

**THE REPUBLIC OF TURKEY
BAHÇEŞEHİR UNIVERSITY**

**VIRTUALITY AS A CHALLENGE
TO ARCHITECTURAL MATERIALITY
AND SPATIAL EXPERIENCE**

Master's Thesis

IHSSANE ALAMI

ISTANBUL, 2016

**THE REPUBLIC OF TURKEY
BAHÇEŞEHİR UNIVERSITY**

**THE GRADUATE SCHOOL OF NATURAL AND APPLIED
SCIENCES
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Ihssane Alami

ABSTRACT

VIRTUALITY AS A CHALLENGE TO ARCHITECTURAL MATERIALITY AND SPATIAL EXPERIENCE

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Contemporary architecture is shifting toward a challenging ground -virtuality-. Innovative aspects of materiality are conceived, and different spaces are occurring. Hence, architects can establish pioneering philosophies, considering the architectural spatial experiences, that might be engendered under virtuality condition. Some aspects of displacement of materiality are already perceptible, however, the appreciation of immaterial architecture is especially compound.

Though virtuality has an immaterial aspect, it has the potential to intensify the spatial experience, making people feel confused and astounded but also concentrated and inspired.

And since architecture has always been a multi-layered discipline, it is, therefore, significant to study about how the two spaces we populate; one physical one virtual; one material and the other immaterial; might complete each other. The immaterial architecture suggested in this thesis is more the apparent absence of matter rather than the absence of matter.

Whether architecture is immaterial or material is reliant on perception. The contributions to this study share a common assumption, in that each is an attempt to stretch our awareness about the relationship between virtuality and architecture,

through shaping a different attitude toward material & immaterial, with the intention of enriching the architectural spatial experience.

Architecture can turn virtuality into an instrument, toward generating an architecture that combines the immaterial and the material; so that they are in juxtaposition, not opposition, with the drive of enriching the architectural spatial experience.

Therefore, this thesis is experiencing the effects of displacement of real architectural materiality; caused by virtuality; on architectural spatial experience, through developing a gamic project “Virtual Zumthor” as part of the thesis. This thesis is structured around three main chapters and a gamic project. It initiates by selecting factors that might be adapted to evaluate a virtual architectural spatial experience. In the second chapter, it specifies the main aspects of architectural materiality; that will be used to develop the gamic project Virtual Zumthor; and then investigates their displacement caused by virtuality. And in the third chapter, it describes the development process of the gamic project, and its outcomes.

This thesis settles stating that, the immateriality of virtuality is a challenge to the materiality of architecture, nevertheless, it offers a great potential to improve and enrich the architectural spatial experience.

Keywords: Spatial Experience, Architectural Materiality, Virtuality, Virtual Phenomenology.

ÖZET

MİMARİNİN MADDESELLİĞİ VE MEKANSAL DENEYİMİNİ SANALLIK İLE SINAMAK

IHSSANE ALAMI

Mimarlık

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Çağdaş mimarlık, yeni ufuklar açan, iddialı bir zemine –sanallığa- doğru hareket etmektedir. Maddeselliğin yenilikler getiren yönleri tasarlanmakta ve farklı mekanlar ortaya çıkmaktadır. Gelinen bu noktadan sonra mimarlar, sanallık koşullarından doğan mimari mekânsal deneyimleri göz önüne alarak, öncü felsefeler kurabileceklerdir. Maddeselliğin ortadan kalkmasının bazı sonuçları hali hazırda hissedilebiliyorsa da, maddesel olmayan bir mimarlığın takdiri özellikle çok yönlüdür.

Her ne kadar sanallığın maddesel olmayan bir niteliği olsa da, insanları bocalatan ve şaşırtan ama aynı zamanda odaklayan ve ilham veren yanları ile mekânsal deneyimi yoğunlaştırma potansiyeli vardır.

Mimarlık her zaman çok katmanlı bir disiplin olmuş olduğundan, yaşadığımız biri gerçek diğeri sanal, biri maddesel diğeri maddesel olmayan iki mekanın birbirini nasıl tamamlayabileceği önemli bir çalışmadır. Bu tezde önerilen maddesel olmayan mimarlık, maddenin yokluğundan çok, maddenin görünür yokluğu üzerinedir.

Mimarlığın maddesel olması ya da olmaması, algıya dayanmaktadır. Mimarlık ve sanallık arasındaki ilişkiye olan farkındalığımızı genişletmek üzere mimari mekânsal deneyimi zenginleştirmek amacı ve maddesel olan ve olmayana yönelik farklı yaklaşımları biçimlendirmek yoluyla yapılan her bir girişim, bu çalışmaya yapılan katkıların ortak varsayımıdır.

Mimarlık sanallığı, mimari mekansal deneyimi zenginleştirmek motivasyonu ile, maddesel olan ve olmayanı birleştiren, onları karşıt değil beraber ele alan bir mimarlığı kuracak bir araca dönüştürebilir.

Tez, böylece, sanallık sebebiyle gerçek maddeselliğin ortadan kalkmasının, mimari mekansal deneyim üzerindeki etkilerini, tez kapsamında geliştirilen oyun benzeri bir proje “Virtual Zumthor- Sanal Zumthor” üzerinden araştırmaktadır.

Tez, üç ana bölüm ve bir oyun-benzeri proje üzerine yapılandırılmaktadır.

Sanal mimari mekansal deneyimi değerlendirmek için uyarlanacak faktörlerin seçilmesi ile başlar.

İkinci bölümde, oyun benzeri “Virtual Zumthor-Sanal Zumthor” projesinde kullanılacak olan mimari maddeselliğin başlıca öğeleri belirtilir ve devamında sanallık ile ortadan kalkmasını araştırır. Üçüncü bölümde, “Virtual Zumthor”un geliştirilme süreci ve çıktıları yer almaktadır.

Bu tez, sanallığın maddesel olmamasını, mimarlığın maddeselliğine bir meydan okuma olarak ele alarak, mimari mekansal deneyimi geliştire ve zenginleştirme potansiyeline işaret eder.

Anahtar Kelimeler: Mekansal Deneyim, Sanal Fenomenoloji, Sanallık, Mimari Maddesellik

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1. INTRODUCTION

New aspects of materiality are conceived, and then different spaces occur. Hence, architects can establish pioneering philosophies, considering what architecture might be, backing to sort architecture of originality and of the contemporaneous day, to lay the groundwork of the 21st-century architecture. However, architecture practitioners and theorists; supportive of traditional architecture; assumed that the introduction of the virtual materiality by means of technological advancements; disconcerted the lucidity and objectivity of the discipline, through being a continuous challenge to the doctrines of classical architecture, an architecture that is expected to be solid, the putting together of materials.

No one can deny that the technological advancement; such as virtual reality technologies; is a challenge to the acquainted experience of architecture. Therefore, the understanding and appreciation of immaterial architecture are especially complex. Nevertheless, this will not change the established habits of traditionally - practicing; producing, and experiencing – architecture. Rather, it may offer those habits a greater flexibility. The immaterial aspect of virtuality is a particularly poignant and rewarding challenge for architects since it influentially provokes what they practice and produces. However, the desire to produce an immaterial architecture cannot be spontaneously denied, and has alternative drives, and positive consequences.

The rapid advance of virtual reality technologies is frequently presented as a challenge to one of the architecture's critical dimensions: the concrete features of construction and building technologies; its materiality. Nevertheless, admitting the current phase of technology; hardware and software; as if it were setting conclusive standards, is not accurate. Since the virtual reality technologies are still in their infancy, we should be vigilant not to draw conclusions about the temporary features they offer. The introduction of virtual reality, offers new materiality aspects, through the juxtaposition of the physical and the virtual. Whereas this juxtaposition is not entirely advanced,

some aspects of the displacement of materiality are already noticeable, such as the displacement of materiality from the real environment architecture to virtuality.

Present-day architecture is probably getting in a transitional phase, just as it was in the second half of the 19th century when industrial materials - steel; glass; and concrete - , and industrial production – standardization; mass production; and mechanization - , shaped the path to modern architecture. Hence the introduction of, virtuality and virtual reality technologies to architecture, is carrying about new concepts, as these tools are changing the approach to architecture, its materiality, and likewise the way spaces are being experienced. Under this angle, the impact of the technological revolutions of the virtual, on architectural theory and practice, might be appreciated by examining their effects on the realms of a new materiality, and therefore a new spatial experience.

1.1 SCOPE OF STUDY

Even though virtuality has a challenging immaterial aspect, it has been making a splash in architecture offering it a potential to expand in many dimensions. Virtuality has the capability to intensify the spatial experience, making people feel confused and astounded but also concentrated and inspired. The contributions to this study share a common assumption, in that each is an attempt to stretch our awareness of the relationship between virtuality and architecture, through shaping a different attitude toward materiality with the aim of enriching the architectural spatial experience. Affirmatively, it is much more than a new approach. However, architecture has always been a multi-layered discipline, that's why this thesis offers and examines the interplay between materiality and virtuality on the playing field of architecture.

The exploration of immateriality in architecture is relatively fresh. This awareness might offer an architecture that can turn virtuality, into an instrument to enrich the architectural spatial experience. The drive is an architecture that combines the immaterial and the material so that they are in juxtaposition, not opposition. Virtuality offers an architecture that combines the immaterial and the material and considers its consequences, perplexing presumptions about architecture, its practice, purpose, matter,

and use. Therefore, the concern is not the immaterial alone or the immaterial in opposition to the material. Instead, proposing an architecture that embraces, the immaterial, and the material for the purpose of enriching the spatial experience in architecture. Accordingly, the gamic project Virtual Zumthor was developed, to experience this approach, and henceforth support the hypothesis. Because of the short time is given to try the project, it was necessary to limit the study. Therefore, merely the main materiality aspects were contained to be examined. And, since the gamic project is going to be developed in a virtual reality environment, it was significant to select only the factors of spatial experience that might be adapted to a virtual environment, to be able to evaluate the results of the gamic project's trial. Concerning the results of the trial of the gamic project, the thesis concentrated on the effects of virtuality on architectural materiality, its displacement, and the consequences affecting the architectural spatial experience.

1.2 METHODOLOGY

Three methods were used to develop the thesis; the first is the literature research, the second is the development and trial of a case study and the third one is a questionnaire.

To approach the thesis subject two fundamental questions were addressed: How architecture, requiring a material aspect, is going to encounter with the immateriality of virtuality? Then, which consequences is this encounter going to have on the architectural spatial experience?

For addressing these questions, the research started with a general observation of spatial experience in the third chapter. This observation was conducted by examining separately, the spatial experience of a real environment –architecture-, and a virtual environment –virtuality-, through collecting factors of involvement from each of the environments, that might be adapted to evaluate a virtual architectural spatial experience. Then to precede the research, in the fourth chapter, a selection of the main aspects of materiality in architecture was required, to appreciate the materiality of the architectural environment, and then to experience the effects of virtuality on it. Since

virtuality is referred to as the main challenge to this materiality, it was vital to question its materiality aspect, and then to investigate the process of displacement caused by it. The technological potentials and limitations, available for the reproduction of materiality in a virtual environment, had to be taken into consideration to precede the investigation. After collecting materiality aspects to develop the gamic project, and factors of involvement in spatial experience to evaluate it, the gamic project called 'Virtual Zumthor' was developed as a major product of this thesis; as it is discussed and introduced in detail; in the fifth chapter. As for completion evaluation of the thesis statement, a questionnaire has been designed and applied for the trials of Virtual Zumthor by the participants. Since the available technology limited the tools for the case study, the experience of the gamic project was only possible by the use of the oculus rift, in a 360° animated architectural model, in a virtual environment.

