function is to implement 'structures of atmosphere' (Baudrillard, 1996), suggests to me an intelligent and deliberate understanding of the human experience of light. Alberti is posing an observation which suggests that that man developed a psyche which is illuminated philosophically by light. That man is connected through and by the experience of light within contained space which provides meaning to the perceiver at the moment of experience. This understanding is developed through the relationship of light's ingress to the space via the external environment. Light is being delivered by windows that 'view nothing but the sky' (Alberti, 1988). In the 'System of Objects' Baudrillard projects a perspective of understanding in which the relationship between objects are made based on their relationships with each other. The relationships, he asserts, between the environment and the object, is portrayed thus,

'what is consummated and consumed is never the object but the relationship itself, signified yet absent, simultaneously included and excluded; it is the idea of the relationship that is consumed... the relationship is no longer directly experienced: it has become abstract, been abolished, been transformed into a sign object' (Baudrillard, 1996, p. 201)

With Baudrillard's consideration in mind we can examine Alberti further; as such he refers to the temple as an, 'edifice dedicated to accommodation of objects of religious reverence' (Alberti, 1988, p. 1190). Automatically, in this instance, light is being 'consummated' (Baudrillard, 1996) and coupled to a

religious setting. This makes it an object intrinsically linked to the any associated projected or man-made construct which forms the basis of belief. '[P]laced high up' (Alberti, 1988) suggests space which is greater than human scale. It is out of the immediate reach of man. This is space to which one reaches by vision alone. It meditates on the nature of the light. It is manifest in space. This notion is constructed by windows which 'view nothing but the sky' (Alberti, 1988). The viewer contemplates only the form of the building, these apertures act as an aid for reflective practices. This reflective practice is described by Alberti as 'awe'; (Alberti, 1988), which is reverence to something strange or remarkable, a wonder which is incomprehensible and beyond the viewers understanding. Light transformed into wonder by windows high up within a temple setting connects this natural phenomenon to something constructed by man. Light at this moment becomes a transposed sign. The space within this building is what Baudrillard describes as 'consummated' (Baudrillard, 1996) by the light. It is the light, which activates the emotional responses through the vision of the perceivers, coupled to their belief system and the form and design of the space must encompass more than brightness, but darkness too.

Light is a sign for some, according to Alberti, which represents the setting of the internal context for everyone. The context of individual experience is made by our relationship to the experience we have of self in the world, when 'the darkness of the body, connects with the outer space' (Levinson, 2001, p. 2). This internal world we each possess provides the mechanism for release of individual and collected contexts. We can recall that Alberti suggested 'awe... is naturally generated by darkness' (Alberti, 1988). Darkness this research contends is light. Light is often misunderstood and/or misrepresented if it is solely considered to represent brightness.

In his text Alberti is making an important and quite astonishing point, darkness within contained space has an emotional effect. It influences the individual and is created through the individual's perception of brightness and darkness which are naturally entwined. (Steidle and Werth, 2013) suggest that darkness triggers a, 'chain of interrelated processes including cogitative processing which is beneficial to creativity' (Steidle and Werth 2013, p. 67). One might argue it is a cognitive process in which a perceived sensation of darkness is outside the realm of our understanding. I suggest that it is a natural part of what Merleau-Ponty described as our 'horizon' (Merleau-Ponty, 1964a, p. 12) or what Gadamer called 'effective history' (Gadamer, 1985, p. 284). The space which Alberti describes as an object seen in light reinforces our reading of this manifestation as a process for

perceiving the object world. Light makes objects present to us within a visual percept. Light, arguably is the first object which we perceive and as such provides developing understanding of the connection between 'light responses in [the] retina...[which] increase the number and strength of synaptic connections and change in neuron excitability required for the generation of mature [and] spontaneous signal processing... these developmental changes interact to shape sensory responses' (Colonnese et al, 2010, p. 664).

What this means is that the functional experience of 'light' by new born babies, becomes the explicit instigator and primary building block in the development of visual sensory processing. It establishes light and its relationship with the object world as a fundamental element in the processing of human experience. As the eye rapidly develops in the new born child (Colonnese et al, 2010) the physiological relationship which light provides, becomes the mechanism for the development of the synaptic connections between the eye and the brain. As an individual, each person has an experiential 'horizon' (Merleau-Ponty, 1964a) of experience, such as the experience of light in space. This horizon determines individual responses to the environment experienced, based upon what Gadamer termed 'effective history' (Gadamer, 1985). Descriptions of architectural space are often used to describe the experience of light. These descriptive terms rely on individual horizons and on a shared biology of vision for received experience. The 'eidetic memory' (Costa-Mattioli, 2008, p. 875) of light is, arguably, a recollection of an experienced perception, this experience may be of a perception processed yesterday, last week, last year or, arguably, a biological memory that recalls a reflective consciousness through our shared evolution.

This reflective consciousness may not be part of our individual lived experience today but is arguably an aspect of light remembered through millions of years of evolved synaptic connections. The deep chiaroscuro form of darkness and deep shadow, which Alberti describes within architectural space may be a totemic part of eidetic memory. In this context it may have become a memory of an experience of light. One which man recognizes as captivating, that is connected this to a biological memory, if such a thing exists or indeed is possible. Architecture which has a phenomenological or emotional context, like Alberti's temple, makes the perceiver feel something beyond the expected. This may arguably be a recollection of eidetic insight. Phenomenology assists exploration of the presences of light through Gadamer's 'effective history' (Gadamer, 1985)

and Merleau-Ponty's 'horizon' (Merleau-Ponty, 1964a). This reflective consciousness touches something we cannot grasp, only sense; it may be at this point that light places our percept within a collective human history.

Our interpretation of space based upon a received visual stimulus has the capacity to become the beginnings of phenomenological precept. Wonder and incomprehension outside of collective understanding of the space must arguably be based upon some sort of insight. Henry Plummer takes this notion further in his book 'Nordic Light: Modern Scandinavian Architecture', in which he pursues the conceptual idea of different and opposing experiential conditions of light found within different architectural spaces. Plummer suggests that we use association or personal allegory to place oneself in space. He expands upon this by arguing, 'metaphor suggestive of natural phenomena resonate with images that arouse the human psyche, causing the beholder to conjure ephemera beyond the reach of the human eye' (Plummer, 2012, p. 9).

What Plummer may be suggesting is that when we are in an architectural space and we experience light; we make association with that light based upon a perceived experience. It presents to us a mode of thought which relates the light we encounter which we are sensing, to an experience of somewhere or something else, real or imagined, contained in open space. This experience provides us with a mechanism for processing what vision receives and as such how the phenomenological is manifested. The phenomenological allows us to place an experience, toward an association of an experience. As an experience 'awe' (Alberti, 1988) is a response beyond our comprehension. It includes the dynamics of an experience which pushes our comprehension to the limits. Plummer is attempting to reconnect Alberti's suggestion back to an association so that we can frame them within an experience that we can comprehend.

He uses the association of the darkness within a vernacular church as an awareness of, 'blackness... is evidently not a void but a place' (Plummer, 2012, p. 228). The breaks of piercing light become 'stars...[the vaulted ceilings] dramatic cloud forms unique to the land' (Plummer, 2012, p. 228). These metaphors are common to everyman. An individual's experience of phenomena contains differing, imagined points of view, individual to each. The metaphor is usable to us individually; it provides the capacity for a universal frame of understanding for 'awe' (Alberti, 1988), but within individual processing it is pertinently singular. Plummer continues, suggesting,

'architecture serves to aim beyond itself, allowing designers to loosen light from the physical objects with which it mingles, and in the process to liberate light itself from its duty as an instrument of definition, and assume a more commanding role in buildings' (Plummer, 2012, p. 13)

While from the point of view of this thesis, I would contest with Plummer that light of itself is already a physical object within our understanding, and that it has already achieved the presence of being an object amongst other objects, it therefore needs no distinction. However, I would agree that as an object it provides the definition to all we perceive. It is the mechanism through which the wall is real to us as a wall or the door as a door. Light is already more than a comparison with another entity and doesn't always have to be governed by the object reality of something else.

Within 'Biophilia' Edward O. Wilson considers what he describes as the, 'poetic species' (Wilson, 2000, p. 57) which man has become in relation to experiences. His text questions the reasoning behind scientific pursuit, and its search for truth within the object reality that binds all living entities with each other. 'the inversion of purpose is more than just a trait, it is the essence of the matter' (Wilson, 2000, p. 58). What Wilson is testing through this text, is that the basis of scientific discovery. The result of the research is not to know, rather, to know, is part of understanding within existing knowledge, through which scientific discovery will emerge. Comparing knowledge of light through metaphors and allegories of experienced precepts will not result in discovery, only decorative ways to describe the undiscovered manner of how light is. Yet, the system for presenting this awareness is difficult to grasp as Finnish architect Aarno Ruusuvuori suggests through the experience of the churches he has designed, 'Lighting is not an end in itself... but its meaning is to create a feeling of the infiniteness of eternity' (Ruusuvuori, 2000, p. 47).

Alberti's treatise on the art of building has had an enduring legacy and continues to have an influence since renaissance architecture and painting. Many architects and artists today are still concerned with how light enters space as the way it is done influences every aspect of space and experience of space. The nature of the window openings Alberti writes about could be round or rectangular, would they have had clear glass or coloured glass, divided with lead or simply open apertures. Brunelleschi's cupola within the Duomo in Florence received criticism from Giovanni di Gherardo da Prato, for not allowing enough light to enter within the openings because

Brunelleschi did not use glass. da Prato presented his interpretation of medieval writing on optics', which suggested that the use of lenses or glass projected light, he suggests,' 'Natural light not broken by the refraction of a window would fall flat and not illuminate the cupola' (Strehlke, 2006, p. 209). The way in which light entered the cupola and created the 'awe' (Alberti, 1988) which Alberti writes about was a highly charged debate at this time. The manipulation of the light to generate the right kind of reaction from those perceiving the light was important. As such, how the light was within these buildings will arguably have influenced painters such as Fra Angelico. Within a growing field of understanding in the developments for representing light, painters, must have taken reference from radical new building work, such as the Duomo in Florence or St Peter's in Rome. Architects had been currently developing an ongoing and increasingly sophisticated conversation with light. To create form, which could manipulate and understand the complexity of light as physical material must have provided the painter and architect with influence.

Two/Four Opening

Laurence Kant in his essay 'Fra Angelico: A Decade of Transition' presents a hypothesis that Fra Angelico, formerly Guido di Pietro, joined the Dominican Order, in part, because it was an important commissioning organisation. This organisation with multiple and extensive possibilities for frescos to be painted within their newly built convent at San Domenico in Fiesole provided Fra Angelico with his first major commission, 'the high altarpiece for the new convent' (Kanter, 2005, p. 79) more formally known as 'The Madonna and Saints' circa 1438-43. Within other San Domenico frescos such as 'Saint Peter Ordaining Saint Stephen' Circa 1447-48 Fig 1.5, and 'St Laurence Distributing the Goods of the Church' Circa 1447-48 Fig 1.6, we can see Alberti's window openings, high up within the respective churches. The clear openings are both rectangular and ocular and form part of the distant backdrop to these works. 'St Laurence Distributing the Goods of the Church' has been structured based upon an emerging single point linear perspective. This places St Laurence in the foreground standing in front of the open entrance, distributing church goods. The linear perspective on which the geometry of the painting is focussed leads the viewer's eye using the top of the heads and the tips of the toes of the group to the left of St Laurence into the deep shadow of the church interior. The representation of this dark interior, where the window opening is placed directly behind and above St Laurence's haloed head makes this area of the painting the

brightest. Fra Angelico is painting the representation of radiant light within the complexities of internal shadow.

In the foreground of contemporary discussion and argument within painting and architecture, light, has a central and unassailable role. Where Alberti believes that, 'awe...is naturally generated by darkness' (Alberti, 1988, p. 223), and darkness is the instigator of divine contemplation, Fra Angelico began to explore the representation of this built form through his painted work. He painted the complexity in the mixture of radiant light and coloured shadow. In the over layering of shadow and light presented within architectural space of 'St Laurence Distributing the Goods of the Church' we are able to see that the interior left-hand side of the church is in deeper shadow than the right. The high windows projecting the brightest light are on the left, seemingly projecting the light onto the right side of the church suggesting the possibility that it is morning light. Fra Angelico employs occluded edges throughout the painted interior space allowing for the rhythm of light and dark between the columns leading to the aisles on either side of the nave toward the chancel. This technique being adopted by the artist presents the idea of voluminous space and depth of field within the church primarily through the representation of the light within the space. The artist is developing a rational way to project to us a representation that we will believe and understand. This representation does not have to be true or accurate, it can be just a technique that works for the perceptual understanding of the human eye as such,

'the visual system has evolved in order to be able to recognise objects irrespective of the features of their variable, unstable, cast shadows, and for this reason is immune to them... in contrast, shadows are potentially informative as to the spatial layout of the scene' (Bonfiglioli, 2004, p. 1302)

What (Bonfiglioli, 2004) presents to us here is that the human perception has advanced being able to recognise the representation of object form through shadow. Fra Angelico through his painted work presents shadow incongruities in his representation of the interior space, however, this technique still reads as recognisable to the human eye – just as 'A Vision: The inspiration of the Poet' does. These incongruities are present within 'The Annunciation', Circa 1425-26, by Fra Angelico through a very delicate representation of light within a chamber leading off the loggia which forms the focus of the work.

The light enters this chamber through an open window in which the Garden of Eden can be seen. The window surrounds are painted to indicate that the light is entering the window like 'St Laurence Distributing the Goods of the Church', from the upper left. The artist uses three tones of yellow ochre to achieve this illusion. The brightest yellow being on the right window edge, the sill is a mid-tone yellow and the left side of the window edge is the darkest ochre. This suggests the technique to which Cennino writes about in the depiction of shadow using three tones of one colour. The position and strength of the radiant light is once more emphasised by the artist in the projection of this light captured on a wall to the right of the window which appears to run at ninety degrees to the window. We are able to deduce this by the corner shadow which Angelico has painted, (see Fig 5.2 in Chapter Five regarding a practice Illustration of a corner shadow). The artist has painted the wall which contains the window in a darker grey/green tone than the wall with light projected on to it creating a perceived visual weighting.

This darker grey/green colour accentuates the brightness of the window and differentiates it from the other wall. The vertical edge line of the corner junction between these walls has been further emphasised by a dark green subtle stripe which delineates this junction. The artist displays knowledge in capturing and accentuating the depth of field which contributes to our understanding and belief that this is a three-dimensional space. The golden rectangle of the radiant light bleeds gently out into the green hue of the wall. The very subtle representation of light painted in yellow ochre bleeds very gradually into a lighter green whose gradient of transition travels further vertically down the wall from the light source than it does upwards. The artist has faded this transition from brightness to darkness to, it would suggest to me, to be able to further accentuate the direction of the radiant light entering the chamber. This technique of using a gradual change or gradient enables the darker occluded edge which frames the shape of the doorway leading from this side chamber into the loggia to stand clear of its background.

The warmth and strength of the light entering this room is further emphasised by the bench which is situated below the window. Upon first looking at this bench within the side room it seems of no interest and of no significance. However, it appears upon further examination that the bench is being used by the artist as a further tool for drawing our eye into this room and adding a three dimensionality to this space using colour and shadow formation. The combinations of all these factors add, it would seem, to the familiarity of the situation. The painting of the bench is full of incongruities. The manner to which this bench is top lit seems to be wrong. The bench top

is too bright. It has the manner of something which is top lit by a spotlight or another strong source of light which emphasizes the brightness of the bench seat closest to the window. If we make the judgement that the golden rectangle of yellow ochre on the wall above the bench is the trace of light falling, then how is it possible for the bench to be illuminated in the manner which it is? The bench doesn't 'feel' right – it should be in shadow and darker rather than lighter.

The leg of the bench closest to the window opening projects its shadow across the illuminated floor moving away from the window toward the loggia. The chest situated directly below the window has a convincing tone to it, as one would expect it to have, being in the shadow of the lower wall. The bench however, one would expect to be in part shadow, based upon its placement in relation to the window opening and the angle of the sun, based upon the shadow display around the window. Logic would also suggest it to part be illuminated by reflected light entering through the opening to this room from the loggia.

Two/Five Construct

In consideration of the suggestion by (Bonfiglioli, 2004), which is that the human visual system has an ability to 'recognise objects irrespective of the features' (Bonfiglioli, 2004, p. 1302) suggests that our visual system constructs an understanding of space based upon how light is, how it presents to us. This is significant as environmental conditions are the construct through which we sense the world, how we experience the 'variable' (Bonfiglioli 2004). It is these calculations which our visual perception considers and as such they appear to be made unconsciously, possibly through an 'endowment' (O'Hare, 2016). They do not appear to part of conscious decision making and appearing to be an automatic implication of our vision. The suggestion that our visual system has the capability of overriding the consciousness of our decision making to facilitate purposeful understanding of scene must have profound implications.

In acceptance of this understanding this application of our vision, allows us to progress notions about why we see light within architectural space in the way we do. The shadow of man, strikingly is still largely absent within the painted form of Fra Angelico. Within the frescos and tempera work he clearly begins to paint and explore the representation of the projected shadow of architectural space and the manners of texture and construction details within the scene and environments portrayed. However, the absence

of projected shadow from the figures within these works is less obviously represented as the folds within their clothes. In Fra Angelico's work we can see the beginning of the intimation of projected shadow. The projected light of architectural form is being shown in a very tentative and speculative way, as if the artist is beginning to recognise its importance and relevance in the way the viewer of the work will understand the story being told, the reality of its setting. At the same time as the artist is evolving this type of analysis, the representation and portrayal within the surface detail of decorative architectural assemblages is portrayed with unprecedented detail.

The painting of form in decoration has been lifted from the flatness of pattern into three-dimensional analysis of shadow representation. This change can be seen by the flatness of pattern alongside the representative form of the figure. Like the presentation of architecture, there is very tentative representation of projected shadow which the figures might cast, however the folds within the clothing have been defined with great authority and consideration. These beginnings in the representation of projected architectural shadow make the environment more cohesive, real and easier to understand but the representation of man within the paintings and his presentation as part of the space and part of the world is tentative.

THREE

Illustrative

'Material imitation...indicates a radical transformation of the mythical conception of architecture' (Perez-Gomez 1985 p49)

This chapter will consider how architecture is able to be designed for and connect with conditions of light. It will make these considerations through reflections upon the design process of two architectural projects set two thousand years apart. For the first project, I will analyse the illustrative plan and section drawings for a Roman bath house proposal by Vitruvius within his 'Ten Books on Architecture'. The second project this chapter will consider through its design development drawings and associated imagery will be the Therme, Vals by Peter Zumthor. The comparison and contrasting of these works is important because the drawings for both projects inform us a great deal about the visual presentation of light, particularly how the confluence between the darkness's of light within each project becomes a vital and imperative aspect. The works have been designed in consideration of, and within a sensorial relationship to the ecologies of light which has been tuned, I will argue to create fascination and allow the user to bask in light.

By studying the drawings for each project, they provide us with visual cues to the nature of light being imagined and their role as illustrations provides an imaginative and conceptual framework through which light translates inherent phenomenological cues. These are illustrative responses to our knowledge of light which we respond to through our knowledge of the qualities which light evokes. Exploring how the image of light provides context for the development of architecture we are acknowledging that light activates something within us that is beyond learnt, beyond our life time, but within our operating system as biological response.

The orientation of architectural space, subject to light, is a key element in influencing the type of light which space will manifest - a precedent outlined by Vitruvius in circa AD30. The orientation of architectural elements as considerations along with that of climates and climatic conditions becomes man's response to nature. This response provided essential knowledge for the siting of every architectural proposition, which included cities, temples, fortifications, and all of their component elements. Orientation of a proposed site in the context of its climate was for Vitruvius what he described as the 'winds' (Vitruvius, 1999, p. 72). Vitruvius suggested that there were eight winds in total, each invested with a character, possibly a metaphor for different conditions of light. Each of which needed to be considered by their characteristics. Vitruvius suggested,

'choose as warm a site as possible... one facing away from the north wind (Septentrio) and the north-west wind (Aquilo)... the caldaria and

the *trepidaria* will have light [winds] from the west in wintertime' (Vitruvius, 1999, p. 72)

This contextual analysis by Vitruvius is being offered for the placing of Roman baths, known as the *Balneae* (Vitruvius, 1999, p. 72) amongst other things. From the plan of the *Balneae*, it suggests that the apertures which introduce light to the space of the baths, and which also release the steam as water vapour, have value in being south facing. The orientation of the *Balneae*'s window apertures avoids facing North or North West. This demonstrates certainty an understanding about the nature of climate and orientation in relation architectural space.

The nature of the internal space created is given consideration along with, quite possibly the health and wellbeing of the users. Wind becomes the reference here for nature. It is divided initially, into four directional winds such as 'Solanus' from the East, 'Auster' the south, 'Favonius' the West and 'Septentrio' from the North. Vitruvius further expanded this ratio of winds into eight winds including, 'Eurus' in the South East, 'Africus' in the south west, 'Caurus' in the north west and 'Aquila' to the north east (Vitruvius, 1999, p. 166). These eight winds were used by Vitruvius as the means through which orientation was the first principle in consideration of architectural propositions.

These principles rationalised how nature was to be acknowledged through architectural design. These notions depict the value in understanding nature in relation to structure and particularly space. They guide architecture with understanding governed by the implementation of nature knowledge. This naturally makes the darkness's of light, I would suggest, fundamental in formulation of Vitruvius's theory of the wind and therefore of architecture itself. Light is being rationalised here not as view, but as the significant material informer and shaper of architectural space in relation to our nature and need for light. As Vitruvius states in his consideration of the placing of the *Balneae* so that it 'will have light' (Vitruvius, 1999, p. 72) one needs to have a clear and precise idea within the orientation of a site to know from which direction the strongest intensity of light predominates. To do this one needs to understand where north, south, east and west are. From this understanding, it is possible to precisely place the respective winds in their reputable direction, which makes my earlier suggestion that it is light that Vitruvius refers to, not wind, more plausible. I would also suggest that wind is a metaphor used by Vitruvius to represent light. Therefore, understanding

where light predominates is key, orientation based upon light, is arguably one of the first principles of architecture still fundamental today.

Shadow is the mechanism through which orientation is derived. The 'skiothérés' (Vitruvius, 1999, p. 30) which is Greek for 'shadow-tracker' (Vitruvius, 1999, p. 30) is a bronze Gnomon used to track the course of the sun over the period of daylight. Through using this tool, comparisons of shadow length can be annotated from north, south east and west. The process of annotating light over time, takes place with this tool placed centrally upon a flat dressed surface. During the hours of the morning the length of the shadow made by the 'skiothérés' is marked upon this surface. At the point at which the morning shadow is longest, and at the point of the shortest shadow at around mid-day, a circle is drawn using these marks with a compass placed at the centre point between the two. The afternoon shadow can then be observed and where the shadow crosses the circle, these points are marked. The entire circumference of the circle can then be divided with the compass based upon these four intersections.

From these divisions north, south, east and west are derived; from such knowledge the winds can be charted. Shadow represents the fundamental through which light is given meaning to man. It becomes the mechanism through which man defines an understanding of what light is, what light does and what light will help man create. In Vitruvius's description of the 'Balneae' he suggests that, the 'washbasin should be built beneath the window, so that those standing around it will not obscure the light by casting shadows' (Vitruvius, 1999, p. 72). This suggestion of placing the washbasin beneath the bathroom window still has contemporary relevance today within domestic scenarios. The relationship between window, wash basin, and light, becomes design utility. For light, particularly within the context of bathing, one could consider the distance between Vitruvius and our present context and question the relevance of this consideration between the 'wash-basin' and light. However, if we consider Baudrillard's 'System of Objects' the question of authenticity in relationships between objects over time has relevance to this point.

Baudrillard suggests that practical objects 'speak [and] are checked by practices – that account for reality' (Baudrillard, 1996, p. 10). The functional aspect of light in relation to the 'practices' of ablutions is largely designed with a dialogue to light which has now, arguably, become an intrinsic relationship as both practical and environmental. The drawings by Thomas Noble Howe in relation to Vitruvius's written prescriptions illustrate how the

Balneae shown in section and plan, place attention to the drawn depiction of light and darkness Fig 3.0. It clearly defines the placing of the 'labrum' (Vitruvius, 1999, p. 251) below the high windows. The apertures in the ceiling of the bathing rooms achieve duality by allowing the light to enter the chamber, while also allowing the evacuation of steam and heat from the Balneae. It is the combination of orientation, internal climatic conditions, and the placing of window apertures which contribute to conditions pertinent to the bathing room. In the section drawing of the Balneae one can decipher the grammar of the drawing through the signs of the graphic illustration used. The upper left-hand window has eight straight lines radiating from the aperture of the window in the ceiling of the Balneae. These lines indicate the position of the sun in the sky outside of the chamber. They also represent the notion that light has the capacity to expand upon entering the space. This notion is achieved by the lines radiating outwards after it passes through the small aperture of the window itself. The drawing presents knowledge of light, as well as presenting a message of how light may behave within the space.

The drawing depicts the ingress of light in the upper right-hand window as six straight lines radiating in an outward motion from the aperture of the window providing an indication of the sun position. We see these lines as they actively interact with steam mixing with light to create the tracery of the light piercing the air. The drawing provides indication of what the interior climatic conditions of this space may be like at this time. The heated water vapour rising from the pool to the far left of the illustration, indicates the source of the vapour moving toward the window apertures to the right and joining the water vapour rising from the labrum. Both vapours are expelled from the chamber through the window, via the air flow created by the door opening.

One can visualize the steam created by the heated water which flows from the bronze tanks above the furnace in the caldarium to the Balneae. This objectification of the materiality of light, in steam, within the drawings are defined through the prescriptive work of Vitruvius's' writing. It provides evidence of how an understanding of the way light is or shown to be in certain contained environments can be described graphically to impart an understanding.

This simplification does however underscore how the interior light and atmospheric conditions provides cognitive captivation through illustrative means, however, lines of illustrated light belie a necessity to think within a

negative form. For instance, in the illustration of the Balneae the space has the appearance of a brightly lighted space, however, considering the window positions and the size of the apertures of these openings, the amount of brightness illustrated does seem somewhat improbable. Improbable even with the assumption that in a sectional drawing, the window apertures are likely to be repeated within the half of the space not recorded, and these apertures will be providing an amount of light to the area of the section illustrated. I would suggest that this is an illustration of a dark space. A space filled with shadow and areas of almost complete darkness.

The radiating straight lines projecting into the space from the window apertures within the illustration could be considered as illustrative of light contacting moisture within a dark space. Although the illustration looks to be of a bright and luminescent space, I suggest it is dark and luminescent. It is the darkness of the space which makes these lines relevant. Small apertures which allow light to be introduced to a dark space create an effect like a spotlight. When the dimensions of the aperture and the combined textural form of the external and internal edges of the window shape are transposed to the position of the sun and the climatic conditions, this is what is illustrated.

The Balneae responds, I suggest, to the relationship man has with the darkness's of light. The Therme Vals, Switzerland by architect Peter Zumthor, which was completed in 1996, and arguably represents a contemporary architectural space in the spirit of Vitruvius prescription for the Balneae. To strengthen this argument, I would like to consider some of the projects key developmental drawings, Figures 3.2, 3.3, 3.4 & 3.5. These drawings were used by Atelier Peter Zumthor during the design process for Therme and clearly illustrate the material palette, of which light was key. What is important are the ways in which the drawn representation of light, contributes comprehensively to the architectural principles which develop in relationship to light. Peter Zumthor described the difficult beginnings, in which the work had to evolve and grow thus,

'Raised in the spirit of classical modernism and besieged by fashionable postmodern designs, we were cautious about models. But there was a colour photograph of the Rudas Baths [taken by Müller, G. P.] in Budapest dating to the days of the Turks, which I had copied from a book and stuck on the wall. The rays of light falling through the openings in the starry sky of the cupola illuminate a room that could not be more perfect for bathing: water in stone basins, rising steam,

luminous rays of light in semidarkness, a quiet relaxed atmosphere, rooms that fade into the shadows: one can hear all the different sounds of water, one can hear the rooms echoing. There was something serene, primeval, [and] meditative about it that was utterly enthralling. The life of an Oriental bath. We were beginning to learn' (Zumthor, 2011, p. 27)

Three/One Process

Before I discuss the project drawings, I would like to explore the architect's use of a single photographic image which he refers to Fig 3.1. in which the beginning process looked for inspiration and reference within an image. It became the philosophical spirit of the project from which the architect launches his own investigation into the relationship between orientation, light, water and stone.

The first element of interest is the 'the rays of light' (Zumthor, 2011, p. 27) which become the central fixed core from which every element of the project follows. Light becomes the mechanism through which the image of the bath penetrates the architect's visual perception: it is governed, one might suggest, by the intensity of light being pushing into the baths. We are not certain what the climatic conditions outside the baths are; we are not certain if this internal light is being created by radiant or 'hemispherical' (Pont, 2006, p. 1334) light. One might suggest that it is radiant light based upon consideration that the central beams of light have an intensity and power that is not equal to the coloured points of light to the left or to the right. This may indicate that the brightest luminance is congregated centrally as a direct result of the position of the sun aligning with the position of the image maker. This has the function of making one area appear brighter than another, possibly due to the sun being aligned and visible in the sky to the picture taker?

The second element of the image described by Zumthor is that the light rays are 'falling through the openings in the starry sky of the cupola' (Zumthor, 2011, p. 27). The use of the word, 'falling' suggests that the light is moving in a downward fashion, that it is coming from above, that it is the light of the day. How we read light is important. How we place the direction of light and the materiality of objects on which it falls 'provides us with cues' (Pont, 2006, p. 1331). Through this our direction of light judgements makes assumptions learnt from experience connecting human vision with learnt historic precedents of the diurnal sequence. This is derived from, and a

consequence of, living in a world that is governed by night and day, light and dark, brightness and shadow.

(Casati, 2014) provides a reconsideration of (Kleffner and Ramachandran, 1992) hypothesis that visual perception is based upon two primary summations, which are 'uniqueness of the light source and light from above' (Casati, 2014, p.351). The question that Casati poses is why the visual system can make a functional understanding of the scenario presented. In the case of this paper, a re-evaluated consideration of (Kleffner and Ramachandran, 1992) illustration of round convex and round concave inversions of light is made. The author suggests that the visual system can tolerate the absence of cast shadows within situations where they ought to be present, based upon an inherent understanding that light comes from above. Research such as (Casati, 2014), (Mamassian and Goutcher, 2001), (Sun and Perona, 1998) along with (Ramachandran, 1988) consider this hypothesis. (Morganstern, 2011) does not provide evidence to the contrary, however suggests that 'the human visual system's assumption that light comes from above is weak... [however] the light-from-above prior is a reasonable assumption' (Morganstern, 2011, p. 12551).

Making an understanding of light by reading light as coming from above the horizon, leaves the probability that our visual system does consider the cues of directional lighting as a way of understanding space by the environmental conditions of light we encounter. This means that our experiences of light and the cues which light contain become a system which we have learnt, and which have become embedded within our experience of light through time within our evolutionary history.

Zumthor describes elements of the light entering the Rudas Baths as 'openings in the starry sky of the cupola' (Zumthor, 2011, p. 27). These openings, reflecting notions of the natural world, become key design elements. The type of light provided by the manner and orientation of the openings will become central tenets in the Therme baths design. How light gets into a space is fundamental in developing how that space is experienced. One might be able to argue that these 'openings' are not windows, in the sense of making a visual appreciation or navigational placing of where the perceiver is in relation to the surrounding environment. The purpose is to facilitate the introduction of light into a contained space. The introduction is made in a very precise and considered way, yet exploration of the Rudas Baths image, does not offer anything definitive

about the apertures themselves, only one may consider them to be round, but this is not definitive.

The ceiling openings within the baths at the Alhambra are 'polygonal skylights in the main vault of the hammam' (Bermudez Lopez, 2010, p. 127). When these are viewed at a distance, and from an angle, while conditioned by specific internal atmospheric conditions, could belie the shape of roundness seen in the Rudas Baths image. The phenomenological interpretation of light by Zumthor creates a space in which an image can have imaginative repercussions for derivation, an area of interest to John-Paul Sartre. Sartre tested ideas regarding what one can gain through the ultimate use of imagined objects in creative imagination. In the *Psychology of Imagination*, Sartre makes a denial of the potential to gain anything from imaginative thought of an image. He contests that 'If I amuse myself by turning over in my mind the image of a cube, if I pretend I see its different sides, I shall be no further ahead at the close of the process than I was at the beginning, I have learned nothing' (Sartre, 1972, p. 23). That we gain nothing from the mental exercise may belong to a notion that objects in thought will by their nature be 'tainted, or false' (Merleau-Ponty, 1964, p. 72) within an imaginative process.

Imagination and perception are radically different posits which on the one hand share the desire for the objects to be present, but conflict this by taking routes which by their nature will always present conflicting constructs. When Peter Zumthor perceived the image of the Rudas Bath, he was engaging with the perception of the materiality of the object of light which existed for the moment of the picture only. He did not perceive the actual light in the baths at that moment, only a recording of it. The imaginative processing of the image constructs a process whereby the actuality of the Rudas Bath does not exist; it is outside of perception, what Sartre describes as being within an 'immediate awareness of its nothingness' (Sartre, 1972, p. 13).

This awareness of nothingness, one might argue, provides the opportunity for the creative process to gather more and penetrate deeper into the possibilities of the creativity being engaged. All consciousness is consciousness of something' (Sartre, 1972, p. 10), Sartre suggests, but this posit raises questions regarding the act of perceiving and the act of thought. Non-reflective consciousness could be argued to be perception of an object which exists in time and space at a particular moment in time, whereas, reflective consciousness is recollection of the experienced object. The imagined or reflective aspect of this materiality of light in the image of the

Rudas Baths for Zumthor provides freedom from the constraints of the perceptive aspect of the same image. Within perception of the existing object our focus is different. The time of the perception is moving and there may be other factors pushing into our set of sensorial parameters.

The image of the Rudas Baths becomes at one totemic and inspirational and it informs through a conscious decision to place the image on the wall of the studio wall during the design process. It becomes a background reference to the sensuality of the space, and the imagined realm of light, water and stone. Within process, imagination and reflective processing of ideas, notions, considerations and hunches are tools from which inspiration and insight emerge. Imaginative consciousness provides the opportunity for man to realise more, it is different from conscious perception. It can be achieved by not being constrained by boundaries or horizons. It can create and imagine a variety of horizons which deepen understanding of the image object, an example of this may be to look at the direction of light in the Rudas Bath for example.

What Peter Zumthor described as 'the rays of light falling through the openings in the starry sky of the cupola' (Zumthor, 2011) can be imagined as a tool for navigation of the space in relation to external space. The 'rays of light' (Zumthor, 2011) tell us that the image was created possibly during the middle part of a diurnal sequence. It suggests that it may have been taken during the summer months rather than the winter. We are able to make these deductions based upon the angle to which 'the rays of light [are] falling through the openings' (Zumthor, 2011). Considering the two outer rays which are distinctive in their brightness and intensity, the left ray is thinner and sharper than the softer wider right ray, however they both angle in an outwardly similar degree.

With a rudimentary measure made by eye based upon the projected vanishing point of these two rays above the image I suggest that they are approximately set at an angle of 82° to the horizon line, and we know that Budapest is sited at approximately 70° latitude. Considering the tilt of the earth, and the assumed time of year makes an approximate reading possible, based upon the angle of the 'rays of light' (Zumthor, 2011). This rudimentary observation tells us nothing of the quality of the light within the Rudas Baths, but it does offer an ability to consider the image of light as a tool for making an understanding and for reading light from above the cupola.

The art historian L. Goldscheider in his forward to 'Roman Portraits' considers and reflects upon the pertinent and extensive divisions created through time in the developments seen between Egyptian, Hellenic and Roman portraiture. L. Goldscheider's thesis considers in detail the principles in which the illusion of the portraits used and relied upon light and shadow within the mouths, eyes and ears. He presents the notion that they in fact developed their technical ability so that 'they left the depth of the mouth rough so that shadows might collect there' (Goldscheider, 1940, p. 8). Within Hellenistic portrait sculpture and architectural building, the colouring of the stone from which the works were created was a prevalent and normal process. However, L. Goldscheider presents the notion that because of the technical developments in portrait carving, and through philosophical belief, the 'body [for the Hellenes] was the only reality... [and attempted to] depict an eternal reality' (Goldscheider, 1940, p. 5). This eternal reality began to renounce the polychromatic tinting of architecture and portrait busts to the point where, through this philosophical and cultural shift, 'light and shade replaced colour' (Goldscheider, 1940, p. 9).

Merleau-Ponty provides consideration and argument for how this understanding may inform understanding of the image. The Rudas Baths image, and its confluence with light, makes us 'concerned with truth' (Merleau-Ponty, 2004, p. 49). This truth is concerned with that of the interstice of light in time. To understand this consideration further, Franz Brentano within 'On the Origin of Our Knowledge of Right and Wrong' might be helpful. The conceptualisation of truth within the context of understanding light within visual experience relies upon the conceptual notion of what those experiencing light understand 'truth' to mean.

Brentano's notion of 'truth' is based upon an understanding, or interpretation of the experience which is a judgment on the reality of that experience. He suggests that we cannot make nor understand what the reality of experienced sensation is because interpretation is in itself a judgement. Which means that this is an impossible formula for understanding 'truth', because neither interpretation or judgement are independent of each other, they both rely upon the same mechanism or concept. What Brentano presents as a way of circumventing interpretation and judgements was the notion of 'evidence' (Brentano, 1969, p. 78). Evidence or something being self-evident, are judgements. They are being formulated and made from that which can be presented as true, therefore, not interpretations or judgements. The concept of 'truth' to which Merleau-Ponty refers allows research to connect itself to the notion of 'evidence' or 'fittingness'

(Brentano, 1969, p. 74) from which phenomena is evaluated by how it appears, and the way in which we make judgements of it.

Merleau-Ponty frames space as 'the uniform medium in which things are arranged in three dimensions and in which they remain the same regardless of the positions they occupy' (Merleau-Ponty, 2004, p. 50). He suggests that an object is presented as being different at both the North Pole and at the equator. At these places the object will change its form, which may be the weight of the object or its shape, and this change is governed, by 'temperature' (Merleau-Ponty, 2004, p. 50). In addition, he also suggests that the changes that may appear in the object are wholly related to 'temperature' (Merleau-Ponty, 2004, p. 50) changes at the North Pole or the equator and not to the 'movement' (Merleau-Ponty, 2004, p. 50) of the object to these places. 'Space [he suggests] is the same at the pole as at the equator' (Merleau-Ponty, 2004, p. 50) which means that space, is the same wherever it is and at whatever longitude or latitude the space is, 'thus the fields of geometry and physics remain entirely distinct: the form and content of the world do not mix' (Merleau-Ponty, 2004, p. 50).

These notions however don't consider how light can be within architectural space based on the position of the space itself. This thesis practice models are fixed and located on the earth in a manner which does not change position or alter its shape as they rotate in relation to the fixity of the sun. The model space and the sun are fixed points of reference from which the 'evidence' (Brentano, 1969, p. 78) of light presented within the model space can be observed and the analysis of its presence undertaken. My practice seeks to inhabit this realm. These 'objects [which light is considered to be one] cannot be considered to be entirely self-identical, one in which it seems as though form and content are mixed, the boundary between them blurred' (Merleau-Ponty, 2004, p. 51). Light, we can argue, is an object (Gibson, 1986) and as such, an object instigator of visual change within architectural space.

Three/Two Detail

The detail of light in space is the evidential truth of its being. In this detail, light is different, in different places, at different times, but also in the capacity to be different, at different times within the same place. Light changes in conjunction with the rotation of the earth and the climatic conditions of the environment to which the space is located. The space does not change, because it is fixed, the dimensions of the space do not alter in any critical

meaningful way. The architectural spaces I am concerned with do not move. However, the light being presented within this space, will be within a state of constant flux and change within every moment in which light is entering the space.

The image of the Rudas Baths has meaning because it is dependent on a single moment in the flux of change such as the 'Heraclitan doctrine' (Zeki, 2009, p. 2827). Architectural space which is prone to the influence of ecological motion but has been focused upon in one moment of time by Zumthor, from which his design is imagined. These project drawings annotate light as a material, it is given the same material status as water and stone. The design for the Therme is derived based on light made physical, made tangible. He has endeavoured to work with it as an object whose material structure and reliability has the same capacities any other material an architect can use in the design of structure.

To quantify the importance of the drawn representation of light as a design tool, is to quantify it in the same manner as drawings used to quantify the positivity and reliability of structure. Zumthor's drawings consider the interaction of the senses. The image of the Rudas Baths generates complex recollections of experience and provides the opportunity to imagine experiential and sensorial experiences. The imaged moment of the Rudas Baths, is tuned to a moment which aligns many sensory dynamics for Zumthor. It has the capacity to unlock his ability to recall or re-imagine the intensity of the climate within the bath. This recollection of perceptual stimulus and the configuration of re-imagined possibilities are touched upon within the Phenomenology of Perception where Merleau-Ponty places the body as the tool from which we can derive some contextual meaning.

The world we sense, he suggests, is part of our proximity, both physically and intellectually to the experience that 'our own body is in the world as the heart is in the organism: it keeps the visible spectacle constantly alive, it breathes life into it and sustains it inwardly, and with it forms a system' (Merleau-Ponty, 1962, p. 203). He is observing that we process our experience of the world as a representation of being at the centre of the experience. Our ego, should not, on this occasion, be understood as a closing of proximity, rather an opening. It is through this opening out within processing experience which informs the breadth of potential. Our body as 'intentionality' (Kearney, 1994, p. 74) seeks to place man at the centre of physiological sentient making experience.

Experience becomes a capacity to make meaning through the encounters, sensorial or otherwise we have with the world. This 'intentionality' which Kearney suggests, is the making of substance derived through the experience of encounters, seen within Zumthor's drawings for the Therme. These drawings become and provide the ability of the action which 'breathes life' (Merleau-Ponty, 1962) into the process of consideration and formulation of the outlying ideas. The drawing 'sustains it inwardly' (Merleau-Ponty, 1962) by processing the fragments of imagined or re-imagined formulas from which the proposal is carried within the mind of the author. These drawings provide the author 'a system' (Merleau-Ponty, 1962) from which to derive and communicate meanings and proposals. They offer a method which is organic and fluid and from which traces of the stages in building the model of the work can be traced and followed, characterised and developed.

The gradient and texture of the darkness's of light becomes the central tenet at Therme very quickly. Zumthor brings into this consideration the body and its relationship with the light, as Merleau-Ponty states 'our own body is in the world' (Merleau-Ponty, 1962) and the Therme is centred upon the body. Zumthor seeks 'to create a sensuous environment for the human body, for naked skin, for young bodies and old bodies, which look beautiful in the soft light or half shadows' (Zumthor, 2011, p. 142). It is this which informs the visual experience of the baths, and in turn penetrates the whole bodily experience and 'keeps the visible spectacle constantly alive' (Merleau-Ponty, 1962, p. 203).

The process of drawing the Therme is the process of drawing light. However, this process is created within the imagined structural manner of how the work will develop. Zumthor considers the landscape and the place of the Therme within it. He considers the mountain rock upon which the Therme is to be built, he considers the spring water held deep within the rock through which it will filter and congregate heat and chill, contain and release. He places the Therme within an imagined historical timeline of the earth; he places man as the 'organism' (Merleau-Ponty 1992, p. 203), part of the body of the earth itself. In *Labour, work and architecture*, Kenneth Frampton pays attention to the Therme placing it within a distinct category of architectural premise, one of 'ontological focus' (Frampton, 2002. P. 326). This concern with the nature of being is central within Zumthor's work philosophically and is particularly apparent within the Therme. Frampton has correctly, I would argue, suggested that Zumthor's 'unique approach to both time and material... [allows him] to create a work that looks as though it has always been there... that time and material are the two intrinsic attributes of

[this] built form' (Frampton, 2002. P. 326). Both 'time and material' (Frampton, 2002), for Zumthor become the basis of drawing.

Three/Three Time

Light is both time and material in this instance. The representation of time is made through the tuning of the Therme to the changing character of the light. This changing character is created using the structural alignment of the large stone blocks which leak light into the chambers of the baths. The representation of this relationship has been extensively explored through drawing. Drawings present and test the relationships between the large stone blocks which Zumthor describes as 'the configuration of large stone tables' (Zumthor, 2011, p. 46). These blocks edge toward each other creating a dynamic of proximity. This dynamism utilises the relationship between mass, and void, intensifying ecologies of light within a structural combination of visual cues. By leaving just six centimetres between each slab, it creates the mechanism for light intensity to, 'filter down from above' (Zumthor, 2011, p. 46). This intensity derived in part through the gap between the 'stone tables' (Zumthor, 2011) has grown from drawing light to communicate the essences of the designing with this materiality. Louis Kahn is quoted by Arthur Zajonc within his book 'Catching the light: The Entwined History of Light and Mind' when reflecting upon the difficulty of drawing light. Khan describes the process and the enlightenment achieved when he sets out to do so,

'I gave myself an assignment: to draw a picture that demonstrates light. Now if you give yourself such an assignment, the first thing you do is escape somewhere, because it is impossible to do. You say that the white piece of paper is the illustration: what else is there to do? But when I put a stroke of ink on the paper, I realise that the black was where the light was not, and then I could really make a drawing, because I could be discerning about where the light was not, which was where I put the black. Then the picture became absolutely luminous' (Zajonc, 1993, p. 290)

While I understand the logic of what Kahn is saying, I disagree with his analysis, particularly the notion that 'the black was where the light was not' (Zajonc, 1993). One of the fundamental parts of ecologies of light which this thesis posits, is the suggestion that darkness is part of light; it is an aspect of its ontology. The premise of Kahn's argument and his distinction between 'where the light was not' (Zajonc, 1993) is counterintuitive. The difference in

Kahn's drawings and that of Zumthor's for the Therme is that the darkness is understood to be light. This significance regarding an understanding of light calls for further and closer examination. Zumthor began to explore the placing of the 'stone tables' (Zumthor, 2011) which while they were a fundamental part of the structural configuration of the roof of the Therme, became the tool which had the most insightful impact upon the project. Challenging the dynamics of the situating of these masses, made the placing of these objects manifest in the darkness's of light they created. Kahn stated that, 'black was where the light was not' (Zajonc, 1993) and by inference, suggests that the white paper was where the light was. For Zumthor this relationship is a much more complex and complicated exercise. His drawings begin to suggest and represent light as a material which encompasses darkness. Black become light. Within the process of design, exploring the diverse possibilities of potential is a fundamental tool of discovery in whatever context the design is taking place. Fig 3.2 is part of a range of sketches which Zumthor makes in which he begins to evaluate the system and relationship between the masses of stone. It is within these sketches that the relationship between the material concrete and the material light begins to shape its potential. An ontological point of view begins to inhabit the process, as the consequences and manner of delivering material light into the voids of the Therme begins to evolve.

Juhani Pallasmaa within 'The Thinking Hand' considers the 'animistic' (Pallasmaa, 2009, p. 115) emptiness of architecture. This occurs, he suggests, when architecture departs from the biological boundedness of living. It does this, I suggest, by failing to introduce the phenomena of animated absorbance through the experience of life in motion, such as within the 'heraclitan doctrine' (Zeki, 2009). Pallasmaa continues this consideration by stating that;

'form needs to be reconnected with its ontological essence, particularly when the art form tends to turn into an empty aestheticised mannerism... architectural works of the modern era that echo the tremors of origins... such as works of Sigurd Lewerentz, Louis Kahn, Aldo van Eyck and Peter Zumthor... project an authoritative radiance and depth of feeling' (Pallasmaa, 2009, p. 115)

These thoughts regarding the 'ontological essence' (Pallasmaa, 2009) of architecture and most particularly what the author terms the 'tremors of origins' (Pallasmaa, 2009), lift the work of the Therme and its process of consideration within design to a place where the nature of its being can be

investigated. The nature of Being in relation to the ontological layering of the Therme, is, as Peter Zumthor has suggested when he presents his objective 'to create a sensuous environment for the human body... which look beautiful in the soft light or half shadows' (Zumthor, 2011, p. 142). This is its essence. Light in relation to stone, to water, to temperature, is the determining factor - the bridging element. Fig 3.2 becomes part of the catalyst from which this objective arises. The different movements of the hand, how it begins gesturing in different ways with the paper, how it uses different and varying ways in which the hand holds the pastel, all inform the marks it makes.

In design, when intuition and feeling, introduce the gesture of the pastel, which inform the line and edge of line, the pressure of impression, and lightness or strength of touch, these have discerned, informative roles. Zumthor has written about the light and dark of light, of which differentiation must be understood if the ways in which light is, or can be, is to be investigated within the drawings of the Therme. They explore and investigate the way in which light has become central within an authoritative and highly individualistic methodology of drawing light as a material on, between, and over and inside the voluminous space. Light is not differentiated from the stone in its physical presence; it is given the same value and representational quality as every material used to make the building. Zumthor created a system where drawings were made to explore and integrate light within the process, allowing it to develop its meaning through drawing;

'one important rule is seen in a sketch ... it defines the relationship between ceiling slab and pillar block: the ceiling slab of a stone table must always be placed flush with the pillar block on one side or at a corner ... daylight penetrates the joints between the tables, those blocks that are flush with the edges of the ceiling have direct light from above: twice a day – if the sun is shining – light at different angles washes the wall of a block all the way down to the floor' (Zumthor, 2011, p. 64)

When he describes the penetration of the light into the Therme, it is particularly telling, 'if the sun is shining' (Zumthor, 2011) which I've interpreted as meaning or referring to direct radiant light linking the strength of the light to the manner of its possible perception and directional angularity. An important consideration as climatic conditions are always changing, and in a state of constant flux and therefore light is fundamentally

connected to this change – consider the previous discussion on the image of the Rudas Baths. Within Fig 3.2, we see the beginning of the relationship between the weight of structure and the weight of the light flooding around the structural tables of stone. The broad pastel marks within the illustration tentatively begin to rationalise the placing of the stone blocks. However, one may be able to suggest that these pastel marks also begin to imagine how light is or might be.

As the architect imagines how the light ‘washes the wall of a block all the way down to the floor’ (Zumthor, 2011), we see the beginnings of this imagined scenario within the pastel mark making. The pastel has been drawn across the paper, pressing hard at the beginning of the stroke and easing the pressure as the pastel is moved across the paper. This action is repeated again and again within the drawings. This technique presents the idea of structural slabs in different locations beginning the dialogue of where and in which direction the slabs will move, but also what size of the slabs, their breadth and length. Most importantly perhaps, they begin to provide an insight into the way light moves across the surface of the stone, with intensities indicated by the strength of the gradient marks made, what I have coined the ‘weight of light’.

This illustration by Zumthor begins to demonstrate more than just the material form of stone or water; it begins a dialogue where the material form of light is explored. The gradient made through mark making with black pastel is a useful metaphor for the gradients of shadow light which occur because of light's relationship with form. Where hand pressure upon paper is the instrument by which pastel adheres to the paper, weights of pigment infer qualities of light. These gradients of pastel within the illustrations are radically different to each other in that they display different tones, different widths, and different lengths. They are used by Zumthor to be reminiscent of qualities of light. These gradients suggest different scenarios of light, such as different intensities and directional qualities. Many of these gradients have different intensities of clarity with harder or softer edges suggesting scenarios of many types of darkness.

The rationale for this is that ecologies of light, contain the multiplicity of inference which light is and leads to darkness being as vital to human experience of space as brightness. Many types of darkness's are presented within the Zumthor illustrations each providing a tentative hint at how light will be within the spaces. Spaces for the sweat stone, spaces for massage, spaces for the fire bath, space for the sound bath, spaces for rest, space for

aqua-therapy; all therapeutic strands of space present different possibilities for the darkness of their own individual light. The drawn strokes, with their individual pressures and substances provide the beginnings of understanding these spaces. Harder strokes or lighter strokes all indicate a tentative imagining of the potential lights. On occasion Zumthor uses double strokes; these strokes register lightness at the meeting points of the movements. These may be indicators of light penetrating the potential darkness of a treatment room or describe the way in which intense brightness pushes at the failing brightness which eventually migrates into deep shadow. Some of these drawn gestures are thin, imagining a room in which a single spa user imbues the therapy of heat, water and light, or broader where many people experience the intentionality of light by its presence. The movement of the hand in these works exploits the imaginative response we have to mark making. The marks translate within these works as potentials, possibilities, so that the image of the darkness's of light are given freedom to inform and transport design. Fig 3.3 begins to introduce the idea of colour being representative of the material that light has become. Yellow becomes the colour of light. Yellow was the colour chosen to represent the relationship between the arrangement of the stone masses and the proximity gaps between them where light became the seams between the expanses of weighty stone.

Using yellow ink on the illustrations revisits notions of childlike presentations of the setting sun as yellow, light therefore becomes defined by the yellowness of its representation. Light can be seen to be yellow, but it can also be every other perceivable colour. The penetration of light into the Therme is never described by Zumthor as yellow, rather as esoteric 'seams of light' (Zumthor, 2011, p. 67) or 'shafts of light' (Zumthor, 2011, p. 68). Light was colourless except for the tinting blueness of light made by the skylights over the indoor bath, other than this, it was shape and form as opposed to colour. What became essential within the design process for the architect was an understanding of how light can be when informed by its situation or manner of introduction, the architect continues,

Three/Four Shaping

In the process of shaping the stone, we learned to distinguish between lateral light entering the building from the valley, which is not specifically perceived as daylight but rather as a panorama view: points of light from traditional skylights, which we reserved for the indoor bath; and a special kind of atmospheric illumination created by

slits in the ceiling, through which shafts of light wash certain walls. But since the slits are a mere 6 cm in width the ceiling joints between the tables are not conventional skylights. Very little light is visible in these joints themselves. The light is perceived primarily as an illumination of the walls and the floor, which, like a sundial, traces the course of the sun' Zumthor, 2011, p. 67)

Beginning to understand how the form of an objects shape, materiality, and edge qualities affects the way in which light is, becomes central in appreciating why we perceive light as we do. Zumthor is describing material, direction of light, climate and terrain, form, structure and the rotation of the earth. These are all considerations which are being calculated and ruminated over because they influence every space subject to light. Zumthor has demonstrated a design ethos which seeks to explore how architecture connects the individual, to the experience of being as a species diurnal by nature. We have been programmed to respond to light (Dawkins, 1996, p. 126) and therefore when the term 'atmospheres' (Zumthor, 2006, p. 11) is used in conjunction with architectural space it suggests a response to the ecologies of light which encompasses much more than the space. Rather it refers to our inherited concepts, our 'eidetic memory' (Costa-Mattioli, 2008, p. 875) of light, which is ecological, not architectural.

We are, this thesis suggests, responding to weights of light and their relationships to each other, not only to the space. Fig 3.3 is just one of many drawings where the ideals which surfaced earlier in Fig 3.2, could be explored. Fig 3.3 develops the notions of its predecessor, but the concerns of the work have changed considerably. It is the same but completely different. The yellow lines translate as design concern which begins critical thinking and developmental analysis while still retaining an illustrative compositional form.

I began this chapter with consideration of the work of the illustrations of Vitruvius's 'Balneae'. These illustrations constructed representations of light within the chambers of the roman bath house and sought to capture and illustrate where light entered the space and what its character was within that space. In Fig 3.4 we can follow the similar logic, which Zumthor now expresses in 'the sequence of spaces, from entering the baths to the first point on the gallery that affords an overview...masses of stone, changing light from above' (Zumthor, 2011, p. 84). These sectional drawings have the manner of fast thinking works. They have the character and manner of what David Hockney has described previously as 'groped for, there are signs of

hesitation... groping suggests uncertainty – exactly where is the correct position?’ (Hockney, 2001, p. 26) These are thinking drawings, where the spaces are being imagined and formed in imaginative thoughts.

When David Hockney was considering his thesis for ‘The Secret Knowledge’ he compiled a wall in his studio, which was an assemblage of post cards and prints which documented portrait and still life painting from the twelfth century to the seventeenth century. This wall of cards was a thinking space for the artist where connections and imaginative reflections took place. Figure 3.4, is an imaginative thinking work too. Sections through spaces are imagined so that ‘the shadowy mass of meandering hollows in the bath [are laid out] in order to observe the effects created by daylight ... stone and water, shadow and light’ (Zumthor, 2011, p. 70). The blackness in the solidity of mountain rock frames each section, connecting this mass to the darkening shadow light of the spaces. The vertical lines of yellow introduce the sign of light on the outside of each section. A small portion of this yellow penetrates the spaces; this reduction of the ingress of light may contribute to Zumthor’s use of the term ‘shadowy mass of meandering hollows’ (Zumthor, 2011). The reduction of light entering the spaces engenders the mood of each. The reduced paths of the yellow lines are presented as side lighting, demonstrating the six-centimetre niche where the light seeps inward. The yellow does not blend into the entirety of the spaces, it remains vertical and singular. It is not presented as multiplying and radiating out throughout the space, it retains its path ‘the ceiling joints that cast shafts of light on certain walls’ (Zumthor, 2011, p. 68) are purposeful and deliberate. They have deliberated dimensions which have been reasoned and calculated to achieve purpose.

In the same manner to which other construction details will have been designed and made in response to the materiality; light has been understood by Zumthor and utilised with intentionality. Having knowledge of, or understanding in the intentionality of material, is based upon a mental process or processing of previously experienced presentations of light. Brentano suggests that ‘it is impossible for conscious activity to refer in any way to something which is not presented’ (Brentano, 1995, p. 198). By ‘presented’ Brentano is referring to sensorial reception. When I hear a bang, I have a presentation of that bang, or when I see a green leaf, I have a presentation of green. Within each of these sensorial presentations they will have their own unique combinations and references, which may be cognitive or visual, or it may be touch or olfactory. Brentano continues, ‘we speak of

presentation whenever something appears to us' (Brentano, 1995, p. 198) and if something does, a cognitive concept of that object will be formed within our individual mental processing. This 'presentation' (Brentano, 1995) provides part of the system from which we can make and derive possible assumptions or understandings of experience.

Three/Five Imagine

It is this imaginative speculation concerning the image of the recollection which Zumthor uses to re-imagine light in the context of the design for the Therme. The architect comes closest to the re-imagined light of the Rudas Baths within Fig 3.5. In this work the light is given a shape and a form which recalls the intensity of the light within the photographic image. He presents the solidity of the mountain rock, the 'shadowy mass' (Zumthor, 2011, p. 70) of the voluminous space, and the penetrating intensity of light falling upon the bodies in the therapeutic enclosure of the Therme. The architect has imagined the image of the Rudas Baths and re-imagined the elements of this photograph which connected most intently to his own creative landscape. The process of imaginative rediscovering informed the design and Figure 3.5, begins to tell the story of what the atmosphere of this space wants to be. The elements from which we make this deduction are stone, form, space, ecologies of light and persons unknown. The sometimes tentative, and sometimes strong graphite marks offer visual guidance to the logic of the space and the shadow light inferred. It is the shadow light which offers the strongest and most reliable clues to the sense which this space projects. The brightness and the darkening nature of different areas of light are weighted within visual perception.

This weighting presents a reading which describes different intensities in the darkness's of light; in turn these visual relationships inform individual and collective responses. This chapter discussed the historical notions of situating architecture and its connections to environmental conditions. It considered how the illustration of space provided visual cues to the nature of the space's atmosphere, and the role which a found image provided in enabling imaginative and conceptual ideas to emerge. The translation of these ideas became phenomenological responses which explored how an image of light gave context to the development of an architectural project. We considered the imaginative process of drawing light through qualities of mark making as a way of responding to light through the mirror of reflective intuition. In this chapter I have attempted to base our knowledge of what light is, upon our inherited understanding that the ecologies of light. As a

natural consequence of our biology darkness is a natural and necessary aspect of light, and the darkness's of light equally and proportionately inform our insight of light within the bounded experience of architectural space.

FOUR

Interstitial

'difficult, if not impossible, to classify, the architecture of St Peter's at Klippan is that of the fragment and fragmentariness.. not only does it comprise many different facets, but there are many possible ways in which each of these is related to the others... in fact, it is neither possible to sum up this approach to architecture in a few words nor reduce its significance to any one of the themes contained within it... it is only in the physical presence of this church built mainly of one material and in the moving, silent darkness of its interior that a thin, almost intangible thread may be found that is capable of linking together all the single part of the whole' (Lewerentz, 2001, p. 340)

In this chapter I will explore work by two artists whom I consider have introduced artificial brightness and light as a material through their practice. My analysis of their work outlines the relationship each has developed between sculpture and the human experience of time. The fundamental correspondence between these works is found in their reliance upon the interstitial, particularly the interstice between perception and experience, where I suggest the beginning of our response to light is located. I will argue that the occurrence of passing time and our experience of changing light is interconnected and demonstrated when the passing of time is captured during the experience of the artist's work. As such, when light changes during the passing of the diurnal sequence, the experience of architectural space is informed within the interstitials of these changing experiences of light, and our relationship with light through 'eidetic memory' (Costa-Mattioli, 2008, p. 875) may be the basis of our response. My intention within this chapter is to suggest the relationship between brightness, light and time as significant influencers of our experience of light.

The first work to be considered is Fig 4.0. 'Your Strange Certainty Still Kept' 1996, by Olafur Eliasson which utilizes artificial brightness and water to question the condition by which the observer understands the possibility of what they are observing. Although this sculpture does not use light, its philosophical framework creates a dialogue between artificial brightness and passing time. This complex sculpture presents ideas and notions about the nature of experience which interoperate closely within the ecologies of light. The second work is 'Shift' 2006 by Sian Bowen. I am discussing this work because its presentation in gallery space and published images, has utilised the flux of light in space. 'Shift' clearly uses and defines itself through the communication exchange between it, the interstitial gallery moment, and the future representative understanding of the work in image form. 'Shift' situates light as a fundamental appropriator. What this may mean for Bowen is that she has recognised a moment in time and used it to provide future knowledge of her work. By recognising the characteristic of an ecology of light, and recording it, her work continues to occupy this space thereafter.

Similarly, Eliasson projects the extended recognition of a characteristic moment in time and seeks to extend this perception indefinitely. The following chapter explores the differences between these two works and their individual relationship with interstitial stasis, which I argue is the continuation of a moment beyond its happening. This chapter also considers the juncture between the past and the future which 'now' inhabits. Understanding light in architectural space from the phenomenological point

of view, requires an acknowledgement of time, which is important because our understanding of space, subject to light, is governed by time. This is the diurnal sequence, which starts at the beginning of Astronomical Twilight and finishes at the end of the following Astronomical Twilight. Twilight subcategories of the diurnal sequence are; Astronomical Twilight, Nautical Twilight, Civil Twilight; Sunrise; Daytime and Sunset; Civil Twilight; Nautical Twilight; Astronomical Twilight. The length of day relationship between these sequences will differ day to day and season to season as the length of each day is composed within this sequence. Our experience of space changes, moment by moment, although we may largely be unaware of this, but these experiences nevertheless impact upon our 'Circannual cycle' (Wood, et al, 2015, p. 2652) due to our physiology as mammals.

Four/One Influence

The diurnal sequence naturally influences space because of its relationship with climate, and this relationship changes the appearance of space which systematically and directly impacts upon how light is perceived by us. It is hoped that through this chapter's analysis of sculpture, my aim will be to draw attention to the mechanism of space experience by understanding the importance in which the experience of 'now' has in relation to the perception of light. It is important to discuss this because I am arguing that perception facilitates reflection. My methodology suggests that we design future experience relationships, be they with images or experience upon previous encounters because the human experience of changing light has evolved through biological development.

The work of Eliasson and Bowen utilise and explore ways in which we perceive and although the work by Eliasson relies upon artificial brightness and not light, I believe it's necessary because the eye will naturally respond to any form of brightness, and 'Your Strange Certainty Still Kept' (1996), manipulates sensory perception therefore creating a particular response. Also, within vision science be that Psychology or Neuroscience, there is a long standing and wide-ranging use of computer generated imagery within perceptual science research. I have chosen to rely wholly upon light within my practice, but nevertheless I acknowledge most vision research relies upon digital technology to explore the human perception of form, and Eliasson's work has been developed with artificial brightness which makes it acceptable.

William Tucker's seminal essay 'The Condition of Sculpture' published in 1975 as the introduction to the South Bank Centre's exhibition of the same name, situated sculpture in the world as the 'language of the physical'. (Ryan, 1993, p. 35). In his essay Tucker presents many contexts of light as both the property and materialism of our perception and the possessor of movement. Light and gravity, Tucker suggests are the fundamentals through which sculpture is, and in which we experience it. In this relationship, however, 'the property of actively giving light must remain that of the world, not of sculpture, just as movement is the prerogative of the spectator' (Ryan, 1993, p. 36). Movement and light, perception and the experience of both intertwine within 'Your Strange Certainty Still Kept' (1996) by Olafur Eliasson. This work hinges upon the possessive pronoun 'your' to draw our attention to experience. This experience however is outside of the ego-centric; rather it presents itself as another's experience.

The work is constructed around Tucker's 'language of the physical' (Ryan, 1993) but the presentation of 'your' – an experience outside of our own makes the work tangible and intangible at one time. It is both static within another's possession of their 'now', and at the same time fluid within our acknowledgment of another person's moment of experience. This context provides Eliasson the opportunity to present time as a frozen element within collective experiences. His work while able to become known by the perceiver, acknowledges a collective experience in what we perceive to be time standing still, while we move within the interstice of time.

The irresolution of 'now' in relation to our experience of time makes this work perhaps more pertinent within our internal experience of time. That is, if we consider the memory of time to be an amalgam of the past and of the 'now', we are only ever able to recollect, while experiencing each moment which is 'revealed by light' (Ryan, 1993, p. 36). Time 'arises from [our] relation to things' (Merleau-Ponty, 1962, p. 412). While we seemingly experience the infinitesimal present, understood as the droplet of water hanging in the air, we understand our experience from memories. As Eliasson suggests, '[h]istory is not external and objectified in a situation but is inside the spectator' (Eliasson, 2007, p. 33). An interpretation of this may suggest that in every moment with which we become aware of a memory of experience, is by its nature historic. The history of a moment was at some point within our experience represented as a now – the interstice between past and present. This is an internal device through which experience of a moment outside of our bodies becomes through the translation of the senses, a remembered event.

Although this interchange reflects a phenomenological point of view, such as 'historicity' (Merleau-Ponty, 1964, p. 92), the key written text by Eliasson for 'Your Strange Certainty Still Kept' (1996) utilises just ten words. These words such as 'darkness; frozen; light; moving water; optical illusion; seeing differently & time' (Eliasson, 2014) become the interchange between now, following upon a previous now, upon a previous now. Time is the mechanism within which we process a snapshot of experience. This snapshot becomes, a memory. 'Your Strange Certainty Still Kept' (1996), places the emphasis upon the possession of a moment, and inhabits a spectrum in which moments are extended to become fully aligned in time. If we can consider time being a series of moments, then this work allows them to join one to another. The extended version in which 'Your Strange Certainty Still Kept' (1996) becomes a moment halted within time allows us to evaluate time as a static entity. Within this moment we can walk away from it, move to the side of it, close our eyes and re-open them to continue an observation which seemingly does not change.

The possessiveness with which Eliasson locks the perceiver into an ownership of awareness where they are able to question their personal understanding of experience is all encompassing. This connects us to the work. It does so in such a way that you are able to take possession of your personal experience. This work provides permission for the observer to relate to the experience with un-certainty rather than certainty. The observation is anything but certain. It is outside of the observer's reality of experienced time. The visual perception of falling water in the form of rain is a familiar occurrence for most people. However, the observation of droplets of water in the form of droplets captured within a vertically dropping cascade is uncertain and unusual. There is no 'certainty' within our perception of this work. The image is not a photograph of a still moment of water captured. It is not a freeze frame within a film poised upon the edge of movement once more. 'Your Strange Certainty Still Kept' (1996) invites us to witness beads of water seemingly hanging in their very own, individual now. The possessiveness of each bead is captured within the reality of the perceivers now.

Four/Two Encounter

Encountering the reality of beads of water hanging in the air where their dimensions are present, their volume and size are open to close examination presents a reality where one can seemingly hold time still. This stasis explores the sensorial body through the reality of observation and

challenges our idea of now. This juxtaposition between the subject of observation and the observation of the subject within the environment of experience for Eliasson's work comes to the centre of the way we experience space. 'Your Strange Certainty Still Kept' (1996) requires questioning of what is being perceived and perhaps more pertinently why am I able to see this in the manner to which it is presented to me. His sculpture questions why it is that our vision has been manipulated by the scene to create something everlasting. The historian Pamela M. Lee suggests within her essay 'Your Light and Space' that he 'Implicates his observer in a feedback loop of self-perception... seeing oneself seeing... is a phrase that goes far to explain one's immediate encounter with his work' (Eliasson, 2007, p. 35). This continual loop draws our attention to the moment in which the perceiver of the work questions that which they are sensing. In the experience of perceived environments, and encounters of perception, these moments will be rarely noticed, making this work an important discussion point.

Lee suggests that Eliasson's work has the capacity to render the perceiver into a position of self-awareness of their awareness of self. The challenge of this work is its capacity to shift our consideration of the experience of environments. The strobe produces flashes of artificial brightness many times per second within a continuous set of intense pulses, this combination within an environment of complete darkness enables the visual perception to be constructed. The flashes portray moving, transient droplets of water as static, an illusion, as the bead of water is not a single droplet, nor static. The bead is part of a moving sequence of droplets falling vertically against a black background. The droplets of water are frozen in our perception within a moment of brightness. This sequence between brightness and darkness, brightness and darkness is the mechanism in which the successions of falling beads hang weightlessly in the air. The repeating pulses of intense brightness bracketed by complete darkness interlock moments in the droplets fall upon our retina as both perceived image and perceived afterimage. When we perceive the droplets hanging in mid-air they remain with us in thought, we are held by our perception of the object, not the object itself. Franz Brentano expands this point,

"by an object of thought I [mean] what it is that the thought is about, whether there is anything outside of the mind corresponding to the thought. It has never been my view that the immanent object is identical with the "object of thought". What we think about is the object or thing and not the "object of thought" (Brentano, 1966, p. 77)

The environment of the 'immanent' object within 'Your Strange Certainty Still Kept' (1996) could be any number of things. It could be the brightness; the darkness; the bead of water, or a combination of all. Brentano provides guidance on the separation of the 'immanent object' from the 'object of thought', while suggesting that one may provide an opening to the second, he is clear that they are not part of the same sense experience. The bead of water which comes from the collective cascade of falling water is made individual and isolated in its singularity from the motion of its falling. Ownership, presentation, and objectification present to us as consideration. Brentano continues, 'All the appearances of our consciousness are divided into two great classes – the class of physical and the class of mental phenomena' (Brentano, 1995, p. 77). Consciousness for Brentano can be suggested to be understood as the 'intentional inexistence of the object' (Moran, 2000, p. 48). This is derived from the Latin verb 'in-esse' meaning to be. If we consider what Brentano believed, which was that when a thought relating to a sensed object occurred, such as the 'bead', let us say, it was an act of consciousness outside of the reality of the 'bead'. He combines the phenomena which can be sensed and a phenomenon which is derived through thought as, 'examples of physical phenomena' (Brentano, 1995, p. 79-80). He suggests that they are 'a colour, a figure, a landscape which I see, a chord which I hear, warmth, cold, odour, which I sense; as well as similar images which appear in the imagination' (Brentano, 1995, p. 79-80). The space which he provides between the experience of lived life in the reality of sensed living and the imaginative exploration through interaction with the phenomena of this lived world is close and seemingly inseparable. If 'images which appear in the imagination' (Brentano, 1995) are physical phenomena it confuses understanding of the power of 'immanent object' (Brentano, 1966) which Brentano has indicated he believes are not 'identical' to the 'object of thought' (Brentano, 1966). This ambiguity presents difficulty in building upon Brentano's considerations of the correspondence between 'object of thought' (Brentano, 1966) and 'immanent' (Brentano, 1966). The 'bead' cannot be both, if they are not 'identical'. This discussion is important because it allows us to expand upon the phenomenological notion that the body is the instrument or 'tool' (Sartre, 1995, p. 325). In this it acts as the filter through which sense is opened. At the same time as this it is juxtaposing this between the primordial and biological evolutionary process which Dawkins explains,

'All animals have to deal with their world, and the objects in it... what a bonanza of benefit was waiting for the first animal to develop a remote

sensing technology: an awareness of an obstacle before hitting it... the sun provided not only the energy to drive the chemical cogwheels of life, it also offered the chance of a remote guidance technology... the (sun) pummelled every inch of the earth's surface with a fusillade of photons: tiny particles travelling in straight lines at the greatest speed the universe allows' (Dawkins, 1996, p. 126)

For Dawkins man is already a technological being. Much of what Brentano suggests is derived by what Dawkins refers to as 'remote sensing technology' (Dawkins, 1996). The phenomena derived through the sense of visual perception such as 'a colour, a figure, a landscape' (Brentano, 1995) are vision based. Through vision we make descriptive analyses that become the 'object of thought' (Brentano, 1966). This mechanism may allow perceptual analysis to make sense of what we apprehend. It orders them in a way that allows us to filter the aberrations of vision into a comprehensible shape.

Language is one of the tools through which we shape our experienced perception of environments. These perceptions are moments and glimpses that are part of time-based recognition of something outside of us. They afford captivation and intrigue of our senses such as that which Brentano describes as 'a chord I hear' (Brentano, 1995). The sound of 'Your Strange Certainty Still Kept' (1996) informs the sensed reality from which experience of the work comes. Like a chord, this work is not silent either. The object made in our thought is not a quiet 'bead' if we do not consider the bead in isolation. Consideration of this work accounts as multiple 'beads' which appear seemingly static, captured in mid-flight. If the water is static, why is there noise, and why is it accepted as static when we hear the end of the fall? Noise which the perceiver is surrounded by is rapid and clear, loud and penetrating, the silent captured moment of stillness and the silent held fixity of the 'bead' hints toward the lie.

'Our view of man will remain superficial so long as we fail to go back to that origin, so long as we fail to find, beneath the chatter of words, the primordial silence, and as long as we do not describe the action that breaks the silence. The spoken word is a gesture and its meaning, a world' (Merleau-Ponty, 1962, p. 184)

We use our body to sense the physical, but the physical is always outside of our reach. Vision presents a scenario, and as Dawkins suggests 'remote sensing technology' (Dawkins, 1996) evolved to allow all animals to sense

the environment they inhabited and to prevent them from bumping into obstacles contained within it. Vision has evolved in many different fashions within animals; the camera eye uses the lens, pupil and retina as the evolved biological solution for man as one animal among many. Man uses his body as an instrument of perception as do innumerable other animals. Sartre extended upon this thought by including the tools man has developed within his lived life as extensions of our biological sensorial nature. This sensorial capability which man uses instinctively to understand environmental conditions, and to navigate through environments is connected most profoundly with how man visualises his place within the world. How he recognises the conditions of that experience.

'my body always extends across the tool which it utilises: it is at the end of the cane on which I lean and against the earth, it is at the end of the telescope which shows me the stars; it is on the chair, in the whole house, for it is my adaption of these tools' (Sartre, 1966, p. 325)

Sartre's suggestion provides the possibility for man to inhabit the world and respond to the world. We adapt the world and we adjust objects within this world to accommodate us being in the world. Man has the capacity to change his place in the world by affecting the environment inhabited. Tools such as the 'cane' or the 'telescope', the 'chair' or the 'house' are made by man to navigate a path through, what Husserl coined the 'life-world' (Moran, 2000, p. 181). Paul Ricoeur in his analysis of Husserl's phenomenology described this as a 'pre-given passive universal in all judgemental activity' (Ricoeur, 2007, p. 12). Merleau-Ponty continued this process by considering the 'meaning' of experienced phenomena of the life-world without the imposed constraints of a 'Cartesian' (Perez-Gomez, 1985, p. 49) frame. This makes understanding perceptions, I suggest, a biological universal inherent in our system, through time and, over time. Husserl may have held a broad appreciation for scientists such as Galileo for the certainty of his concepts; where as Merleau-Ponty questioned the validity of scientific authenticity hence,

'the question modern philosophy asks in relation to science is not intended either to exist or to close off any particular avenue to its enquires... rather, the question is whether science does, or ever could, present us with a picture of the world which is complete' (Merleau-Ponty, 2004, p. 43)

Phenomenological enquiry based upon the sensorial openness of the body which becomes the instrument of measure is a naturally transposed and calculated activity. Reading the perceptual openness of the body's experience, where environment is key, makes phenomenology an exploration of the way meaning is made inside and out of individual consciousness. It became a discipline concerned with the beginning, the birth of consciousness. 'Your Strange Certainty Still Kept' (1996) has the distinction of combining a constructed use of technology for the creation of a prosaic reality experienced by the perceiver. The idea that architecture from Vitruvius point of view, is based upon an objectification of space which is 'Euclidian' (Perez-Gomez, 1985, p. 49) as opposed sensorial, misconceives how man can embody space. Vitruvius finds the prosaic within the framework of geometry, but loses sight of the possibility that in this creation, architectural space generates a sensorial response in man, however Plato distinguishes between them,

'techne understood as a purely human activity, and poiesis, the artistic creation of the poet, which is still related to divine creation but founded on intellect rather than manual dexterity' (Perez-Gomez, 1985, p. 47)

'Your Strange Certainty Still Kept' (1996), is the combination of techne and a poiesis. The work becomes the technological realisation of a poetic moment in time. The work relies on strobe technology to formulate and condition the perceptual response of vision. It portrays it as a seemingly continual static sequence. Complete darkness shuts down visual acuity while brightness and afterimage connect the body to a sequenced moment. The work becomes a mimesis for the relationship man has to the diurnal sequence in which we see the day as one entirety, rather than the interstices between past and future which the body experiences and perceives. This percept is an outward realisation, distinct and detached, the body as percept becomes the perception,

'my body does not perceive, but it is as if it were built around the perception that dawn through it: through its whole internal arrangement, its sensory motor circuits, the return ways that control and release movements, it is, as it were, prepared for a self-perception, even though it is never itself that is perceived or itself that perceives' (Merleau-Ponty, 1968, p. 9)

Perception is not of oneself, rather the experience of the object to the subject, a relationship between object and subject creates the outcome of

experience which formulates a perception. 'Your Strange Certainty Still Kept' (1996), becomes a work which has demonstrated the capacity to translate a technical situation to become poetic. This poeticism created through the individual's perception of the elements of the work combine to become an individual whole for the perceiver. This whole makes the work what it has become, missing one element may have make the work less of a convincing poem in light, and more of a technical exercise, empty and void of perceptual stimulation and intellectual dexterity. The concern of the subject and the object within Eliasson's work is also a fundamental concern within the work of Siân Bowen.

The complexities of the subject and object divisions are central in the understanding emerging through the artist's use of the materiality of artificial brightness and light. Within Bowens work artificial brightness and light are as centrally placed as her use of paper, needle or silver stylus. Artificial brightness and light are the tenets through which the artist work becomes known to us. Bowen's image of light: static or moving, fixed or transient undoubtedly influences our perception of her work. Unfolding within this perception is the relationship the object has with the subject, as the image of light as material presentation in the work is vital and essential to its interrogation of light as material.

Her work in the Victoria and Albert Museum in 2006-07 and that of the Installation within the Kyoto Art Centre, Japan in 2006 carry many differences, however they juxtapose artificial brightness and light. Bowen uses these as arbiters of how the work is seen and recorded, by connecting the different relationships between brightness and darkness. In her installation Fig 4.1. 'Gaze No 9' within the Victoria and Albert Museum, artificial brightness was used to back-light the works. A variety of smoked, clay-covered or indigo dyed papers enhance the qualities with which artificial brightness reveals the nature of the relationship between different papers.

The use of artificial brightness allowed her to present a reality of paper transformed, but which artificial brightness seeps into the grain and the fibres and differentiates saturated pigment and hue with variable intensities. Where the paper has been broken, cut or torn, it reminds us of the paper from which the works began, untouched or unaltered by the artist. These breaks in the fabric of the paper are the places where the artist has displaced the fibres in varying degrees.

'[Bowen] decided simply to prick the sheet. If the light [LED] behind the work is switched off, these marks are lost: it appears as a blank page. Hence the general feeling, throughout Gaze, that forms are somehow fighting for their existence and could easily be overwhelmed. All these papers diffuse and reflect the light in different ways' (Bowen, 2007, p. 28)

Brightness creates form where the paper has been pricked. The dimensions of the clean edged holes or elongated strokes provide different grammars. They suggest a different cause or purpose of mark. The openings in the paper allow the artificial light to bleed through the weave presenting graphic shapes and lines which interact with the pigmented patterns of the embedded textures of colour. The papers provide volume and depth. The dichotomy of the contexts such as the materiality of material in the work of Bowen is presented with deep complexity. The observance of the influences of brightness is correlated by the fragility of the relationship of paper with the intensity of brightness. This relationship will eventually lead to degradation of the paper. 'Yellowing and embrittlement' (Craft and Millar, 2000, p. 54) of paper through the relationship light has with it over time is a contextual element in the life and display of Bowens work.