In his 1941 book -Space, Time and Architecture: The Growth of a New Tradition-, Siegfried Giedion, situates modern architecture and its typologies, in a social chronological framework. Nowadays, we are again assisting to the appearance of new typologies, of spaces that are developing, over the superimposition of the physical and the virtual. Digital games, established over the conjunction of 'space', 'time' and 'play' are simply the start. By devising new means and exploring old concerns, a new approach is introduced in this thesis, about how the two spaces we populate one physical, one virtual, one material, and the other immaterial, might complete each other.

Computer games became a part of our present, their audiovisual language, besides the interaction processes related to them, have shaped their route into our everyday lives. Nevertheless, deprived of space, a game can take no place. Likewise, the precise space of a game is produced by the action of playing, the gameplay situation itself. The digital spaces frequently experienced by gamers, is changing the concept of space and time, as film and television did in the 20th century. However, games went beyond this phase; they have uninhibited their virtual location (the stationary computer) then, shaped their way into physical space as mobile and omnipresent applications, to generate a ludic reality. The spaces of computer games are an assortment; from two-dimensional representations of three-dimensional spaces, to composite structures of social communities, to innovative ideas; of applications aimed at producing interactions

between current physical spaces. The reason behind using a gamic project to support the hypothesis is that the significant component in computer games is spatiality. Computer games are fundamentally apprehensive with spatial representation and conciliation; hence, the classification of a computer game can be founded on how it represents or, conceivably, implements space. Numerous computer games had the spatial inspiration from physical architecture. Comparable to films, certain places and arrangements are preferential and retroactively form our perceptions. Furthermore, computer game players experience real space differently and thus use it differently. Innovative feedback options, as gesture and considerable physical movement, are making this hybridization of virtual and real space accessible.

Through rivaling the complex conceptions of; materiality and spatial experience possibilities of architecture, and by consuming the expertise of interaction immersion and spatial fun of the games, Virtual Zumthor, is expected to provide support for the hypothesis.

2. LITERATURE REVIEW

Conversations about virtuality and architecture are more about parametric modeling than how the two spaces we populate one physical, the other virtual, one material, and the other immaterial, might complete each other.

One of the few studies about immateriality of architecture is by Jonathan Michael Hill, *Immaterial Architecture* (2006). Hill commented about his book stating:

*"In Immaterial Architecture (2006) I focus on the perceived absence of matter more than the actual absence of matter in order to devise further means to explore the creativity of the designer and the user, which may be complementary or conflicting. The user decides whether architecture is immaterial. But the architect, or any other designer, devises material conditions in which that decision can be made. Emphasizing that architecture is not just conventional building fabric, Immaterial Architecture concludes with an 'index' of thirty architectural 'materials' that can be perceived as immaterial, such as condensation, glass, and rust. (...) Most architectural research focuses on one subject, such as history, technology or design, and one output, such as the text, drawing or object. In contrast, my research combines historical investigations, material studies and design propositions, results in books, exhibitions, and installations and encompasses personal scholarship, teaching, collective projects and public discourse."*¹

The book deliberates the stresses, on architecture and the architectural career, to be correspondingly solid matter and solid practice. Then it reflects concepts that face architecture with the immaterial, such as the supremacy of ideas over matter, expertise of drawing and design, of spaces and surfaces. Centering immaterial architecture as the noticeable absence of matter, Hill considers diverse resources to search the creativity of both the user and the architect. With the intention of supporting architecture that fuses the immaterial and the material, deliberates its consequences, challenging presumptions about architecture, its practice, drive, matter, and use.

The other significant literature that had a great influence and was the drive behind this study is about the materiality aspect of the architecture of Peter Zumthor. Peter Zumthor is a chief architect esteemed by his colleagues from all around the world for work that is uncompromising, focused, and remarkably determined. He only takes a project if he senses a profound empathy for its program, then from the instant of commitment; his

¹ Hill, J. (2016). The Bartlett. [online] Ucl.ac.uk. Available at: <http://www.ucl.ac.uk/bartlett/people/?school=architecture&upi=JMHIL80> [Accessed 25 Mar. 2016].

dedication is through, overseeing the realization of the project to the very latest detail. His buildings ensure an imposing existence; however, they ascertain the command of thoughtful interference, demonstrating us all over again that modesty in approach besides boldness in general outcome is not reciprocally limited. Modesty exists in conjunction with boldness. Though some have entitled his architecture silent, his buildings remarkably affirm their existence, appealing our various senses, not merely our vision but also our senses of hearing, smell, and touch. Zumthor ensures an acute skill to generate places that are further more than a single building. His architecture asserts deference for the preeminence of the site, the inheritance of a local culture besides the significant architectural history's lessons. According to him, the architect's role is not merely to create a static object; but moreover to compose and anticipate the experience of moving around and through a building. In Zumthor's expert hands; alike those of the skilled craftsman; the wide range of materials are exploited in a manner that reveals their particular distinctive assets, all intended for an architecture of durability.

Beyond the mythical episode at the beginning of the novel *Remembrance of Things Past* by Marcel Proust; the instant when the narrator experiences a memory of his childhood while dipping a madeleine into a cup of tea. A less-recognized episode at the end of the novel is more intriguing; the instant when the narrator offers the way to an upcoming carriage in a courtyard in Paris, steps back then stumbles beside some randomly positioned paving stones. He resides there, reiterating the movement, one foot upon the higher cobblestone, and the other on the lower. He attempts to comprehend what this movement recalls him of, while the passers-by look at him with enjoyment. Ultimately, he remembers the similar feeling he had several years ago, then is overwhelmed with contentment: "It was Venice". The incidence in the courtyard aroused the sensation he had experienced as he: "Stood on two uneven stones in the baptistery of St. Mark's". What Proust designates as; the tactile feeling of the rough ground under his slow moving feet; is basically related to what Maurice Halbwachs designated as: "Spatial memory", a key constituent of the experience of architecture.

"We actually never talk about form in the office. We talk about construction, we can talk about science, and we talk about feelings (...) From the beginning the materials are there, right next to the desk (...) when we put materials together, a reaction starts (...) This is about materials, this is about creating an atmosphere, and this is about creating architecture." (Zumthor, 2013)

Peter Zumthor is amid those architects who appraise further than merely the pictorial features of a project. According to him, the appearance of the architectural elements is not the only significant thing; but furthermore, the feelings and sensations they evoke, besides what memories, expectations, and mental images they recall. His buildings always consider the relationship amid the human body and its environment, as well as how the individual subject experiences particular circumstances. Peter Zumthor said that he every time developed his spaces according to a bodily experience and: "A feeling for the body, for a physical presence, or a certain aura" inspired the design course. During the Pritzker architecture prize acceptance ceremony speech Zumthor said (2009):

"When I start to do research, I'm really bad. This I know from studying. No research. You are just hanging out, listening, feeling, having the place resonate a little bit. And then all of a sudden, ideas come naturally. I don't know when and where. I think this is a very natural process. Everybody; all of you, all of us; we experience this. And what I discovered was that when I have these feelings, it is like being a boy again. All of a sudden, I think this is me when I was 10 years or 12 years old. I'm dreaming. I'm there and something comes to me, but it's not, of course, naïve dreaming. Everything, which is part of my biography, is there. But it's not there as a research product or as reference material. It went into me, as part of my life. Then it comes out from somewhere; from my emotions or whatever, my feelings."

His buildings appear as if they were crafted by hand, and while they are candidly modern, they imply craftsmanship more than high-tech. Zumthor asserted that; what counts to him, is the building's experience, and not the philosophy behind it. He begins with thoughts concerning the physical architectural aspects, not the intellectual, and then drives them as far as conceivable into the territory of sensory experience. He desires to exercise using materials, texture, space, and light, and his utmost desire seems to be resolving how to let us experience the most traditional materials; such as wood and glass and stone; by new means. Zumthor is a proponent of the real: "Architecture has its place in the concrete world", he has affirmed: "This is where it exists. This is where it makes its statement". His buildings are accurate, and its splendor remains in the fineness of its details and materials, gracefulness and weightlessness occur in the majority of the buildings of Zumthor. He liked to talk about seeking for a crucial architectural soul, concerning light, memory, and the sensory aspects of variable materials. He is more of an artist who has perceived the world and preferred to extract just a fraction from it, all the better to ensure an influence on it. Zumthor locates the self at the core of the experience of architecture. He is more concerned with pushing out of

the daily experience a sense of refinement, than in transcendence. That's the reason why he talks about the poetry of William Carlos Williams and the paintings of Edward Hopper. He declared: "There was a time when I experienced architecture without thinking about it". He narrated his experience in his aunt's house:

"Sometimes I can almost feel a particular door handle in my hand, a piece of metal shaped like the back of a spoon. That door handle still seems to me like a special sign of entry into a world of different moods and smells. I remember the sound of the gravel under my feet, the soft gleam of the waxed oak staircase, I can hear the heavy front door closing behind me (...) Memories like these contain the deepest architectural experience that I know. They are the reservoirs of the architectural atmospheres and images that I explore in my work as an architect." (Zumthor, 2001)

The buildings of Zumthor, alike all prodigious art, inspires you to think of other things, for the reason that you require to associate them to your entire life experience. You require touching them, being in them, feeling how their realism undulates through all what you know. Zumthor generates astoundingly beautiful objects; nonetheless they are by no means merely objects. They acquire their significance from the existence that goes on within them. The utmost sensation a building might deliberate, Zumthor has stated, is of:

"A consciousness of time passing and an awareness of the human lives that have been acted out in these places. At these moments, architecture's aesthetic and practical values, stylistic and historical significance are of secondary importance. What matters now is only the feeling of deep melancholy. Architecture is exposed to life." (Zumthor, 2000)

3. SPATIAL EXPERIENCE IN ARCHITECTURE

The spatial experience in architecture is dominated by two main perceptions, the mental perception, and the physical perception.

Considering the mental perception, Descartes's conception of space is the vital conflict between the experiential dimension, defined as having spatial aspects, and the superiority of the mental gained through a routine of progressive doubt, which permits Descartes to consider thought as the only activity not exposed to doubt. "We can doubt everything", he writes in the meditations (1641), except that we are thinking beings: "Even if we think that we are not thinking, we are still thinking." (Descartes, 1641) Presumed as self-reflection, the thought is self-contained, within justified, independent of all kinds of empirical support. In the circumstance, the unavoidability of thinking does not ascertain at all that we are aware or entirely sober. All it ascertains is that thought is certainly crucial and sovereign of anything that is prolonged in space. This superiority of thought is what leads Descartes to define space as mutually exclusive of anything active and spiritual. What is termed the Cartesian theorem demands accurately the mutual exclusion of space and thoughts. The reception of passivity of space, as juxtaposed with the absolute activity of thought, is the leading characteristic, in philosophy and architecture, of what might be termed rationalize space. For Descartes, it is the exclusively mental capacity of understanding that is able to abstract the concept of extension, which in and of itself is unnoticeable. Accordingly, the very existence of space relies on the mind. The mind supplements space with ideas and forms, then sequentially, the utter emptiness of space does nothing except obtaining them.