These works rely on brightness, but this brightness will destroy the material in time. In her work as an artist in residence at the Victoria and Albert Museum, Bowen studied the 'Parkes Collection' of Japanese papers which had been in storage for one hundred years. She gathered inspiration from the marks of time, the staining and dirt, the exposed and unexposed areas of paper fresh and vibrant, dull and yellow, or brittle. This became part of Bowen's vocabulary. Working with paper and understanding the damage which light can impose upon paper became an inspiration for Bowens own treatment of paper within her work. This duality of understanding leads Bowen to work with material which necessitates the eventual destruction of her own work.

Four/Three Inhabit

Artificial brightness is the material Bowen utilized in 'Gaze', however, Bowen also works with the textures of light, in 'Shift' Fig 4.2. upon the sheaths of paper within the gallery space carrying the perceived weights of light within the presented shadows. The paper is inhabited by light, becoming a charged receptor for its intensities. The North Gallery at the Kyoto Art Centre, during April 2006, 'Shift', explored the artist's interest and influence of the

Hotarukago located in a Kyoto Temple. Through a misunderstanding in the translation of the Hotarukago, she began to imagine what it might be, and more precisely, what its relationship with light may entail.

The exhibition which Bowen began to construct consisted of nine drawings, each measuring 185x156cm and were made from three layers of Shoji paper layered one upon another. The drawings were made by burning marks into the paper which were directly inspired by her interest in the Hotarukago. Light was manipulated as a philosophical contrast between the diurnal light of the gallery which presents to us on the surface of the paper, and the juxtaposition of this gradual degradation of paper by the same light over time. Linked to this Bowen used similar papers to the work she explored within the conservation department of the V&A.

“Hotarukago” in English ‘Firefly Basket’, hovering between the rival notions of a container and a trap... that would rely on the very absence of any external light in order to become visible by the glow of the tiny insects’ (Bowen, 2007, p.23)

In the ‘Hotarukago’ of Bowen’s imagination, the dazzling specks of light within the darkness of the basket became the inspiration for the pin pricks and cuts in the works undertaken. This imagined response created an idea of light emanating from the insects, the nature of this light relied upon the darkness of the fire fly basket.

The light of the ‘Hotarukago’ can only be imagined with the benefit darkness provides, without darkness, light holds no meaning. The intensities of light would have no gradient without the notion that there must be a backdrop of darkness for the intensities to exist. These imagined notions and the context of their perceived reality inform our perception of light. Perception is situated between the ‘corporeal and the psychic’ (Ricoeur, 2007, p. 45). Projected, imagined perception, ‘subjectivity of the thing perceived’ (Ricoeur, 2007, p. 45) can have creative benefits to the artist, and Bowen has achieved this within ‘Shift’ in the imagined darkness of the ‘Hotarukago’,

‘the “Firefly Basket” was in reality an eighteenth-century folding paper tea house, the name referred to the sense of light within the structure’ (Bowen, 2007, p. 23)

The Shoji paper that Bowen began to explore within ‘Shift’ is the paper used to make sliding Japanese screens and is used as partitions or divisions within rooms. This paper is immensely strong and pliable allowing the

'Hotarukago' to be made from it so that it could be folded and un-folded numerous times. Beginning as a folded piece of paper it becomes space, this paper space is a ceremonial Tea House for four or five people, not a basket for insects. The relationship between space, paper, light and ceremony are elements becoming one figure in which the harmony of the elements merge to inform each other. They relate to the nature of each other and bind together to form a coherence which the 'Hotarukago' translates into meaningful experience. The tea room as an aspect of Japanese culture is discussed by Junichirō Tanizaki in his book 'In Praise of Shadows'. The qualities of light and the nature of these spaces are referred to when he recalls a former restaurant in Kyoto, the same city in which Bowen was exhibiting 'Shift'. Tanizaki suggests that 'the room[s] at the Waranjiya are about nine feet square, the size of a comfortable little tearoom' (Tanizaki, 2008, p. 22). The tea ceremony uses black lacquer ware, which would have been the darkest elements within the tea room, unlike Bowen's imagined darkness,

'is an indispensable element of the beauty of lacquer ware... the lacquer ware of the past was finished in black, brown, or red, colours built up of countless layers of darkness, the inevitable product of the darkness in which life was lived' (Tanizaki, 2008, p. 23).

Tanizaki presents an understanding of aspects of lived experience; in 'Shift' Bowen allows experience to inform her work. The 'Hotarukago' unfolds into walls and ceiling the language of the vertical and the horizontal, dividing and enclosing, overlapping and enveloping within an illuminated, enclosed space. Shift begins to interpret the weights of light falling upon it, and Bowen uses these papers in the knowledge that, 'Western paper turns away the light, while our paper [Japanese] seems to take it in, to envelop it gently, like the soft surface of a first snowfall' (Tanizaki, 2008, p. 17-18).

The paper layers form the conditions of structural elements interacting and overlapping. The seams between the layers of paper joined to each other provide areas of darkness between the seeming fragility of the body of each piece. Countless precise holes burnt through the fine paper provide the texture of form. Row upon row of these deliberate holes generate formality perceived as planes, the areas untouched by the marks align themselves to the possibility of openings or breaks in the structural composition. These burn marks create texture in a linear fashion and make a formation, a stratum of burns in lines which follow the geometry of planes. They fold upon

themselves creating part enclosure, part opening, as if the 'Hotarukago' is being opened within a greater enclosed space.

'Shift' translates Bowen's interest in the form of light upon the layers of the paper, composing this work within the Kyoto Art Centre harnesses the inherent light of the space. Being the first exhibition in which Bowen hung paper from the ceiling, to divide the space, allows each sheet to address each other as well as the space. It suggests that a formal relation between the work and the gallery space was important as 'it was imperative for Bowen that the light should fall behind these drawings' (Bowen, 2007, p. 27). The published images of 'Shift' incorporate and utilize the weights of light upon the work to become the extra dimension of the work. Light introduces another measurement of perception within the work which Bowen has been decisive in capturing within the photographic records of the exhibition. The falling light crosses these works to project another layer of intensity and structure, they become an exploration of time.

The images chosen by Bowen to represent how we understand her work, bear the marks of the interstice of time, and in doing so, become a future record of their past. The images have achieved this by incorporating the changing grammar of light into the photographs. Shadow, shadow edge and overlapping darkness's upon 'Shift,' borrow fragments of light which touch the work. The light and shadow of the space are used to add an extra dimension to the work. What the artist achieves through this photographic record is the representation of 'Shift'. We now know the work by its published images alone.

In Tony Godfrey's essay 'To see is to touch, to touch is to see' he refers to William Tucker and 'The Condition of Sculpture', with which I began this chapter with, however Godfrey suggests that,

'the condition of sculpture was to be seen by light and subject to gravity; then the condition of drawing would be that the traces of the hand are disclosed by light' (Bowen, 2007, p. 73-75).

What Godfrey may be alluding to here is although Bowen's work hangs from the ceiling – and therefore subject to gravity - it isn't sculpture but remains drawing? In the first instance, Tucker says 'Sculpture is subject to gravity and revealed by light' (Ryan, 1993, p. 36). Bowen's work is subject to gravity by the nature of its installation, and it is not 'seen by light' (Bowen, 2007) as Godfrey asserts, it is 'revealed by light' (Ryan, 1993). The word 'revealed' used by Tucker carries so much more weight and possibility than 'seen'

(Bowen, 2007). In the context of how the artist's work is 'revealed by light' (Ryan, 1993) it characterises the possibility of differences and change and places the interstices of light as integral to it. It is through images of the installation that the history of the exhibition is rooted. Light has become central to this historical rooting. The integration of the momentary passing of time has been translated as a central element in our understanding or experience of the work. Light coalescing with paper alters the nature of 'Shift', which has become historical and fixed. Shadow edge and the body of shadow is part of the work. The interstice of light is attached to the image of 'Shift' which can never be realised again as the moment in time has passed. The shape of the shadow edges seen on the work, provide our perception of three dimensional shapes, they present another layer to which the work of Bowen grasps sculptural form. The work presents formal sculptural intentions and these intentions allow Bowen to inhabit the form filled world of sculpture, as opposed to the two-dimensional presentations of framed works such as 'Gaze'.

If we recall Pamela M. Lee's considerations of Eliasson's work she suggested that, '[c]onsiderations of the environment were formative to the Light and Space artists' (Eliasson, 2007, p. 39), to which Bowen can arguably be considered. What Lee presents here is the notion that artists who made active and intuitive use of the vagaries of time and daylight light, as well as developing bodies of work with artificial light, consider the passing elements of experienced life in the work they do. Passing time and the changes in light are used as the formal material upon which and through which their work is concerned and develops. When we look at these works we are observing light, E.H. Gombrich make an analysis of what it is we recognise when the materiality of light is perceived,

'It is particularly the impression of light... that rests exclusively on gradients... whenever we observe a sudden steep rise in the brightness of tone we accept it as a token of light' (Gombrich, 1996, p. 49)

Arguably, Gombrich is recognising the ecologies of light presented as intrinsically material weights of light to our vision. The image of 'Shift' invites the objective presentation of light to become part of the work. The shadow edge and the brightness is creating layers upon the paper, which presents additional planes and conditions which we experience in our perceptual reading of the work. The image of 'Shift' presents new dimensions within the body of the work which we recognize and understand as the work falls into

the apparent shadow of the gallery space, only to be reconnected with another element of the work a short distance away. The published image uses the weights of light as an element of the drawing. The shadow, visible on 'Shift' intertwines between disappearance and reappearance between the layers of paper - vanishing from perception yet continuing its journey across the body of another sheet of paper. The movement of this light's interplay between the pierced burnt planes of the work and the space links and intertwines by merging layers of light upon layers of paper and space.

'watching the creation of the tea house confirmed for Bowen her interest in a space that stills everyone entering it. She wanted her own drawing to possess a similar quietness, and for the first time in her career Bowen took the finished work away from any supporting walls' (Bowen, 2007, 24)

Bowen is making a distinction between her work and the space which is subject to movement, yet she uses this sense of stillness, evoked by the weights of light within space. The work hangs from the ceiling of the gallery falling in verticals of transparency which hold the light, resonating and glowing through intensity light reacting with the fibres of the weave. The work becomes an intervention 'revealed by light' (Ryan, 1993). The papers react to the light by transmitting the brightness further by absorbing light into the body of the paper dissipating and reflecting between sheets to create an ever-diminishing conversation of intensities.

Light moving across the papers, the walls, floor and ceiling informs our experience of the work and the space. The structure of the work influences the way the light by inhabits the gallery space; it becomes structural and integral to the space at that time. The paper tempers the relationship between the light and the space. The cavities, openings, holes and distances between papers connect the work to the light within the space The Swedish architect Sigurd Lewerentz contributed to this notion which when he considered that,

'subdued light was enriching precisely in the degree to which the nature of the space has to be reached for, emerging only in response to exploration' (Lewerentz, 2001, p. 20)

Lewerentz is suggesting that we have to be open to our experience of architectural space by being receptive to the experience which that space presents. Dean Hawkes provides analysis of the Chapel of the Resurrection in Stockholm, Sweden by Sigurd Lewerentz in which he suggests that

Lewerentz manipulates 'the potential of visual adaption' (Hawkes, 2008, p. 131) within human vision. It is with intent that he creates spaces within the chapel which force the pupil to open or contract in relation to the darkness's of light. The response by the perceiver to the work within the gallery in Kyoto may be a reference to silence but also to the loss of silence in contemporary life. The connection to be made between silence, light, and space is how the human physiology connects and becomes part of our response to light. Silence and Light was the key theme in Louis Kahn's lecture to architecture students at ETH in Zurich on 12th February 1969. In this address he suggested that 'silence is not very, very quiet... it is something that you may say is lightness' (Kahn, 2013, p. 23). Silence for Kahn became the signifier of a quality of perception, light between the drawings of Bowen introduce the silence of light.

Four/Four Silence

The experience of silent light mixing within our experienced environments may be a tuning mechanism for an intuitive quietening of the perceiver's cognition. Light may at some deep subconscious level provide a reflective cognitive response which is part of our shared biological makeup. When observing the holes within 'Shift' we see much more than degradation in the fabric of the paper. Each hole contributes as both singular and multiple due to the layering of the paper. The repetitive marks formulate change in the body of the work. The paper responds to this in different ways, it thins and contracts as the weave of the paper is opened by the penetration of the pin through the structure, areas directly surrounding the mark of the pin become ridged and structured. The action of the pin changes the dynamics of the paper near the hole as the structure of the paper is being re-designed by the action of the pin.

During the making of the work the paper is placed upon a horizontal surface, and the repetition of the pin being pushed through the paper alters how the structure of the paper is thereafter. The action of pushing the needle through the paper creates a rise and a fall in the surface. This rise and fall catches the light in different ways. The concave side is the direction from where the pin is pushed from, the action causes a fall or indentation in the paper. The convex side of the paper is where the pin exits out of the paper; this motion of the pin being pushed through raises the edges of the paper in contact with the pin. Light reacts in different ways to the paper at the points of entry and exit. This difference is dependent upon many things. It involves the position of the hanging papers, the relationship between the pin holes, and

the position of the earth to sun. This interaction of light is a source of constant movement and change, time and light are central, through which nothing can be made static.

Fig 4.3. 'Below' 2015, traces the image of light upon paper laid on the floor in an East/West direction. The drawn boundaries follow brightness and shadow edge at two-minute intervals. The timings demonstrate how light changes ad-infinitum within every architectural space which is subject to light. The two minutes between annotations allows for significant rotation of the earth in relation to the sun to allow a new line, separate from the previous line to be drawn. This timing provides a clear tracery of movement which demonstrate the flux of light. The delineation of the inner edge of the window is demonstrated by the clear rectangular form within the drawing. The clear edge of the rectangular form at the top of the page was sited at the western edge of the paper. This rectangular shape can be seen to move down the page and toward the right side in a diagonal stepping motion. The stepping records the passing of time between drawn lines. The inner edge of the window shown at the top of the drawing, (which was the western edge of the paper) clearly shifts towards the eastern edge of the paper. This change is occurring because the rotation of the earth causes the sun to appear higher against the horizon, and because of this, the aperture of the window in relation to the sun angle alters. This gradual change of angle between the inner window edge and the sun generates the movement we perceive in the radiant light upon the page.

In the Mendota Stoppages, James Turrell tested the notion that no moment in time is permanent; nothing we become aware of in any moment in time is more than a recollection or memory of a moment which has past. Momentary permanency after momentary permanency is the perception of changing impermanence. It is through the interpretation of this sequence with which we process the experience of that to which we are witness to. That which we perceive has no life beyond the moment, Turrell comments, 'nothing we know is permanent... all exists only in shifting relationships with everything else - we have little to fall back on except ourselves, our own processes of being' (Turrell, 1980, p. 7). In this notion I would argue that our awareness of our experiences of light will always be through the interstices between moments.

In 'Below', as the rotation of the earth continues and the angle to which the window frame is presented to the sun alters so does the imprint of the brightness upon the paper. The first annotation of the outline of the radiant

light is presented as a long slender outline. This outline appears to retain its width horizontally, as the earth is rotating in an anti-clockwise direction toward the east, with the sun appearing to move overhead in a more lateral fashion. The date of the drawing was 22nd June, if however, the drawing was made on the 22nd December the horizontal width may appear to alter more readily. This would occur because the sun would be perceived to be lower in relation to the horizon and the brightness received through the window aperture would have a more oblique presentation.

The reality is that each dimension of the imprint of light upon the paper will always be in constant flux. The eastern horizontal edge is maintained throughout the drawing; however, the vertical length is constantly changing. This vertical change reduces the size of the presentation of the light upon the paper in a constant and unstoppable reduction. Within 'Below' this change has been shown by the outlines of the brightness being recorded every two minutes. This recording has resulted in the step changes of the shapes within the drawing, each representing one captured moment within a sequence which flows without any stoppages.

The form within this drawing is a ceramic vase containing flowers placed on a window sill. The presence of these objects outside of the structure of the window frame was made so that a secondary object, the vase of flowers, could be evaluated at the same time as the window frame. Being able to evaluate if there is a difference in relationship between the aperture - which facilitates the light entering the space and subsequent objects contained within the space is important. This is because both may have similar or dissimilar perceptual influences on our experience of architectural space. In our consideration of this drawing, the step changes in the apparent movement of what was the top of the window are clear and apparent and well defined, see Fig 4.4. However, if one considers the bottom edge of the window, it does not reflect the same amount of physical movement. This edge steps in the same amount of increments, but these are smaller and much more tightly grouped together, quite different to the brightness edge at the top of the window.

This is occurring because the altitude of the sun presented to the window changes due to the rotation of the earth, which can be followed by the apparent edges of brightness and darkness annotated in the drawing. These edges are constantly moving. This incremental movement becomes an unnoticed tapestry of layers of light overlapping and crossing one another. The simplicity of the patterned shape of brightness on a paper belies its

complexity and intrinsic qualities of constant change. To compare the lines at the top of the work, and those that have been drawn at the bottom, show very different relationships to the light presented. The presentation of the window aperture on the floor of the room follows a systematic shape change. The form presented by the aperture of the window and perceived by those experiencing the space is of a rectangular geometric shape, linear and formal, with defined boundaries clearly presenting the transition of precise change.

The representation of these objects within the drawing, presents evidence of shadow shape and form being presented by the objects into an architectural space. These objects can be seen to overlap and interchange position over time as a succession of shadow layering. Our conscious perception may be unaware of this environmental change and therefore ambivalent to the consequences of it, alternatively cognitive perception is aware of the environmental change contributing to our experience of space and this generates our phenomenological response through our biological awareness of light.

The individual recognises a 'presentation' or 'feeling' in relation to their environment which appears to be a consciousness of our biological response to light. Time and light have become inextricably linked through different elements of consciousness. Peter Sellars has written about these considerations as moments transposed within the work of Bill Viola, he references Gertrude Stein when he suggests in his essay 'Bodies of Light' that, 'each time there was a difference, just a difference enough so that it could go on and be a present something' (Sellars, 2003. P. 173).

Every moment of life is changed from the former, to the latter Sellars is suggesting. It is just 'enough' (Sellars, 2003) to be different so that it can become 'a present something' (Sellars, 2003). Each 'present something' (Sellars, 2003), is based, I would argue, upon the experience of a moment in time different from the previous one. Each is individual, distinct and meaningful. Bowen's work recognises this 'just a difference enough' (Sellars, 2003) in the relationship between light and paper. The relationship which Sellars aligns to the work of Bill Viola and to the repetition of the needle marks by Bowen creates a reality in sequencing of moments. These become the punctured passing of time in the relationship between the hand, needle and meditative practice. In Nova Zembla 'Suspending the Ephemeral', Bowen recognises the link between time and light and the capacity of her works to be photographed as a 'present something' (Sellars,

2003), as such she writes succinctly about the relationship between passing time and its meaning in her work,

'It doesn't seem possible to describe anything perfectly when nothing stays still. So rather than attempting to describe things in a perfect way, I have focussed on the shifts and the changes that make this such an impossible task' (Bowen, 2012, p. 59)

These 'shifts and the changes' are critical elements of light in architectural space and as such require consideration of the human capacity to calculate these trace changes in what Bowen calls the 'shifts and the changes' (Bowen, 2012). Can there be an awareness link between the seemingly unnoticed ways in which light and time pass in moments of 'just a difference enough' (Sellars, 2003). Peter Sellars suggests that if,

'we recognise the exterior world with the pause button on, and its interior workings and ongoing processes begin to reveal themselves' (Viola, 2003, p. 186)

Experience is a continual overlapping of now. It is linked and ongoing, so when consideration is given to the notion Bowen calls the 'shifts and changes' (Bowen, 2012) and the, 'pause button' (Viola, 2003) we can begin to arrive at an unawareness of moments in time by man. My practice seeks to address this, by holding time, by providing an experience of light which is paused, in the same manner to which other artists have present a moment of light. The invocation of light, by Bowen, means that what we understand the passing of light within time is united by 'shifts and changes' (Bowen, 2012). One must consider that it is within this mechanism that man is cognitively absent to light. By being unconnected cognitively to our rotation upon the earth, in relation to the stillness of the sun, provides an expectation of immovability. Within this expectation, an apparent idea of stillness and being stationary may arise.

The notion of environment stillness in perception of is considered within 'Suspending the Ephemeral'. The essay entitled 'Art of Recollection and Material Memory', by the art critic and historian, Jan-Philipp Fruehsorge drives home the notion that the drawn exploration of light and time is a coalesced form when he states, 'drawing is a conversation with the objects about time' (Bowen, 2012, p. 84). In this thought he reinforces David Hockneys earlier point that, 'all drawn lines have a speed that can usually be deduced: they have a beginning and an end, and therefore represent time as well as space' (Hockney, 2001, p. 26). Time and flux are a prerequisite of

drawing. The passing of time is essentially and inextricably con-joined to drawn light. This reflects the earlier question regarding 'Your Strange Certainty Still Kept' (1996) by Olafur Eliasson which was; what does now mean within this work, and what place does now have within the experience of time?

The experience of time through the work of Bowen places an emphasis on the perceiver's ability to encounter stillness. This encounter, incorporated within expanding time, settles consciously within a moment. It is as Hockney suggests a 'line' represents time; Jan-Philipp Fruehsorge expands this idea and suggests that,

'every drawing is a pause in the flow of time, capturing the current state of the moment, an overall physical condition, like an historic, psychosocial, or mental state of awareness' (Bowen, 2012, p. 84)

Four/Five Awareness

The presentation in this thesis of the idea that our bodies are aware of the interstitial of time, but we are cognitively unaware, present awareness within a linguistic frame. As individuals we develop cognitive intuition of the object world through which we navigate. We are aware of physical objects like the chair or the tree. However, light, generally is not understood as being a physical entity in the same way. Light presents a different cognitive intuitive, to which I would argue many people are largely unaware or only grasp through senses. It therefore follows that we may only become aware of this possibility when a conscious thought connected to light or time arises. What Husserl termed 'monad' (Husserl, 1989, p. 26). One might attach to this relationship between the self in the world and the actual experience of the self as a connection to the 'life-world'. For Husserl the individual ego was a central facet in the manufacture of cognitive experience. Natural psychological ego through which cognitive representation of self are made, is ego-centric experience. However, ego through which phenomenological experience of environment is made is for Husserl a transcendental ego. Transcendental ego is based upon unknown, unidentified eidetic composition through our shared biological history. Intuitive knowledge which we could say is sensed and not rationalised, or cognitively constructed is transcendental.

This is what Husserl described as 'monad' (Husserl, 1989). For Husserl the combining of both pure ego and transcendental ego as the mechanism through which experience emerges, must contain the notion of 'now' or at

least the sequence of time from which the now is a central component. Reflecting once more upon 'Your Strange Certainty Still Kept' (1996) places the idea of now centrally to the experience of light. F4.3. attempts to capture the sequence of now at two-minute intervals in time. The now had passed before I moved the graphite pencil, so the drawing is made of a series of now.

Husserl extended his consideration of the self in the world when he said that 'Time is the universal form of all ecological genesis' (Husserl, 1967, p. 37). The temporal natures of points of view are informed by the ego. The ego is transformed through and developed in the situations and experiences of life. These temporal ways of seeing the world through the 'monad' of one's learned understanding of self in the situation of living gives rise to our understanding of how we process what we experience. That is if 'time' as Husserl suggests 'is the universal form of all ecological genesis' (Husserl, 1967), then the rationale for all perception which we process regarding the environmental conditions which surround us, most pertinently architectural space, must be governed by our relationship to the moment.

Time and light, we have established are inextricably linked; each exists within the realm of the other. The changes in light which alter environmental conditions are linked to time, distance, proximity and the form of light which make the observer open to conditions of light. These generate observational points of view.

Richard Serra's work, 'Mies's Corner Extended' 1983 Fig 4.5., presents long rectangular sheets of steel placed upon the gallery walls. When this work is viewed the point of view of this perception must be by its nature both close up and enveloped within the entirety of the work, or at the maximum distance the space of the gallery allows. These two points of view we have of the work provide relatively different ways of seeing the work. Each way in which perception our is gained, generates vastly different perspectives on the experience received. Viewing the work within the gallery space is the experience of the work. Perception of it is the combination of being up close where the viewer can see nothing but the expanse of steel on the wall and is oblivious in perception to the rest of the work. The space will only become apparent when the viewer moves or changes their point of view. These points of view combine and join, from which our status view is achieved, where a sense of what is being looked at is processed cognitively.

Perceptual movement within a space is informed by proximity and distance in the same way. Within architectural space we are close to light and at the same time distant from the light we perceive. Perception of the light on the objects which surround us is as important to our recognition of the shadow on the wall a distance from us. Light has the capacity to transfer an inexhaustible multitude of different qualities within a single moment. Like 'Mies's Corner Extended' the actions of light within a space present perception which is available to vision as whole environment or as one which envelopes perception within part of that environment, but each undoubtedly informs the other. Both Eliasson and Bowen have used individual and informative relationships to the perception of brightness and light and my analysis sought to present phenomenological consideration of each work through reflection upon their interstitial relationship to time.

Both works made themselves available to experience by manipulating our natural relationship with the flux of passing time. The first 'Your Strange Certainty Still Kept' presented time as an extended encounter, introducing the notion of time being held static. The second 'shift' presented the image of a moment in time as the inherent future representation of the work in the knowledge that the work could never recreate this. This chapter introduced the idea of, and drew attention to, the importance of time in the perception of light. It also highlighted the parameters through which time influences and guides every perception of light in architectural space.

Five

Weights

“on the earth” already means “under the sky”...[t]he 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 the blue depth of the ether’

(Heidegger, 2001, p. 147)

Arguably an understanding of 'the blue depth of the ether' (Heidegger, 2001) indicates a relationship between our visual perception and the transitional relationships from one colour intensity to another intensity. This transition within our perception can be visualised as a 'gradient' (Cutting, Millard, 1984, p. 198) of colour, I suggest Heidegger was making a reference to, 'the dome of the sky' (Foster and Hankins, 2007, p. 748). This 'dome' (Foster and Hankins, 2007) is most evident within the 'twilight transition' (Foster and Hankins, 2007, p. 747) as the mechanism for synchronising our individual 'circadian time to local time' (Foster and Hankins, 2007, p. 747).

Within this innate functioning we are individually and collectively as mammals accustomed to unconscious reading of the visual 'gradient' (Cutting, Millard, 1984, p. 198) of the sky as a 'dome' (Foster and Hankins, 2007). If you were to describe what a 'dome' (Foster and Hankins, 2007) is, one would have to describe a shape and a form. Therefore, it is reasonable to argue that we make sense of the visual world of light, through an impression of dimensionality. This dimensionality is sensed by the process of reading gradients within the display of light, providing the 'phenomenal impression of flat and curved surfaces' (Cutting, Millard, 1984, p. 198).

This chapter will draw upon earlier chapters arguments and build them into an argument that suggests we construct a phenomenological experience of architectural space through our innate and imbued visual consciousness of ecological light cues. This contribution to our knowledge of space experience and the suggestion of ecological cues being used to determine subjective response to light by man 'on the earth' (Heidegger, 2001, p. 146) is developed primarily through the recognition of the visual weight of light.

Issues such as primary shape, environmental conditions, gradients and the interstices of light are, I have argued, principal sources within mans constructed response to the experience of light in architectural space. This chapter will explore these notions further, through consideration of the way in which man processes these experiences of light, which I suggest incorporates a perceptual interpretation of visual weight. I will outline some key observations, based primarily, though not exclusively upon interpretation of my own practice investigations.

Fig 5.0 shows three images of a 50mm square cube taken at three different times during the 1st September 2015. The image of cube 'C' has been recorded six hours after the image of cube 'A', whereas the image of cube 'B' was recorded just five minutes after cube 'A', however, cube 'B' and 'C' bear

striking similarities to each other. Cube 'A' has produced a defined projected shadow as the cube was subject to direct, uninterrupted light. Cube 'B' was subject to light interrupted by a cloud. Its shadow now displays a diffused, softer presentation of the projected shadow, while displaying an angular secondary, darker shadow within the diffused shadow. Cube 'C' was subject to the reflected light of the space because of the rotation of the earth, light entered the space indirectly. However, cube 'C' projects a similarly shaped angular shadow to that seen in 'B', but with the addition of a wider spreading secondary shadow. I suggest that cubes 'B' and 'C' display different visual weights, and this difference has occurred as a consequence of climatic conditions and the diurnal sequence.

Shadow 'A' presents as visually darker than shadow 'B', while shadow 'B', presents as visually darker than 'C'. The notion that light has a visual weight provides opportunity to consider why space appears to us through perception as it does, and why this may be instrumental in forming subjective responses to visual weighting. Light has qualities which present perceptual cues from which subjective visual presentation arises - the subjectivity of spatial response. At the beginning of this chapter it might be useful to reflect upon the introduction to this thesis, and the importance of E. O. Wilson's seminal work 'Biophilia' and its architectural inspiration, 'Biophilic Cities' by Timothy Beatley. These texts use research to reinforce our coexistence with nature, as an acknowledgment of response to nature. This is a high value proposition vitally important to the health and wellbeing of man (Lee Philips, 2009). Where Biophilia introduces the correspondence of our individual connection to nature through our evolutionary past, Biophilic Cities considers and guides our innate needs within the environments in which we live. When Hawkes investigates the 'The Environmental Imagination: Technics and Poetics of the architectural Environment', he does not acknowledge Wilson or Beatley, however, I would argue, the exogenesis of his thesis is undoubtedly embedded within theirs. There are many principles to Biophilic design but one of the founding principles, according to Beatley, is 'natural light' (Beatley, 2011, p. 113), but the connection between light as phylogenetic in our response to space is not made.

My practice, suggests that every shadow which we perceive in architectural space has shape. This shape occurs along the edge of shadow, can be perceived in many different forms. The edge of shadow may be visually sharp and concise, or it may be soft and undeterminable. However, it displays to us, and in whatever configuration we experience as the visual perception of shape, this will always be identifiable. An example of this can

be perceived in Practice Model Five, as a bright area with a darker area above it. When I allow my eyes to rest on this image for a period, I begin to perceive a dark edge in the transition between the darker area and the lighter area. This appears as a transition, or a gradient in the shadow area which begins with a dark edge. So, my perception no longer sees just a dark area and a lighter area, but it also recognises that at the limit, the boundary of the shadow between the darker and the lighter areas appears to have a dark edge. If I observe this image for a longer period, I begin to see that this transition from dark edge into the main body of the shadow begins to present to my perception as form.

The lighter area in the image appears for all intents of purposes to be a flat surface above the darker area. However, the dark area appears to curve away beneath the lighter area. The image of Practice Model Five is made solely by shadow against a paper screen, there is no form present, only the representation of form made by shadow. In Fig 5.1. you are able to recognise the beginning of form in the shadow of cube 'B' and 'C'. If we look at a portion of this in detail, you may see the variations in transition of shadow weighting, from lightness to darkness. The edge of the shadow from cube 'A' being the most distinct, most representative of a shape defined shape, 'B' and 'C' present as a softer gradient. In Chapter Two we considered 'A Vision: The inspiration of the poet' by William Blake in detail and demonstrated the correspondence between light and form in relation to our perception of space depicted within the painting, can we extend this understanding of space by suggesting that we observed and interpreted this light as visually perceived weights.

Fig 5.2 'Room Interior with Corner Shadow', which is a practice photograph, presents the projected shadow of a window screen upon a wall plane in a room. We can perceive many different types of shadow intensity and shadow edge made by the screen shadow. But look closely at the corner of the room, on the far left of the image. One can clearly perceive a darker shadow line within the corner junction itself. This line appears to have a constancy of shadow darkness running vertically, while horizontally appears to encompass the same transition of darkness to lightness as we noticed in Practice Model Five. This transition of the shadow light from darker to lighter appears to instigate the perception of curvedness running vertically parallel to the corner. This is an important point because, when we look at shadow light within architectural space we can see form, Practice Model Seven shown in Fig 5.3 helps demonstrate this by presenting light as constructed form. While the apprehensions of this shadow in the architectural space will inevitably

disappear due to the flux of light in space, the Practice Model remains constant. It will hold the shadow light still, in one place to allow it to be examined. The model provides the opportunity to draw attention to the phenomenon of the shadow form at any time, enabling the viewer to revisit the same shadow form. As measuring devices, the practice models become tools for drawing attention to how the detail of light can be at one moment. They provide the opportunity to study shadow light and familiarise with the form of the weighting which its presentation displays.

For students studying architecture in University, and architects in practice together with those interested in becoming familiar with the weighting of shadow light form, the models are instruments through which to gain closer and more detailed understanding how light in space is perceived. They provide the opportunity to be better situated in understanding the elements of light in the spaces which surround us, the spaces which we design and the spaces to which we experience changing light conditions - the qualities of light within space. As individuals we have a physiological awareness of environmental light conditions we experience and are subject to day in, and day out, and through this our physiology is always responds accordingly (Lambert, et al, 2002, p.1842).

The form, the shape, and the constructed boundaries which light makes in space is always physiologically informing our awareness, however we may not be aware that this ongoing awareness is being constantly updated by changing light conditions. Practice Models introduce a technique for holding a shadow for analysis, necessary because of light being ephemeral, in constant flux. Space is never static, because light is never static, Practice Models aim to strip away the constantly updated and changing conditions of light by keeping one shadow arrangement in place for analysis. They hold one single moment of this change in place so that it can be considered and analysed.

According to Archimedes, 'The word "weight" denotes a quantity of the same nature as a "force": the weight of a body is the product of its mass' (Taylor, B, N. 2008. p. 52), let us consider this notion in relation to the perception of light within Taylor's reflection upon weight. In doing this we may be able to construct a consideration that the perception of light within space could be the recognition of the relationship between visual weights. 'Weight denotes a quantity of the same nature' (Taylor, 2008, p. 52), shadow, I argue, is an integral part of the 'nature' (Taylor, 2008, p. 52) of light. Shadow is fundamental in how we understand our perception of light, and the spaces

we experience. One might say that shadow is a 'quantity' (Taylor, 2008, p. 52) of light. As such it is represented in our perception of space in different and ever-changing quantities. Different parts of a space we experience at any single moment will encompass different quantities of light and therefore shadow. We can see this very clearly in Fig 5.4. It shows both the presentation of brightness upon the 'Floor of an Architectural Space' and the edge qualities of shadow surrounding this area of brightness. I suggest that both are integral to each other. Shadow light is integral to brightness's of light, and brightness's of light are integral to that of shadow light, they are interdependent and interrelated to each other.

When we study Fig 5.5. which show details of shadow edges from Fig 5.4, what becomes apparent very quickly is the apparent differences of these shadow edge qualities. There are four distinct edge qualities of the shadow presented; I have named these A, B, C and D. To my perception, A is the sharpest, the most well-defined edge, through to D, which I perceive to be the softest, the least defined edge. If we look at the detail of these shadow light edges, we are able to differentiate, and clearly see the difference in each distinct edge quality. This difference, and individual distinctiveness of the shadow edge, is I suggest, part of the creation of shape and form in shadow which we perceive becomes an influence upon our reading of space.

This presentation of shadow will present to us as differences in gradient (Cutting, Millard, 1984, p. 198). The representation of this 'quantity of the same nature' (Taylor, 2008, p. 52) is the presentation of gradient/tonality in the perception of light. However, unlike other physical materials, such as metal, stone, timber or concrete, light has a significant and fundamental difference. If a quantity of stone is cut in half it will contain half of its original 'mass' (Taylor, B, N. 2008) and as such, it will therefore naturally contain half of its original weight. It will contain half of its original area and appear smaller in size while still retaining a similar visual appearance. This means that its colour may not change, only perhaps in the cut.

Five/One Measure

If we consider a quantity of light introduced to a space reduced by half, this light will still illuminate the space, however, it will do so to a lesser measurable extent. It will illuminate even though it will naturally contain half the photons/wavelengths it previously contained. Our perception of the space, will appear less bright and darker than previously observed. This is an important point, as the space appears to contain more of something. By

losing photons/wavelengths light becomes darker. Within our perception of darkness, additional weight appears to emerge. If for instance I have printed Pantone® Solid Coated 423 C, Fig 5.6 onto a piece of paper and having done this decided to change this colour to Pantone® Solid Coated 426 C, which within the Pantone® colour guide appears to be darker, the printer will therefore have to use additional ink to achieve this colour perception. We must add ink to make the colour darker, we make an addition.

If, however, I decided to change this colour to Pantone® Solid Coated 420C, which within the Pantone® colour guide appears lighter, the printer would make this colour using less ink than both 426 C and 423 C. I use this example as a way of understanding the principles for lightness and darkness, based upon addition for darker and subtraction for lighter. Within this understanding it is possible to make the philosophical connection between addition, or more of a 'quantity' (Taylor, 2008) for dark, and the subtraction of, or less of a 'quantity' (Taylor, 2008) for light. If we accept Taylor's suggestion that 'the weight of a body is the product of its mass' (Taylor, 2008) and that mass is recognised within our visual perception of darkness as degrees of darkness within shadow as a visual weight, then we can accept these as perceptual weights.

However, light can reverse this principle, as Kahn said, 'by will; by law' (Kahn, 1967. P.26). Darkness is naturally of fewer photons/wavelengths than that of brightness. With this thought in mind 'The effect of colour on brightness' (Beau-Lotto and Purves, 1999) suggests that there has been intercellular correspondence which developed within the evolutionary history of mammals. Mammalian experiential history during its lifetime considers the notion that 'natural selection in phylogeny, and the feedback of neural activity on the formation and maintenance of synaptic connections in ontogeny' (Beau-Lotto, Purves, 1999. P1013). This outlines a long-lasting relationship to light, based upon the biological evolution, between light and the experience of light. Within Colour Theory, and in particular, the 'Theory of colour Impression' (Itten, 1961, p. 79) the relationship between our visual analysis of colour (how we see colour) and the language which is used to describe the relationships between different colours, provides the opportunity for colour theorists to construct methodology. This method provides rules, principles and a resource explaining colour to colour relationships.

Within 'The Elements of Colour' Johannes Itten sets out a series of words which can be used when trying to describe or where we are seeking to construct an understanding of the 'Cold-Warm Contrast' (Itten, 1961, p. 45).

These are the properties of colour recognition. Itten suggests to the reader that 'light' (Itten, 1961, p.46) is representative of 'cold' (Itten, 1961, p.46) and the word 'heavy' (Itten, 1961, p.46) is representative of 'warm' (Itten, 1961, p.46). While this represents for Itten the linguistic representation of colour temperature, it does introduce the notion we are able to construct understandings of visual representations using key descriptive words to present the basis for a point of view. This concept can be further reinforced within 'Designing with Colour: Concepts and Applications' by Chris Dorosz and JR Watson. Within their discussions on 'Balance and Symmetry' (Dorosz and Watson, 2011, p.208) they suggest that our visual perception does apply a hierarchy of relationships between the objects and colours which we see. They use a key phrase within this suggestion which is 'Visual Weight' (Dorosz and Watson, 2011, p.209).

The notion that any perception which we construct of a space, can be said to be based upon the visual presentation of that space is important. It provides the opportunity to suggest our reading of space can be made sense of by the notion which this chapter's title, 'Weights of Light' embraces. While conceding that (Dorosz and Watson, 2011) are concerned with the visual symmetry of space, and when they describe this notion of symmetry they suggest that, 'visual weight refers to the dominance or importance of a design element and refers to a feeling of physical heaviness or lightness' (Dorosz and Watson, 2011, p.209). It is acceptable to understand light as a 'design element' (Dorosz and Watson, 2011). Therefore, the visual weight it brings to a space when we consider how we process the image of light in space is by default, our recognition of shadow within this processing. The 'processing weight of cast shadows' (Bonfiglioli, 2004, p. 1295) is recognised especially within the recognition of 'salient' (Bonfiglioli, 2004, p. 1295) objects. Shadows can be both noticeable and subtle, but as such carry a 'processing weight' (Bonfiglioli, 2004).