Considering the physical perception, vision is the most dominant sense. Fuchs (1995) stated that: "Vis-à-vis his own perception of the reality, man has conceptualized the notions of space on which he can interact only as per the immutable physical laws". The belief of the physical world is not by any means a newfangled interpretation. The understanding of three-dimensional space is filtered by our perception of it, which we apply to both the real and the virtual world. As with any other visual perception, the visual perception of architecture is a two-dimensional image, mapped on our retina on

the surface. Yet, on the other hand, Zevi (1957) who writes about architecture as the: “Art of space”, proposes a third-dimensional description to spatial experience. Makings of architecture are three-dimensional concrete artifacts engendered via the molding of space. Though, the concluding perception is a series of two-dimensional images, which produce the identity of a definite architectural space. While perceiving through the act of seeing, we not only generate a detached image of the external world but also carry our individual background, coming as cultural and psychological impressions.

Furthermore; the spatial experience in architecture is not just about how we perceive the space and understand it, but as well about the type of space we are experiencing. During an interview, Virilio (1998) identified the occurring problem saying; “the problem is that the architect is back to working with two types of space. He has to build real space and allow immediate – meaning active – space, and virtual – meaning latent or potentially present – space to co-exist.” Nowadays, nearly 20 years further, we might come to the deduction that the problem; working with both real and virtual space in architecture is still occurring. There is an intersection amid virtuality and architecture, an architecture that does not specify any sorts of spatial experience, however, endow all of them, a common ground amid the virtual and the real; an endowing platform; and a lively open space. Therefore the upcoming subchapters are introducing the two types of space; the real and the virtual; and the main factors of involvement; in each of the environment; that affects the architectural spatial experience.

3.1 REAL SPATIAL EXPERIENCE OF ARCHITECTURE

Afer a brief definition of real space, this chapter introduces the real spatial experience of architecture, and one of its most dominant factor; the visual perception; and others including the body, memory, and imagination.

Moholy-Nagy approves that space does not have an autonomous presence: “A definition of space which may, at least, be taken as a point of departure is found in physics”, “Space is the relation between the positions of bodies” (Moholy-Nagy, p: 57).

However these bodies are a minor necessity; the relation between spaces is his main concern: “Space creation becomes the nexus of spatial entities, not building materials. The building material is an auxiliary, just so far can it be used as a medium of space creating relations. The principal means of creation is the space itself.” (Moholy-Nagy, p: 62). Then he states that: “The phrase ‘material is energy’ will have significance for material architecture by emphasizing relation, instead of mass” (Moholy-Nagy, p: 61). He opposes the acknowledgment that matter is energy consideration on space, as a moving force-ground of fluid relations and marginal constituent. Space is considered the material of immaterial architecture; Moholy-Nagy perceived that by movement users² are capable of regulating their experience of space, he generally denotes architects regarding space creation. Nevertheless, he furthermore proposes that the conception and experience of space can be one: “The dance is an elemental means for realization of space-creative impulses. It can articulate space, order it” (Moholy-Nagy, p: 57), Moholy-Nagy appreciates space as an extension of the body in vibrant associations with other spatial forces. Such a notion of space associates the immaterial with experiences rather than abstractions. A different approach than Lefebvre’s support of “Space made by the user and many architects”, “Advocacies of space made by the architect”, Moholy-Nagy mentions the spatial creativity of the architect as well as the user.

The experience of architecture might contain many aspects, the feelings of gravity and lightness, the sense of, center and focus, tension and comfort, time and interval, besides, the emaciated and well-developed metaphors, as well as the commitment of the body system, memory, and imagination. The sensations of architecture do not take place in an abstracted and disconnected world, architecture inhabits our being the world, and it is faced and qualified largely by our very sense of being. Therefore, thoughtful architectural experiences are crucial to architecture for manipulating space.

A chiefly significant aspect of the architectural spatial experience is the unconscious physical perception hidden in vision; as John Dewey and Merleau-Ponty debate, we experience the weight, texture, temperature, and moisture of materials and surfaces then these concealed assets sort the sense engaging our revolting, defensive or menacing.

² Within the term ‘use’, the complete assortment of behaviors; in which cities and buildings are experienced; is included.

The sense of estrangement and detachment, frequently faced in buildings of nowadays rises, at least partially, from the physical insufficiency, abstraction, and illusoriness of the unconscious haptic experience intervened by vision. The mental commission of architecture is to reinforce the existential position and arouse the senses, as well as the consciousness of reality and self-being. The existential sense, rejuvenated by poetic images, similarly unites the abilities to dream, imagine and desire. Thoughtful architecture constantly turns the consideration to the lived world and ourselves. The art of architecture is essentially not merely about producing objects of visual beauty; nonetheless, around the enigmatic existence of human, and how to comprehend our very being in the world, hence, architecture is the art of space.

Our spatiality is made with an up and a down, a left and a right, an in front and a behind, a near and a far. Well, comprehended human space is a limited space; for instance, when it creates an angle when it stops. Architects permanently expected buildings' forms and dimensions to be adjusted in order for the experience of systematic constancy to be reassigned to a living inhabitant or spectator. We must admit that embodied orientation is major for our perception of senses. In our primary engagement with the world, this divergence is not an illusion but a fact. Our vertical position is distinctive amid animals. We are similar to a line between the earth and the sky, given a spherical head and frontal vision, in a world whose transparent atmosphere permitted it to contemplate the skies, and therefore, realize the consistency of mathematics, finally pointing toward our scientific theories. This verticality is not incidental; it permits us to know in a certain manner, to perceive and then experience differently our spatiality.

Descartes compared the human body to a machine controlled by a computer equivalent to the mind. Our awareness is embodied, the stomach knows and the hand thinks. Everything in our environment is first experienced through our body's perception. The distance between the home and the working place, changes continually, experienced mainly by this embodied awareness. If on varied circumstances, while traveling from work to home, if tiredness, hunger, or depression occurred, that sorts a different experience of distance, which is a more crucial truth than the distance in kilometers appearing on the odometer of the car. It is major, to take into consideration, the situation, context, or specific experience, for the quantification of distance. No one can deny the significance of measurements; space might certainly be perceived in

mathematical terms, and this has proven greatly useful. Rather, phenomenology demonstrates that in human perception the enigmatic simultaneity is constantly functioning. This is the enigmatic nature of human perception, the base of significance and linguistic comprehension.

Two different factors of involvement in architectural spatial experience are studied in this thesis. The first one is the phenomenological factor by Pallasma (*Geometry of Feeling: A look at the Phenomenology of Architecture*, 1986, in Nesbitt 1996). And the second one is the insiderness and outsiderness factor by Edward Relph in his book (*Place and Placelessness*, 1970). Both of the factors are going to be adapted to a virtual environment, and used in the last chapter of the thesis, in the development of the questionnaire of the gamic project; *Virtual Zumthor*.

3.1.1 Phenomenology

The term architectural phenomenology denotes the study of architecture as it introduces itself to awareness by means of supposed typical human experiences, for instance, the perceptions of shadow and light, the feelings of wetness and dryness, or the bodily orientation of down and up. In several points, architectural phenomenology was an extension of previous efforts to reinstate architecturally the missing unity of experience; however, it was also dissimilar insofar as it assumed accurate experience as something primarily external to modernity and timeless. Architectural phenomenology is one of the main non-inspected academic sources of postmodern architectural thought. The name confuses as much as it exposes its roots, making them appear mainly philosophical when actually they were as well aesthetic and comprised practices such as photography, graphic design, and camouflage. Architectural phenomenology denotes this vague intellectual realm, and to the course whereby architects raised self-conscious of its vagueness, contesting, celebrating, testing, and using it with the drive of maintaining the certainty that architectural practice exemplified a distinctive mode of intellectuality that might not be detached from aesthetic experience. Architectural phenomenology generated different architectural standards of aesthetic, intellectual, and

historiographical ability. Phenomenology, by means of a descriptive method of subjective experience, and with an essential concern with bodily activity and perception (Ihde, 1990), allows the exploration of phenomena as they are experienced and lived (Ronald Valle and Mark King, 1978). Associated to the existentialism of Jean-Paul Sartre and Maurice Merleau-Ponty, phenomenology has demonstrated to be a way well appropriate to explore the experience of being embodied.

Pallasma offers a phenomenology of Architecture in *Geometry of Feeling: A look at the Phenomenology of Architecture* (1986, in Nesbitt 1996). Pallasmaa puts down: “The primary feelings of architecture”, created by the architecture which is a: “Direct expression of existence, of human presence in the world (...) based on the language of the body” (Pallasmaa, 1986, in Nesbitt, 1996, p 451).

As introduced by Pallasma (Pallasmaa, 1986, in Nesbitt, 1996, p 451-452):

“The following types of experience could well be among the primary feelings produced by architecture:

- a. The house as a sign of a culture in the landscape, the house as a projection of man and a point of reference in the landscape.*
- b. Approaching the building, recognizing a human habitation or a given institution in the form of a house.*
- c. Entrance into the building's sphere of influence, stepping into its territory, being near the building.*
- d. Having a roof over your head, being sheltered and shaded.*
- e. Stepping into the house, entering through the door, crossing the boundary between exterior and interior.*
- f. Coming home or stepping inside the house for a specific purpose, expectation, and fulfillment, sense of strangeness and familiarity.*
- g. Being in the room, a sense of security, a sense of togetherness or isolation;*
- h. Being in the sphere of influence of the foci that bring the building together, such as the table, bed, or fireplace.*
- i. Encountering the light or darkness that dominates the space, the space of light.*
- j. Looking out of the window, the link with the landscape.”*

Pallasmaa’s factor for evaluating the involvement in architectural spatial experience is based upon the feelings that architecture arouses in the person, and the way of perceiving and comprehending the space. And then differentiated according to distances, and point of references; for instance: the entrance, the window, in the room, (etc.). As another approach, Relph proposed insiderness and outsiderness by means of a factor of involvement in the architectural spatial experience, introduced in the coming chapter.

3.1.2 Insiderness and Outsideness

Relph proposed levels of experiential involvement based on insiderness and outsideness as factors. Seamon discusses Edward Relph's proposal for understanding structures of: "Human experience of place", in a scale between: "Insiderness and Outsideness" in Relph's book *Place and Placelessness* (1970).

Probably Relph's approach to outsideness and insiderness was his most unique contribution to the comprehension of place. The key phenomenological point is that, through the levels of outsideness and insiderness, diverse places adopt diverse identities. Differently said, Relph claimed that outsideness and insiderness establish a crucial tension in human life and that over variable intensities and arrangements of outsideness and insiderness, diverse places adopt diverse identities for diverse people, and human experience adopt diverse assets of feeling and significance.

Relph proposed that further inside a place the person feels, further will be her or his identity with that place. If a person feels inside a place, he or she is enclosed instead of exposed, safe instead of endangered, at comfort instead of stressed, here instead of there. This is the deepest sense of place experience, what Relph termed existential insiderness; a state of profound, unself-conscious immersion in place and the experience majority of people are familiar with; when they are at home in their own region and community.

And when a person might feel estranged or detached from the place, Ralph termed that mode of place experience outsideness. In this level, people feel some kind of separation amid the world and themselves. It is what he termed existential outsideness; the opposite of existential insiderness; a sense of separation and estrangement, for instance; that habitually felt by strangers to a place, or else by people who have been away for a long time from their home, then when they return, they feel strangers; for the reason that the place is not anymore what it used to be.

Relph introduced in *Place and Placelessness*, seven levels of outsideness and insiderness as factors of experiential involvement (Table 3.1). The significance of these modes, mainly in terms of self-awareness, is that they apply to definite place experiences, however; offer a conceptual structure based on which those experiences might be comprehended in wider terms.

As mentioned before, there is an intersection amid virtuality and architecture. Architecture is dealing nowadays with two types of space; a real and a virtual one. Henceforth the upcoming chapter is going to introduce the second type of space; virtuality, and its three main factors of involvement in spatial experience; presence, immersion, and movement.



Table 3.1: Relph's seven levels of insideness and outsidership for experiential involvement in Place and Placelessness, (Seamon, Modes of Insideness and Outsideness, 1996)

1. Existential insideness

A situation involving a feeling of attachment and at-homeness. Place is "experienced without deliberate and self-conscious reflection yet is full with significances." one feels this is the place where he or she belongs. The deepest kind of place experience and the one toward which we probably all yearn.

2. Existential outsidership

A situation where the person feels separate from or out of place. Place may feel alienating, unreal, unpleasant, or oppressive. Homelessness or homesickness would be examples. Often, today, the physical and designed environments contribute to this kind of experience unintentionally--the sprawl of suburban environments, the dissolution of urban downtowns, the decline of rural communities.

3. Objective outsidership

A situation involving a deliberate dispassionate attitude of separation from place. Place is a thing to be studied and manipulated as an object apart from the experiencer. A scientific approach to place and environment. Ironically, the approach to place often taken by planners, designers, and policy makers.

4. Incidental outsidership

A situation in which place is the background or mere setting for activities--for example, the landscapes and places one drives through as he or she is on the way to somewhere else.

5. Behavioral insideness

A situation involving the deliberate attending to the appearance of place. Place is seen as a set of objects, views, or activities. For example, the experience we all pass through when becoming familiar with a new place--figuring out what is where and how the various landmarks, paths, and so forth all fit together to make one complete place.

6. Empathetic insideness

A situation in which the person, as outsider, tries to be open to place and understand it more deeply. This kind of experience requires interest, empathy, and heartfelt concern. Empathetic insideness is an important aspect of approaching a place phenomenologically.

7. Vicarious insideness

A situation of deeply-felt secondhand involvement with place. One is transported to place through imagination--through paintings, novels, music, films, or other creative media. One thinks, for example, of monet's paintings of his beloved garden giverny or of thomas hardy's novels describing 19th-century rural england.

3.2 SPATIAL EXPERIENCE OF VIRTUALITY

After introducing the physical space; architectural spatiality; its spatial experience, and two selected factors by Pallasma and Relph to evaluate the experiential involvement. This chapter is going to introduce the space of mental inhabitation; the virtual. Not from a technological point of view, but rather from the point of view of its relation to architecture, and its significant role in spatial experience. Hence after; to introduce the virtual spatial experience, and the main factors of its experiential involvement: presence, immersion, and movement.

The concept of virtual spatiality would involve more than experience a presumed dimension of its own, assumed that the forces composing it; mostly contained in the spatial institute of the world, and expressed by it; are by their turn rambling. Subsequently spatial organization of the world is the responsibility of architecture; therefore it performs a fundamental role termed the virtual of architecture, in the establishment of the human subject, at both the level of its awareness and its depictions. From the viewpoint of the virtual of architecture, as Heidegger would have set it, the individual is not simply always already thrown into existence, but rather always already built into existence. Architecture does not intricate aesthetic, theoretic, practical suggestions in space, nevertheless turns into the demand of opportunity for the interpretive interchange among the environment, others, and the individual self. It is this interchange that makes the human subject a being in the world. Referring to Heidegger's language, the virtual of architecture adopted the way in which, we come crossways ourselves; explicitly in a world that is not just merely there for us, nevertheless is the historical, social, and cultural configuration of our world, that is delivered to us over the organization of the space in which we live. The traditional arrangement of architecture rigorously limited by distinct aesthetic, requests reconsideration, meant for architecture constructs us as much as we construct it.

Virtuality is not a technologically maintained experience, neither the depiction of a more basic reality situated before virtual reality. Virtuality is not the depiction of an inventive presence, nonetheless phenomenologically eloquent of the ultimate intricacy of experience; which comprises individual and mutual memory, as well as imagination

and common activity. Virtuality adds a different dimension of experience, grounded on virtual spatiality instead of on space. Virtual spatiality does not play the role of space, as much as it does not dispense forms with independent steadiness and material. Whereas space is the receiver of forms, virtual spatiality is the initiator of forms. The present is penetrated from the past and not the inverse, so that experience is the continuous reconsideration of the present according to the past. In concrete experience, as Bergson designates it, the form is not inserted into space as if from some ethereal, eternal, geometrical outer, nevertheless occurs from the multiplicative procedure of its own creation and distortion. Experience, according to Bergson, cannot be diminished to neutral descriptions. Experience comprises a virtual dimension that questions an entire range of philosophical classifications and architectural assumptions. The space of mental inhabitation is the virtual; it advocates to the individual a further dimension through granting the one a virtual environment, where the one becomes the performer. A virtual realm is the substance of a given milieu; it can occur only in the mind of its inventor, or be communicated then shared with others, moreover, it might occur without being displayed in a virtual reality system. The strength of experience of space resides in the potentials it involves as unmediated presence, immersion, and movement, all descent within its sphere.

Virtual worlds are enabling experiences that were not previously available through other media. One such experience is the potential to have a sense of inhabiting the simulated spaces they offer, not just through the use of the player's imaginative faculty, but also through the cybernetic circuit between player and machine. This phenomenon has been described by the terms "presence" and "immersion". The phenomenon these two terms have been enlisted to describe is crucial to our understanding of the relationship between user and virtual world, as it represents one end of a continuum of intensity of involvement with virtual worlds and addresses the very notion of being in the context of such simulated environments.

3.2.1 Presence

“A body only exists to be other bodies” (Burroughs, 1970, p: 28), being is a compound attribution. As a dominant metaphor within the conception of being, space delivers an origin of debate; such as dilemma, having enough abstruseness to permit the dissertation to drift between an abundance of real and virtual spaces, among for instance, the outer space, the space of the imagination, cosmic space, space of the screen, and accurate three-dimensional physical space. There can be no concept of presence without space within an environment, neither, can there be the chance for the reality that being-in-the-world permits. Virtuality delivers the physicality of interactive environments. Virtuality positions itself as fragment of a widespread scientific shift that would reoccur the body to the mind.

The defining elements of virtual reality, for instance; interactivity and vividness, impact the level of spatial presence (Steuer, 1992). Vividness denotes the technological capability to create a sensor-reality rich mediated environment. This comprises stimulation of any arrangement of the senses of perception, along with elements for instance: depth of music or audio, vibrancy and range of colors, and the capability to draw one into the presented environment. Interactivity denotes as stated by Eriksson (2016, p: 38) the level to which users of a medium might impact the content or form of the mediated environment. This comprises together; the capability of the environment to react to user input (responsiveness), and the capability of the user to react to the environment (interaction). Interactivity has as well been explained by other scholars with reference to functionality, or the level of contingency and multimodality, or the level to which interactions are founded on preceding interactions (Brown, Kalyanaraman, Sundar, 2003). Advanced levels of interactivity and vividness might induce users to become more involved in the provided content, which is of significance to the user. There are numerous additional crucial elements that have impact on the level of spatial presence virtual environments can generate. Elements for instance; engaging narrative, the capability to represent oneself within the environment, ease of use, and persistent real-time feedback level, which is high amid the many elements that might have impact on presence. Each of these elements might enhance the virtual experiences, making them progressively engaging. When spatial presence is attained, it

mediates the effects produced via virtual experiences.

Though presence has been issue to abundant deliberation over time, besides now even groups implicated in considerable of the primary description work, are determining to acknowledge diverse terminology; for example place illusion for the kind of presence that affords: “A strong illusion of being in a place in spite of the sure knowledge that you are not there”, then plausibility illusion that attribute to: “The illusion that the scenario being depicted is actually occurring” (Slater, 2009, p: 35-49). Presence is an abstract concept, allied with the mind of the user. Referring to Slater and Wilbur: “Presence is a state of consciousness, the psychological sense of being in the virtual environment”. Presence is when the different simulations (sounds, images, haptic feedback, etc.) are treated via the brain, then comprehended as an articulate environment, in which we might interact and execute some activities. Presence is attained when the user is aware, intentionally or not, of being in a virtual environment. An indication of presence is when people act in virtuality in a manner that is adjacent to the manner they would act in a like real-life situation. Consequently, presence in virtuality is not the depiction of a basic presence.

Moreover; presence is distinct as the psychological perception of being there, within a virtual environment (Waterworth et al. 2012). The main consequence of this approach is designations of presence alike the perceptual illusion of non-mediation (Lombard and Ditton, 1997), created through the disappearance of the medium from the aware attention of the user. Differently said, presence might be described as the utter individual experience of being in a given environment; the feeling of being there; that is the creation of an instinctive experience founded on metacognitive judgment (Riva, G., Mantovani, F., 2012). Intended for, as beings inside the representative where our being is represented by means of signifiers. We already have abandoned the real, the material substance of the universe; reality is therefore, itself virtual: we are beings of significance, not merely being.

Presence; or feeling of being there in the virtual environment; is most likely, the crucial ambition of virtual reality studies. This requires a diminished consciousness of reality, then an intensified reception of the surrounding virtuality. Virtual reality’s hardware should fade, and become transparent, for this kind of presence; the experience of being completely present within the computer engendered simulation to occur. Mark Lajoie

(1996, p:163) asserted that : “To the extent that the terminal, as an interface, acts as an object, it is a constant reminder to the user of their inability to become fully subject in the virtual space; in effect, it marks their lack of presence as subject within the virtual reality”. Presence is a bi-constant psychological phenomenon connected to the subject’s sensation of being in the virtual and/or real world. Accordingly, presence is comprehended by means of the behavioral effects of immersive environments. It implicates seeking the motor, cognitive and perceptual position of the subject, amid the virtual and real worlds. Hence, it takes into consideration both the real and the virtual worlds, and should be determined by way of a dynamic concept by nature. Referring to Lombard and Ditton (1997), presence is designated by way of the sensation of being situated in the virtual world, or even by way of a sensation of non-intermediation amid the virtual world and the subject. Through questionnaires, the notion about the presence sensed by the user is elucidated. Most regularly, questionnaires are similar to visual analogue scales, requesting from the subject to assess features alike his sensation of being in the virtual environment, the degree of control that he has in the virtual environment, or even its reality.

As stated by Grimshaw in The Oxford Handbook of Virtuality (2014, p: 216):

“Presence has three critical features that cannot be explained by other cognitive processes (Riva and Mantovani 2012):

First, presence is an intuitive process: only when we are able to use our body or a tool intuitively can we be present in it or in the space surrounding it. In other words, “intuition” can be the psychological translation of the concept of “transparency” that is behind a significant part of the theoretical reflection on presence.