When we studied Fig 5.4 we make the delineation between noticeable and subtle, I suggest that this occurs through our perceptual processing of the weight of light visible to us. When we see, our perception acts upon this seeing by 'processing weight' (Bonfiglioli, 2004). The weight of light in space presents as a multiplicity of weights. If we study Fig 5.7, Practice Model Thirteen, we perceive this multiplicity of shadow typology. Each shadow corresponds with other shadows present. Each shadow is having an influence on the way our perception presents the activity of light inside the model. This perceptual weighting of what we see, is an influence upon our judgement about the interior space of the model based upon what is visible

to us. We use the same mechanism of judgement to appraise the model as we do when we appraise and make judgments or respond to space. What the models achieve is to draw attention to our awareness. When we experience space and respond to the actions of light in space we become aware within our unawareness. This mechanism of light's action could be argued to be intuitive, however, intuition must be based upon something. It doesn't already exist with us. Intuition is not a conscious relationship with or to something. The relationship we have as a knowing experience or sense is the relationship between complex intricacies. The models appear to unwrap and uncover these intricacies. There is a system of relationships, which the model draws attention to, it is a device we can experience and break down into what it is and how it is. The what, and how is experience, derived out of ecological laws and rules, however, light in architectural space is related to the aperture of its entry into the space and secondary objects beyond the wall planes.

The form of architectural space or the form within space coalesce in the light entering and therefore become an 'event' (Merleau-Ponty, 2005, p. 208) through perception, in relation to the light and object/objects. Everything relates to and influences every element of our perception and manifestation of the space. It is a found experience, within the circumstance of the situation, its construction is based upon the elements at the time. It is embodied cognition, both intuitive and subjective. The dualities of experience are at the heart of how we grasp 'relations obtaining within the world' (Merleau-Ponty, 1962, p. 174). Fig 5.7 attempts to encompass the complexity with which we experience how light is and has emerged as with all the Practice Models in consideration of the howness of questioning.

Undoubtedly qualitative, it lies beneath the duality of our found experience and our embedded experience. It is rational because we are making considered or reflective judgements upon our perceived truth of the experience. It is empirical considering our sensed experience. It provides evidence to us of what we perceive. It provides the proposition through which an environment appears to be derived. It shapes how we may encounter space, leading to directed behaviour. To suggest that found experience can be embedded, seeks to raise the notion that we relate to the howness of space because of an inescapable ecological endowment.

'The body of man is not an experienced object among form, but a composition of 'natural' [authors emphasis] followed by a manufactured cultural or spiritual world' (Merleau-Ponty, 1962, p. 189). We don't

experience our body; we are our body. We experience a space and react to the light within this space. Our wholeness is responding. Our wholeness, one might suggest, is the combination of many factors both inherent and additional. We are tuned as an entity to the materials which surround us. These materials have a bearing upon us. This may be learnt, or created by our body, but may also be embedded, Merleau-Ponty continues,

'Everything is both manufactured and natural in man, as it were, in the sense that there is not a word, not a form of behaviour which does not owe something to purely biological being – and which at the same time does not allude the simplicity of animal life... and through a genius for ambiguity which might serve to define man' (Merleau-Ponty, 1962, p. 189).

This philosophy presents the notion that individually as bodies in the world, we are a mixture, and a combination. We are an amalgam of embedded and aligned possibilities. We have both intuitive knowledge and understanding of the experienced world in combination with an innate embedded knowledge and understanding. Through our bodies there is no one part of us which is not indebted to our biological inheritance. We attempt to make sense of this inheritance with language. In this endeavour we grasp at explaining the bodies sensorial responses. During this attempt to make sense of what we feel, we compound the issue. We respond using language, but language is not adequate, and subsequently we add to the layers of meaning.

Five/Two Response

To distil and respond to experience in a manner which makes it a shared collective understanding, the capacity for uncertainty and complexity occurs, its purpose is to combine with another body in affirming a mutual experience. It draws attention to a collective known and acknowledges its presence. During my Practice model exhibition at PLACE, Fig. 1.1, 1.2 & 1.3, some comments were left by visitors to the gallery in response to the prompt, what do you see? This question allowed visitors to respond to the perception they experienced when considering the light boxes, and they included;

'Door Opening'

'I See a Door Opening'

'Monochrome Rothko's'

'I See the World of Spaces between the Light'

'I See all of a Room'

'Beautiful Boxes Holding Something I Didn't Expect'

'I See Stars'

'I See That Shadows Have Echoes'

'It is Soothing to See Something Form from the Negatives'

'Light'

'I See How Light Disintegrates and Shadow fragments Frey'

'Contrast, Light, Shape, Projection – Something We Usually Take For Granted!'

When the comment of 'I See a Door Opening' is made about Practice Model Twelve, seen in Fig 5.8, it represents observation and recollection drawing attention to a perceived experience. It says; let me explain to you what I am observing and what I have experienced. When I use these words, you will understand the type of experience I have had. The words that I use will represent my experience to you, but these key words themselves are a landscape, and not by any means definitive. They bring no content, they are not visualisations or expressions, they merely provide a horizon from which to survey individual experience or embedded representations.

Fig 5.8, recalls the sense of that which we saw in Fig 5.4. This language of the representation is signalling the area in which one must look for comprehension and understanding. What we think is embedded in our words, the way we speak and the way we say it, articulates the memory of experience. Merleau-Ponty continues, '[t]he orator does not think before speaking, nor even while speaking; his speech is his thought' (Merleau-Ponty, 1962, p. 180). We bring individual meaning to what we hear and position ourselves within our experiences. The words carry no weight only the expression or emphasis which they are provided with. The properties of light are the properties of every other material we meet. Some everyday materials we meet are hard and soft; heavy or lightweight; warm or cold to the touch; shiny or dull; textured or flat; bright or dark; soft or ridged, the possibilities and variables are extensive.

The materiality of light as with these other materials encompasses the essences of hard and soft; heavy or lightweight; warm or cold; shiny or dull; textured or flat; bright or dark; soft or ridged. There is a difference however; within their materiality they combine the sense of touch with that of visual perception. For our understanding of light, we rely solely upon our visual awareness of their essences, arguably the essence of our understanding of light is encompassed within its weight – its visual weight. The materiality of light is bound within the perceptual weight of what we experience. As with all materials, light has a variable character and characteristics and these recognisable signs ebb and flow with the passing of time but it also with the objects and materiality of the space itself.

'[n]atural materials – stone, brick and wood – allow the gaze to penetrate their surfaces and they enable us to become convinced of the veracity of matter. Natural material expresses its age and history as well as the tale of its birth and human use' (Holl, Pallasmaa, Perez-Gomez, 2006, P. 29)

Light within architectural space is a construct, and the character of its material substance responds in relation to what is done to it or with it. Architectural form adjusts light in the same way other materials can be transformed through the action of the craftsman (Sennett, 2008). Space has the capacity to utilize the possibilities of light's materiality. In the same way 'stone, brick and wood' (Holl, Pallasmaa, Perez-Gomez, 2006) have inherent qualities. These are available naturally, they are qualities which can be capitalised upon through an in-depth understanding of their individual potentialities. Material qualities can be dissipated and undervalued in the same way that they are available to being enriched and valued. The value of these natural material essences cannot be underestimated, Juhani Pallasmaa continues, 'synthetic material – present their unyielding surfaces to the eye without conveying anything of their material essence' (Holl, Pallasmaa, Perez-Gomez, 2006, P. 29).

Time is an important factor in how we respond to the materiality of what we perceive. It may be possible to recognise time in the weight of light we perceive through the forms with which we live, as light has the capacity to unlock essences in materiality which rely upon this to provide the qualities we recognise as fundamental to the essence of that material. In addition to this, there are the qualities which come from the 'sheen of antiquity' (Tanizaki, 2008, p. 20) which have been built up over time by touch. The silver stylus which Sian Bowen has used in her work 'Descriptions True and

Perfect' 2010, relies upon light to activate and deepen the possibilities which the work carries. Light both brightens the materiality of the silver and darkens it. Depending upon one's aspect to the work and the relationship it has to the direction from which light falls. This experience will change as the viewer moves or the source light moves. The silver stylus both rejects light and absorbs it. It is illuminated and dazzling. It seems to have the barest of touches upon the paper, while on another part of the same page it appears to be solid and purposeful, fixed and permanent. Within the transition between these aspects, the writing disappears, seemingly melding with the page becoming part of its very substance. Light enables this changing perceptual materiality, by altering how we experience the changing meaning of what we perceive. Consideration however, must be given to the spectrum of the darkness's of light as these contribute in a more fundamental way to the shared human understanding of space. How space presents to us and is therefore conceived within our perception, becomes an important element of our shared ecological interpretation of space. As the manner of the silver is both brightness and darkness, so is space - light enlivens both.

The tapestry of shadow which we inevitably encounter in space, informs our relationship. How we see what surrounds us, calculates the visual relationships between different colours and luminosities. It has been established that we have 'a universal biological basis for these phenomena ... which is fundamentally rooted in sense perception' (Chaplin, 2005, p. 6). This perception provides man with the utility to discriminate between tones. The material of light presents to us in different ways, these may be brightness incorporating lightness, and darkness incorporating heaviness.

Within the field of human vision 'shape-from-shading' (Nandakumar, Torralba and Malik, 2011, p. 258) is judged through 'shading variation' (Nandakumar, Torralba and Malik, 2011, p. 258). Each perceptual tone is acknowledged to be representative of form. It is through the representation of these variations both on form, within form and beside form that human vision perceives and makes sense of perception. From this observation one can suggest that light is more than one thing. As the colour spectrum encompasses colour from 350nm generally understood to be the red end of the colour spectrum and 740nm as the blue end, this is the recognised range of colour within visible light – white light. We can therefore accept that visible light contains a multiplicity of values within one accepted descriptive entity.

In this universal acceptance, we can argue that light is never, and has never been one thing. By its being it is many things within a single whole, 'by will; by law' (Kahn, 1967). If we project this understanding upon the perception of light in space, we are observing the manifest of different aspects of light. Just as the known spectrum is recognised and visible to us, can the differences in the perception of light be acknowledged too, acknowledged as weights? Let us reconsider the earlier analysis from 'A Vision: The Inspiration of the Poet', by William Blake circa 1819 – 20. In this analysis we considered painted tonality as weights. Through this analysis two things come to mind, 'light from above' (Casati, 2014, p. 351) and 'balance' (Dorosz, Watson, 2011).

Within this graphic presentation the argument that our vision has evolved to accept visual perception of the object world within the frame of light is startling. The sun is in the sky, which is above the horizon, therefore the visual cues which we use to delineate objects in light, like Blake's painting, is based upon the understanding that light will always come from above the horizon. It was within this understanding that 'A Vision: The inspiration of the poet' presents as visually uncomfortable based upon how our perception has learnt to read the visual signs of light. We looked at the painting, but we sensed that there was something difficult to grasp about the presentation which it made to us. That difficulty may have been based upon the many source directions to which the light was being depicted to be coming from.

In Fig 5.8, which was seen to be representative of a doorway by a visitor to my Practice exhibition at PLACE, was made by light coming from a top right direction. Within nature we are presented with situations where climatic conditions present alternative presentations of light from above, for instance, a thunderstorm, or when we are amid very heavy rain clouds. In this situation the sky may present to us as virtually black or in the very least to be much darker than that of the horizon. These are passing occasions of climate and not the everyday, where the sky is brightest above us. Existentialism and Humanism, by Jean-Paul Sartre, presented the reader with a consideration of phenomena suggesting how we experience relates to the manner with which we look at whatever we are seeing.

'If we draw, for example, a black Maltese cross upon a white square, we can perceive either the cross itself, or the spaces between its limbs, as the statement that is being made, but we cannot perceive it both ways at once' (Sartre, 1973, p.13).

When we look at Blake's painting, we are seeing both lightness and darkness, but not, according to Sartre, at the same time. He suggests that our visual perception is moving between the two, from one to the other in succession making sense of what we see. I would add to this that within our 'peripheral vision' (Conway, 2009, p. 279) we have the capacity to observe both the lightness and the darkness as being present at the same time. However, we may not be able to distinguish detail, simply shape and form. It is within our use of the central gaze with which we differentiate between these two areas of concern. It is through the 'centre of gaze, called the fovea' (Conway, 2009, p. 279) with which we move from one shape to another. We do this to read or understand what shape we are looking at. Sartre continues to question further our reliance upon intuitive nature, and how this tilts toward interest and experiences.

'What makes us perceive it [the cross] as one or the other? A gardener would perhaps be more likely to perceive it as a flower, and a military man as the cross. Perception depends upon this pre-existent element of choice, which determines the form in which we perceive not only all the varieties of geometrical figures but every phenomenon of which we become aware' (Sartre, 1973, p. 13)

Sartre suggests that there is an aspect of pre-determinisation within our perception of the world. We can interpret this as a position from which our values gained through our experience of the world, inform and guide our interpretation of what we perceive. When we make individual deductions through perception we are creating an order for ourselves, based upon our past experiences, what Sartre terms 'pre-existent element of choice' (Sartre, 1973). We frame an argument of understanding perception based upon this notion of perception which is pre-known, 'pre-existent' (Sartre, 1973). That this perception exists before it is found situates our perception within a much wider, less cognitive field. To do this one must consider research which tests notions of perception which do not rely intrinsically on 'choice' (Sartre, 1973), but rather, upon the possible 'entrainment' (Beauchemin and Hays, 1996) of our perception. The basis for the human perceptual 'entrainment' (Foster, and Wulff, 2005), (Foster, and Hankins, 2007), (Figueiro, Bierman, and Rea, 2008) by light in relation to the diurnal sequences which drives human circadian rhythm, suggests the biological connection of man to light to be over a time longer than the human lifespan.

'What is perceived is not the reflection of something objective which the mind duplicates within itself; it is the result of that

something and of the mind's percipient activity; and this again is a function of some tension or tendency towards a certain goal' (Sartre, 1973, p. 13)

Perception is not an idea, Sartre is suggesting, it is what is perceived. However, his caveat is 'percipient activity' (Sartre, 1973) which suggests perception to be insightful and discerning, but with a conditioning. Here we may understand 'goal' (Sartre, 1973) to be seeking a kind of balance or result which is connected to our individual experience, i.e., we formulate to our individual justification. This justification Sartre understood as not being 'something objective' (Sartre, 1973) like recognition based upon a scientific instrument, more, I would suggest an indication of a subjective alignment. Subjectivity however comes with an element of suspicion given we understand it to be based upon personal opinions or possible feelings which may create bias. (Zeki, 2009) purports that the experience of something objective differs greatly from subjective. However, this research suggests that the subjective truth is a secure form of measurement explained here,

'subjective truths are the only one that we can be sure of, that the brain is a superb measuring device, and that it continually executes measurements, be they measurements of light intensity, or the degree of hate and desire. We are more often sure of subjective truths than objective ones' (Zeki, 2009, p. 2825)

We may have learnt an inherent suspicion of reliance upon 'subjective truths' (Zeki, 2009) and have become acquainted with belief that these are merely biased, prejudiced or one-sided points of view which reflect an over reliance on other instruments of measure outside of ourselves. Therefore, what (Zeki, 2009) suggests is that,

'subjective truths, being experienced by an individual, are truthful in the sense that the individual experiencing these truths can be certain of them... objective knowledge cannot override the perceptual, subjective, experience... the only perceptual reality the brain has is the subjective brain reality' (Zeki, 2009, p.2826)

Five/Three Subjective

Subjective truth is the summation of all we know to that point. In 'Abstract Space: Beneath the Media Surface, Therese Tierney considers the concept forwarded by Sir Joshua Reynolds, the painter, of 'all at once' (Tierney, 2007, p. 50). This suggests that all of one's experience is reflection, a

reflective reaction. That light may have both visual 'heaviness and lightness' (Archimedes, 1959, p.52) within it, and within our moving perceptual experience, leads us toward an acceptance of the notion of weights. Within "Floating Bodies" Archimedes postulates that, 'if their weights are equal, it is not said that one of them is heavier than the other... it is only said to be heavier when one has more weight' (Archimedes, 1959, p.52). This suggests to me that darkness can be understood to be visual heaviness and brightness to be visual lightness. '[B]y means of a balance' (Euclid, 1959, p. 11) the body of the perceiver is the subjective tool through which comparison is made. My analysis relies upon digital media to present my findings, as such I rely upon a record of what I have observed in the field. It is not and cannot be the actual moment as the reader is not with me now and not able to observe my enquiry. When I look at the digital image of what is seen within the Practice Models they must be, by their inherent character, not what I see with my eye. The digital recording and representation lacks the qualities of ecological vision. Sight is missing; my biologically inherent range of reference is not there. Digital representation is devoid of ecological fullness.

Light in concord with an object, may result in a shadow being produced. The perceptual representation of this shadow will have in its nature the possibility of presenting to our vision a further visual shape or form, (Ramachandran, 1988); (Biederman, 1987); (Cutting, Millard, 1984) and (Morganstern, Murray, Harris, 2011). Shadow inherently and naturally encompasses form within its body. The refraction of light around an object creates an 'interference fringe' (Born, Wolf, 1999, p. 323). Interference fringes which are made by light, and manifest through shadow, display to us through our visual perception as form or shape. However, it is of interest to this thesis, that this form may not be immediately or indeed ever have been considered by those experiencing architectural space. Space, which is subject to light, suggests that it is the form and shape of the ecologies of light which may be directly influencing individual and therefore collective experience of space and our linguistic presentation of this experience.

The natural qualities evident in shadow made by light, which we perceive, will naturally, spread throughout space, to various and ever-changing extents. I use the word natural because this perception is based upon evolutionary development, discussed in Chapter One. Phenomenological insight, governing how we see, suggests our sight perceives the action of daylight as natural brightness and natural darkness. As form existent in shadow appears to be remaining largely unnoticed, the development of my

Practice exhibition sought to address this issue through the publication of my practice. The series of twelve Models sought to explore the phenomena of shadow and respond to the perceived gap in knowledge. The exhibition sought to draw attention to the imbued form inherent in shadow. Its proposal endeavoured to make connections between the characteristics of shadow and the experience of architectural space through our shared visual perception. Practice sought to present an awareness of shadow edge which suggests form may be a fundamental ingredient in how perception of space is influenced.

Five/Four Awareness

Awareness requires a consciousness of space, where the phenomena of form, and its encompassing dialogue is what Fig 5.9 and Fig 5.10 demonstrate. They are photographs taken within an architectural space of the same area of wall, a few seconds apart. The apparent difference in the angles from which the images were taken in relation to the shadow being shown, is purely the outcome of using a hand-held camera to take the pictures. When you observe these images, allow your vision time to become accustomed to what your eyes are observing. These figures show a shadow made by light passing over the edge of a wall. Consequential to this, it projects its shadow upon an adjacent wall within the same space. Fig 5.9 was taken on 31st December 2014 at exactly 12.55pm and 15 seconds. Fig 5.10 was taken 25 seconds later. These shadows are elements through which visual perception makes sense of objects and situations perceived, (Ramachandran, 1988); (Casati, 2012); (Norman, et al, 2013).

As such perceptions such as these are a common constituent in experience, as such it's reasonable to argue that shadow body such as these should be familiar and universally known through our visual perception. These forms should become just another picture which captures an area of wall plane subjected to shadow, just a normal and expected occurrence during the diurnal sequence. However, the representation of the transition between brightness and shadow light may not be an awareness which has been closely examined in relation to our experience of architectural space. It may be through an unconscious awareness of shadow, which contributes to our space experience and therefore engenders linguistic responses such as 'atmospheres' (Zumthor, 2006, p. 11) and 'presences' (Kahn, 2013, p. 26).

These images I would argue suggest we can perceive shadow edge on a wall plane as curved form. When we observe the wall plane of any space we

recognise the shape and form of its boundaries – the walls which make up space itself, we do not necessarily recognise or acknowledge the form of shadow. The boundaries of space we visualise incorporate what Plummer calls the 'play of light' (Plummer, 2012, p.9) (Plummer, 2009a, p. 4) (Plummer, 2009b, p. 54). This is an unusual phrase which appears to have a universal meaning, which one might say is the recognition of shadow upon the wall plane. It is consciousness of shadow which reveals other layers of experience. This experienced layer is shape and form. Figures 5.9 and 5.10 demonstrate that through observation, one can observe two very different and distinct responses to light. My visual perception of the image can on the one hand one might say, observe the image as a transition between an area of brightness and an area of darkness. However, my visual perception can observe within this area, the transition between the brightness and darkness as a laterally directed form or curve.

The observation of this second way of seeing the image, is where my perception indicates the possibility that the wall plane appears to be bending away from me. Having taken the photograph, I know that this is not the case and that the wall plane is flat. However, my observation of the transition between brightness and shadow appears to be where form occurs. It is within the interstice, within the relationship of transition between brightness and darkness where form appears to be generated. Fig 5.10 strengthens my earlier arguments regarding the interstitial because it was taken twenty-five seconds after Fig 5.9. I accept that this time scale represents more than an interstice, but its inclusion is an example of the ecological nature of time.

Five/Five Change

David Chipperfield in conversation with Alan Yentob when they were discussing the Hepworth Wakefield Art Gallery in West Yorkshire, commented that,

'I was interested in the idea of articulating the rooms of a museum and extending, extrapolating out of those rooms form... it was that connection with daylight that reminded you of the weather and the fact that you were in a room'. (Chipperfield, 2015)

The ecological nature of our experience of space subject to light will always remain at the forefront, because climatic conditions, will always be at the centre of how light is perceived. The interstice of the passing twenty-five seconds has profound and dramatic influence upon the wall plane, because climate changes and the intensity of light responds. The wall plane

photographed in both these figures is exactly the same area of wall, however my visual perception of the images evolves a duality based upon these changes. In the first instance the image appears as a transition between an area of brightness and an area of darkness and my visual perception observes the area of transition between brightness and darkness as a laterally directed form or curve. However, the area of darkness behind the lateral form in Fig 5.10 is not as fully dark as that observed in Fig 5.9. I suggest that this presents the perception of a curved band lifting from the wall plane toward the perceiver. This curved band creates the visual perception of a 'mound' running from top right to bottom left. Having discovered these two very different ways of seeing, my visual perception can easily pass between these two observations and potentially many, many more.

The images present us with photographic evidence of how shadows can present very different perceptual changes to our visual perception within only a few seconds of each other. The twenty-five seconds of time between them, demonstrates the capacity of light to exhibit radically different visual phenomena just seconds apart. We can say with confidence that light exhibits form which changes momentarily, and these changes are, by nature, always with us, and that we have evolved in concord with these changing perceptions.

Our perception recognises them; it functions and tells us about our environments in conjunction with these changes and differences which incorporate both the shape and form. Shadow edge, is integral to how man perceives shadow light. This shape and form influence our perception, even if we are unaware of its existence, and not consciously observing its perceptual nuances. If we reflect once more upon Fig 5.3, the shape and form which we have observed in Fig 5.9 and 5.10 may become more apparent to your perception. These images suggest that form in light readily exists when space which is subject to the ingress of light; however, it has become less obtrusive to our consciousness. The visual perception of this form is apparent to us in space between darkness and lightness and lightness and lighter-ness. The wall planes we observe are form filled three-dimensionally alive areas. Our visual perception of a flat wall plane is, in truth, a series of visual curves which our vision apprehends, but to which we may largely be unconscious of. Practice Models 1 - 12 demonstrate the shape of shadow within a constructed environment by holding the form of the shadow so that we may observe it. The shape of the shadows do not change, only their intensity, due to climate.

As Chipperfield says, it is the 'connection with daylight that reminded you of the weather' (Chipperfield, 2015), "on the earth" already means "under the sky" (Heidegger, 2001). The elements in the weight of light is the perceivable boundaries between darkness and brightness. Daytime represents contexts of brightness, whereas night time represents intensities of darkness. Daytime is one word for many types of brightness's. Night time is two words many darkness's. We can easily understand the concept of brightness and the concept of darkness. A space of complete brightness is as perceptually impenetrable as a space of complete darkness. The house was in complete darkness; is never the house was in complete brightness.

We understand the value of what complete darkness means. If a space was said to be in complete brightness we may understand this to naturally contain different values or weights of light. Although we would not normally describe a space as being in brightness, in the same way we might describe a space as being in darkness. One might say that the space is contained within darkness as opposed to the darkness being within the space, it appears to be a mixture of the two – brightness and darkness. There is no one type of light, it is inherently multiple. As one understands that the word colour denotes difference, that colour carries the possibility of difference, so weight denotes difference too.

The need for this clarification is because one of the difficulties historically, within architectural thinking is that the use of the word light is used as a descriptive term for how a space presents itself to the observer. This thesis presents the notion that it has in many ways become a meaningless unresolved term which does little to engage with a true projection of the space concerned. It has in effect become an umbrella term used loosely within many different light conditions. How light is, within space, and how this perception is affirmed perceptually necessitates a deeper affirmation of what is seen. How light is, requires a more thoughtful and focussed attention. Within our collective understanding of light, an acceptance must be made that there are probably as many different weights of light as there are hues in the spectrum.

Conclusion

In conclusion, I want to articulate the findings of this thesis and what this thesis leads to.

The literature review in Chapter One considered the biological coupling of man to light which suggests that our perceptual response to light in architectural space is manifest through this coupling. Visual perception, having developed biologically in coalescence with light, arguably informs the human spatial identification of space through the cues of light.

Chapter Two explored analysis based upon the painted representation of light as a counter intuitive visual acceptance. The works revealed many fundamental questions relating to how man ascertains light through its visual cues and can create perception of architectural space through shadow presentation.

The drawings discussed in Chapter Three transpose as illustrative responses to our perceived understanding of light in architecture, as such they appear to activate perceptual cues inherent to our operating system as a biological response.

Chapter Four suggests that the experience of architectural space is bound within the diurnal sequence and therefore, the interstice of time. The correspondence between the interstitial is examined by two works which placed their subject matter within the perception light as passing time.

The weights of light were defined within Chapter Five as the perceptual layering of visual density. The weight of light proposal which provides values to our visual perception, imbues the range of lights visual manifest from brightness to darkness.

This thesis leads to a clearer understanding within architectural practice of the system of values which light encompasses in space and the process through which our interpretation of light in architectural space is shaped and formulated.

Practice models used throughout this research have been used as tools to learn about the nature of light which has led to them becoming part of teaching practice. Becoming working tools for students to explore light and broadening their knowledge of what they understand light to be is a crucial aspect of architectural education. Practice, models provide opportunity for students and practitioners to gain insight into the qualities of light. They

transfer well into teaching roles and practice thinking, by providing a method through which different and varied light cues can be noticed and explored. As tools they convey a much deeper understanding of what light is, how light is and our biological relationship to light.

My findings provide scope for architecture to widen its relationship with sustainability, as literature review connects our health and wellbeing to light. As architecture becomes more imbedded in technological developments, particularly in relation to the use of artificial light which facilitates environments which dislocates our relationship to light, this research is pertinent. Technology can invariably become the driver of many aspects of sustainability within architectural research. However, drawing attention to the human biological need for exposure to the diurnal sequence in architecture in order to facilitate health and wellbeing, it's important for architectural students to be exposed to teaching concerned with light.

It has become clear through teaching that introducing my practice models into project scenarios provided students with the opportunity to challenge their understanding of what light is, and in what way they propose to use it in the work. Teaching which focusses upon light from a deeper understanding of its importance within architectural design, can lead to students using techniques and methodologies such as modelling and designing space through the manipulation of light and darkness with models. These methodologies challenge teaching practice to become more phenomenological rather than metric orientated.

The metrics of design are further challenged by this thesis drawing attention to light as a key driver of human biology. The technological approach to sustainable architecture which does not engage light as key, but instead relies upon artificial brightness, presents no opportunity to increase the health and wellbeing.

Encouraging the natural modalities of light to be encompassed within architectural space through teaching based upon the findings of this thesis provides a contribution to knowledge which allows students to design truthfully and meaningfully with light and an ability take this knowledge further within their professional practice.

The findings of this study suggest that we have a learnt biological interpretation of light, even within the dramatic environmental conditions of diurnal sequence.

This research has implications for previous theories of architectural space experience which emphasized linguistic generalities without its basis being understood.

Chapter Illustrations

Introduction

Illustrations



Fig 1.1. *Practice Work Exhibition Poster 'The Value of Darkness' at PLACE Gallery Belfast.* © Niall O'Hare.



Fig 1.2. *Practice Work Exhibition 'The Value of Darkness' at PLACE Gallery Belfast.* © PLACE.



Fig 1.3. *Practice Work Exhibition 'The Value of Darkness' at PLACE Gallery Belfast. © PLACE.*

Two

Illustrations

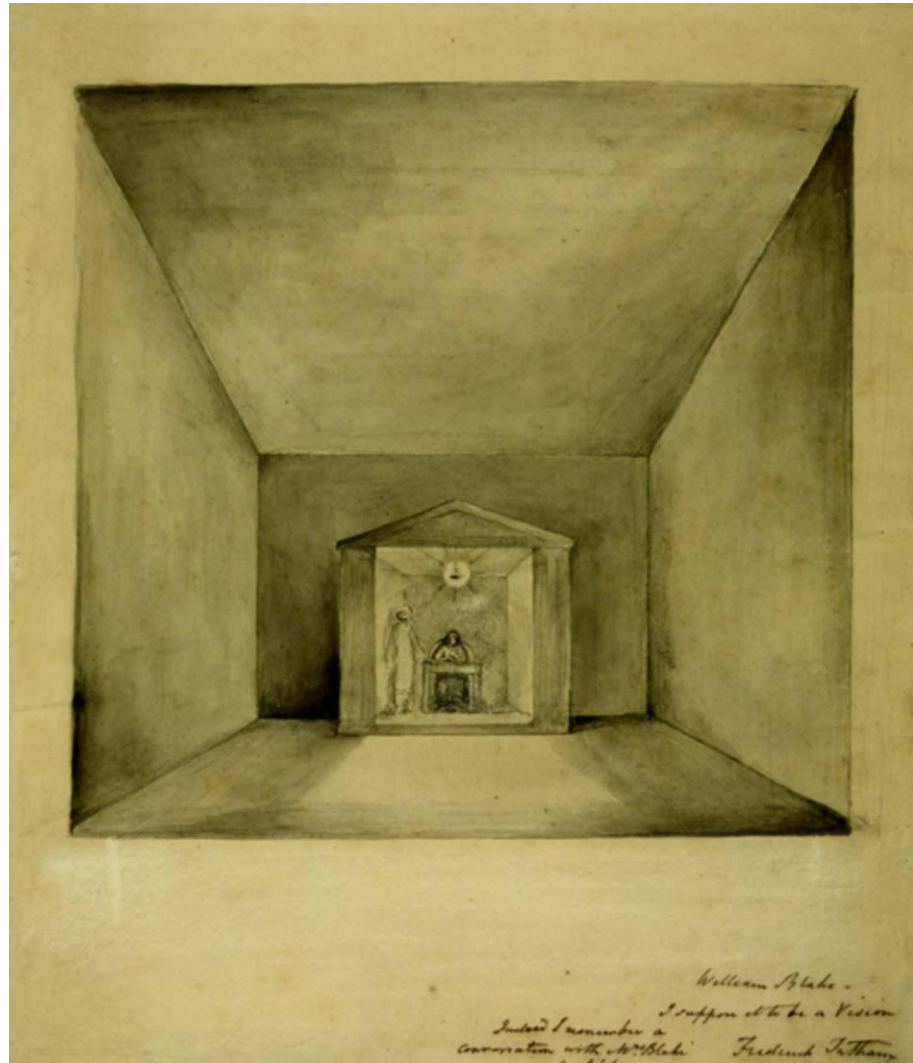


Fig 2.0. 'A Vision: The Inspiration of the Poet' (Elisha in the Chamber on the Wall) William Blake circa 1819 – 20. © Tate Gallery.

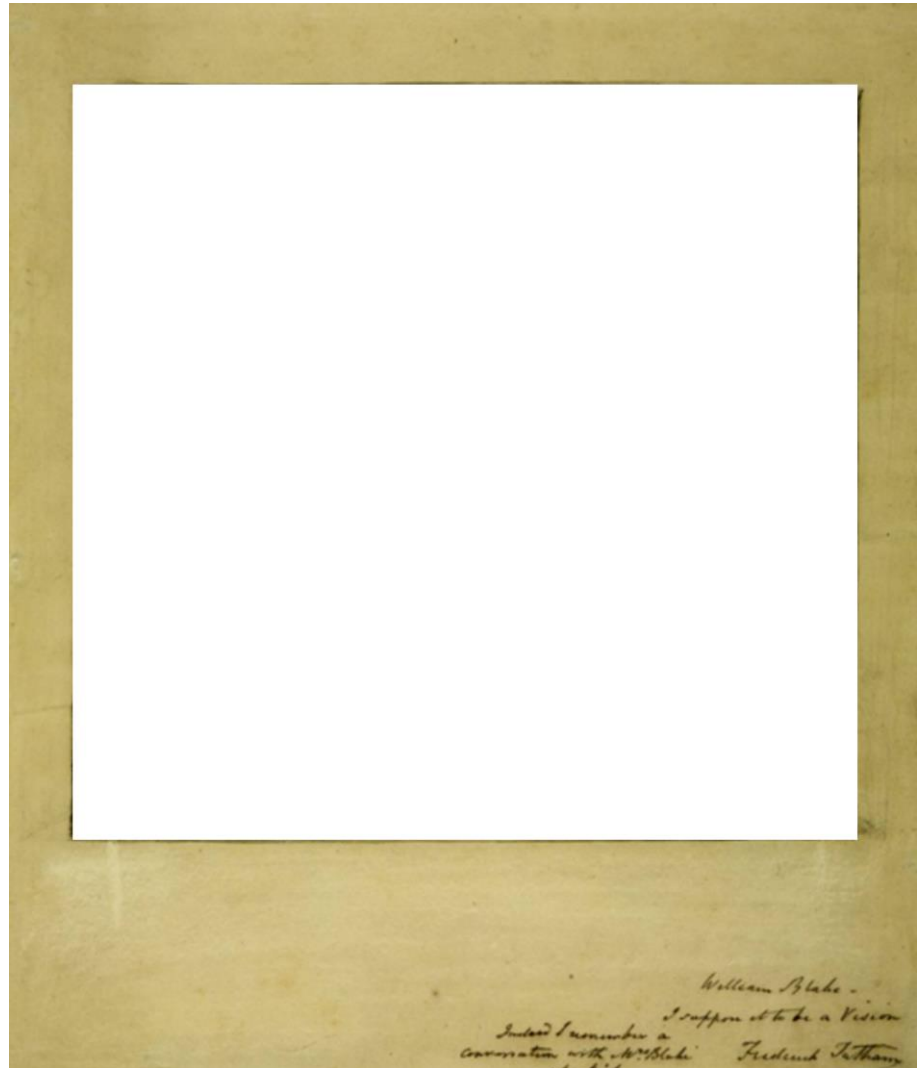


Fig 2.1. 'A Vision: The Inspiration of the Poet' (Elisha in the Chamber on the Wall) William Blake circa 1819 – 20. © Tate Gallery

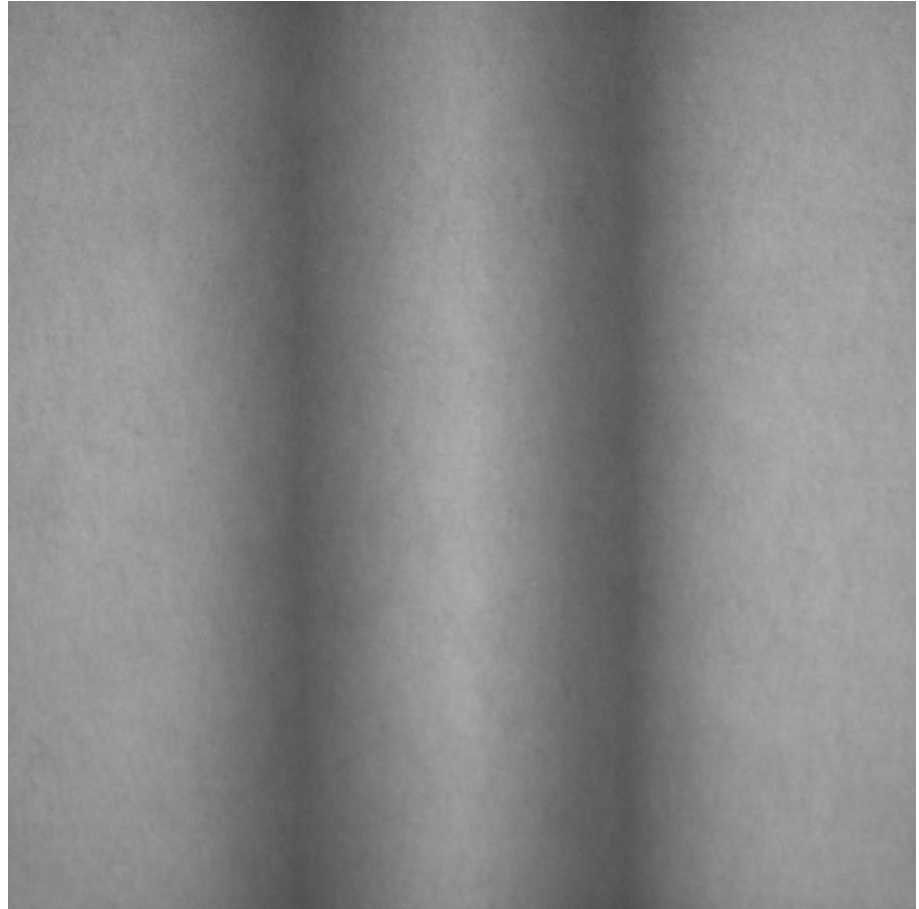


Fig 2.2. *'Practice Model Three'* Niall O'Hare 2015.

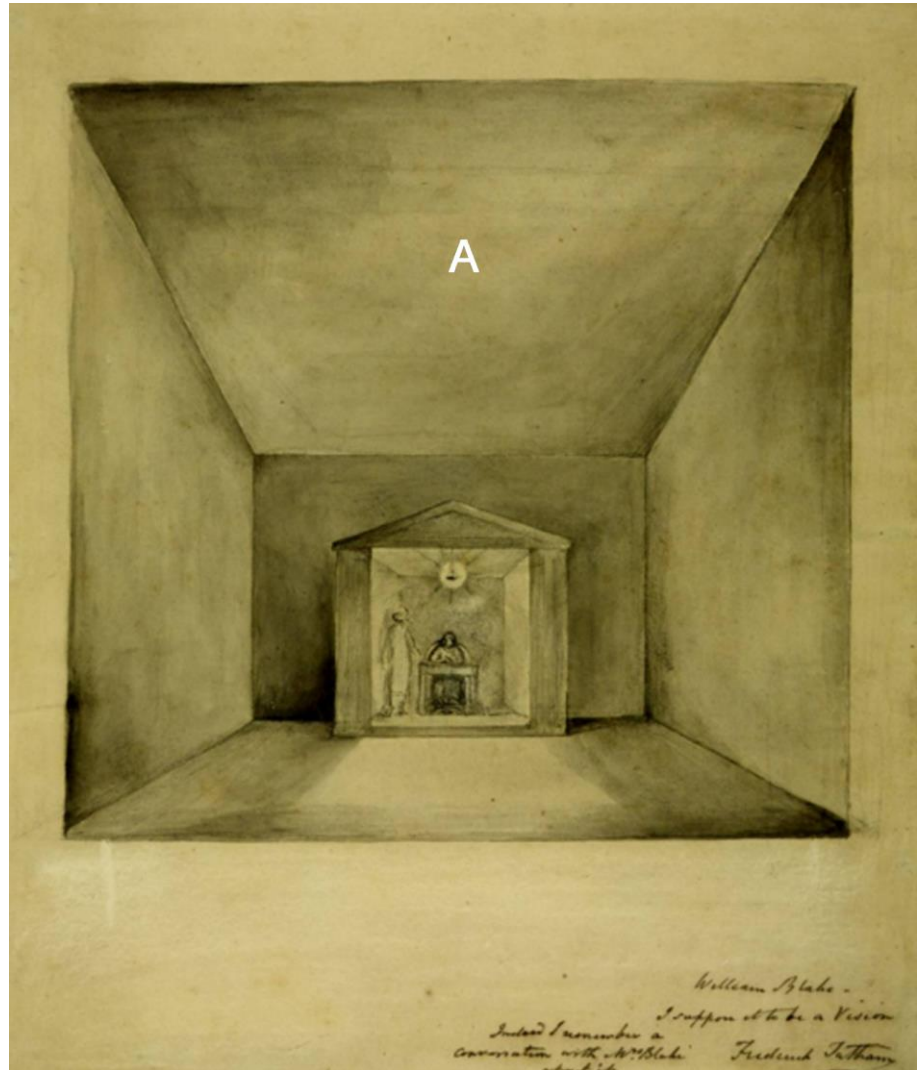


Fig 2.3. 'A Vision: The Inspiration of the Poet' (Elisha in the Chamber on the Wall) William Blake circa 1819 – 20. © Tate Gallery



Fig 2.4. 'The Annunciation' Fra Angelico circa 1435. © Prado Museum.