Second, presence provides feedback to the self about the status of its activity: the self perceives the variations in presence and tunes its activity accordingly.

Third, presence allows the evolution of the Self through the incorporation of tool: tools do not enable us only to extend our reaching space, but when successfully mastered become part of a plastic neural representation of our body that allows their use without further cognitive effort (intuitively). In this way we can focus our cognitive resources on actions that are not only related to the here and now, improving the complexity of our goals (Damasio 2010; Riva and Waterworth 2003; Riva, Waterworth, and Waterworth 2004).”

Concluding presence is designated by way of all the behaviors, from complex behaviors to verbal contacts, going through physiological feedbacks, which are perceived when the user encounters the environment.

3.2.2 Immersion

A coming back to the experience of embodiment is required to elucidate the comprehension of presence in virtual environments. The influence that virtual reality ensures on the body's experience is less explored or assumed. So as to completely comprehend in what manner a user experiences the body in virtual reality, and so as to ascertain the: "Phenomenological dimensions of the technologically mediated body" (Balsamo, 1993), a user embodiment phenomenology is necessitated. This might arise over and over with a qualitative, complete study, of reports from users considering their immersion; via a detailed examination of virtual reality confrontations; and a complete surveillance of the user at play.

The literature of Virtual reality contains numerous descriptions of users; responding to a virtual environment in intuitive behaviors; that indicate they believe, even if for a short time, that they are immersed and even present in the synthetic experience. In the ground of computer graphics, immersion is usually assumed to be a technological product that simplifies the production of the multimodal sensory input to the user.

However the conceptualization and comprehension of immersion is facing some challenges summarized by Grimshaw in *The Oxford Handbook of Virtuality* (2014, p: 230-231) in four principals:

"Immersion as absorption versus immersion as transportation: There is a lack of consensus on the use of immersion to refer to either general involvement (Salen and Zimmerman 2003; Jennett et al. 2008; Ermi and Mäyrä 2005) in a medium or the sense of being transported to another reality (Murray 1998; Laurel 1991; Carr 2006). This is particularly problematic when researchers do not clarify which one of these terms they are using or when they oscillate between the two within the same study (Brown and Cairns 2004; Cairns 2006).

Immersion in non-ergodic media: For a precise formulation of both immersion as absorption and immersion as transportation we need to acknowledge the specificities of the medium in question. In this case, immersion in ergodic and non-ergodic media is simply not the same thing. The challenge of addressing a complex and preconscious phenomenon such as immersion as transportation is increased considerably if we try to extend the concept to multiple media with considerably varied qualities and affordances for engagement.

Technological determinism: Although specificities of the medium are crucial for our understanding of the experiences they afford, we should avoid seeing such experiences as being determined by the qualities of the technology. A bigger screen and a higher fidelity of representation, for example, might make it easier to focus and to retain one's attention on the representation, but this does not necessarily mean that users will feel more present in the environment portrayed.

Monolithic perspectives on immersion: The principal reason for the previous challenge is that both immersion as absorption and immersion as transportation are made up of a number of experiential phenomena rather than being a single experience we can discover and measure. The various forms of experience that make up involvement need to be considered on a continuum of attentional intensity rather

than as a binary, on/off switch.”

Concluding, immersion might be designated by way of all the objective features of a virtual environment, which target supplying the user with the possibilities and sensory stimulations to act in it. It is determined with consideration of two environments; the virtual environment and the real environment. The examination of the behavior of the subject accordingly makes it conceivable to ascertain if he is acting according to the virtual world or the real world.

3.2.3 Movement

The virtual space is a sort of spatiality that ensures diversification and movement as its dominant assets. Direction and movement split transversally across the difference amid objective and subjective.

Virtuality has numerous aspects that associates toward generating a particular unique milieu. These aspects comprise the capability of manipulating the matter of space and time, the possibility of interaction and of numerous instantaneous participants, besides the ability for participants to initiate the story together into a single milieu, generating the possibility for an active relationship amid the participant and the milieu. Likewise, virtuality application can behave towards space in a range of ways: space might be vast, literally infinite, or else restricted to a small area, such that whatever the user might want to control or perceive is in the extent of the tracking technology. In bigger spaces, users have the ability to navigate the space in various methods, as designating wanted gesture via directing their finger in the way they desire to go. Space navigation contains as well a component of time; so as each method of navigation might permit movement over the realm at diverse rates. An immaterial method of navigating over space might be to permit the user to merely point to a place on a map and go there immediately, without passing via time in the real or virtual worlds. Equally with other media that are transferred over time, virtuality contains an abundant amount of flexibility in the manner of treating time and space. The manipulation of time might extend from ensuring no concept of it, to holding it stable, to allowing it to run at the same speed as our regular experience. Virtuality might even permit the user to manipulate time in both

speed and direction, or permit them to jump to a specific point in time. Dictionaries define the virtual in everyday life as: “That which is so in essence but not actually so”, hence, we communicate about tasks which are virtual complete. Philosophically, the virtual internments the nature of objects and activities which happen, yet are immaterial not concrete, therefore the virtual is real but not concrete. Marcel Proust in his correspondence on the remembrance of time past as virtual, defined the past, memories, and dreams by: “Real without being actual, ideal without being abstract” (Proust, 2003, p: 264).

When a subject is in a virtual environment, he has to perform one or more activities. This is termed the virtual behavioral primitives; it is divided into sensorimotor activities, cognitive activities, and elementary activities.

Fuchs, P., Moreau, G. And Guitton, P. in *Virtual Reality: Concepts and Technologies* (2011, p: 26) grouped the virtual behavioral primitives under four categories, defining each of them, and specifying the movements accomplished in each category:

- a. Observing the virtual world**
- b. Moving in the virtual world**
- c. Acting on the virtual world and**
- d. Communicating with others or with the application**

“In the first category (observation), the subject is almost always technically passive in the virtual environment, (...) passive in the sense where he does not use the hardware device to search the sensory information in the virtual environment. (...) In the case of observing the virtual world, we can have multiple subcategories of VBP³ depending on whether the observation is visual, auditory, tactile or a combination of these senses; depending on whether the subject needs to understand the environment or to orient himself with respect to this environment.

In the case of movement, there are several subcategories of VBP made according to the type of movement: 1D path (in a straight line or in a curve), movement on a surface (plane or otherwise) or within a space. The subject can move by changing the direction or even without changing the direction. In the case of an action on the virtual world, we can have multiple subcategories of VBP: handling an object in translation motion (3DOF), adjusting an object in rotation (3DOF), both actions together, bending an object or assembling multiple objects.

In the case of communication, we can have multiple subcategories of VBP: communicating with other users, communicating with virtual characters (virtual avatars or clones) or communicating with the application (...).”

³ VBP: Virtual behavioral primitives (Virtual Reality: Concepts and Technologies, 2014, p:26).

4. MATERIALITY IN ARCHITECTURE

As materiality is one of the major aspects of architecture, this chapter is investigating the architectural materiality, the challenges it is facing, its aspects, and perception.

The architect and theorist Juhani Pallasmaa approached the progression of construction not only as an extension of material assets but moreover as an extension of the human body. In the *Eyes of the Skin: Architecture and the Senses*, Pallasmaa (2012) asserted: “Construction in traditional cultures is guided by the body in the same way that a bird shapes its nest by movements of its body. Indigenous clay and mud architectures in various parts of the world seem to be born of the muscular and haptic senses”. Using this approach Pallasmaa criticized what he considers as an over reliance on the visual sense in architectural design rather than on the tactile. According to Pallasmaa, inhabitants became “spectators”, experiencing architecture alike experiencing an image, which causes a privation of tactile, intimate, bodily association to the work. Furthermore Pallasmaa stated that: “The current overemphasis on the intellectual and conceptual dimensions of architecture contributes to the disappearance of its physical, sensual and embodied essence”, besides that contemporary architecture needed to strengthen material assets of weight, texture, and time.

The user⁴ resolve whether architecture is immaterial, nevertheless, the architect generates circumstances in which that conclusion can be made, together are inventive. The utmost architectural questions, conversely, were not concerned about the material nevertheless about use and scale. “How can a material object like a building impinge directly on human behavior?” On one hand, architecture is concerned about the bringing together of materials. On the other, architecture is concerned about gathering spaces. “Experience, for Bergson, cannot be reduced to objective descriptions, a possibility implicit in Descartes’s pursuit of the dichotomy between internal and external, form and space. Experience contains a virtual dimension that calls into question a whole range of philosophical categorizations and architectural presuppositions.” (Giovanna, 2000)

Experience, in immaterial architecture western dissertation, relies on the dualistic

⁴ Within the term ‘use’, the complete assortment of behaviors; in which cities and buildings are experienced; is included.

opposition of expressions; one superior, the other inferior; that are supposed to be detached and distinctive, one 'external to the other', for example immaterial philosophy and material architecture. However, such expressions are essentially inter-reliant and attached, declining dualistic dissertation. Concealed within one another, the expressions material and immaterial distort and fade, inquiring other expressions such as; form and formless, intellectual and manual, real and virtual. One acquainted meaning of the immaterial relates to the realm of ideas. Subsequently the eighteenth-century thoughts have more frequently been founded in experience, and interpretations have more frequently been personal.

The immaterial architecture suggested in this thesis is less the absence of matter than the apparent absence of matter. Whether architecture is immaterial or material is reliant on perception, which implicates inventive interpretation, fictions rather than facts. Binding immaterial architecture to perception, emphasizes concern on the: capacity to just perceive one perceiving, and the associations between architectural spaces, and users. Pallasmaa states that: "Instead of mere vision (...) architecture involves realms of sensory experience which interact and fuse into each other". As mentioned before; the appreciation of immaterial architecture is particularly compound, besides a challenge to the acquainted experience of architecture.

The practice of architects is estimated to be, as comforting and solid, as their buildings. Regarding immaterial architecture, consequently, architects are comprehensibly vigilant. On a further essential note, immaterial architecture exposes in assets –the random, subjective, momentary and porous– that are opposing the solid, the reputable and objective practice estimated of an architect. The practice of architects requires replicating the essence of the architectural discipline. According to architects; trapped amid the material object and the immaterial idea, the solid expert and the innovative artist; referring to Hill (2006, p: 75) architecture should be constant and solid, as well as spatially porous and immaterial, hence should the practice of architects. Other architectural makers, such as artists, are as reliant on the rank of immaterial ideas, however might encounter minor pressure to create from a solid practice solid objects. Immaterial architecture is a particularly keen and gratifying challenge to architects; since it powerfully provokes what they produce and practice.

Vitruvius (Ten Books on Architecture, 1914, Chapter: 1, The Education of the

Architect) supposes that some architects are chasing the shadow, however not one restricted to or by theory. Chasing the shadow, chasing immaterial architecture, is a significant and inventive architectural tradition revitalized through theory. The greatly persuasive concept that ideas are superior is a modest preconception. One might either neglect it, concluding that its consequence on architecture is unfavorable; as it rejects the solidness and materiality of architecture. However, the devotion to make architecture immaterial should not be unquestionably rejected. It has further drives and positive effects, as well as an extended tradition. Vitruvius positions the beginning of architecture in a primitive shelter made of solid matter, while Semper links it with a spatial, domestic enclosure that is barely material. Yet, they come to an agreement that an immaterial and momentary power anticipated architecture, toward becoming its center.