Fig 2.5. 'Saint Peter Ordaining Saint Stephen' Fra Angelico, Circa 1447-48.

© Vatican Museum.



Fig 2.6. 'St Laurence Distributing the Goods of the Church' Fra Angelico,
Circa 1447-48. © Vatican Museum.

THREE

Illustrations

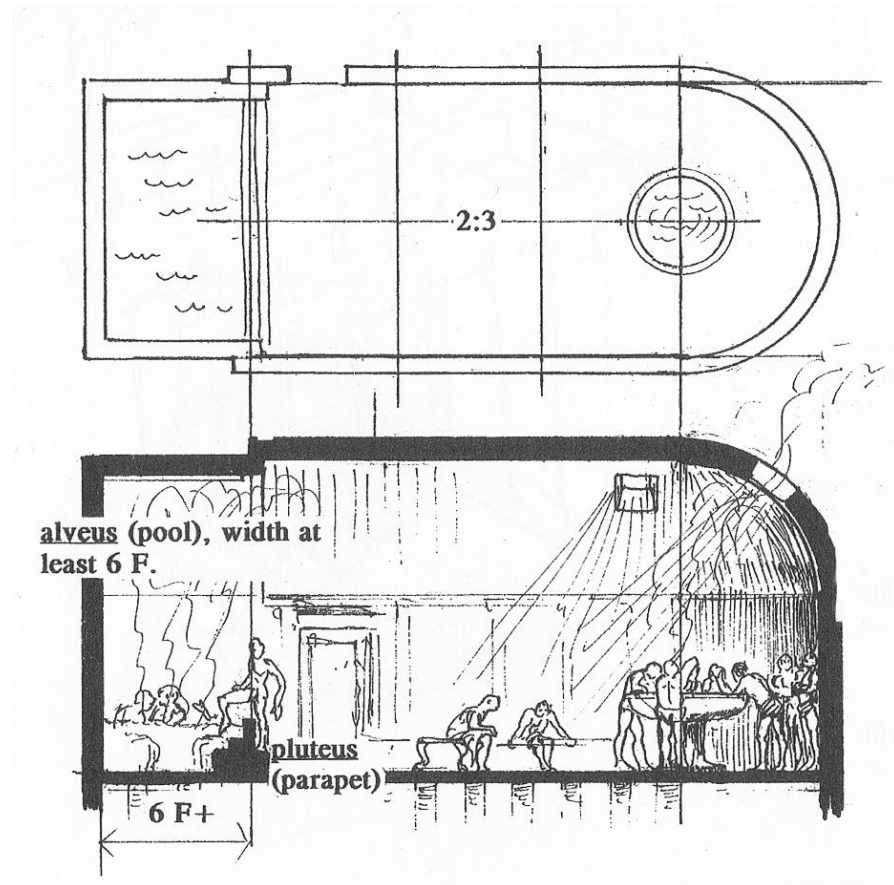


Fig 3.0. 'Balneae' © 'Thomas Noble Howe' 1999.



Fig 3.1. '*Rudas Baths*' Budapest © Gerhard P. Müller, Dortmund, 2011.

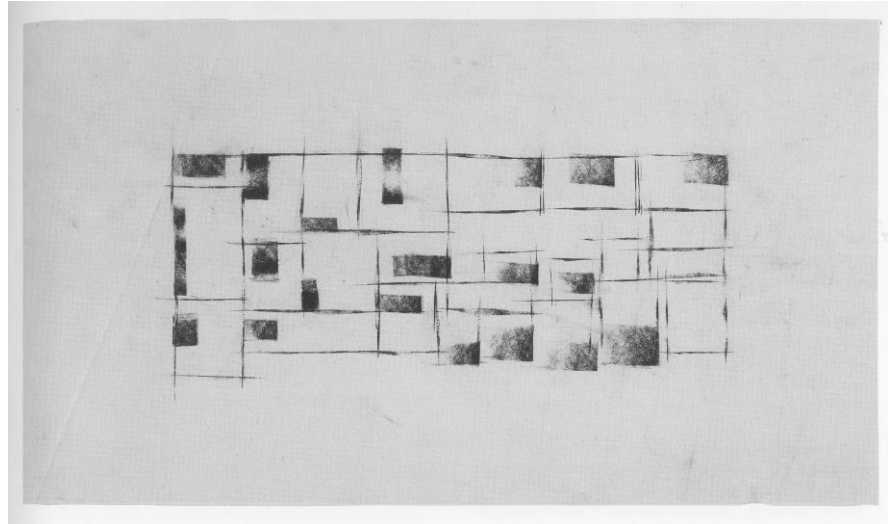


Fig 3.2. © Peter Zumthor, Atelier Zumthor, Haldenstein 2011.

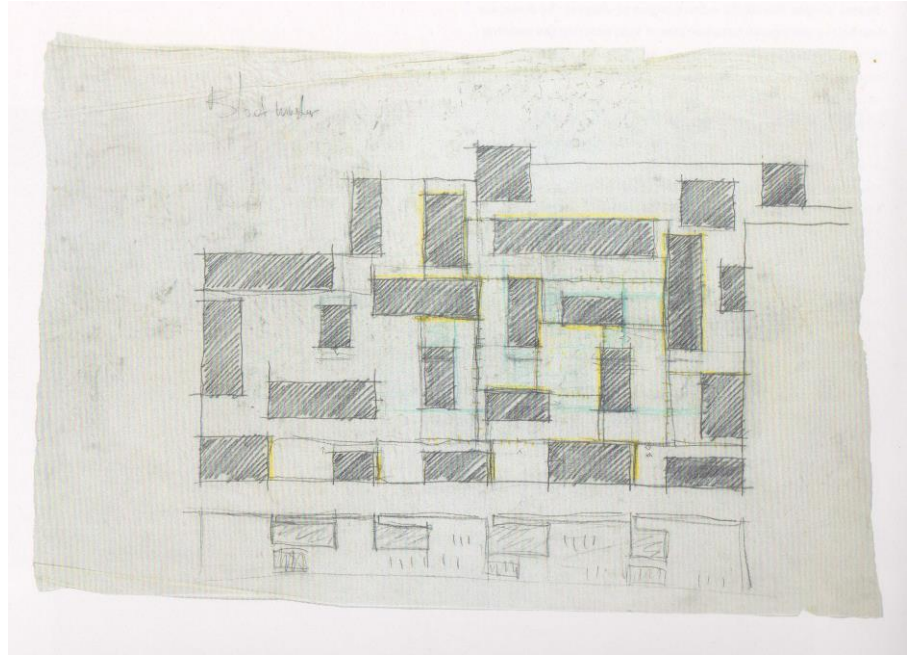


Fig 3.3. © Peter Zumthor, Atelier Zumthor, Haldenstein 2011.

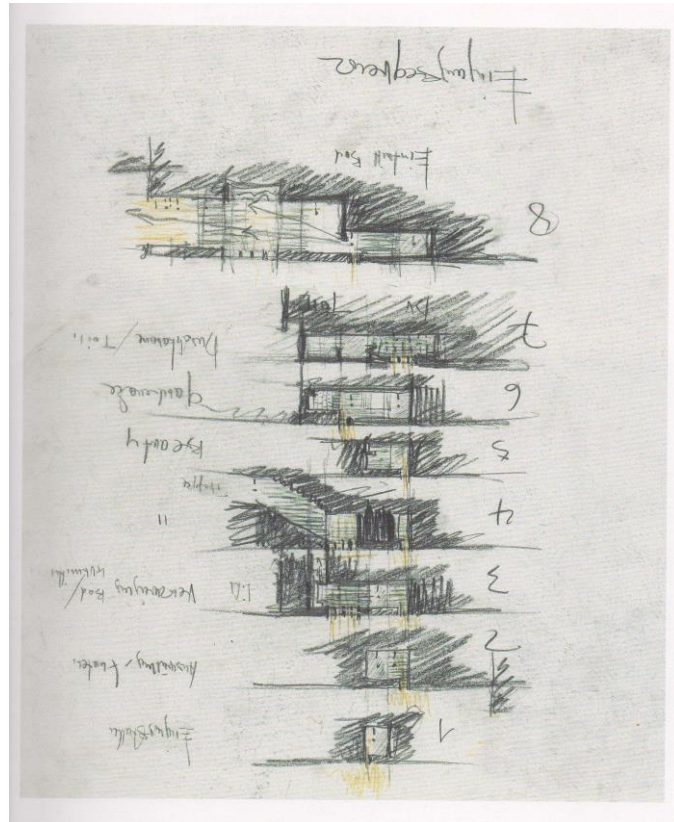


Fig 3.4. © Peter Zumthor, Atelier Zumthor, Haldenstein 2011.

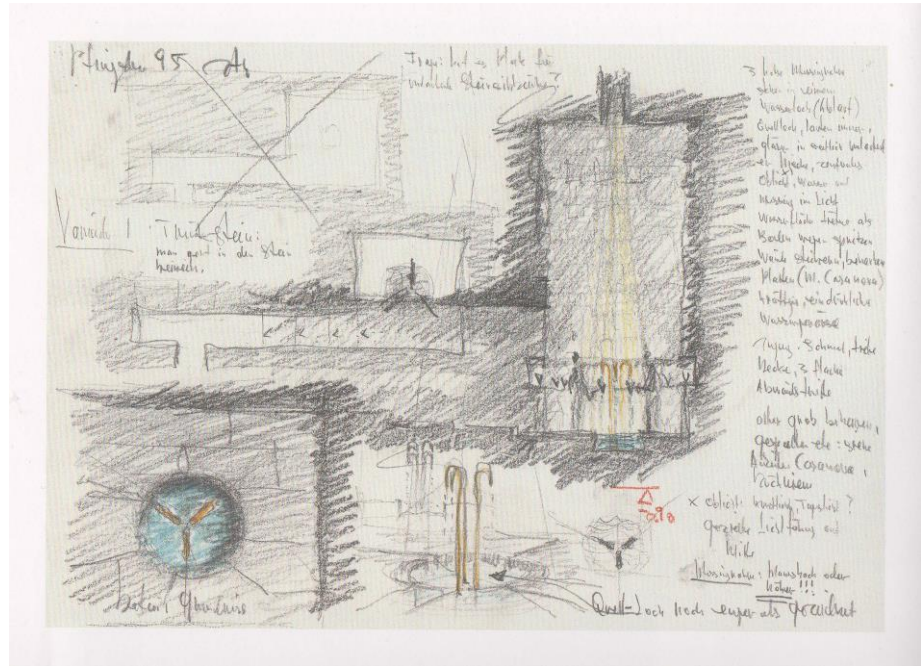


Fig 3.5. © Peter Zumthor, Atelier Zumthor, Haldenstein 2011.

FOUR

Illustrations



Fig 4.0. *'Your Strange Certainty Still Kept'* Olafur Eliasson © Tanya Bonakdar Gallery, New York, 1996.

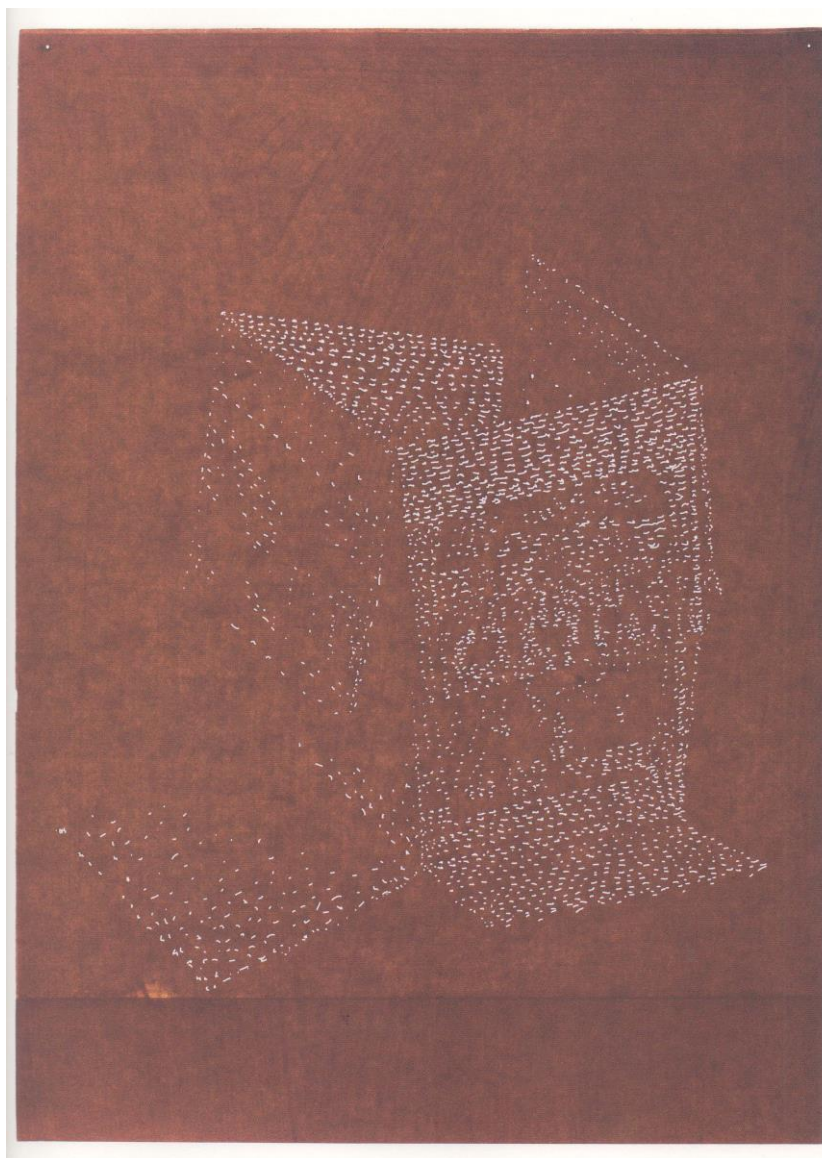


Fig 4.1. 'Gaze No 9' © Sian Bowen 2006, Victoria & Albert Museum, London.



Fig 4.2. '*Shift*' © Sian Bowen 2006, Kyoto Art Centre, Japan.

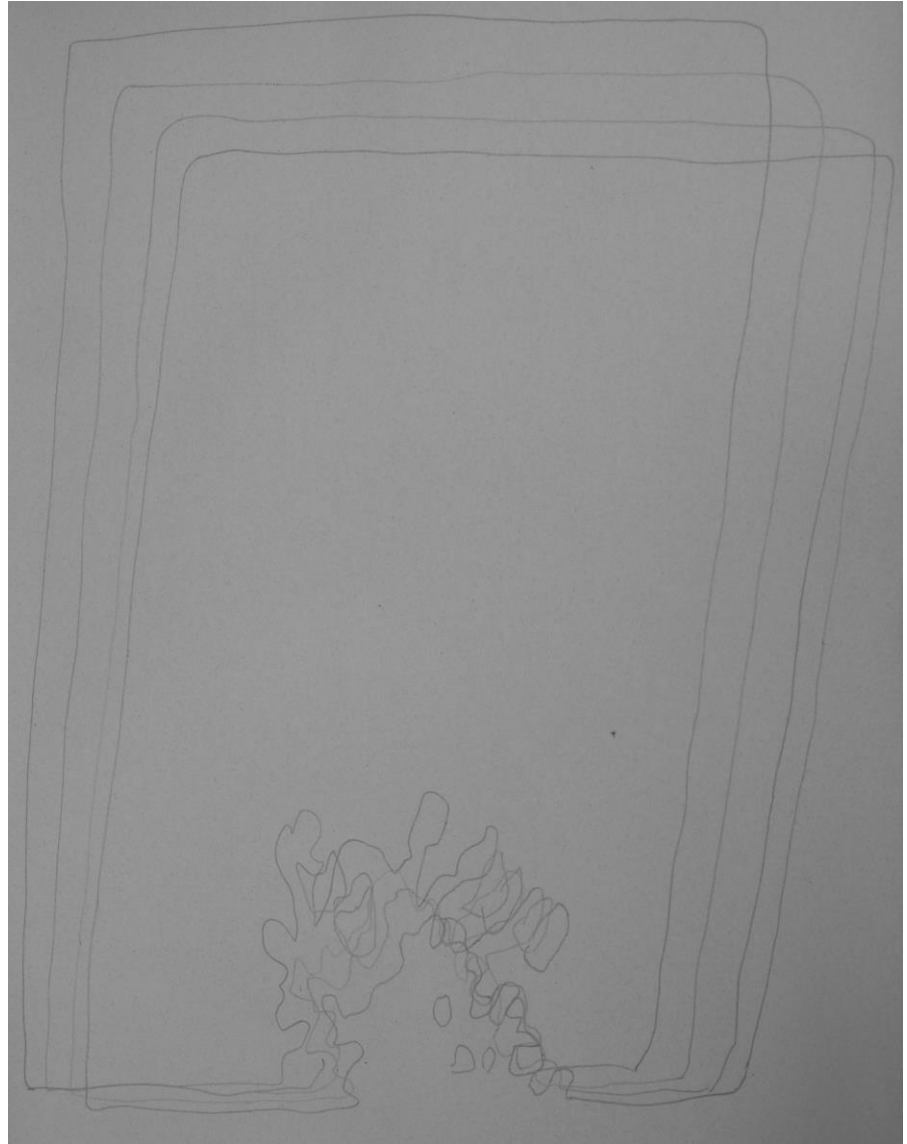


Fig 4.3. *'Below'* Niall O'Hare 2015, drawn at Longitude 54.60374898,
Latitude -5.928744077. © Niall O'Hare.

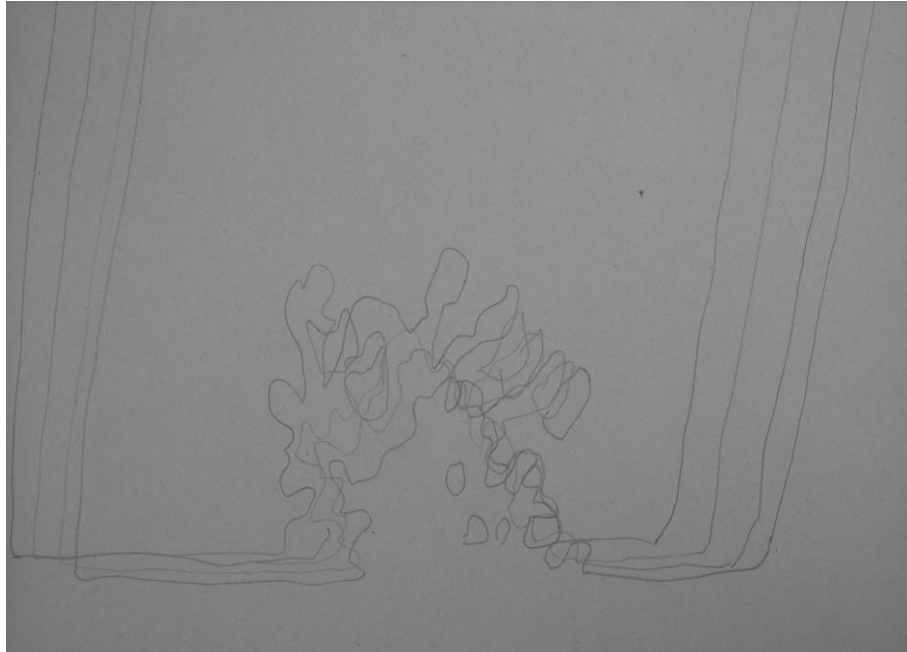


Fig 4.4. *'Below'* (Detail) Niall O'Hare 2015, drawn at Longitude 54.60374898, Latitude -5.928744077. © Niall O'Hare.



Fig 4.5. Richard Serra, '*Mies's Corner Extended*' 1983. © Galerie M, West Berlin.

Five

Illustrations

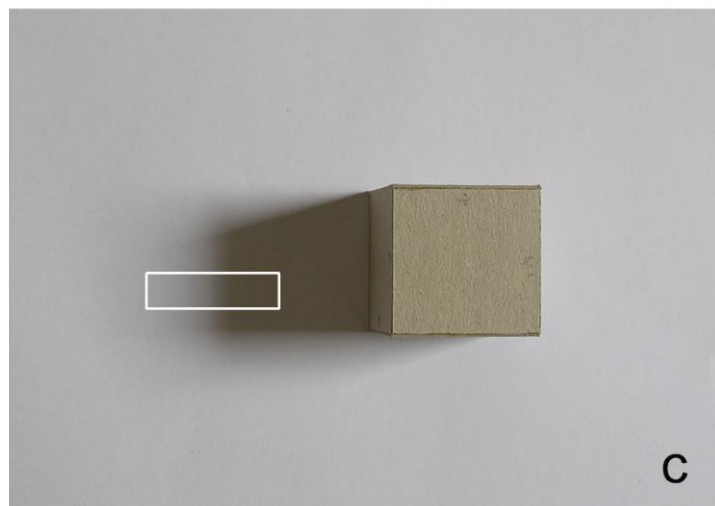
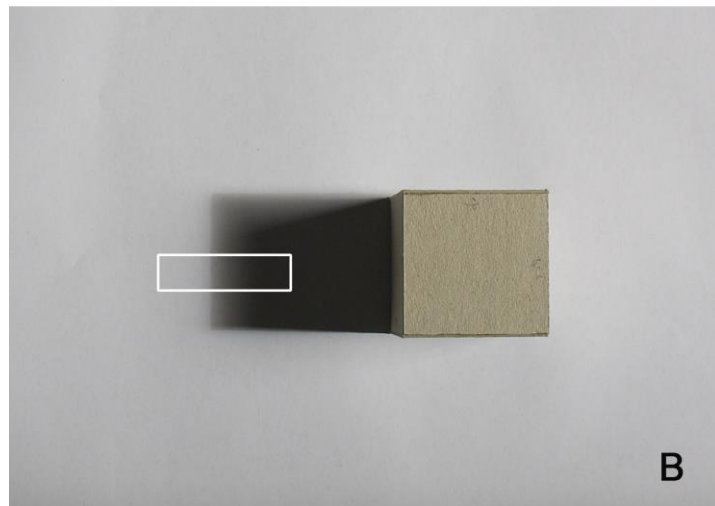
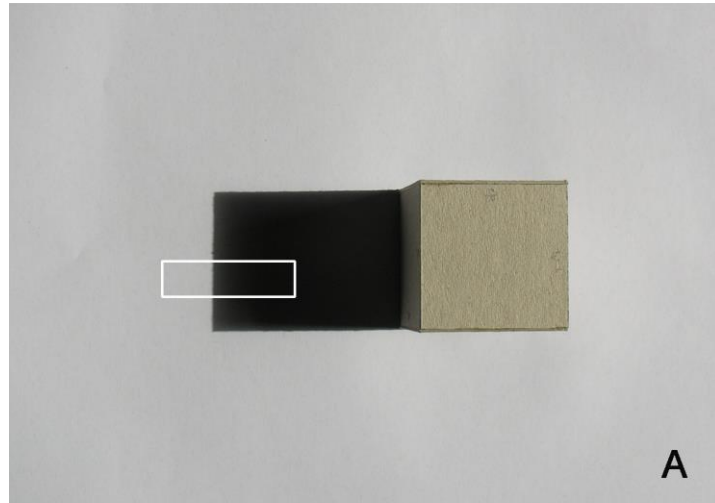


Fig 5.0. '50mm Cube, 1st September' (Images taken over six hours, with shadow edge areas (Fig. 5.1.) indicated) © Niall O'Hare 2015.

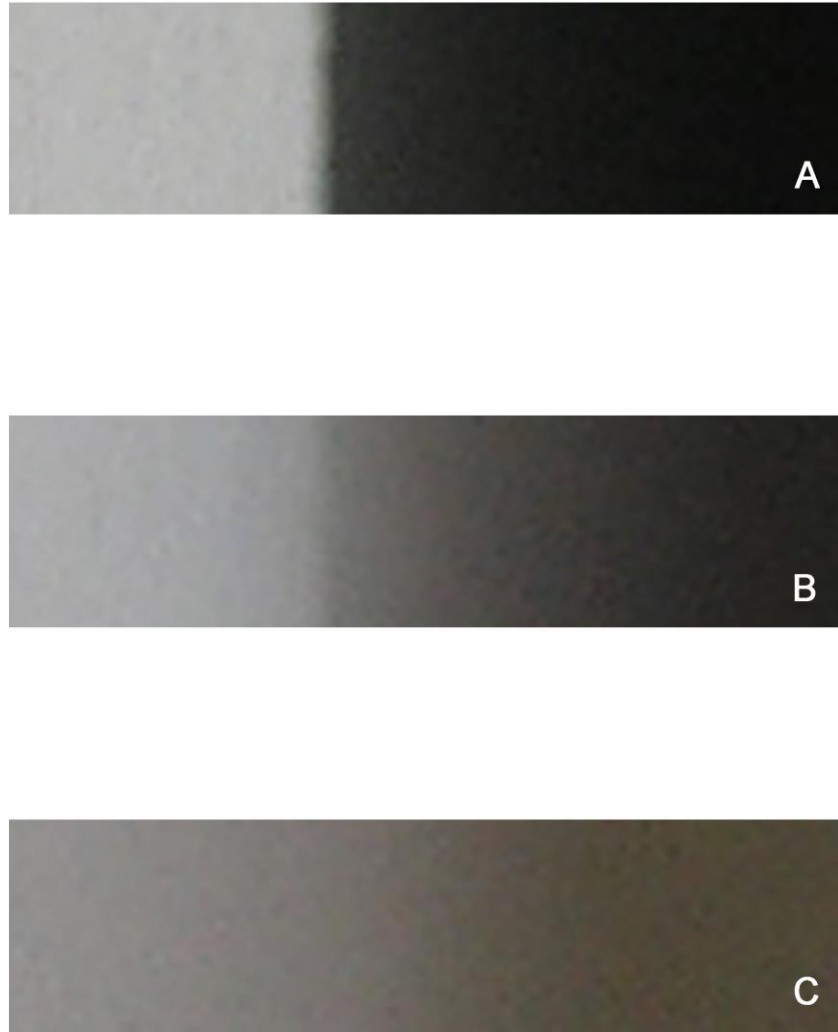


Fig 5.1. '50mm Cube, 1st September' (Detail of shadow edges) © Niall O'Hare 2015.



Fig 5.2. *'Room Interior with Corner Shadow'* © Niall O'Hare 2015.

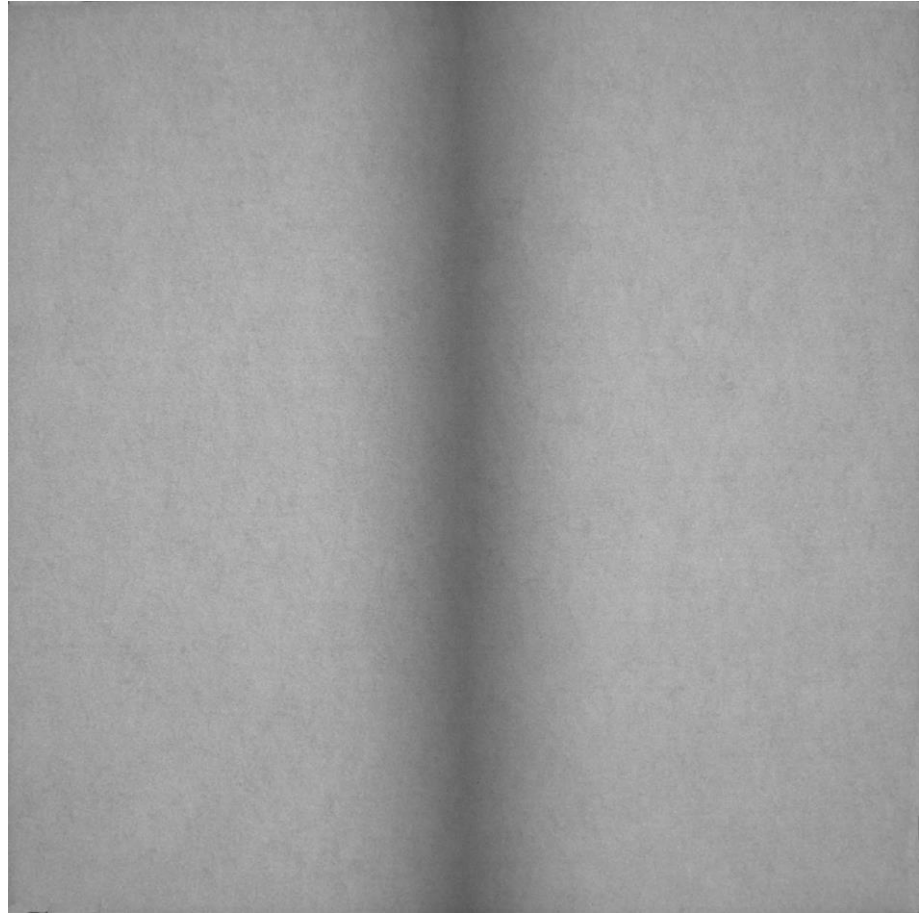


Fig 5.3. *'Practice Model Seven'* © Niall O'Hare 2015.

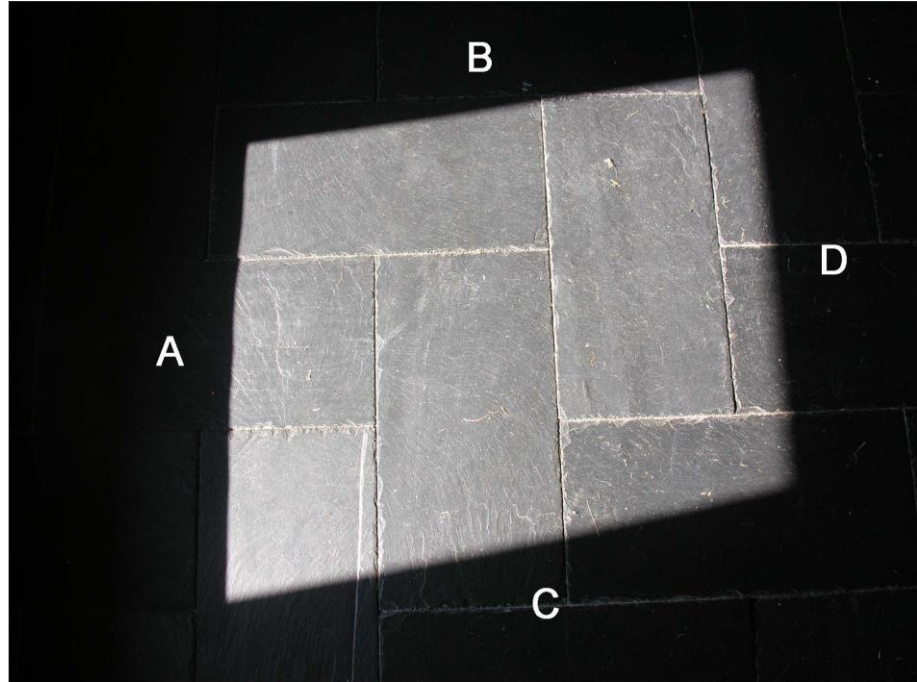


Fig 5.4. *'Floor of an Architectural Space'* © Niall O'Hare 2015.



Fig 5.5. 'Floor of an Architectural Space' (Detail from Fig 5.4) © Niall O'Hare 2015.

**Pantone®
Solid Coated
426 C**



**Pantone®
Solid Coated
423 C**



**Pantone®
Solid Coated
420 C**



Fig 5.6. 'Pantone Solid Coated 426C, 423 C & 420 C' © Niall O'Hare 2015.



Fig 5.7. *'Practice Mode Thirteen'* © Niall O'Hare 2015.

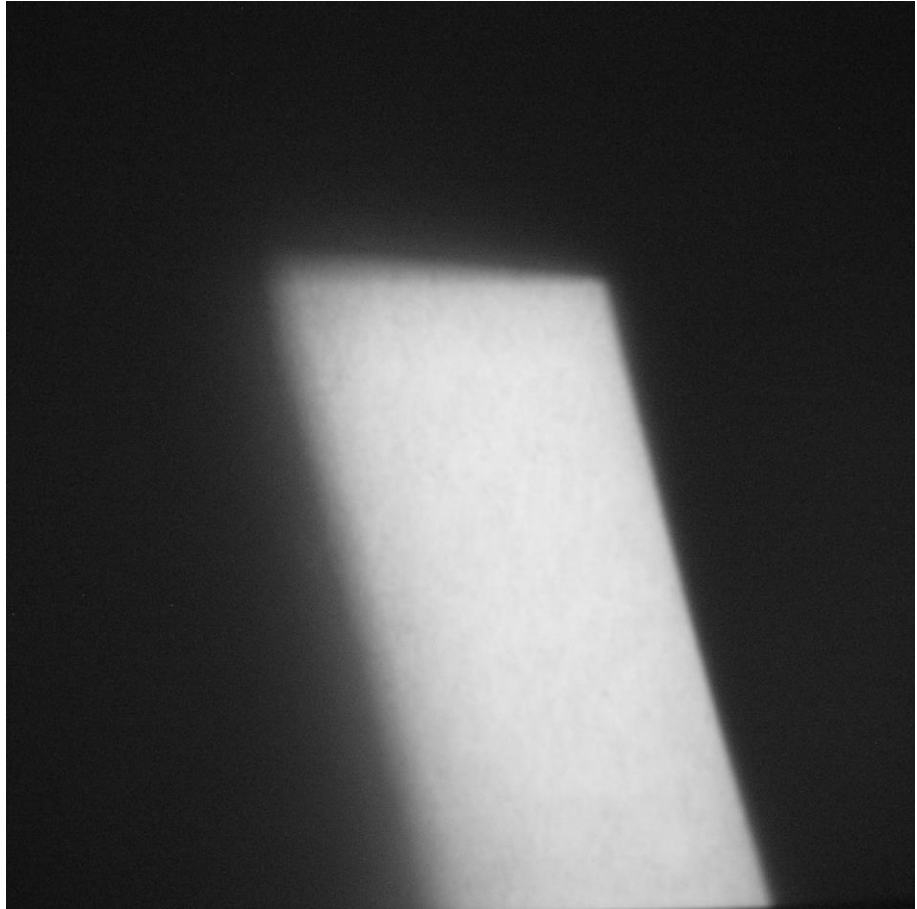


Fig 5.8. *'Practice Model Twelve'* © Niall O'Hare 2015.



Fig 5.9. *'Shadow on Wall 31st December, 12.55pm and 15 Seconds '*

© Niall O'Hare 2014.

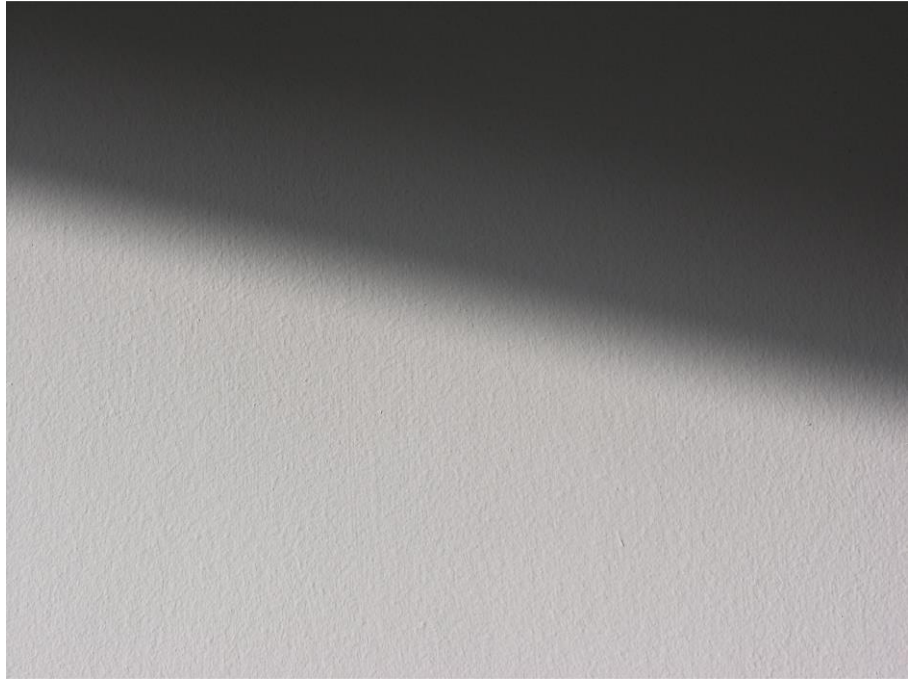
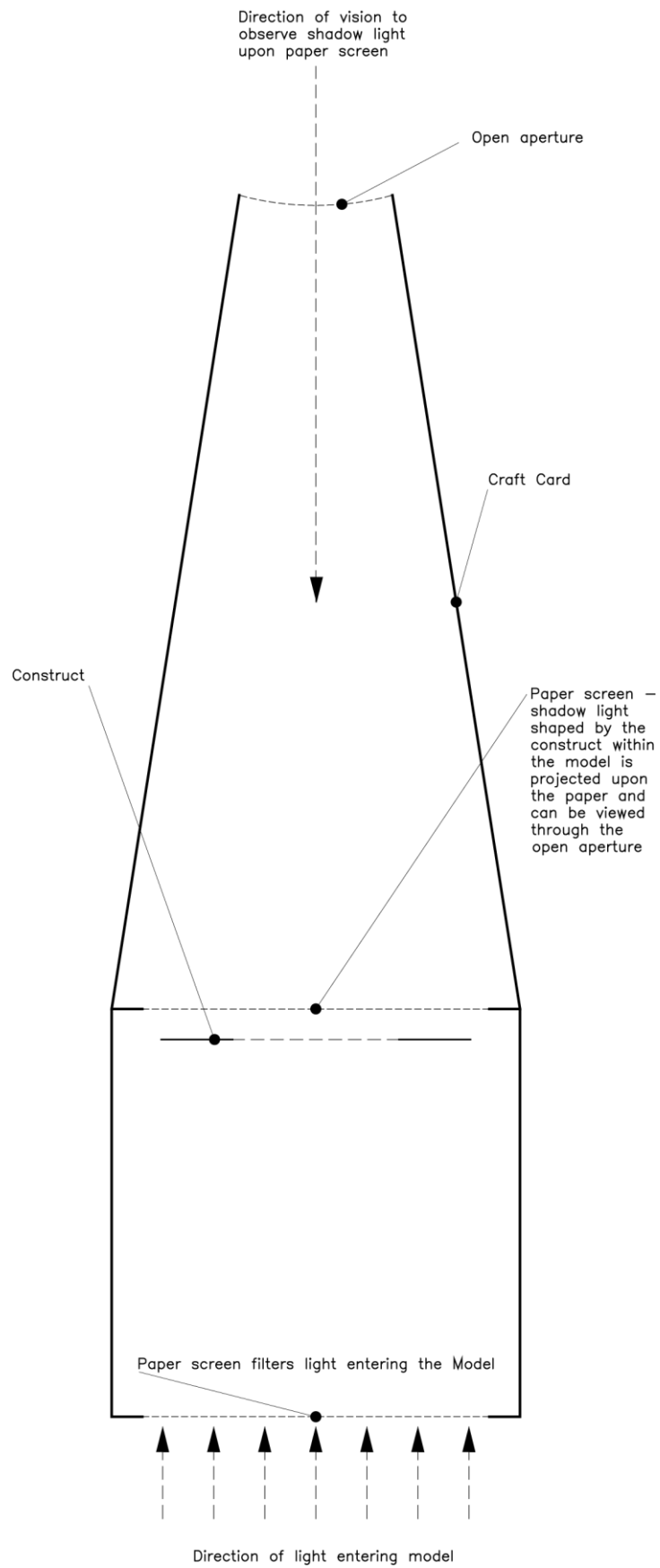


Fig 5.10. *'Shadow on Wall 31st December, 12.55pm and 40 Seconds '*

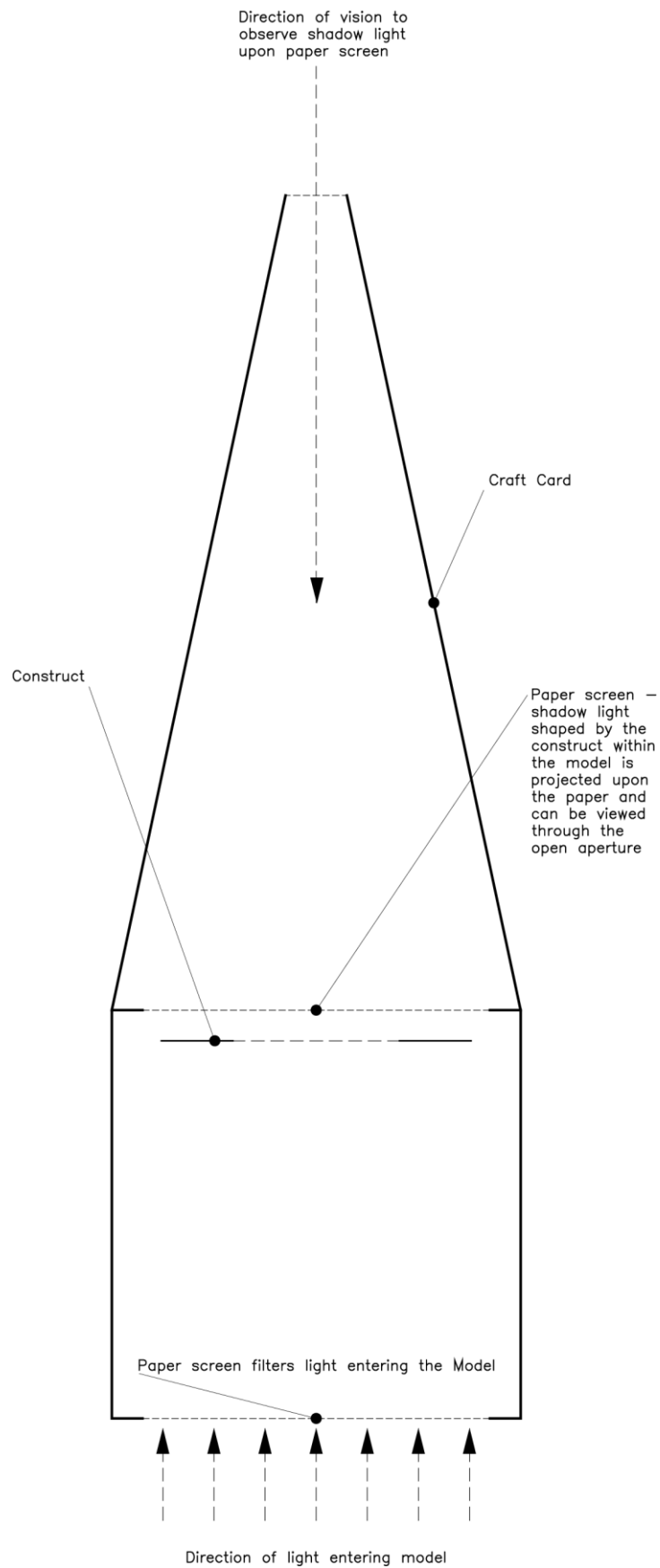
© Niall O'Hare 2014.