During the renaissance, the building was associated with the immaterial over the ideas it bestowed, which considerably designated form rather than matter. And Jacques Derrida and Peter Eisenman explored the idea that the absence of material is not certainly the equivalent of the absence of sense. Architecture is constructed into philosophy, whether in spatial allegories such as exterior and interior, or in insinuations to philosophical dissertation; as a rigorous edifice based on concrete grounds. Concealed within one another, the expressions immaterial and material distort and vanish, inquiring additional terms such as, virtual and real. One acquainted comprehension of the immaterial denotes the milieu of ideas. Few people today approve Plato in that matter is exhibited over supreme forms; however, the majority is relating the immaterial to the intellectual. Contradicting Plato's combination of forms and ideas, the immaterial is occasionally related to the formless, from which some of its captivation originates, "but the formless is not the absence of order; it is ordered that is unacceptable" (Douglas, p: 104).

Modern architecture is valued as an innovative process, which no longer forces form to the material as a subordinate to architect's ideas, however it is considered as a measure of a vigorous development, in which random accumulations of natural agents interrelate considerably with the form to occur. The potentials of this occurred architectural form are not valued according to their scenography presence; as an eloquent performance, but according to their performance, and structural competence configured over a bottom-up procedure of material creation. The route of the materiality of architecture might be

trailed on the diagram: from the idea, to the assembly of materiality. Any separation of architectural materiality from its abstract references is completely dismissive.

Architecture puts the materials together. Architects since Vitruvius to le Corbusier, Alberti to Wright, and Viollet-Le-Duc to Kahn, have debated over the significance of materiality in architecture. No theorist writing on the fundamentals leading materials in architecture has had a better gratefulness; for the intrinsic assets of building matter, than John Ruskin. Monumental buildings replicate the essential forms of a primeval, nevertheless instable construction in enduring and noble materials. Developments in material and construction technologies; explicitly innovative forms of iron; were the chief substances of architecture innovation. Some theorists and architects opposed that innovative methods of construction would, and should lead to original architectural uses, forms, and spaces. Others, loyal to traditional architecture sensed that technological developments disconcerted the objectivity and lucidity of the discipline, which was a challenge to the doctrines of classical architecture. However, there were some supporting hybridization, an association of traditional and new, technologies, forms, and architectural materials.

Innovative materials permitted the appearance of diversity in effects, structures, and forms. Since heavy materials have become light; transparency and opaqueness have set the way to translucency; besides form, structure, and space have become gradually more detached from one another. While Ruskin expressed his trepidation, and anxiety concerning the usage of innovative materials, Viollet-Le-Duc proclaimed that the usage of present-day technologies and materials played a role in producing architecture of 'the present day' and of 'originality'. Still, each intermediate phase should have a limit; it should lean towards a purpose of which we get a preview only when, exhausted of exploring in a disorderly mass of materials and ideas transported from each quarter, we set to work toward untangling some values from this chaos; toward evolving then applying them by way of a defined method. We should be capable to set the ground of architecture of our time.

If the traditional assignment of architecture is that of designing the physical material environment, the incorporation of virtual worlds within the real built space turn out to be a design concern, not from a common technological perspective, but rather with a different attitude defending virtuality as a potential to expand architectural spatial

experience. Through consuming virtuality feature immaterial; that is beyond the traditional approach to architectural materiality; generating an architecture that does not advocate any specific sorts of material spatial experiences, but rather permits them all. Immaterial architecture stimulates an architecture that combines the material and the immaterial, then deliberates its effects, challenging preconceptions concerning architecture, its substance, drive, usage, and exercise...Accordingly that they are in juxtaposition, rather than opposition.

The computer advocates a different displacement of materiality and physical experience, engendering a variety of experiences. The computer permits the manipulation of immaterial phenomena; for instance texture and light; so that they procure to the architect the eminence of quasi-objects. Rather than discarding materiality, the computer is re-determining it all for the persuasion of untainted images. Furthermore; materiality is progressively distinct through the juncture of two deceptively contrasting groups. On the one hand is the entirely abstract founded on codes and signals, on the other hand is the over-concrete including a severe and nearly compulsive comprehension of material assets and phenomena; for instance texture and light as they are exposed by zoom-like implements. This hybridization amid the over-material and the abstract depicts the new world of movements and perceptions that we are introduced to today.

The actual challenge to today's architectural materiality is not so considerably its conceivable dematerialization, but rather its lack of a distinct clear political and social outline. Rather than exhibiting a challenged aspect of architectural design, materiality will persist as an abundant concern. It is a perpetually detained notion that architecture basically accord with the creation and arrangement of space over material usage. Conventionally, architecture has been engaged to define and answer social circumstances by material usage and spatial configurations. Because of its inflexibility of materials, approaches, techniques, and limitations, architecture was not anymore able to perform its major roles. Therefore the next subchapter is investigating the materiality aspects in architecture, and their displacement.

4.1 ASPECTS OF MATERIALITY IN ARCHITECTURE

Weston observed that: “The classical view that forms were independent of the matter was no longer tenable, and from the early eighteenth century onwards scientists and engineers began to devote increasing attention to understanding and quantifying properties of materials” (Weston, p: 70). During the nineteenth century, the supposition that a specific tectonic language is conferred within each material became acquainted in architectural treatise.

This intensified concern about materiality; the experienced reality of materials, directed toward a search for corresponding assets of immateriality. Architects hunted methods to carry material assets, such as opacity or heaviness, together with immaterial assets, such as translucency or lightness, what Hill (2006) designated as: “An architecture that fuses the immaterial and the material (...) so that they are in conjunction, not opposition”. In *Immaterial Architecture*; Hill (2006) proclaimed that:

“Architecture is expected to be solid, stable and reassuring physically, socially and psychologically. Bound to each other, the architectural and the material are considered inseparable. But (...) the immaterial is as important to architecture as the material and has as long a history.”

When it is recognized by means of the formless, the immaterial is related with all that seems to intimidate society, the home and architecture, being threatening and chaotic.

Architecture should involve the immaterial besides the material, the porous and the solid, the fluid and the static. An architecture that is immaterial and spatially porous, as well as stable and solid where indispensable, will not alternate traditional practices. Rather it might propose those practices more flexibility. Fundamentally, immaterial architecture divulges in assets the momentary, porous, random, and subjective that is opposing the solid, reputable and objective practice estimated of a professional. Immaterial architecture is a particularly fulfilling and poignant challenge for architects; as it intensely provokes what they create and exercise. The architect trapped amid; the material object and the immaterial notion, the concrete professional and the inventive artist. What parallel architecture with the immaterial are notions such as; design of surfaces and spaces, knowledge of drawing, and the preeminence of ideas over matter.

All what mathematical terms could not express was considered to be extraneous,

subsequently not only the material assets, but all the assets of living entities that could not be perceived and measured by means of scientific methods were ignored. Therefore, Galileo constructed the world in which merely quantifiable matter was pertinent; consequently material assets come to be immaterial, becoming a redundant forecast of the mind (Mumford, 1974). Hence, features were autonomous of the material, or else as stated by Alberti: “It is quite possible to project whole forms in the mind without any recourse of the material” (Alberti, p: 7). Thus, as Alberti suggested an architectural conception of form stimulated by theory (Madrazo, 1995), he promoted an architectural comprehension in which materials lost their ability to perform as form-making inputs; an architectural form-outcome diminished to intellectual processes, to lucid dogmatic rules in which material assets are neglected.

The expanding usage of reflective glass in architecture emphasizes the illusory sense of alienation and unreality. The opposing opaque transparency of these buildings returns the look unmoved and unaffected; making the viewer incapable of envisaging or seeing the life behind these walls. The architectural mirror, that reflects the look and duplicate the world, is a perplexing and fear-provoking instrument. The machine-made materials of nowadays scale less panels of glass, synthetic plastics, and glazed metals tend to exhibit their inflexible surfaces to the eye deprived of their age or material essence. Buildings of this technological phase, generally consciously target timeless perfection, and they do not include the time aspect, or else the inevitable and spiritually considerable processes of aging.

During the renaissance period, architecture was not perceived as an independent realm of artistic expression but as mediation between the universe and man. The architectural literatures of the late eighteenth and early nineteenth centuries regarded the language of architecture dualistically. Some writers required that architecture ought to be abstract; while others viewed architecture as an imitative art of nature. In both perceptions, the metaphysical dimensions, along with the centrality of the human body and the senses, were vanished. Instead of seeking to generate striking visual objects that evoke awe and approbation, thoughtful architecture seek at rooting us in our very real world, and releasing our senses for an independent and authentic fronting with the world. A thoughtful concern of the neglect of the sensory realm, has risen from, the apparent experiential impoverishment and mental meaningless of present-day standard buildings.

This reintroduced concern in the multisensory essence of architecture has risen among committed architects, architectural writers, and educators. Numerous of nowadays internationally known architects of diverse artistic persuasions, such as Tadao Ando, Peter Zumthor, Steven Holl, Rick Joy, Tod Williams and Billie Tsien, John and Patricia Patkau, and Kengo Kuma, have stated their clear interests in the sensory assets of architecture. Their buildings are habitually; properly; intentionally; modest in command to reinforce and emphasis sensory experience of materiality. While their architecture provide, open poetic images instead of intended sentimental effects.

4.2 PERCEPTION AND EXPERIENCE OF MATERIALITY IN ARCHITECTURE

Throughout considerable architectural history, architects concentrated on qualities of durableness, heaviness, and solidness. Conversely, innovative materials have allowed innovative qualities; transparency, ghostly or invisibility, lightness, movability. Demonstrated by Diller and Scofidio's (2002), in the Blur building (Figure 4.1) where the main building material was fog, the investigation of immateriality in architecture is moderately new. Drastic innovative materials like this will regularly modify architectural space and form. Although it is motivating to wonder how architecture will adjust to material innovation, it may be more captivating to demand how human perception will alter as we play, work, and live in this innovative material and immaterial environments. The term architecture has numeral meanings such as; it is a matter, practice, and a particular sort of object and space. This thesis takes into consideration each of these definitions, yet concentrates on another; Architecture is a particular sort of space used. Within the term used, the complete assortment of behaviors in which cities and buildings are experienced, is included.

Figure 4.1: The Blur building; a media pavilion for the Swiss EXPO 2002 at the base of Lake Neuchatel in Yverdon-les-Bains, Switzerland



Source: Pinterest. (2016). rezultat iskanja slik za http://www.cliphitheryon.com/images/jpg/architecture/Blur_2.jpg. [online] Available at: <https://fr.pinterest.com/pin/348325352406414281/> [Accessed 7 May 2016].