Model Illustrations

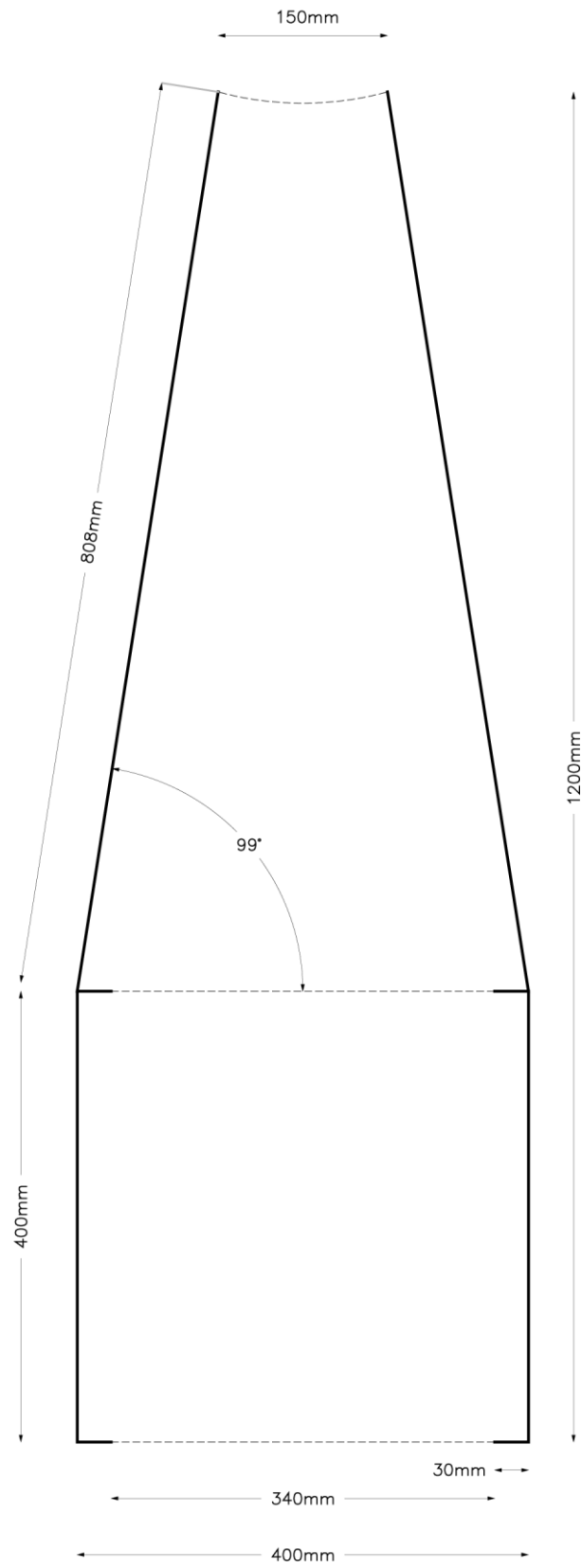
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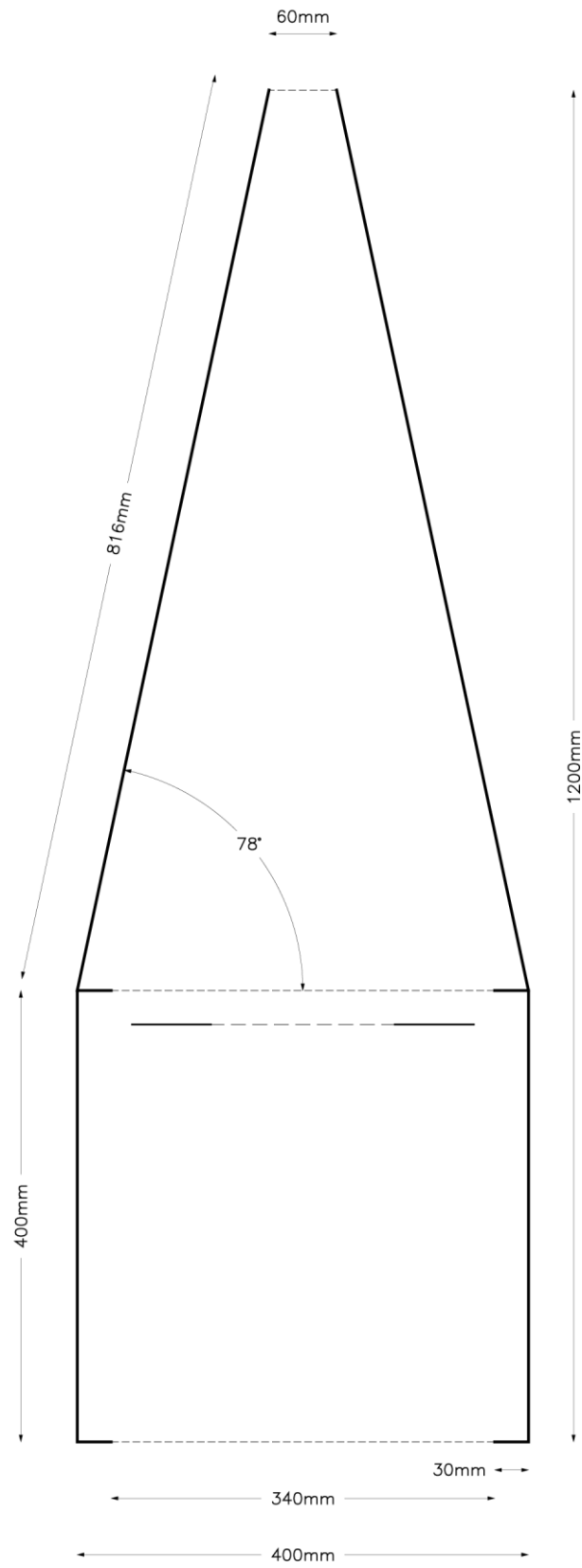
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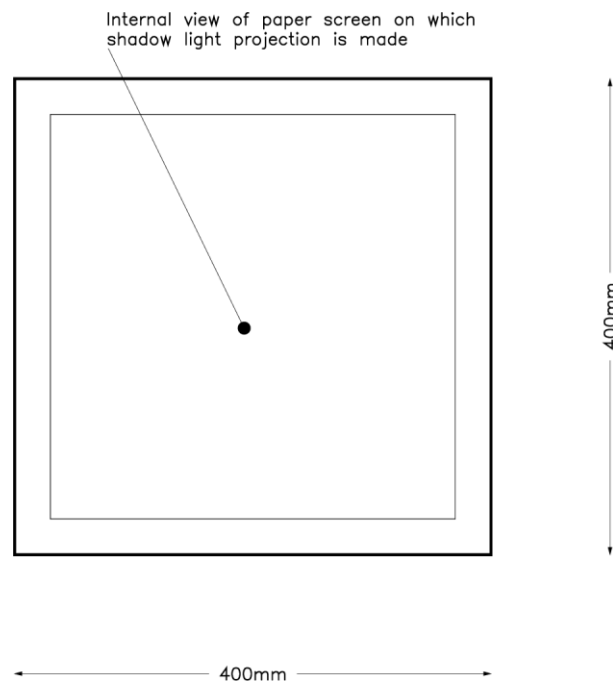
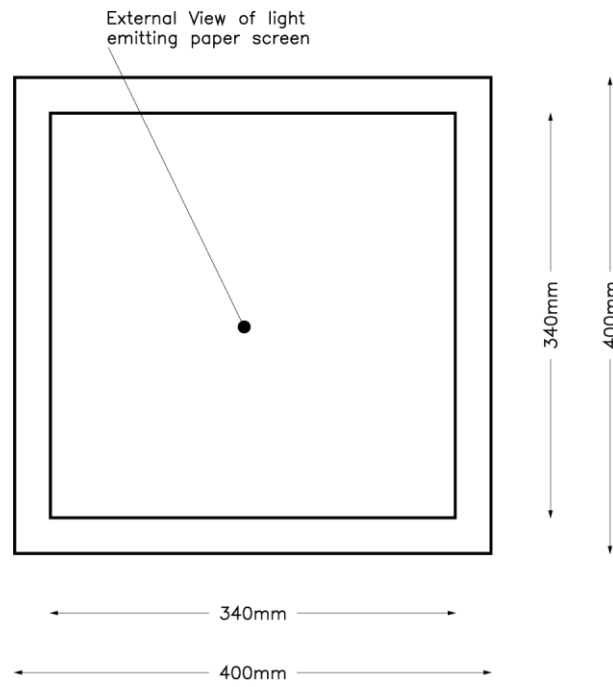
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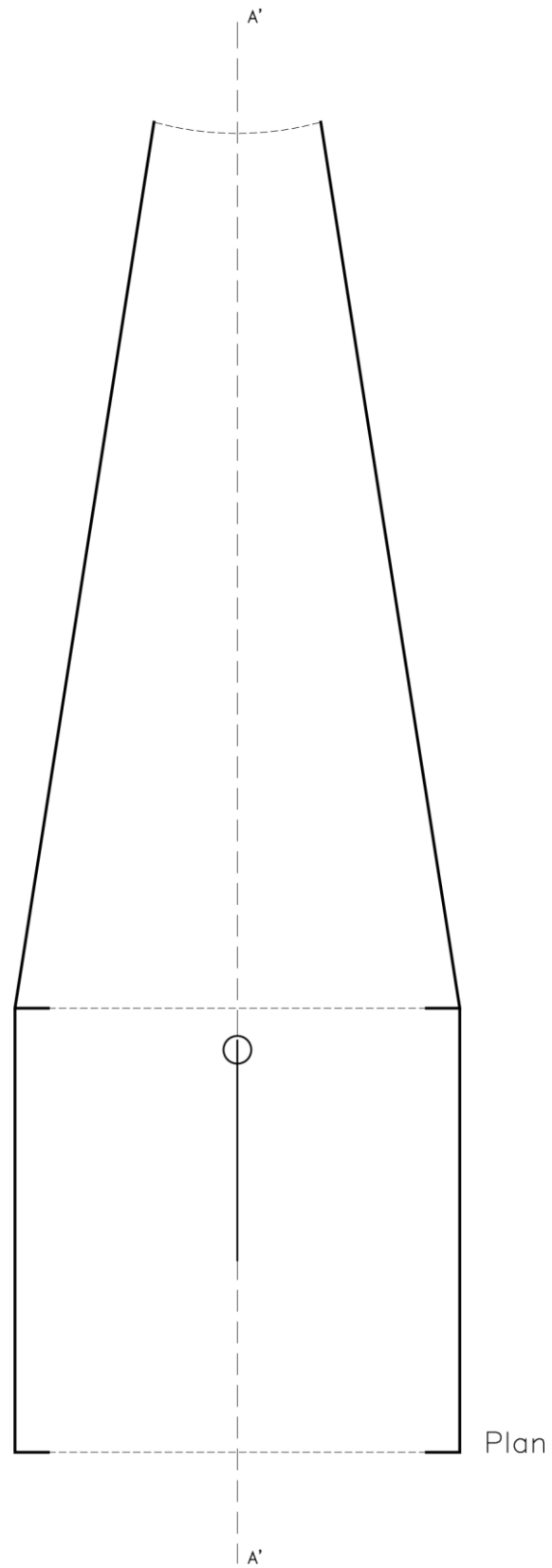
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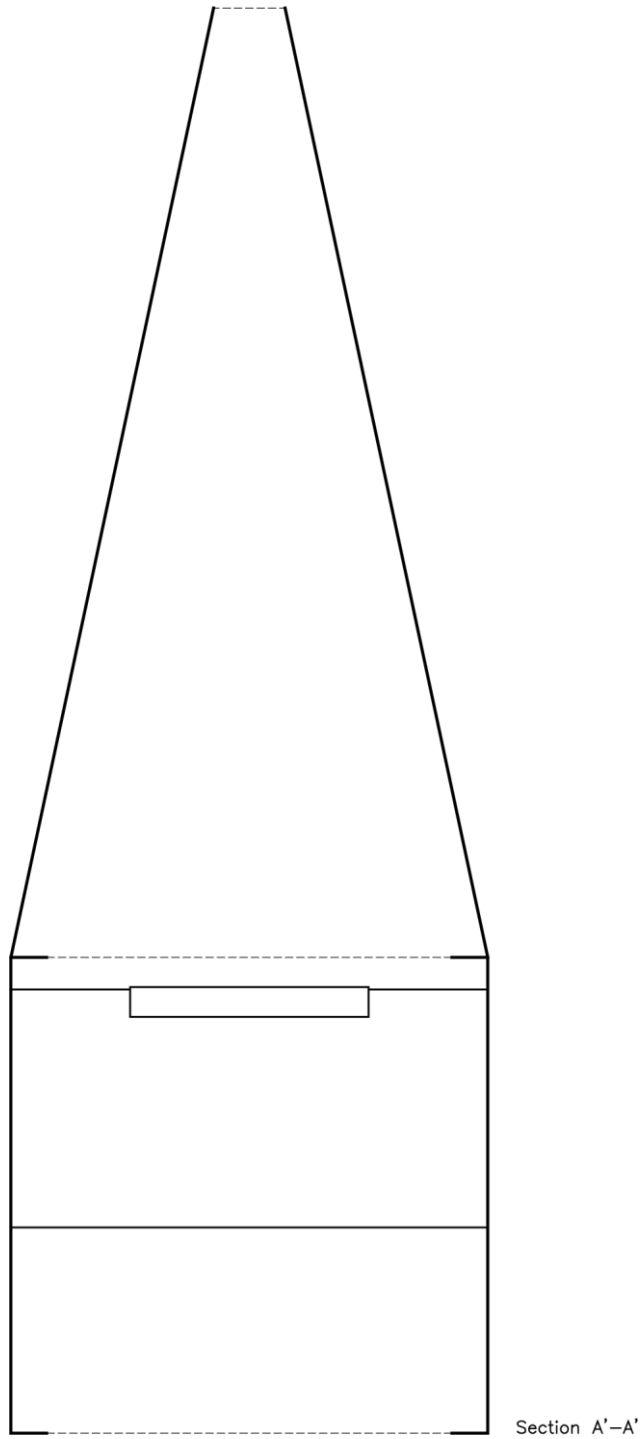
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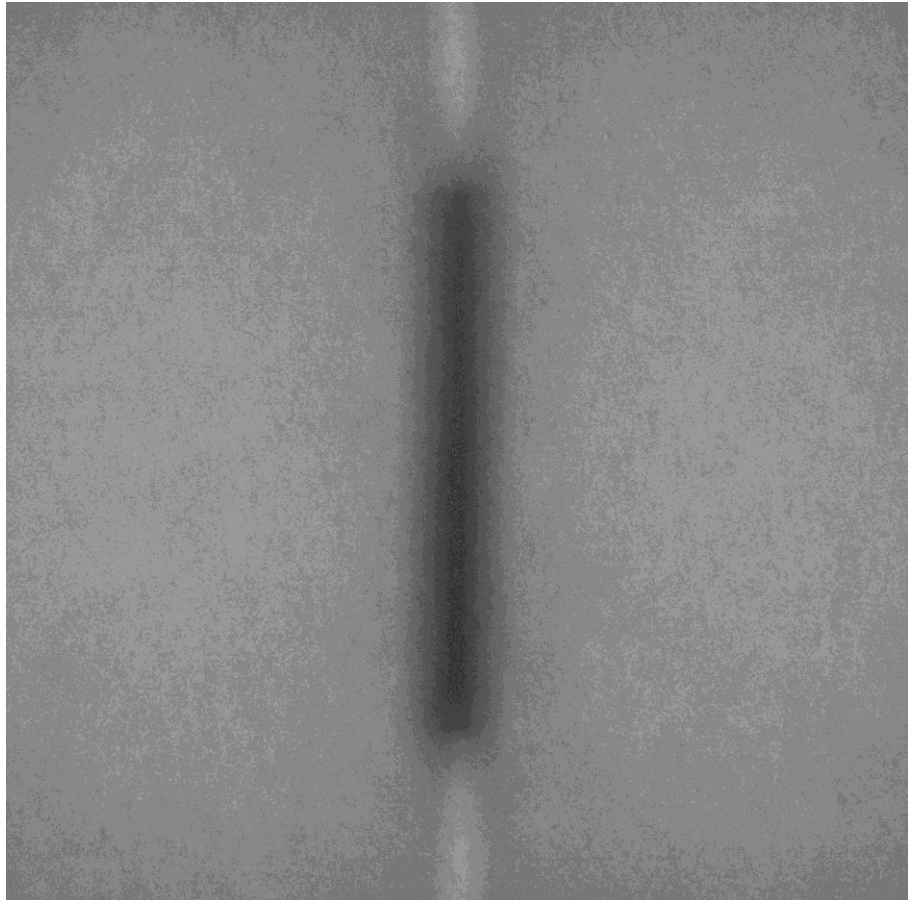
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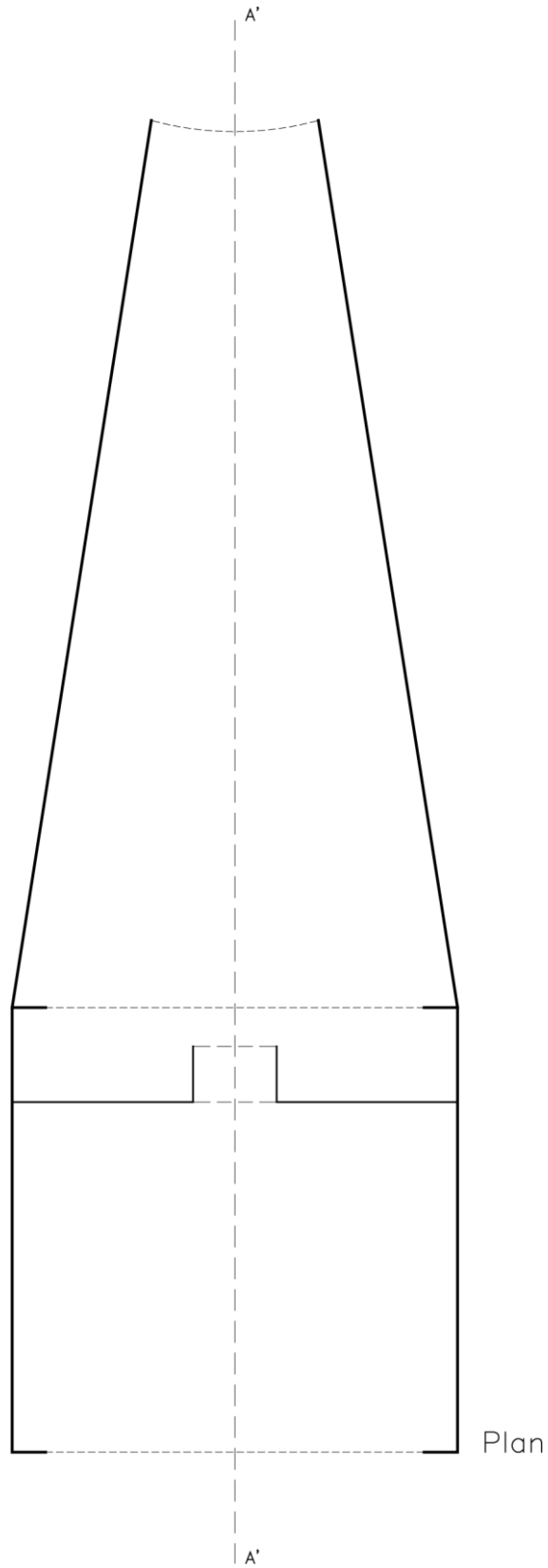
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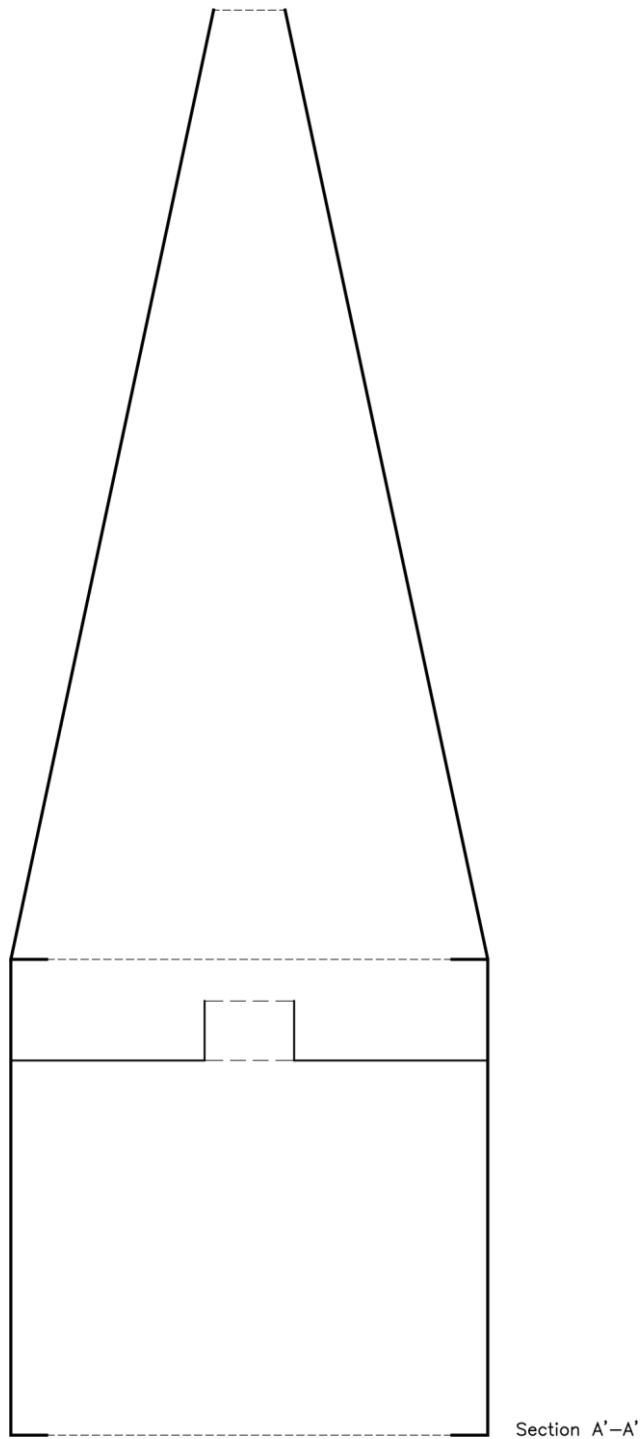
Model One - *Perceived representation of light inside the Model*