Contemplation of art has traditionally been mainly an aspect of visual awareness, of a particular object by a particular spectator, in which the main senses; sound smell and touch; were as much as possible eliminated. The artwork positioned in an enclosed area, then protected from aging, is appreciated yet not used. The spectator leaves no trace or mark, since; touch would reduce the artwork's prestige as an idea, then; associate it to the material world. Contradictory, daily uses expose the building's materiality; it is touched, marked and scuffed. The concept that ideas are superior to matter is challenged by, the usual and tactile experience of the building, restricting its status as an art object. Nevertheless, to confirm the equal status of the architect to the artist and architecture to art, the experience of the building is frequently paralleled with the contemplation of the artwork in a gallery. Founded on art history, architectural histories frequently confer the building as an object of artistic contemplation, and suggest that this is the acquainted experience of the building. The reader is encouraged to perceive the drawing as the origin of creativity, then to consider the experience of the drawing parallel with the experience of the building. However; the perception of architecture as art is not definite, but relating on experience; a communication between the material environment, interpretation, senses, memory, and knowledge. Porter (Enlightenment, p: 163) to

defend the rational status of art, Italian renaissance artists acknowledged the status of immaterial geometry nevertheless diluted Plato's argument that the artwork is constantly mediocre to the idea it illustrates. Instead, they claimed that it is conceivable to articulate an artistic idea in the mind, create the direct visual expression of an idea, then that an artwork can illustrate: "An otherwise unknowable idea" (Forty words and buildings, p: 31)

Whether architecture is immaterial is reliant on perception, which implicates inventive interpretation, fictions instead of facts. Gregory states that: "visual and other perception is intelligent decision making from limited sensory evidence. The essential point is that sensory signals are not adequate for direct or certain perceptions, so intelligent guesswork is needed for seeing objects" (Gregory, p: 1), accordingly, infiltrated through memory: "Perceptions are hypotheses. This is suggested by the fact that retinal images are open to infinity of interpretations" (Gregory, p: 10). Associating immaterial architecture to perception emphasizes consideration of the: "Capacity to just perceive one perceiving" (Turrell, 1992, p: 48), besides the relation amid users, spaces, and architectural objects.

Pallasmaa states that: "Instead of mere vision (...) architecture involves realms of sensory experience which interact and fuse into each other". The appreciation of immaterial architecture is particularly compound, besides a challenge to the familiar experience of architecture. The abundance of the experience of any building relies on responsiveness of all the senses, nonetheless immaterial architecture might generate a sense frequently related with the immaterial, for example smell, and question one more frequently related with the material, for example touch. Hence; the experience of immaterial architecture is founded on opposing sensations; relating to both materiality and immateriality; besides is proper to a dynamic and inventive commitment with architecture. The intricacy of the whole experience relies upon the user's interpretation of what is present and absent. Toward experiencing the whole character of the contrast, necessitates accordingly, a comprehension of the encounter, whether pleasant or not, besides conjecture on an imaginary space or object. The Emphasis here is on immaterial architecture not as the actual absence of matter, but rather as the perceived absence of matter, through conceiving innovative funds to discover longstanding concerns; the originality of the user and the architect. The user decides whether architecture is

immaterial or not, however, the architect or any other architectural maker provides material circumstances; based on which that decision is done. Moreover, Hill (2006) contested that immateriality was a query of individual perception: “The user decides whether architecture is immaterial or not”.

The governance of the visual sense; denoted in philosophical thought; is correspondingly patent in the development of western architecture. Greek architecture, through its sophisticated tools of visual rectifications, was already extensively sophisticated for the eye’s pleasure. Nevertheless, the favoring of vision does not essentially infer a denunciation of the other senses, for instance materiality, the haptic sensibility, and imposing weight of Greek architecture ascertains the eye calls then stimulates tactile and muscular sensations. The visual sense might evokes, and even strengthen other sense modalities; the unconscious tactile constituent in vision is especially significant and very existing in historical architecture, however gravely ignored in today architecture. Western architectural theory, ever since Leon Battista Alberti, has been predominantly involved with inquiries of visual perception, scale, and harmony. The visual sense masters its governing role in the practice of architecture, both intentionally and unintentionally, only progressively with the appearance of the notion of a bodiless viewer. The viewer turns out to be isolated from an embodied connection with the environment by the denunciation of the other senses, specifically via means of technological additions to the eye, and the propagation of images. As Marx W. Wartofsky asserts: “The human vision is itself an artifact, produced by other artifacts, namely pictures.”

The experience and apprehension of architectural form have constantly been examined via the composition laws of visual approach. Correspondingly, educational philosophy has comprehended architecture largely in terms of vision, accentuating the creation of three dimensional visual images in space. As a result of the occurring flood of images, the current time architecture frequently looks as the utter retinal art of the eye, hence concluding an epistemological phase that commenced in Greek architecture and thought. Rather than experiencing our presence in the world, we regard it from outside as viewers of pictures projected on the retina’s surface. David Michael Levin adopts the expression frontal ontology to designate the dominant frontal, concentrated and fixated vision. As buildings drop their plasticity, and their association with the perception and

language of the body, they turn out to be separated in the distant and cool dimension of vision. With the lack of haptic sense, details and dimensions shaped for the human body; and especially for the hand; structures of architecture become sharp edged, hideously plane, unreal, and immaterial.

Transparency and feelings of flotation and lightness are significant matter in architecture and modern art. In modern times, an innovative architectural imagery has occurred, which utilize reflection, degrees of transparency, juxtaposition and overlap to generate a sense of spatial thickness, along with refined and varying perceptions of light and movement. This innovative sensibility suggests an architecture that might convert the relative lightness and immateriality, of current technological production, into a positive experience of space, sense and place. The reduced experience of time in the environments of nowadays has overwhelming mental effects, as asserted by the American therapist Gotthard booth: “Nothing gives man fuller satisfaction than participation in processes that supersede the span of individual life”. We acquire a mental demand to comprehend that we are entrenched in time continuousness, and in the manmade world, it is the responsibility of architecture to enable this experience. Architecture accustoms unlimited space and allows us to occupy it; however it would similarly accustoms infinite time and allows us to occupy the continuum of it. The present over-accent on the conceptual and intellectual architectural dimensions devotes to the vanishing of its sensual, embodied, and physical essence. Contemporary architecture posturing as the avant-garde, is more frequently involved in the discourse of architecture itself, and outlining the conceivable peripheral regions of the art than reacting to human existential queries. This diminutive emphasis contributes to the upsurge of a sense of architectural autism, an adopted and independent discourse that is not found in our common existential reality.

Further than architecture, largely the contemporary culture is sliding in the direction of an estrangement, a sort of thrilling de-eroticization and de-sensualization of the human relationship to reality. Likewise, sculpture and painting appear to be dropping their sensuality; rather than engaging a sensory relationship. Humans are meant to exist in a fictitious fantasy world; this thesis simply indicates that a noticeable change has arisen in our perceptual and sensual experience of the world, one that is represented in architecture and art. The plea of an architecture that has a liberating or therapeutic role;

rather than emphasizing the corrosion of existential significance; ought to be revealed on the multiplicity of clandestine means in which the art of architecture is related to the mental and cultural reality of its period. It should as well take into consideration the manners in which the practicability of architecture is being endangered or disregarded by current cultural, political, economic, perceptual, and cognitive progresses. Architecture has grown into a threatened sort of art. Land artists merge the reality of the lived world with the reality of the work, to conclude, artists alike Richard Serra openly call the body along with our experiences of verticality and horizontality, weight, gravity, and materiality. The identical countercurrent in contradiction of the domination of the perspectival eye has occupied place in modern architecture despite the culturally favored rank of vision. The tactile and muscular buildings of Alvar Aalto, Louis Kahn's architecture of gravitas and geometry, and the textural and kinesthetic architecture of Frank Lloyd Wright are specifically compelling examples of this. The anthropologist Ashley Montagu states: "We in the western world are beginning to discover our neglected senses. This growing awareness represents something of an overdue insurgency against the painful deprivation of sensory experience we have suffered in our technologized world". This recent consciousness is vigorously anticipated via many architects around the world nowadays who are trying to re-sensualize architecture over a reinforced sense of hapticity and materiality, weight and texture, materialized light and density of space.

The perception of a transitional phase in contemporary architecture implies the occurrence of innovative conceptions of materiality and nature, motivated via the innovative materials and methods that are being discovered and adapted throughout this transition. Currently, via digital technologies, the exploitation of information as a raw material in the production course arose the conception of an innovative materiality (Castells, 1996). Hence, as the 19th century, the emergence in architecture of an innovative materiality has been interrelated with the evolution of productive methods promoted through technological advancement. Then through it architectural advances associated to innovative materials; contemporary materiality; such as a consequence of the mass production of materials for construction improved via the industry, and digital materiality; such as a consequence of encoding intangible and tangible features of the physical world, into algorithms which are used as protocols in the production of

architecture via computational methods.

During the 1990s, the perception of digitalization was closely associated with the idea of shifting material substances from the physical world to virtual reality. Similarly, throughout this period, utmost architects were confined by the ambiguous antagonism amid the virtual and the real; frequently using the virtual term to refer to the simple and pure absenteeism of presence, while assuming reality as a perceptible presence and a material accomplishment (Lévy, 1998). As indicated by Manuel Castells (1996), matter comprises nature; nature changed via humans, nature manufactured via humans, then human nature itself. Accordingly, the perception of matter surpasses that of nature, such as reflected in the political and social notions of nature, which have emerged since the second half of the 19th century, under the impact of industrialization: “The first, that from which man takes his materials, the second being the nature produced by man as a result of his activities, and which itself becomes a commodity”. (Forty, 2000, p: 236)

4.3 POSSIBILITIES OF MATERIALITY IN VIRTUALITY

As virtuality is presented as a challenge to architectural materiality, it is therefore significant to question the virtual materiality, and the options and limitations it offers.

The real is what you are able to feel, if you can't sense it, it isn't real; it is an illusion, a dream, or perhaps virtuality. If you assume you are in a dream you pinch yourself to sense, the materiality of pain affirms that the actual is real. This is absurd, since you might in a dream experience pain; it does not demonstrate anything. For instance you can't touch sunlight or a laser beam; however both are real enough to burn your skin. In a haptic display, you are even capable of touching a virtual object. Therefore, the preconception that the actual is material and that the virtual is immaterial is a matter of technological availability. However, it is a frequent conception in popular culture, to relate virtuality with immateriality (Heuser, 2003). The perception of the virtual as being immaterial is associated to the debate of information space and the basic concept of virtual being almost just as though. Information space is not directly founded in physical materiality, and the roughly massiveness of the virtual advocates that it should be more or less material yet not really, nevertheless, the more or less as-if-ness does not

eliminate materiality from virtuality.

It is acknowledged that the virtual is immaterial when understood in terms of the solidity of material; however, this presumption should not be admitted. A typical inquiry advocates that there are numerous representations that are capable of creating signs designating immateriality, for instance void, semi-transparency, and floating. Likewise, unlike kinds of disconnectedness in time and space might express immateriality. Disconnectedness here refers to the situation where; for instance, those two objects appear to share a mutual space nevertheless they can't connect causally and materially; you are not able to shake hands with a hologram. Some terms of immateriality have solid links to the topology of engineered space, the space that is primarily a void. The frustrated world of the virtual can, for instance, have deficiency in people, or textures, or rigidity, or gravity; the deficiency of altogether similarly designates immateriality. Though only one or a few signs inferring immateriality have been perceived there are many other interesting ones.

Virtuality is founded as another place to indorse the decomposed self; a self whose abstruseness and diversity is persistently strengthened as the body appears to progressively dwell the immaterial world that technology generates. Questioning: "Is it necessary to insist that the body, far from disappearing, remains essential to human life?" Hayles comprehends the vanishing of the body as confirmation of a definite sort of postmodern prejudice, one that has a preference for immateriality technologies, for instance VR and Cyberspace.