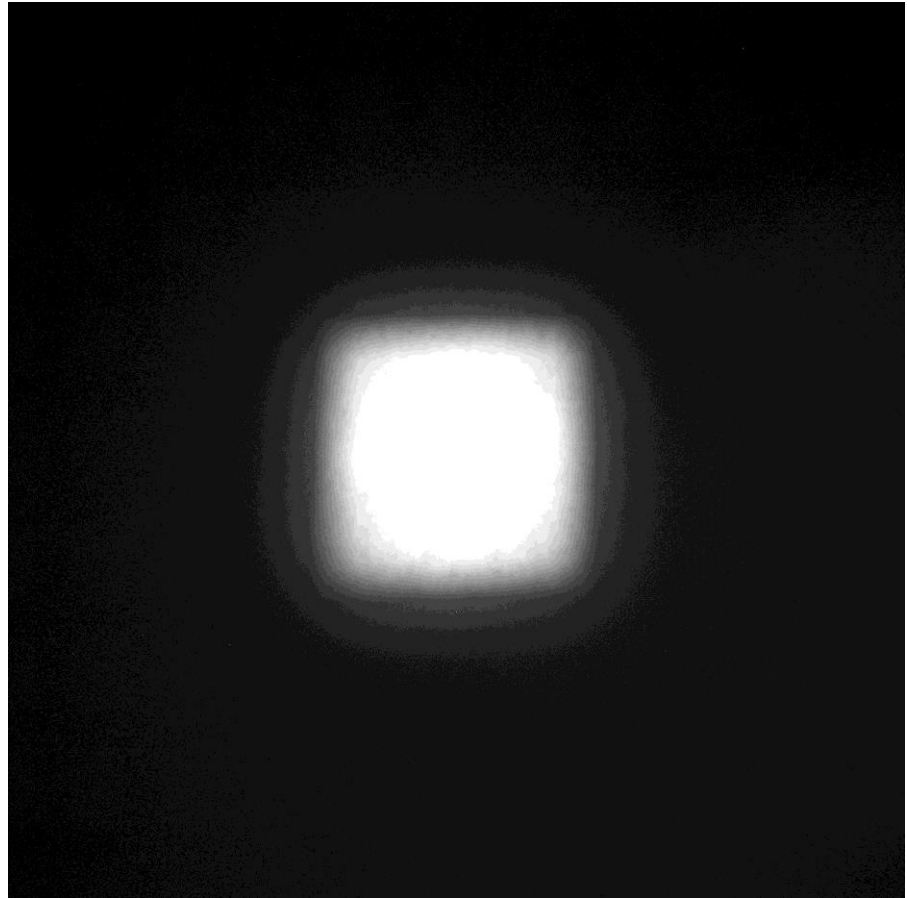
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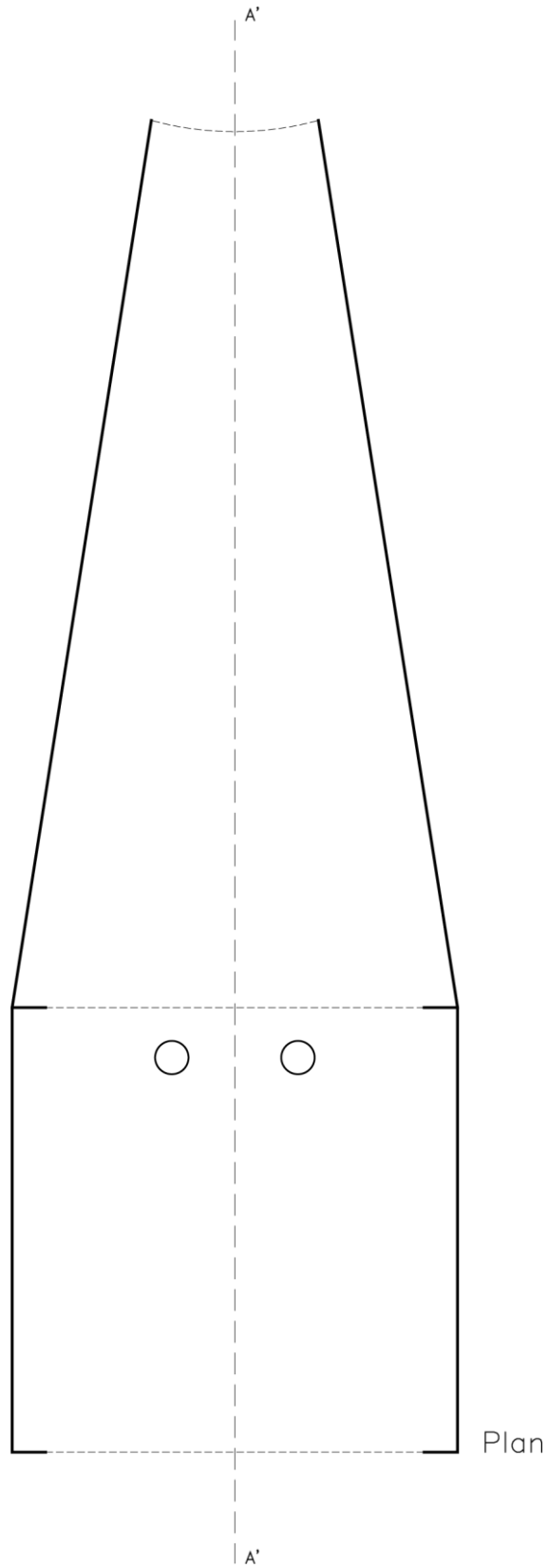
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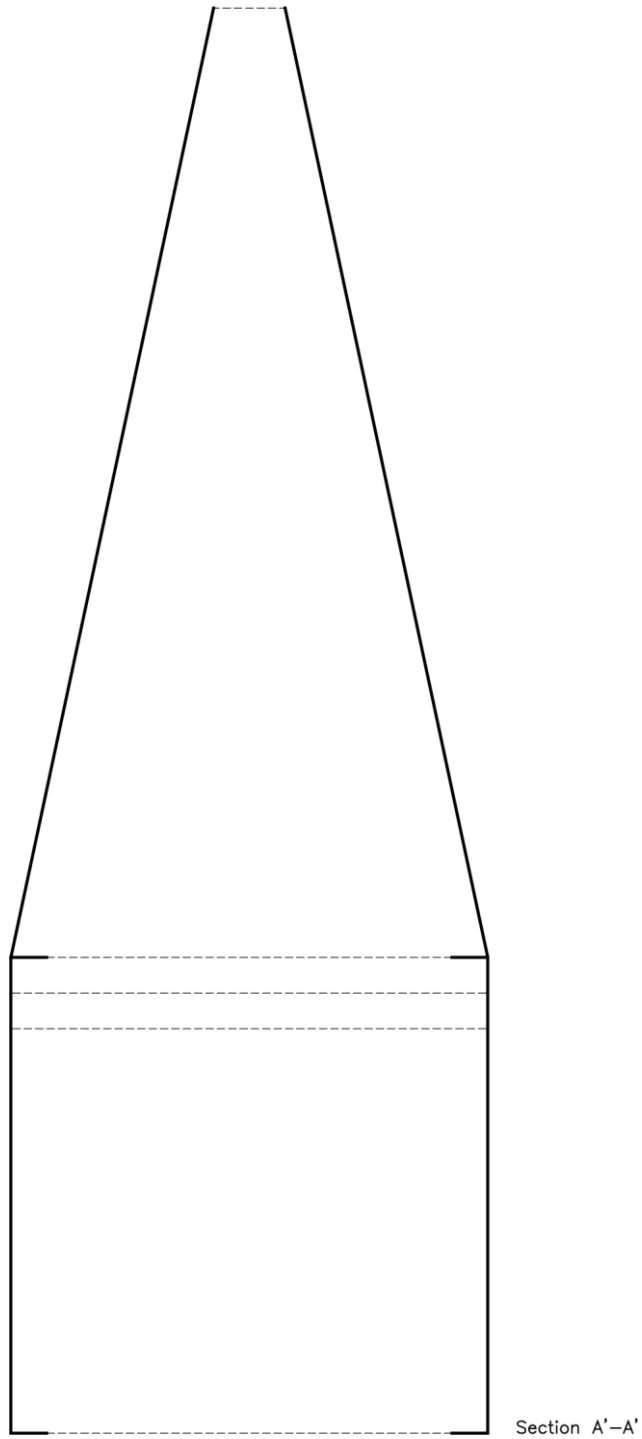
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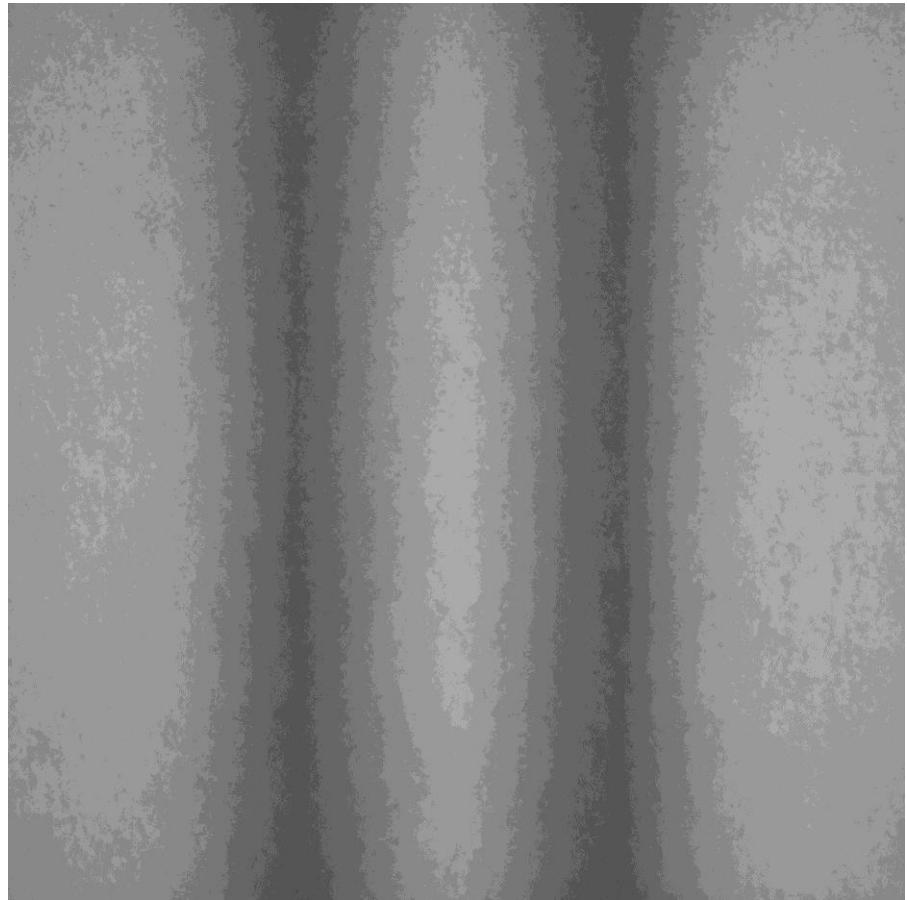
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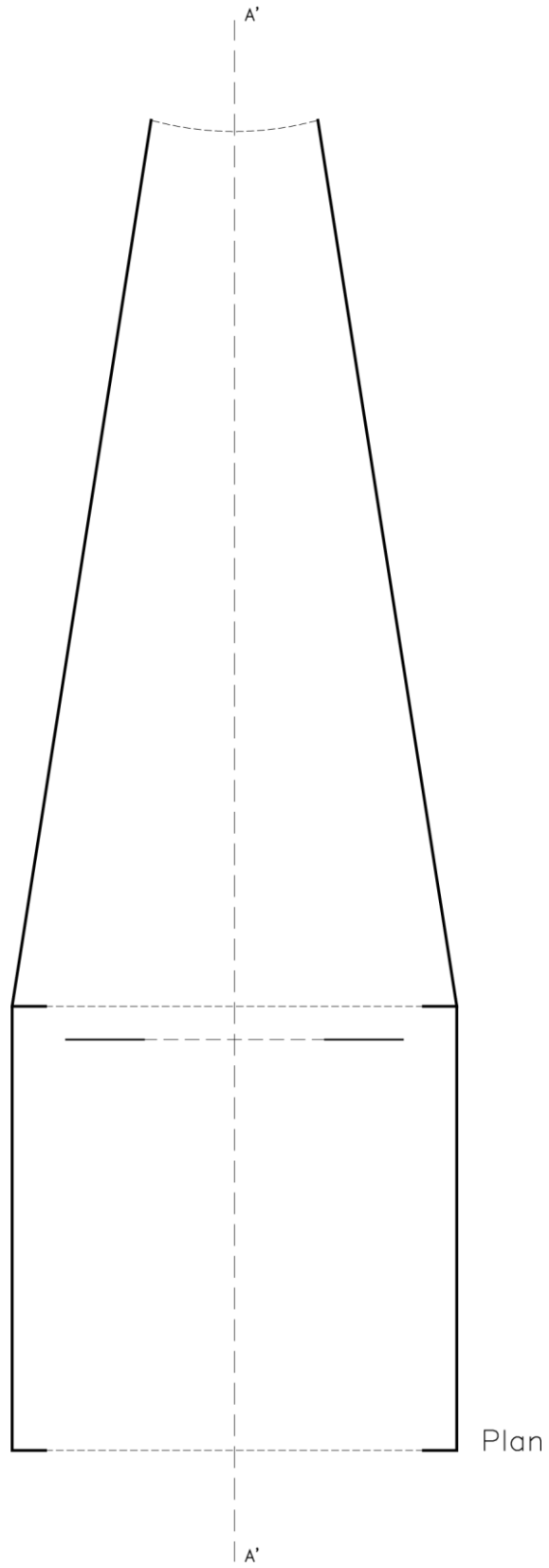
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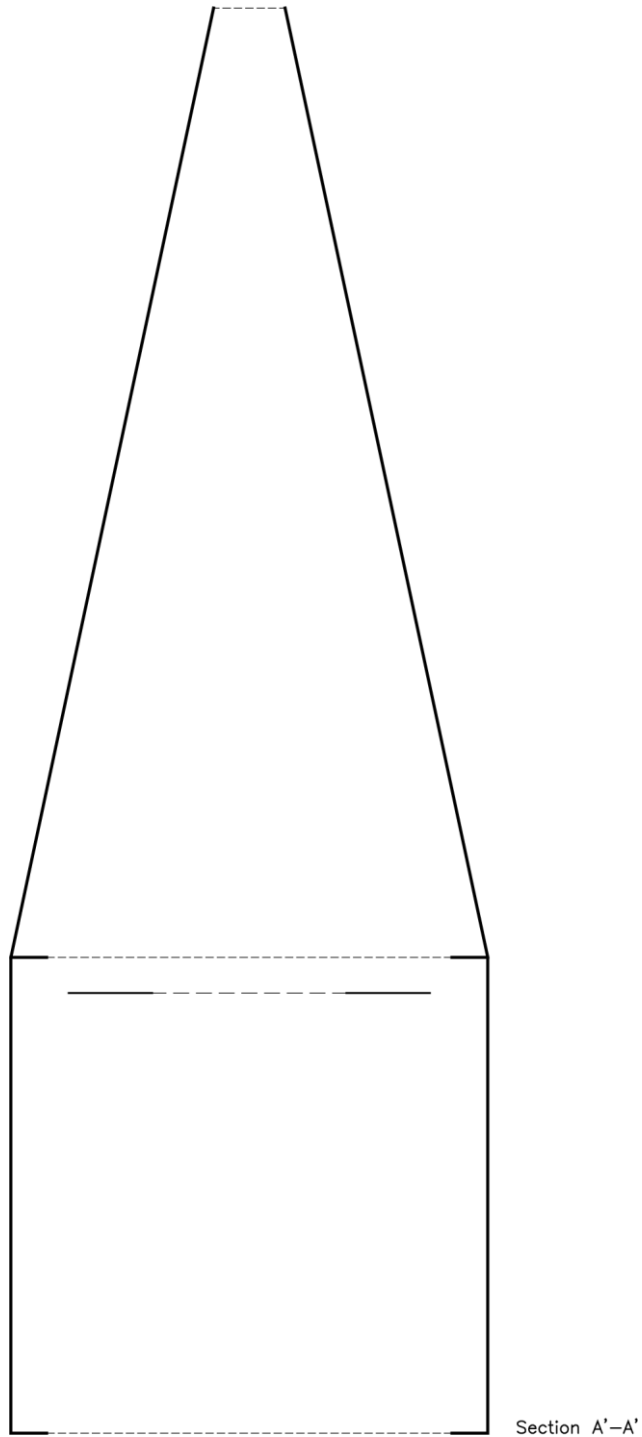
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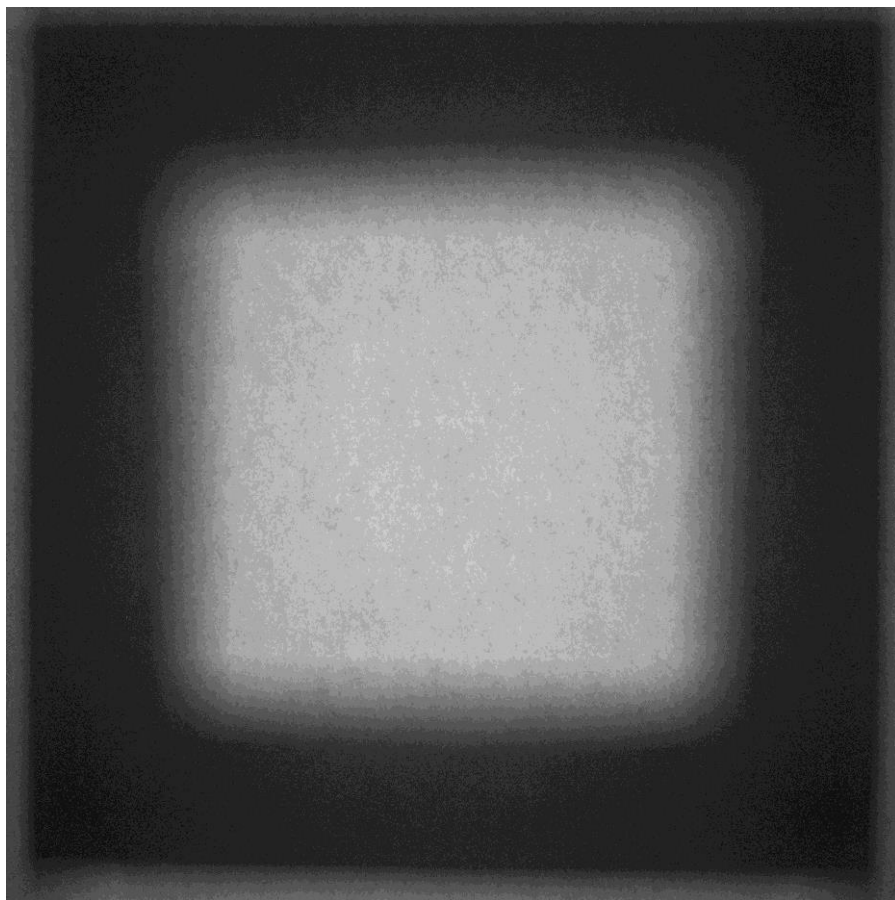
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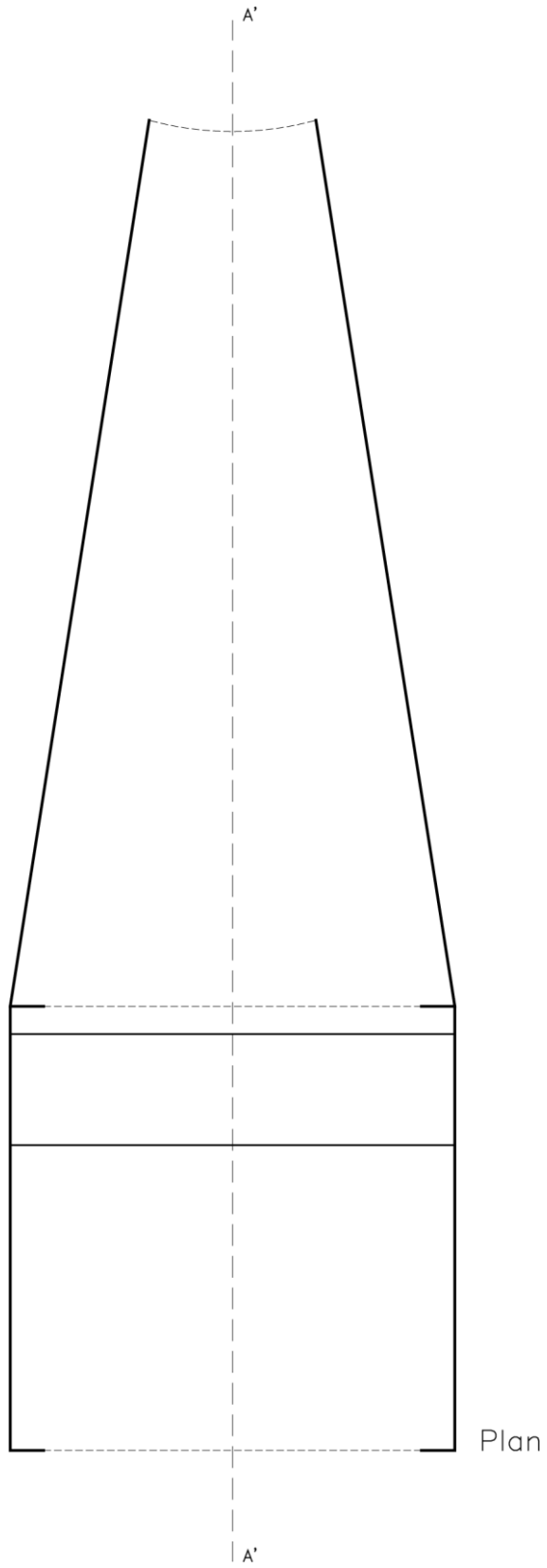
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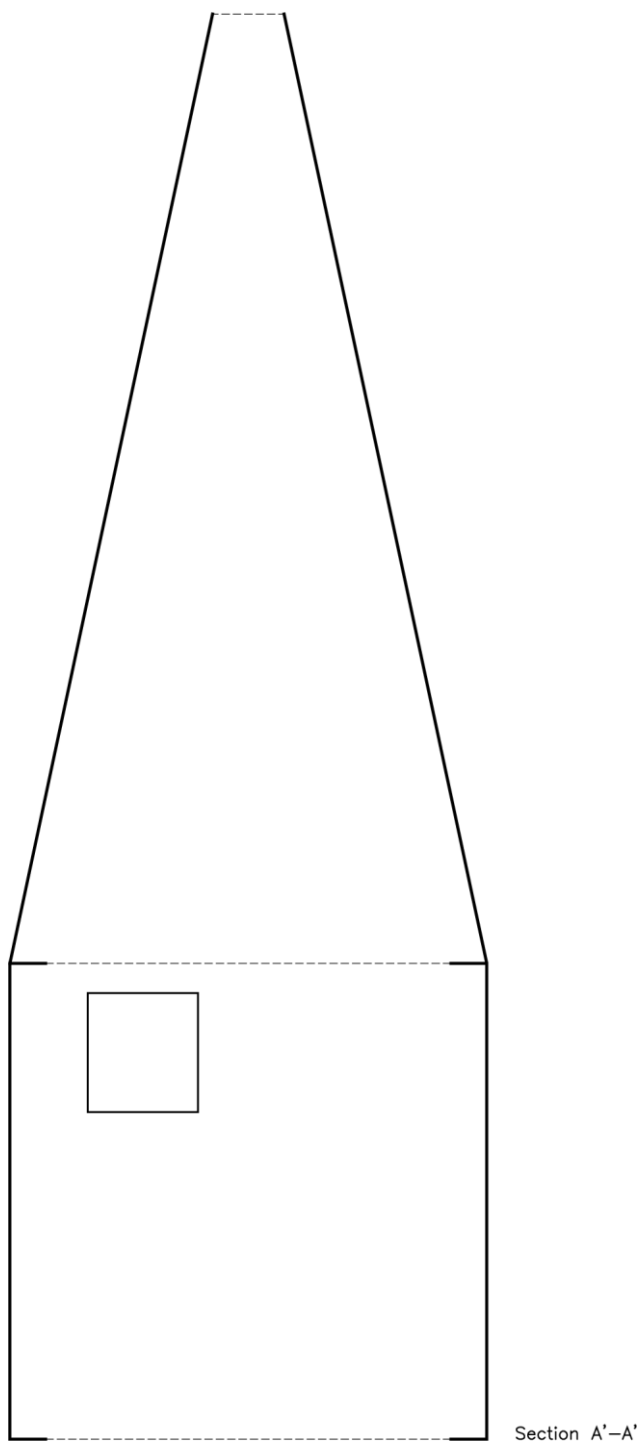
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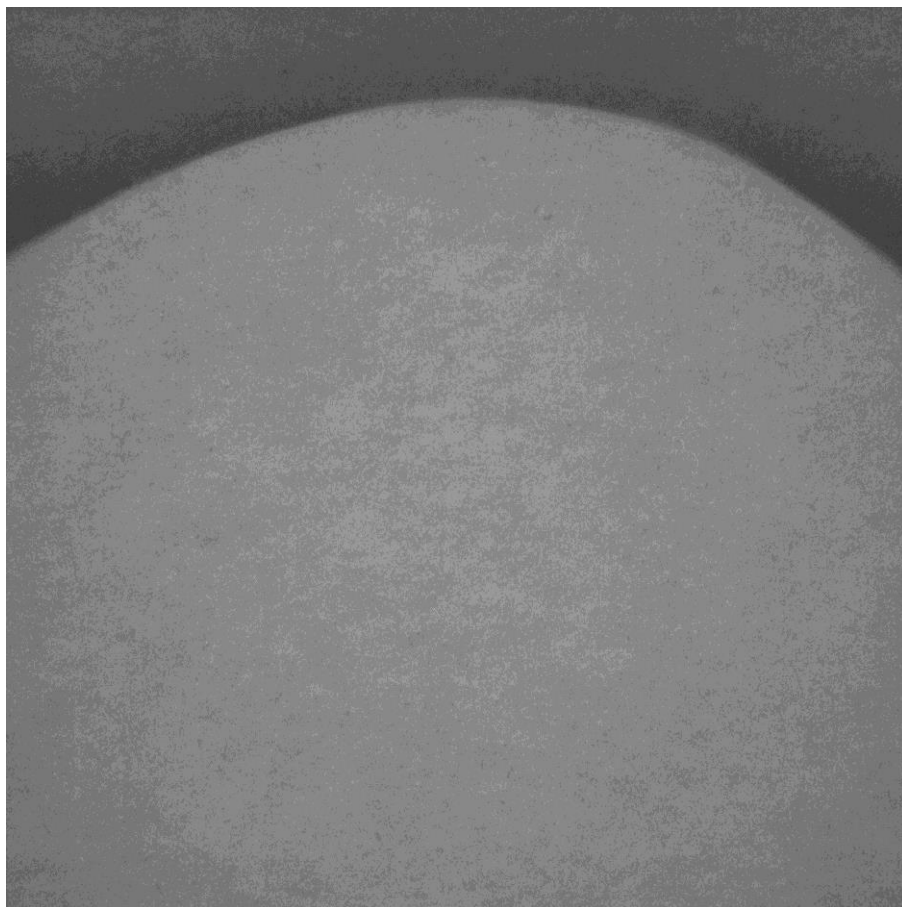
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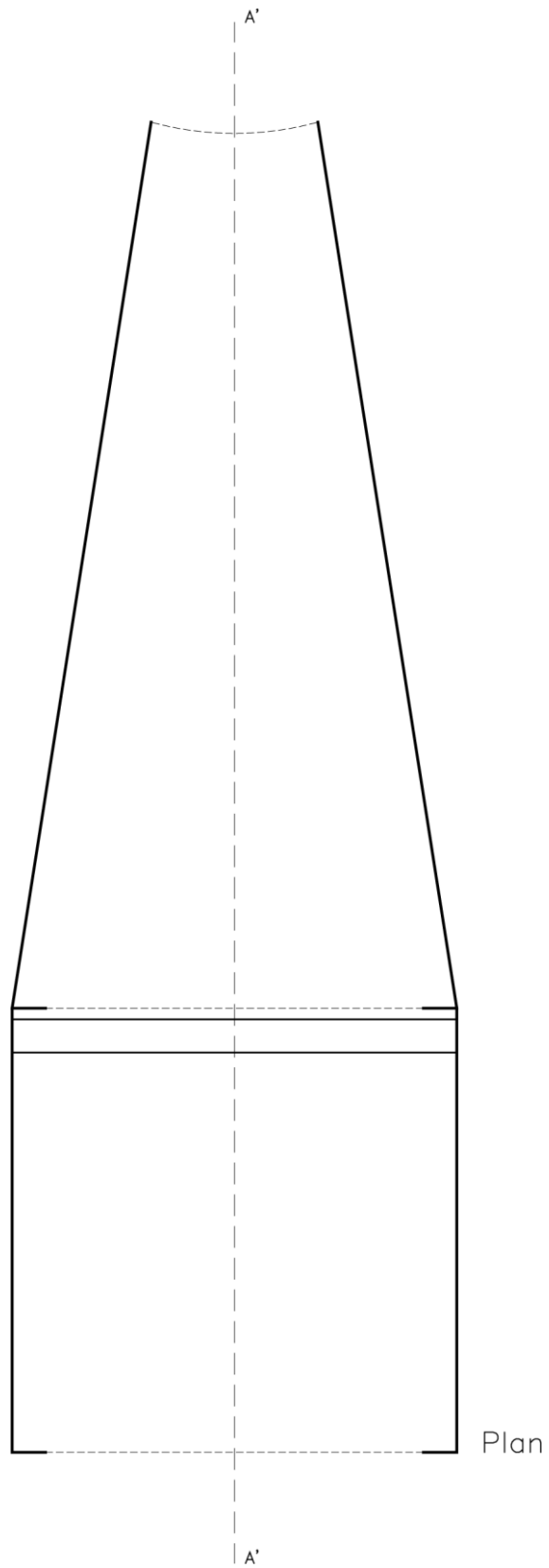
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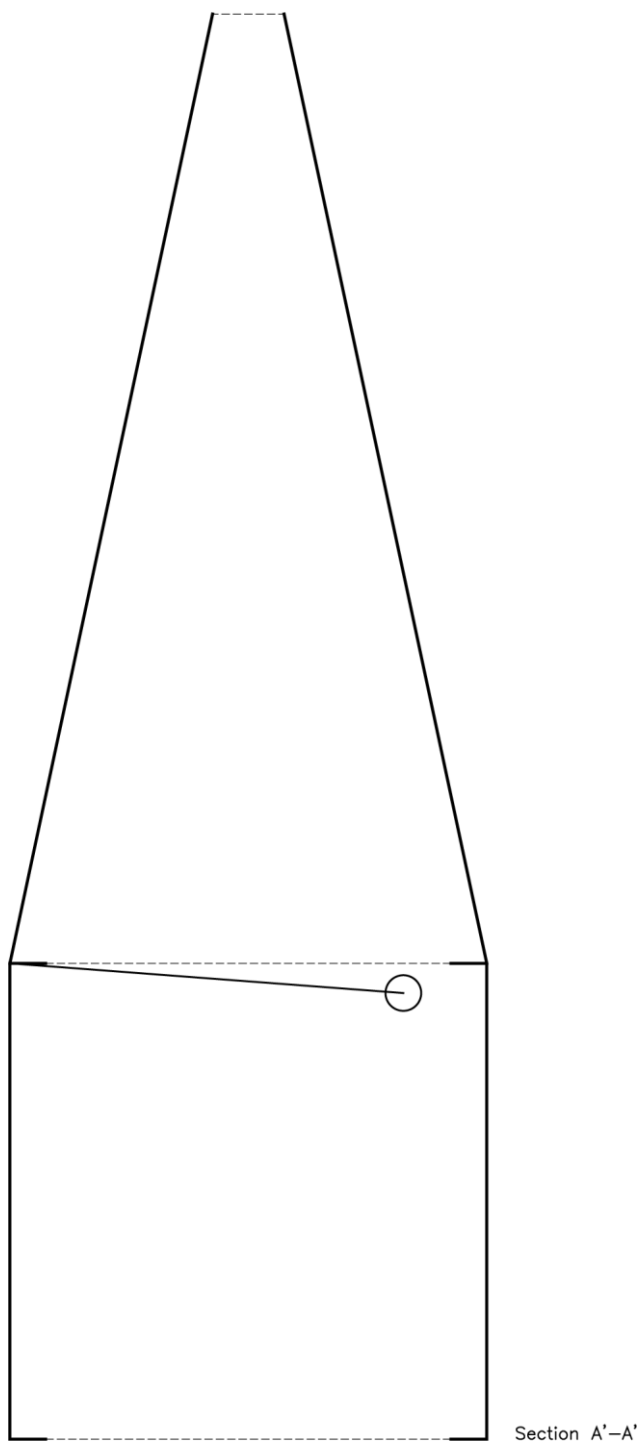
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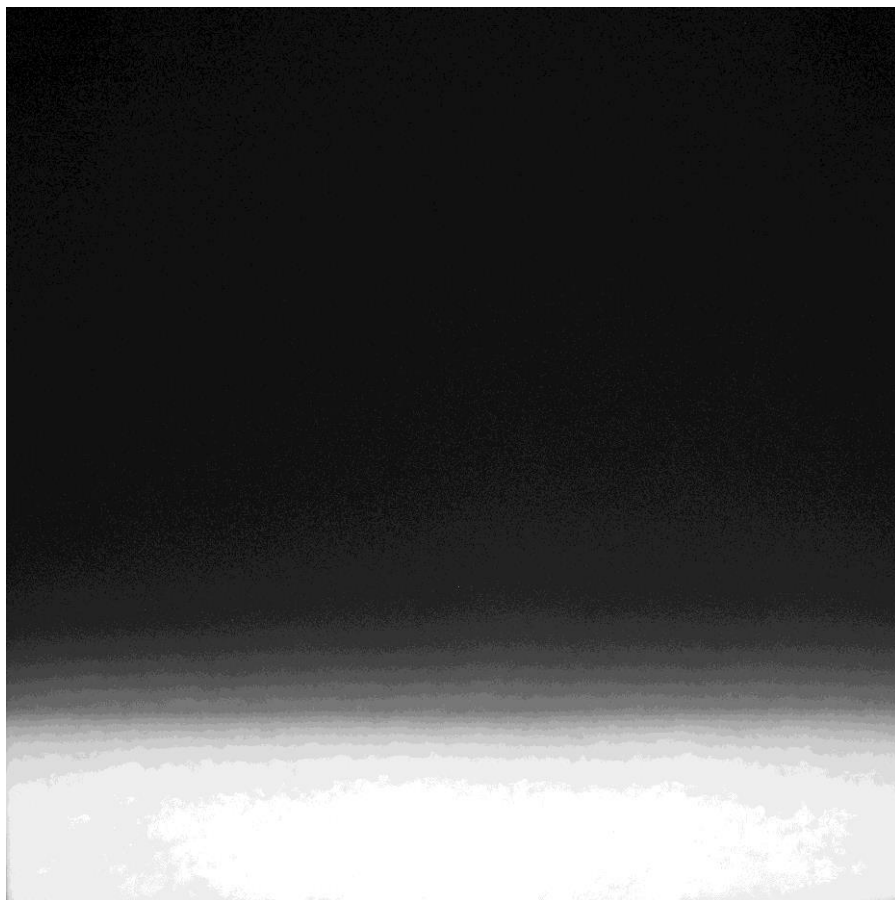
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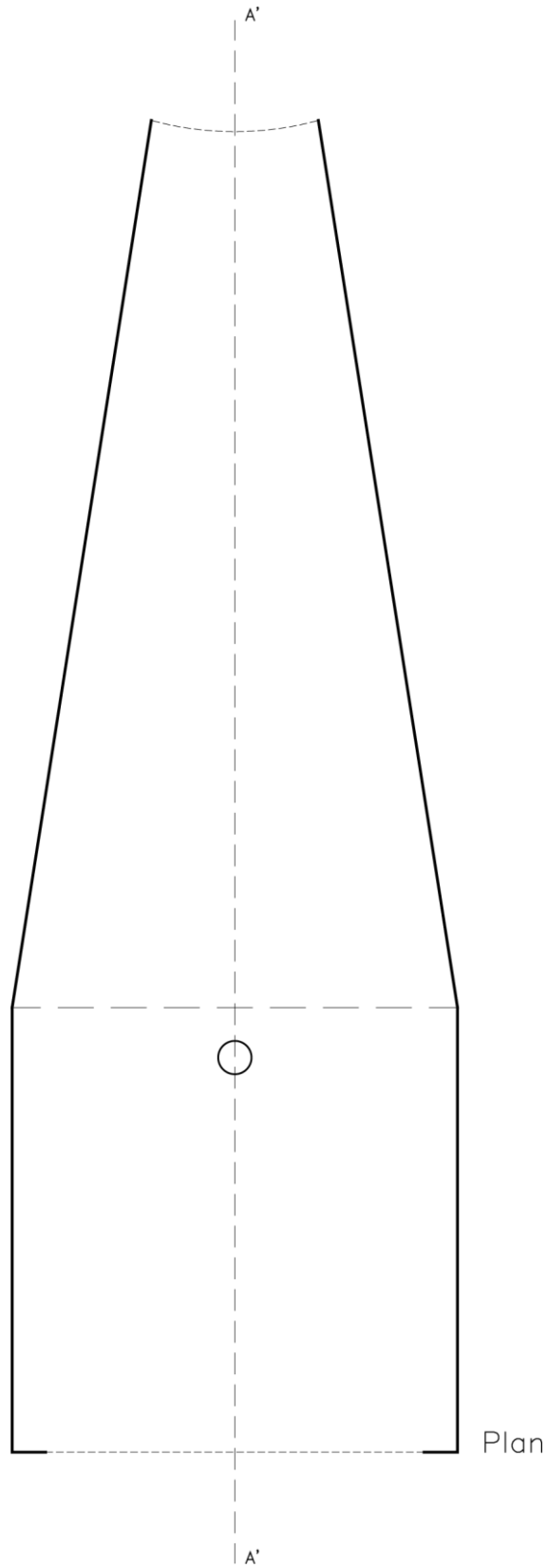
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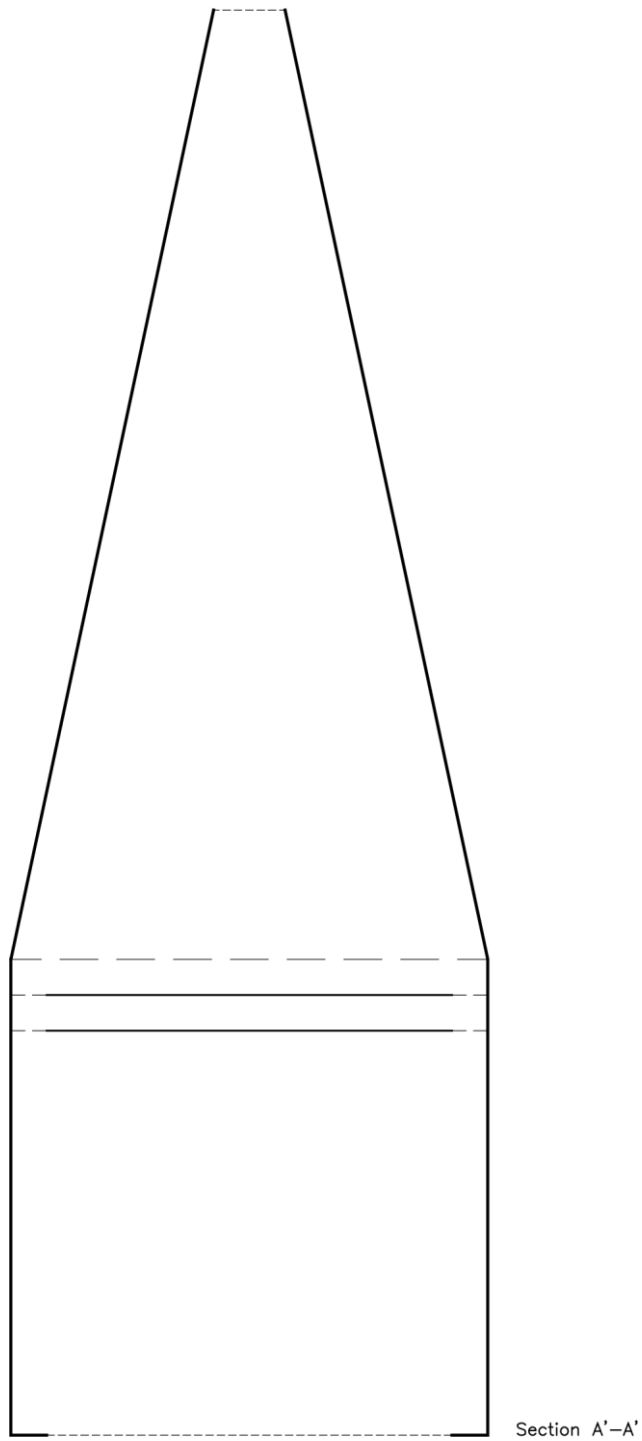
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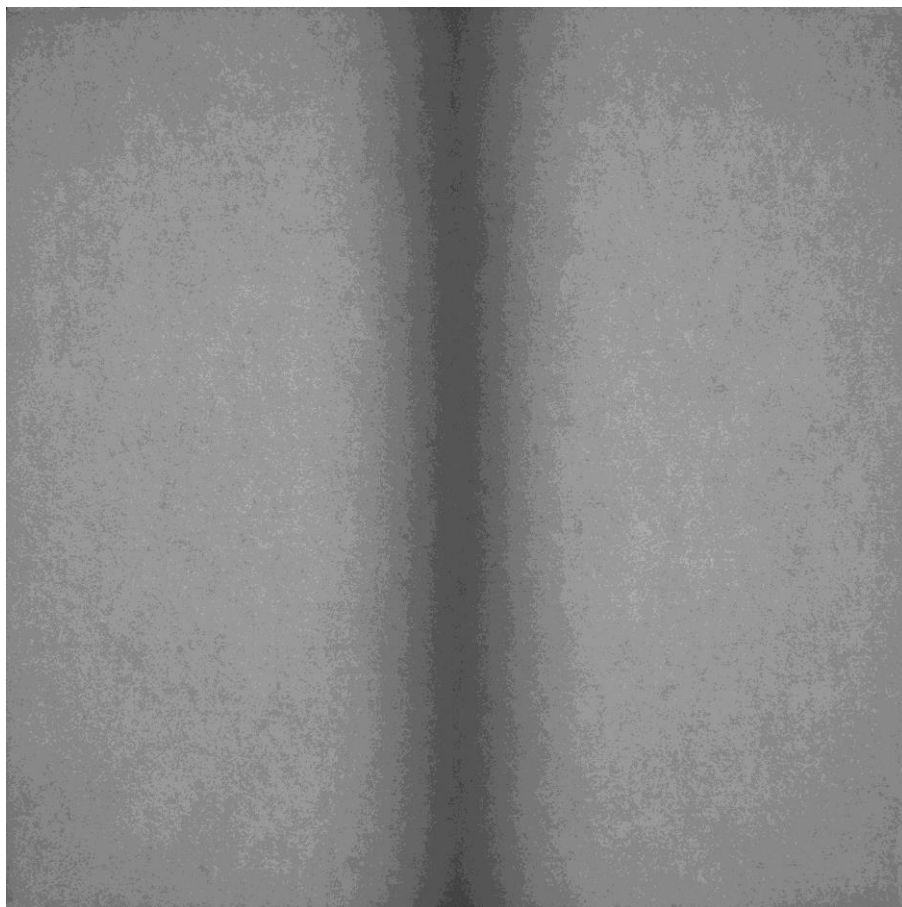
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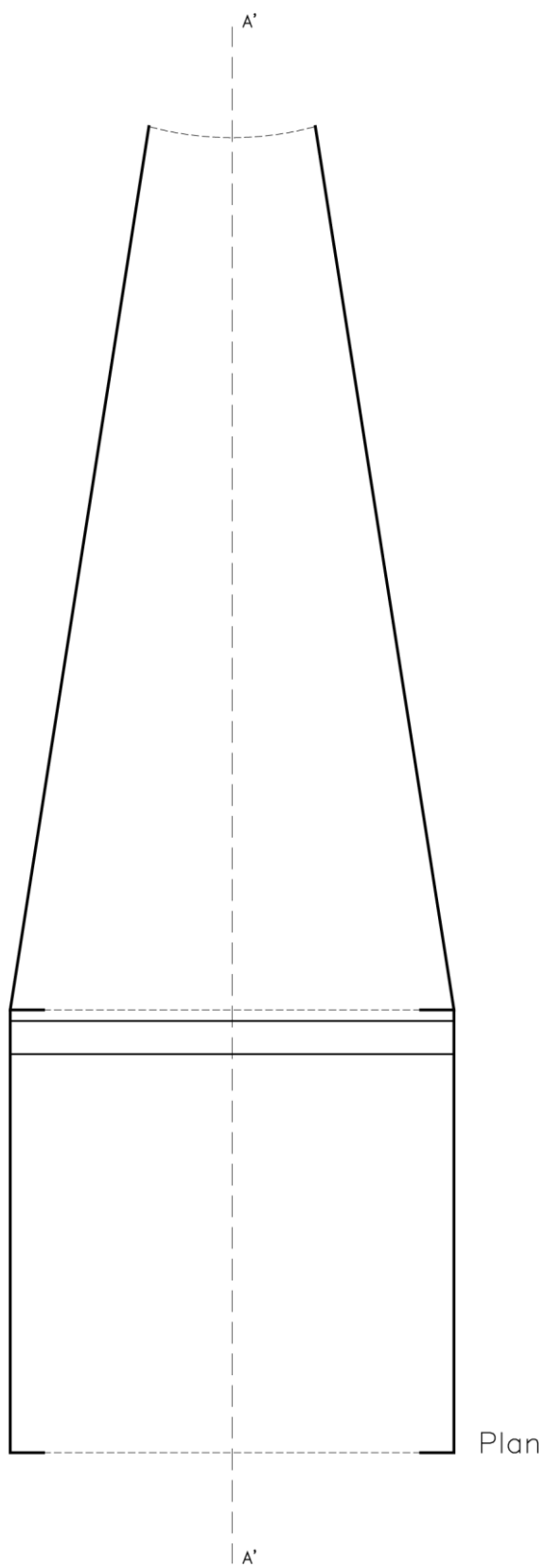
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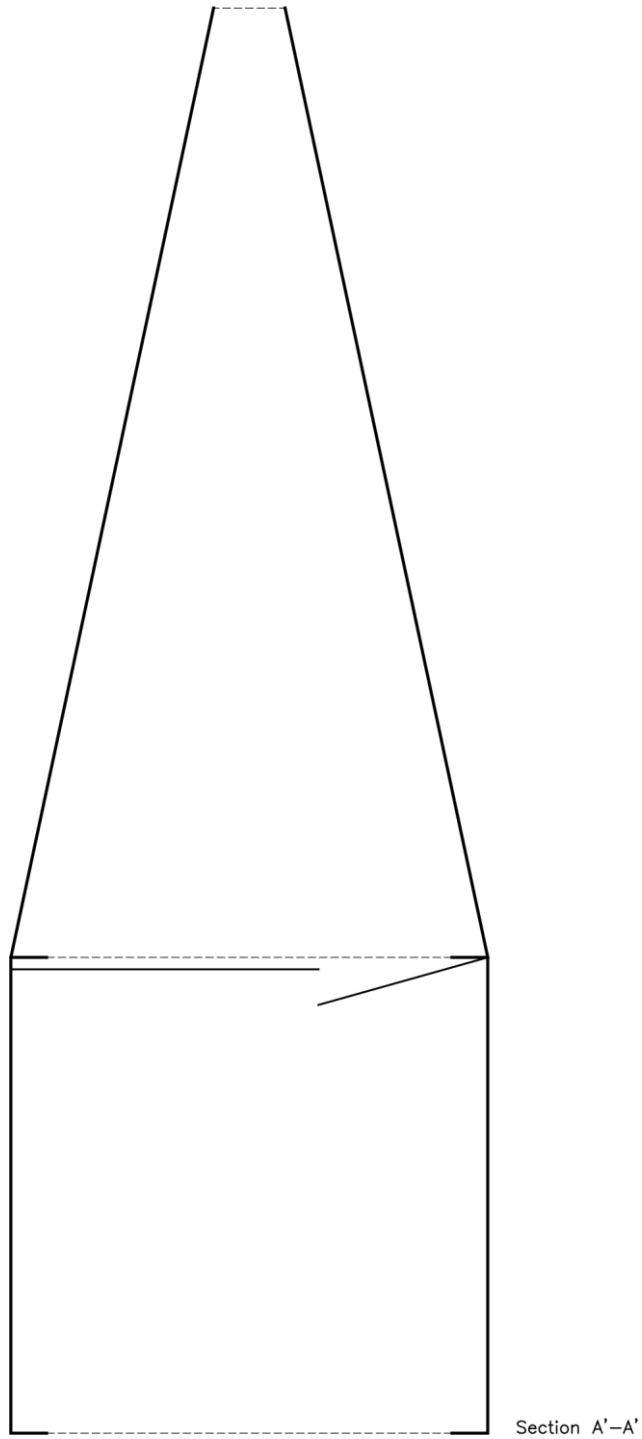
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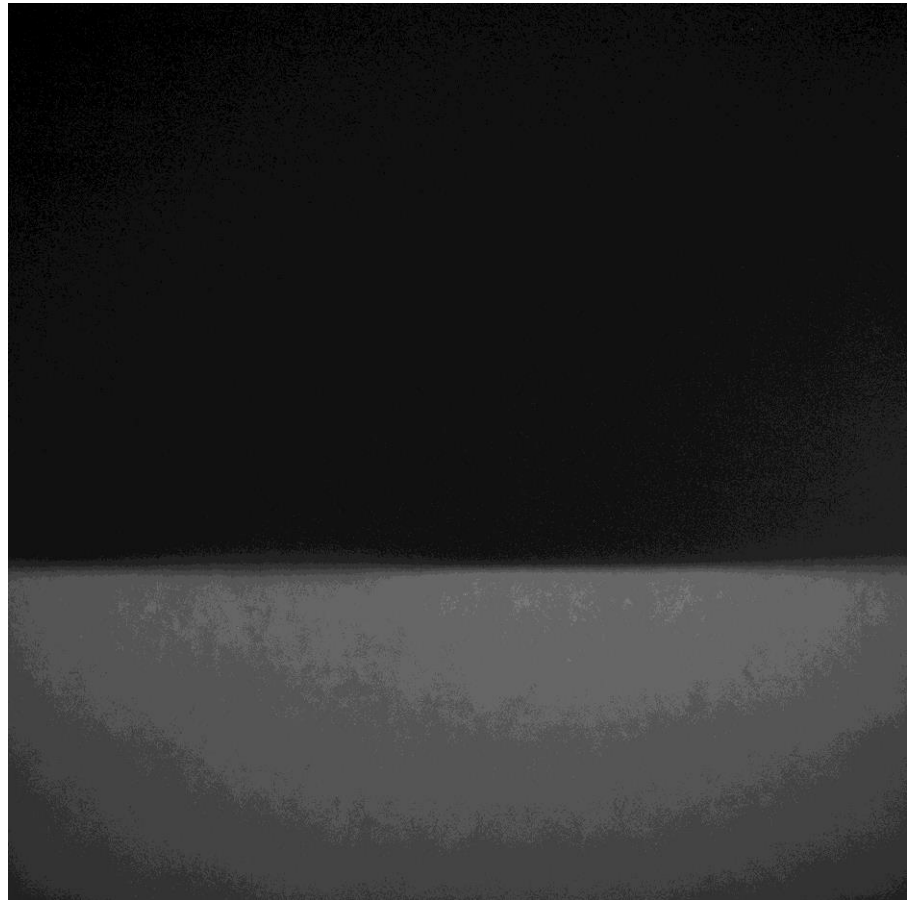
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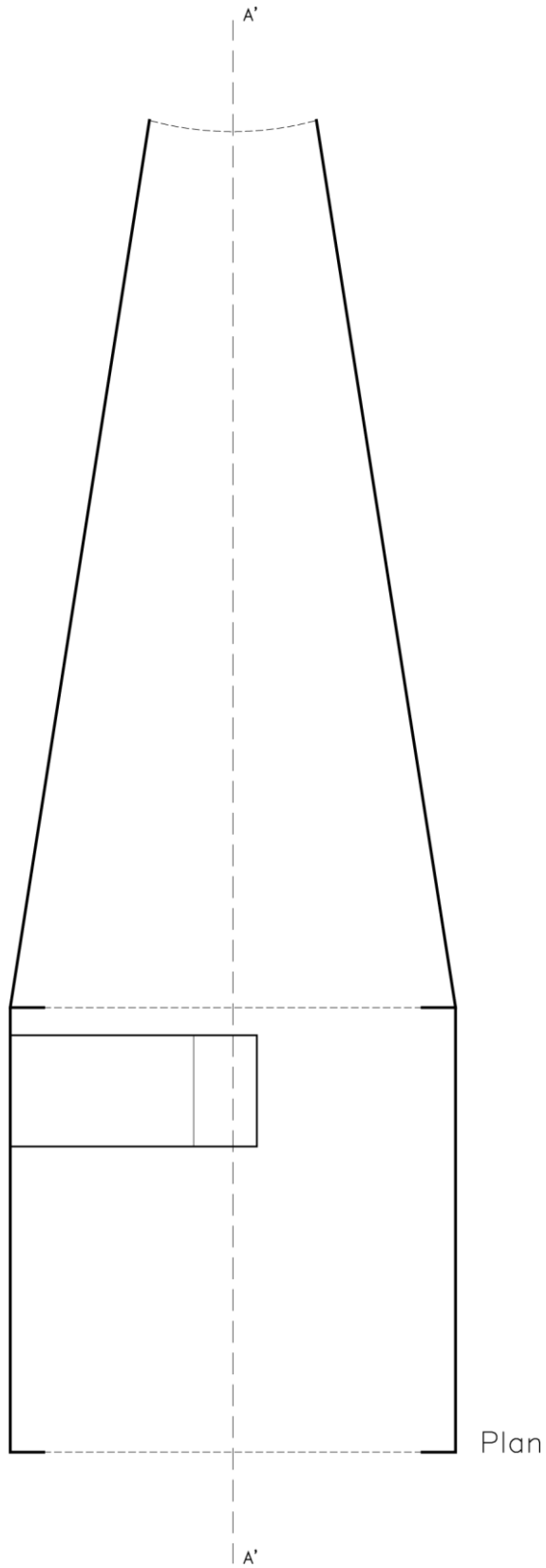
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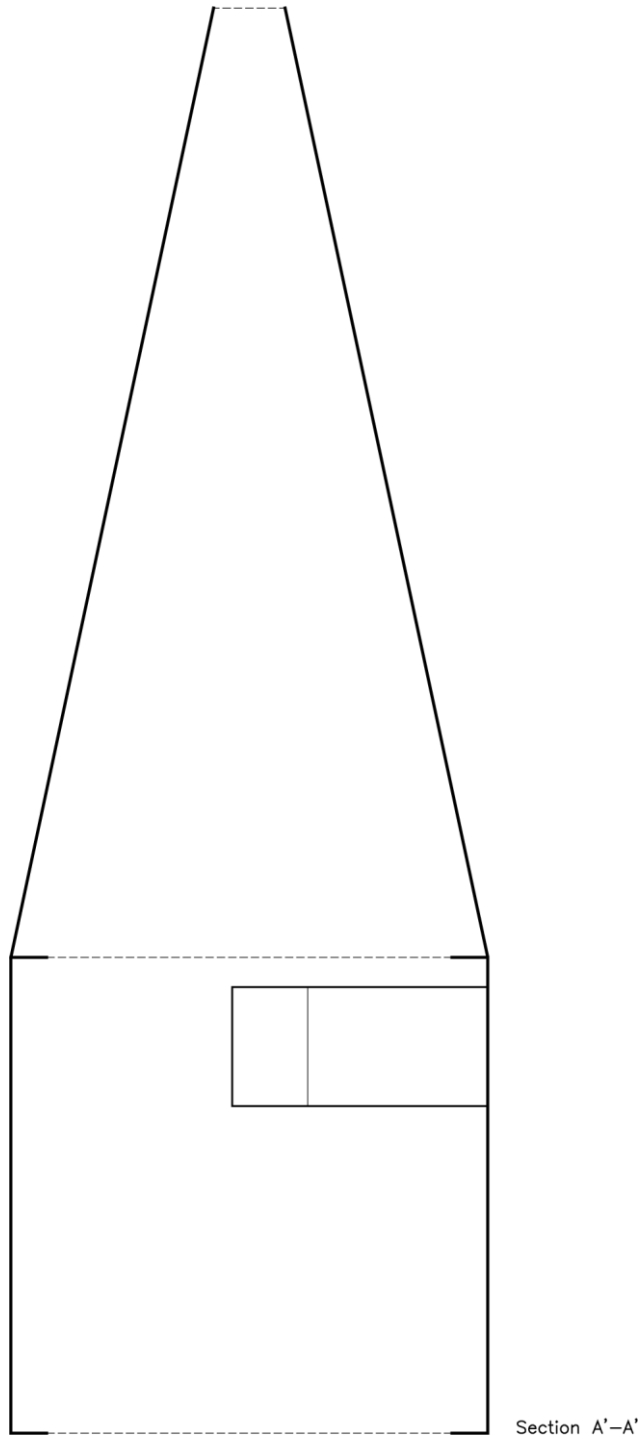
Model Eight - *Perceived representation of light inside the Model*



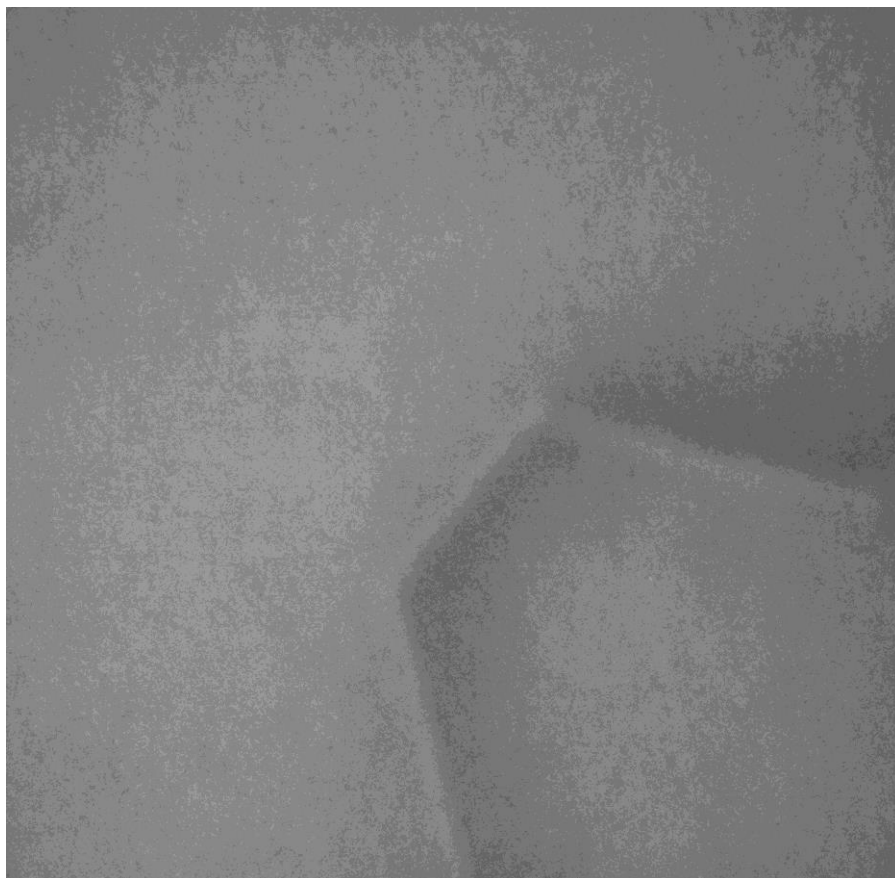
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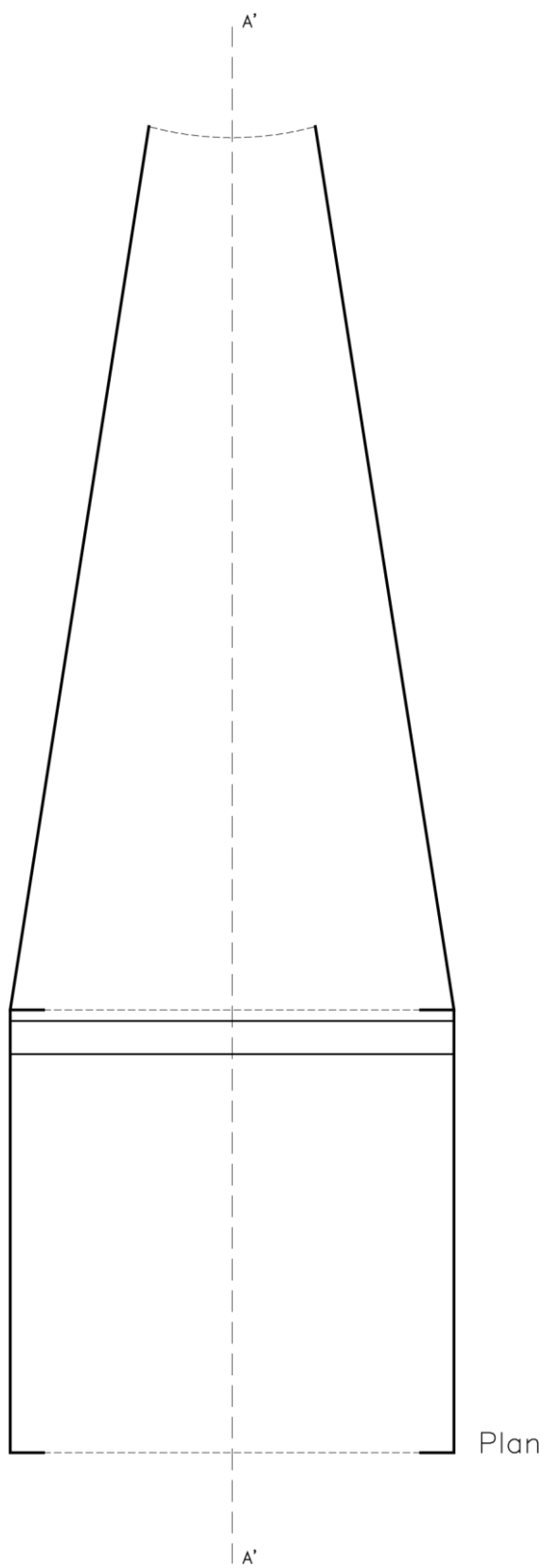
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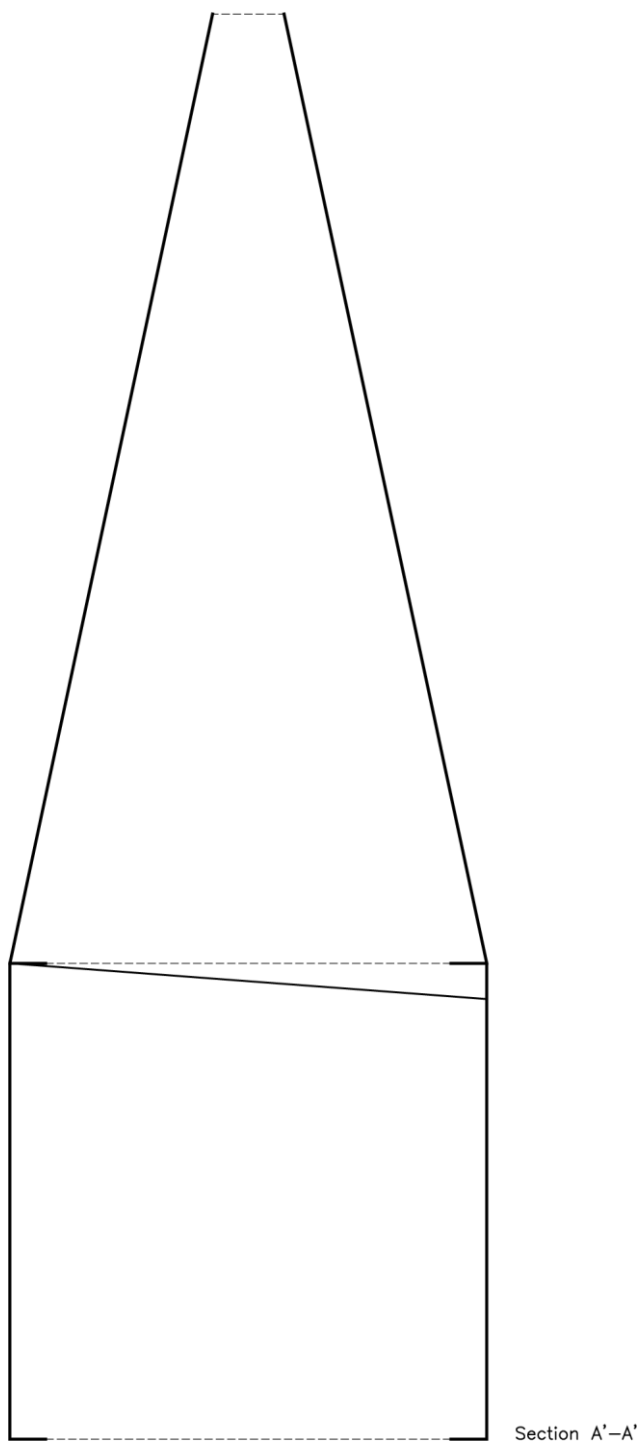
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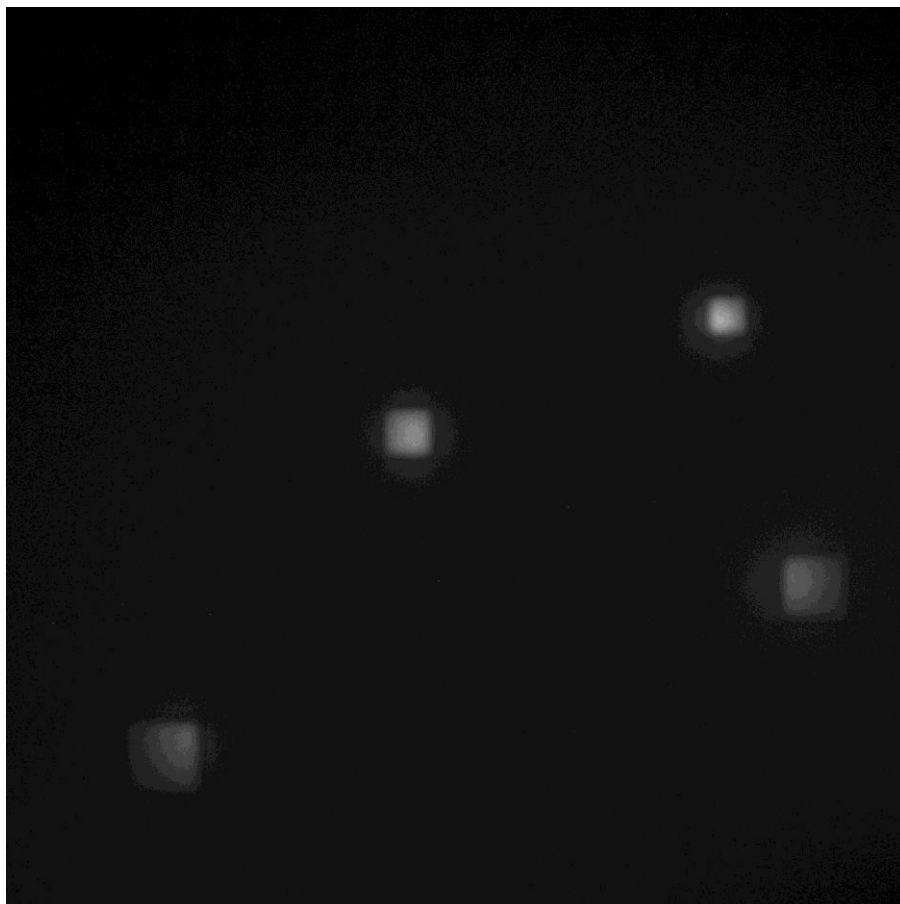
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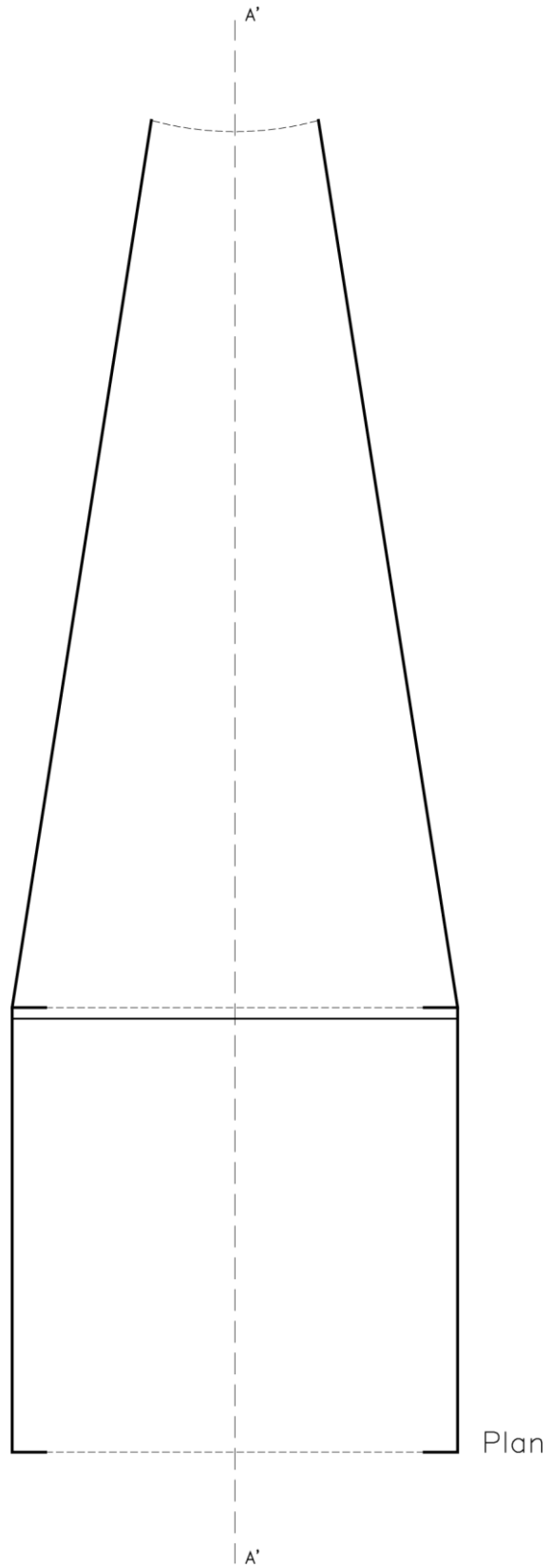
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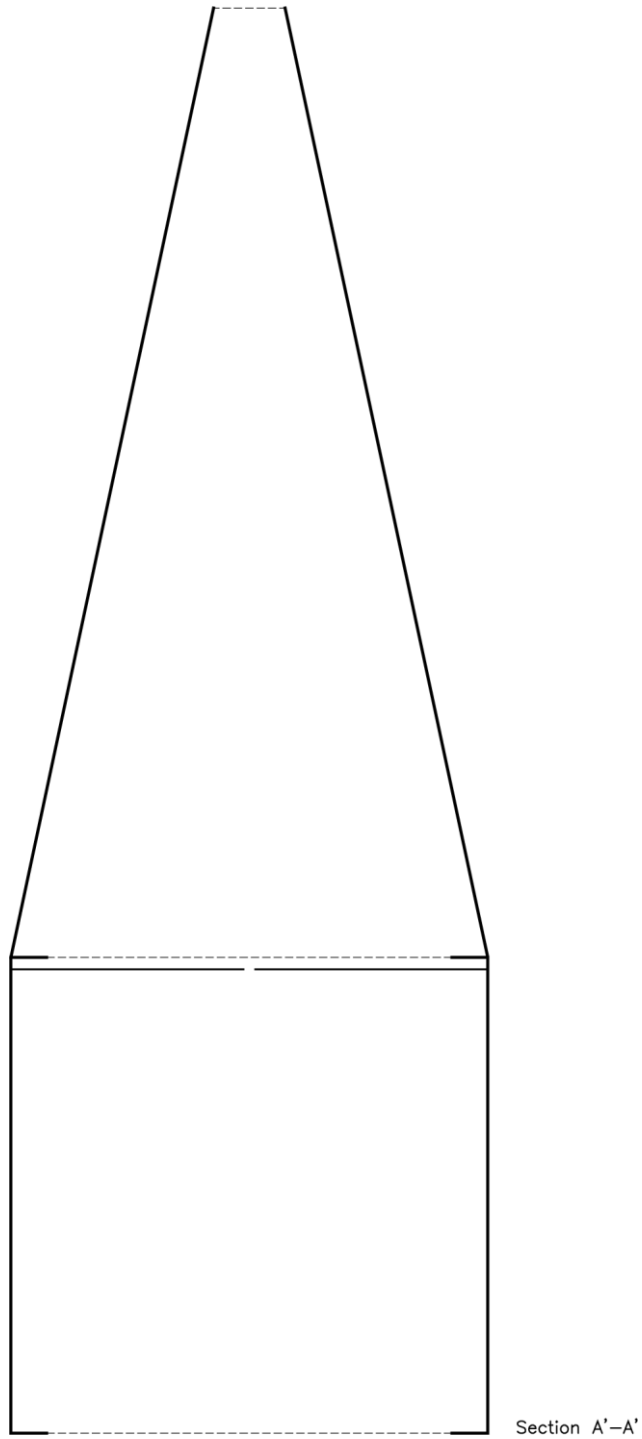
Model Ten - *Perceived representation of light inside the Model*



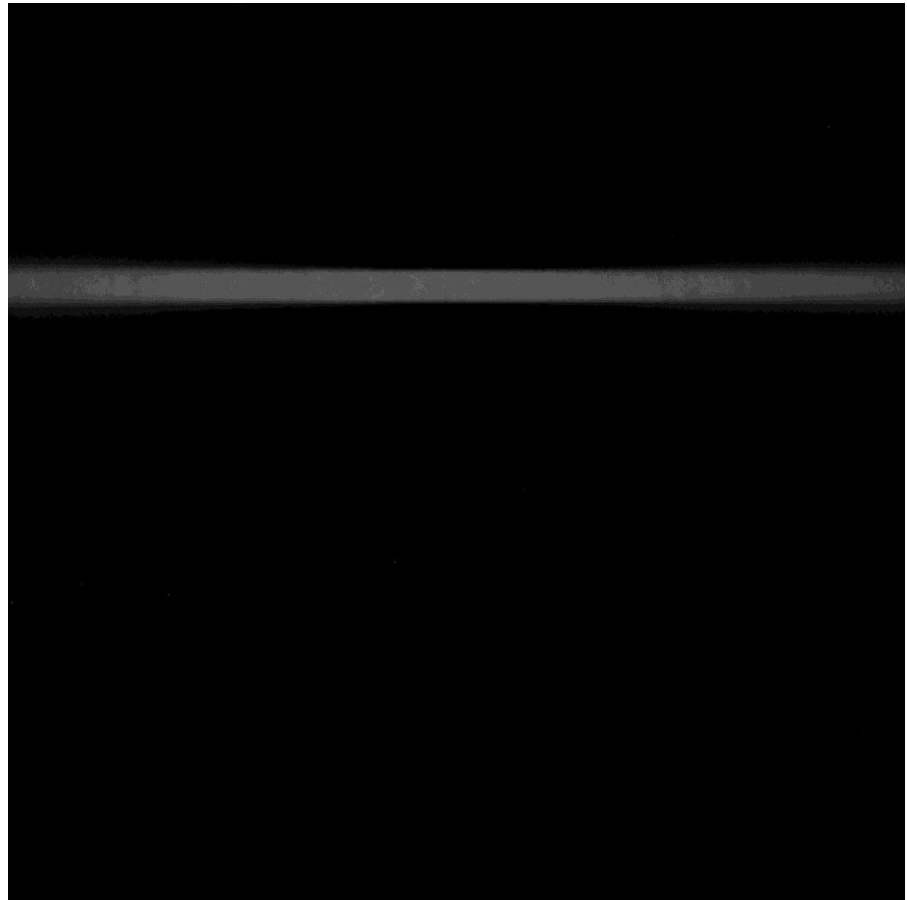
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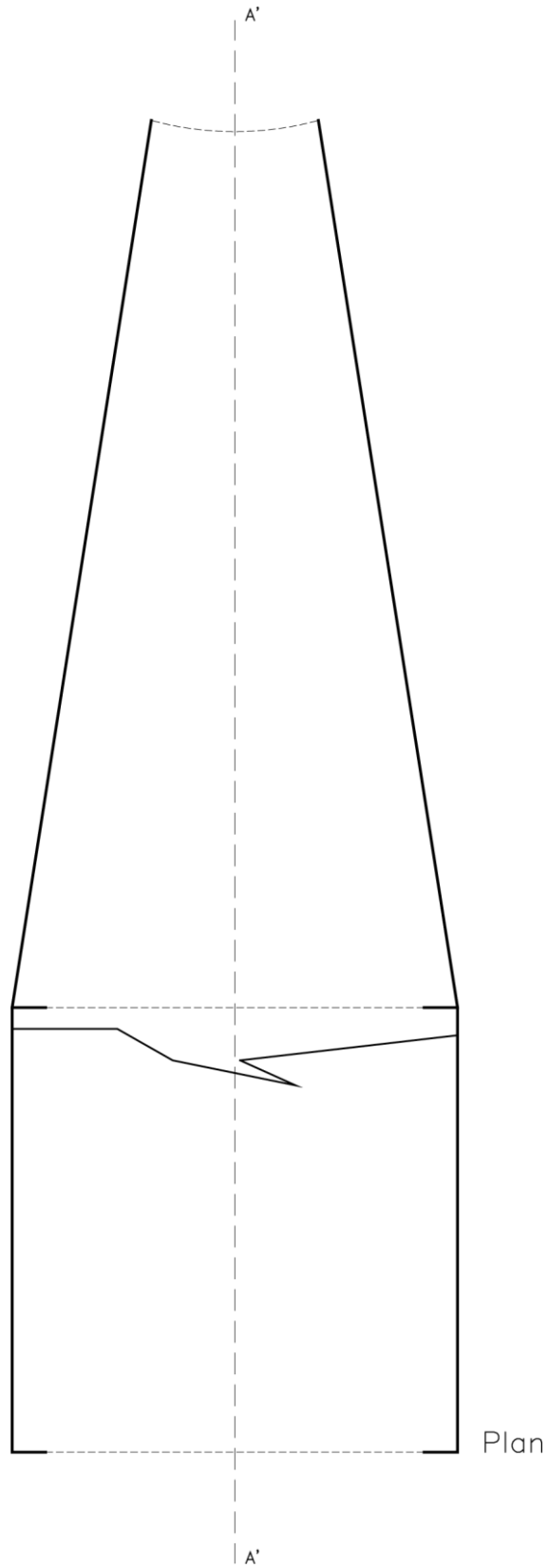
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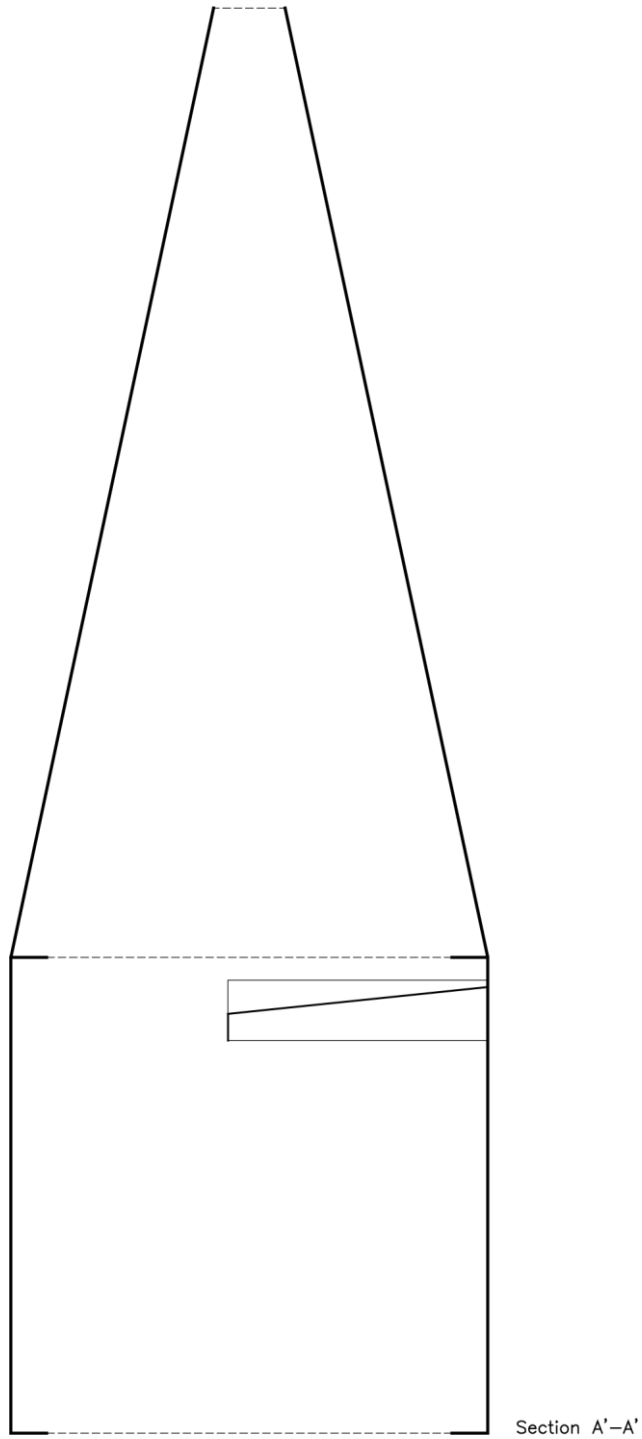
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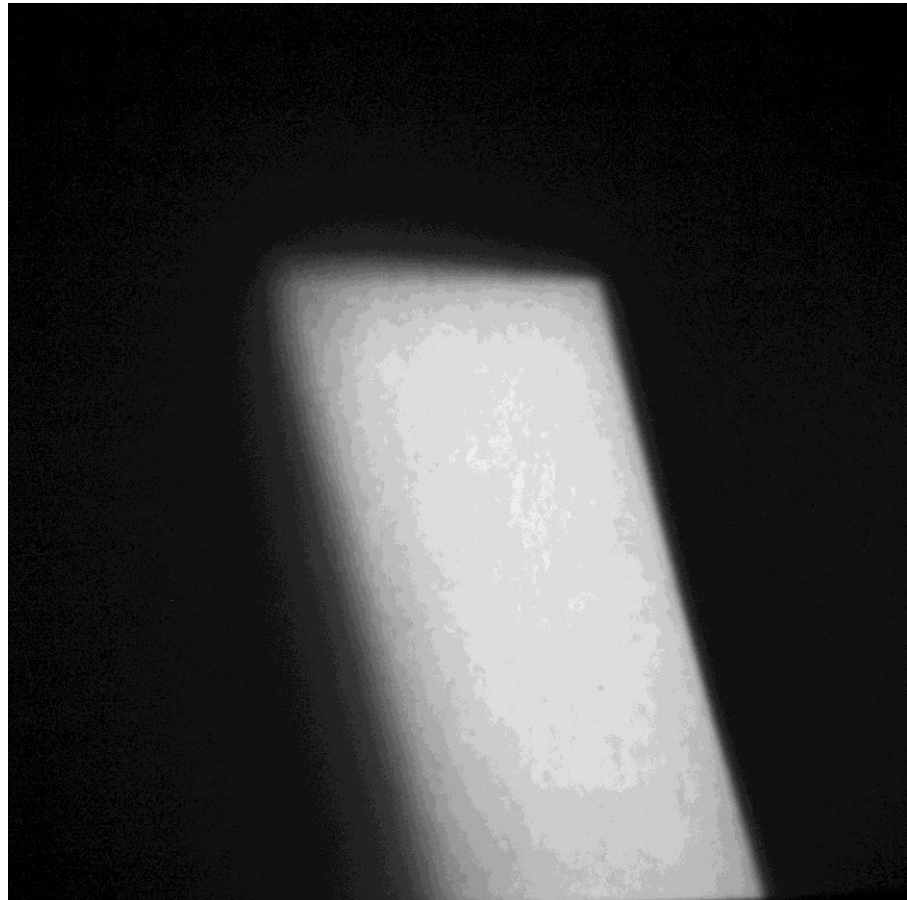
Model Twelve



Model Twelve

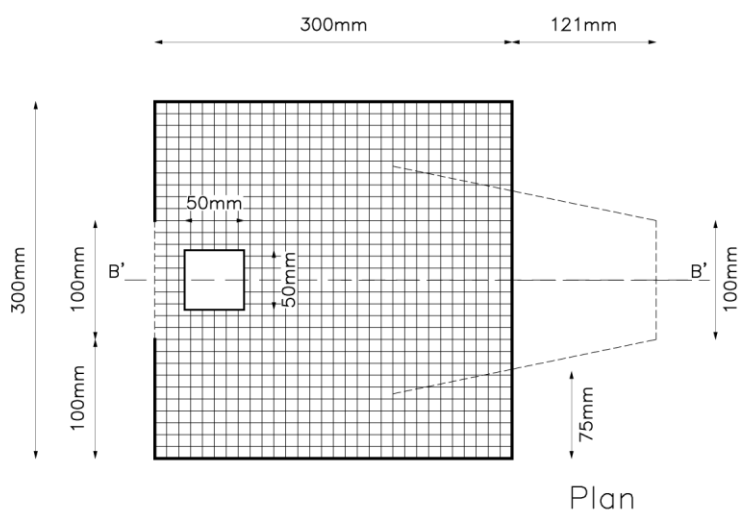


Model Twelve - *Perceived representation of light inside the Model*

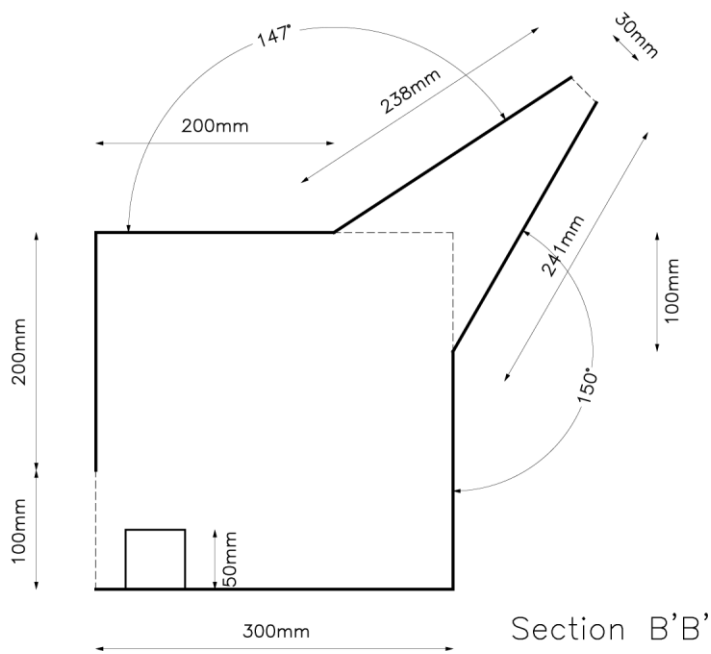


Model Thirteen

Dimensions



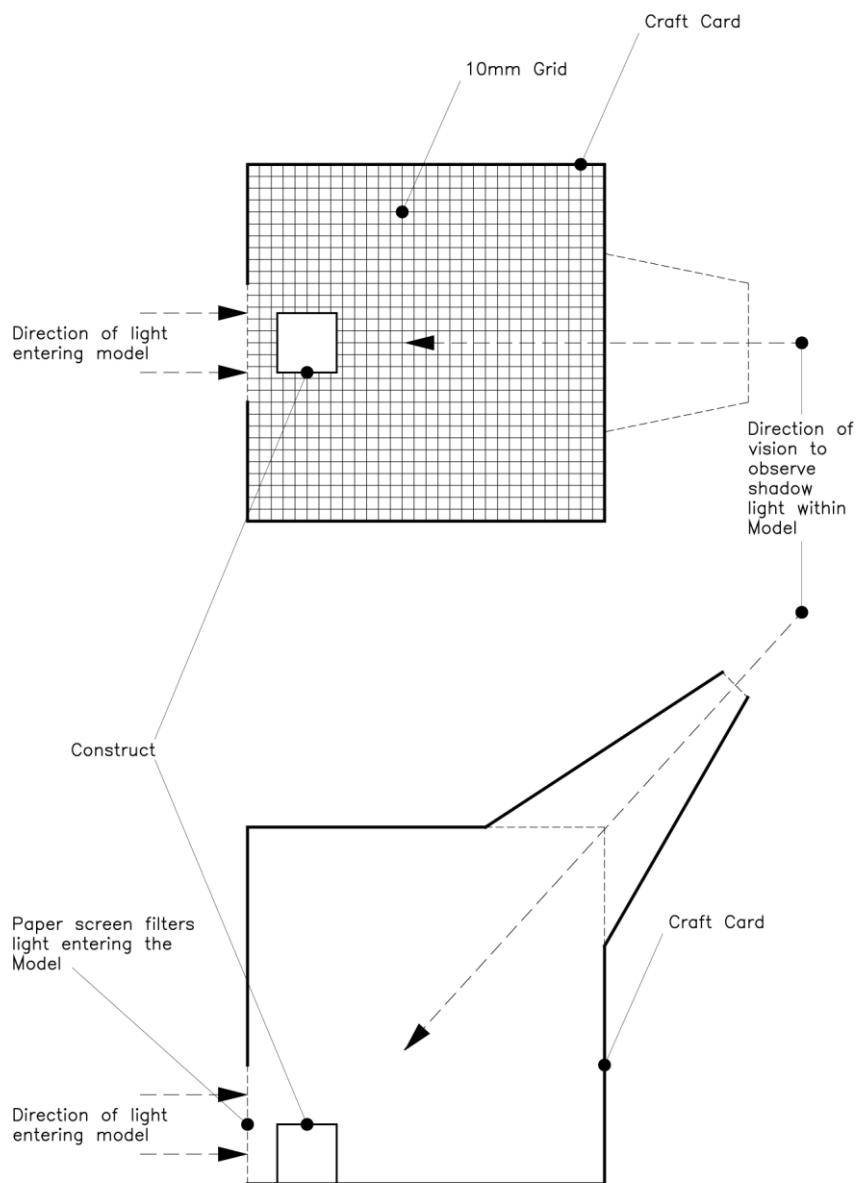
Plan



Section B'B'

Model Thirteen

Details



Section B'B'

Model Thirteen

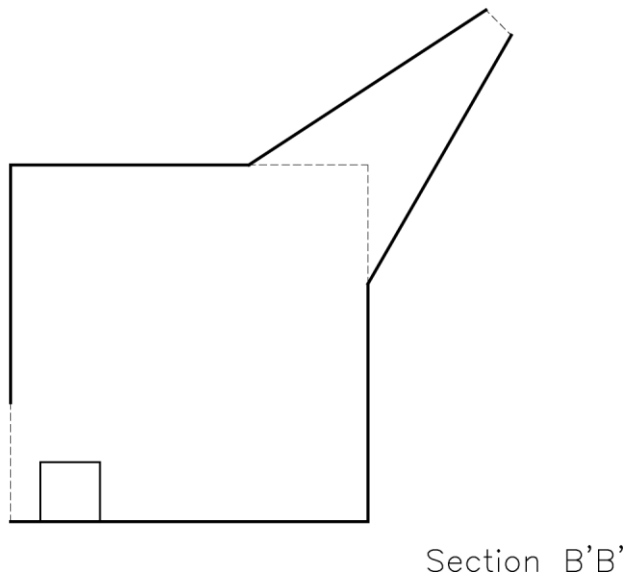
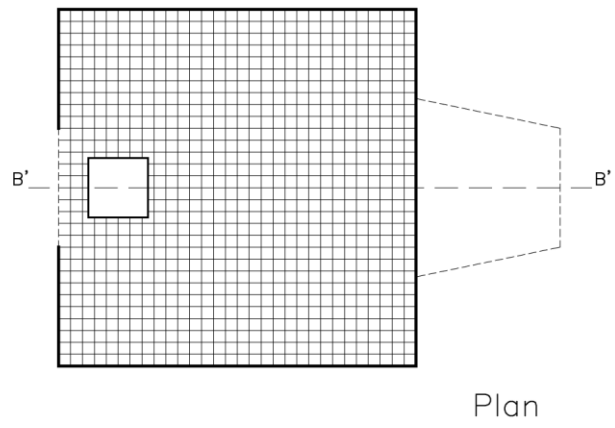
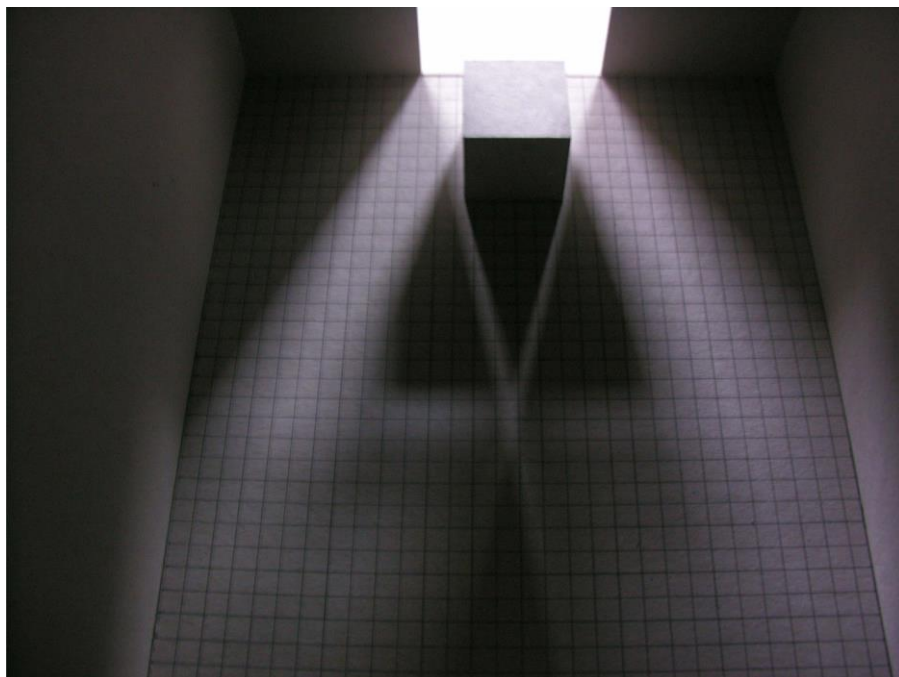


Fig 5.7. 'Model Thirteen' (Interior View) Niall O'Hare 2015.



Index of Terms / Glossary

Architectural form, refers to habitable space constructed by man.

Darkness, refers to the perception of zero or reduced photons/wavelengths.

Darkness's of Light, refers to the perceptual multiplicity of shadow cues. (see Weights of Light)

Ecologies of light encompasses the evolutionary influence and experiential perception of light and shadow within architectural space.

Environmental Conditions, refers to the external weather conditions.

Evidence words – Atmosphere and Presence.

Gradients, refers to the transition of different perceptions of shadow qualities from darkness to brightness.

Interstices of Light, refers to the momentary changes which occur within the perception of the qualities of light and shadow due to environmental conditions and the diurnal sequence.

Space, refers to the area or volume contained or constrained within architectural form.

Shadow, is an area of reduced photons/wavelengths created by an objects occlusion of light.

Shadow cue, is the descriptive representation of the shape, form and visual density of a shadow made by an occluding object, or objects in relation to the intensity of light creating the shadow.

Shadow edge, is the visual perception of the transition area between a shadow and an area without shadow.

Shadow light, refers to the perception of large areas of shadow within an architectural space, this thesis is written from the point of view which suggests that shadow is light and should be considered fundamental to any consideration of light.

Primary Shape, refers to the dominant form of the architectural space being considered.

Weighs of light, refers to the visual perception of different ratios of shadow containing fewer or greater photons/wavelengths.

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