"The predilection catalyzes the technology, and the technology reifies and extends the predilection. Discursively, the technology interacts with metaphoric networks of in/out and container/contained, making the distinction indicated by the slash less a boundary than a permeable membrane across which subjectivity is diffused" (Hayles, p: 168).

Even in this immaterial space, one should content the foremost insurer of existence visibility then one should be liable to objective reality. Through its regulations for virtual participants and virtual objects, cyberspace comes to be a reflection of the economic, the social, the ideological, the physical, and the real world that we presently occupy. From which the neofuturism of virtuality has advanced, it is well to recall Sant Elia's (1914):

"We have lost our taste for the monumental, the heavy, the static, and we have enriched our sensibility

with a taste for the light, the practical, the ephemeral and the swift (...) We who are materially and spiritually artificial must find (...) inspiration in the elements of the utterly new mechanical world we have created, and of which architecture must be the most beautiful expression."

The general consequence of development in computational effectiveness is to intensify the actual space and material accessible; toward expanding the world. Such milieus might deliver an innovative sort of space; through which the mind can float between three-dimensionally protracted, nevertheless virtual forms in an opposing arrangement of the momentarily immaterial with what is supposed and felt by the body to be real.

Virtual spaces embrace "less is more" to a challengingly anorexic limit. They are not entrenched in the earth; therefore they entirely exclude the "earthwork" that Gottfried Semper recognized as the first element of his four elements of architecture, also they don't necessitate the second element "the hearth", neither the third element "the framing". Consequently, all that residues is an utterly attenuated form of Semper's fourth element; the weightless enclosing membrane. Since there is no material to alter, there is no weather or time consequences on surfaces. Moreover it is not requisite to make the connections amid spaces and the forms constant; the designer might program them to change and reform by themselves in any manner he requests. It is no further required to provide alterations of material; neither protection from weather. Briefly summarizing, finesse (or God) in details is no more required; the game is all about surface and space. Unlike a material construction, a virtual space instead of changing a definite site, it covers a subject's physical environment, and then alternates it with an electronically made one. Besides, it can be instantiated anyplace and anytime, on the assumption that network connections and the required tools are accessible. The material now adopts from the virtual, and the virtual from the material.

Gravity established a critical perimeter for architecture that Heidegger would disregard the Greek temple that arises accordingly with the tension of earth (The origin of the work of art). Conversely, architects wanted to be supplied through this limitation; then have constantly fantasized about flying buildings. This propensity was particularly prominent during the Russian and French revolutions. Malevich envisaged floating buildings left without foundations, buildings that were constructed above nothing. Absolutely, this is the hunt after a thing that might never be conveyed to reality; since it is not conceivable to change the three dimensions of a physical space, or to create random adjustments to its curvature. It is simply the momentary occurrence of a virtual

space. Lissitzky stated: “Proun is a transfer station from painting to architecture”, which indicates how persistently he tracked the equivocal space amid two and three dimension, describing it as a subzone, an interval, a transfer station. He termed it: “Immaterial material”, for Novak, this: “Immaterial material”; generated from the motion of objects and light; has a common element with the electronic media space. The fluid architecture of virtuality is obviously an immaterial architecture; an architecture that is not anymore contented with light, form, or any other features of the real world. It is an architecture made of variable relationship amid assortments of abstract elements.

Vis-à-vis the inquiry of materiality, the digital field offers abundant innovative options; such as of designing materials, molding their characters and forms, rather than merely consuming them in a submissive way. The digital age allows each material and object; at each phase of its development; to be thoroughly distinct. Representation is one of the main options virtuality offers to architecture.

4.3.1 Representation of Materialities

Representation through history was the tool to record, translate and express the architectural ideas, thoughts, and exhibit them. And representation is one the aspects of virtuality. Hence; this subchapter is reminding the role representation plays in architecture and how that relates to virtuality.

The ubiquity of design is engendered from the oppositions it set up: “Design provided a means of creating opposition between building and all that implied on the one hand, and everything in architecture that was non-material on the other hand (...) In other words design concerns what is not construction” (Forty, *Words and Buildings*, p: 137). The ancient Greek philosopher Plato (427 to 347bc), is essential to the expansion of the concept that thoughts are greater than matter, therefore, that intellectual work is greater than manual work. He asserts that everything we identify in the material world is shaped on immaterial, ideal, and eternal forms. Therefore, there are two different realms; one made of perfect forms that just the intellect can apprehend, and the other

one made of imperfect, material, and natural reproductions conditional on decay and change. Plato disbelieved art as it imitates natural objects, which are already unideal representation of ideal forms. Art is simply an extra layer of distortion to another existing one, as Flusser states:

“Plato’s basic objection to art and technology was that they betray and distort theoretically intelligible forms (ideas) when they transfer these into the material world. For him, artists and technicians were traitors to ideas and tricksters because they cunningly seduced people into perceiving distorted ideas.” (Flusser, p: 17–18).

“Plato states that the material world is a shadow of the world of ideas, and a drawing is a shadow of a shadow. The allegory’s message is that the deceptive, shadowy world of appearances should be rejected in favor of understanding the ideal forms on which they are modeled.” (Aristotle, Metaphysics, p: 790–792).

“The beauty of bodies does not consist in the shadow of materiality, but in the clarity and gracefulness of form, not in the hidden bulk, but in a kind of luminous harmony, not in an inert and stupid weight, but in a fitting number and measure” (Ficino, letter to Giovanni Cavalcanti, quoted in Hofstadter and Kuhns, p. 204).

Ficino relates the shadow to the material, and not the immaterial, which is every so often the circumstance today. The renaissance architect was facing the predicament of how to associate architecture with the immaterial, whereas occasionally recognizing the materiality of building. Majority of the period’s architects would have recognized Palladio’s buildings from his drawings, and perceived immateriality in the drawing as well as in the building. The architectural drawing is determined by associated however opposing concepts.

A computer is as a combining machine in which material is scanned, gathered, kept, assorted and dispersed. The work of an architect might implicate less manual effort than that of a sculptor or a painter, and then an artwork might be just as material as a building. However, to be linked to the realm of ideas a material object should be perceived immaterial, therefore, to well conform the ambiguity, the artwork is every so often linked with the intellectual labor. The artwork is further expected to be perceived as immaterial because of the manner it is made and experienced. Some perceives design as an artistic and intellectual labor, far from the shabby pursuing of the shadow materiality of a building. Others consider the drawing as the factual representation of the building, designating the architects’ expertise of the smooth conversion of ideas into matter. Though, to convert the drawing into the building necessitates a profound acquaintance of the techniques, and materials of drawing and building. Nevertheless, the drawing by means of correspondent permits more insidious associations of

techniques, process, and materials to arise amid building and drawing. In many ways, drawing on paper is alike drawing on computer. For instance, the frame of the computer screen detaches the drawing from the material world, which evokes the drawing panel that frames the paper placed upon it. Moreover, the computer drawing might launch with a colored or black surface instead of a white surface, and represent significant objects instead of vivacious lines. On the other hand, it prolongs previous inquiries into the immaterial since it is lightened, and light is synonymous with space, taking reference from the Italian renaissance: “So too in architectural drawing, light showed up late. And what it showed up when it arrived was space” (Evans, *The Projective Cast*, p: 109). However, whether lightened or paper, the drawing surface and the lines upon it are comprehended as immaterial. The occurring involvement of the virtual evolves the architect’s long fascination for the immaterial.

*“Paper occupies a liminal space between the material and the immaterial. This allows it to act as a bridge across the classical divide between material and idea. Drawings are seen as a unique form of access to the thoughts of the people that make them. Indeed, they are simply treated as thoughts. It is as if the materiality of the medium is transformed by the quasi-immateriality of the support rather than simply exposed by it. A certain way of looking at the paper, or rather certain blindness to it, allows physical marks to assume the status of immaterial ideas”. (Wigley, *Paper, Scissors, Blur*, p: 11)*

One of the main aspects of drawing is that, it is related with mind instead of matter, and is more immaterial than the building, which inspires architects to construct with an equivalent presence of immaterial, with an attempt to create architecture immaterial. The main determining aspects of modernism; the space manipulation; brings into line, the product and practice of architects, with the intellectual and immaterial. In determining the primary architectural action to be the generation and enclosure of domestic space through surfaces of diminished matter; lines interlaced into textile; Semper Doubly associates architecture with the immaterial. White paper appears not to be there, and a covering of white paint makes the form seems more immaterial, asserting the intellectual and artistic rank of architectural design. Leon Battista Alberti conspicuously asserts that:

“It is quite possible to project whole forms in the mind without recourse to the material. Vasari (...) drew a frame around each of his drawings, a frame that signified their elevation to the status of unique works of art by masking the edges of the sheet of paper and thereby liberating the image from the material world (...). Yet the architectural drawings in the collection are not framed (with the one exception of a design by Palladio that receives the lightest frame possible). While this is understandable in terms of the potential confusion of the architecture of the frame with the architecture that it frames, the result is that

the edges of the paper supporting architectural drawings are exposed. The drawings were never fully liberated from the material world". (Wigley, 'Paper, Scissors, Blur', p: 21)

The connection amid material processing and digital drawing, carry the existence of material nearby the drawing act; then over that reconsiders the drawing's meaning. Although the production of the drawing might be corresponding to the production of a traditional representative drawing, the drawing's meaning changes. The architect might still be the controller of the lines; however, where the traditional lines are representations or representatives for the frameworks of material or recognized alterations or limits, the lines drawn with the aim of digitally instructing the production come to be either unintended or intended instrument routes meant for the tangible material processing.

Furthermore, what the technological world is offering might be virtuality as post-physical existence, or as representation. Hence, the virtual might be considered existence, or its representation. Klastrop (2002) proposes that a virtual world mutually narrate the story of a world, hence being a representation, and operate as per a virtual world. Crang and May (1999, p: 266) asserts that: "Simulacra do not represent anything (...) they are acts, events, and happenings". One conceivable perspective is that the virtual is a representation that has turned out to be very potent that it becomes a simulated existence; a simulation that is not to any further extent a representation; but a post-physical existence, "A house built in a virtual world is not a representation of a house; it is a house" (Lanier, 1992). The other conceivable perspective is that the virtual might be regarded as both representation and existence, harmonizing amid these two (Flichy, 2007). Janet Murray (1997, p: 284) designated virtual reality as: "Foremost a representational medium", then as well: "A theater". At the same time, we reside the virtual as per if it exists, and we observe ourselves execute the measures of the virtual (Heidbrink & Knoll, 2014; Klastrop, 2003). For instance, estimate a virtual laboratory utilized for teaching chemistry; the virtual lab ensures an immaterial yet albeit real existence. Its great level of interactivity and realism offers it an existence that is essentially unlike a drawing in a textbook. However, as the virtual lab simulates a real laboratory function, it might be assumed to represent the real laboratory. In educational applications of virtual worlds, there are numerous examples alike. For instance, in second life where education tours are organized to virtual models of real places, or else

where performing is utilized toward producing scenarios and conditions that are unsafe or hard to perform in reality (Educause, 2008; Educause, 2006). Other virtual environments; that imitate actual environments; (for instance the game 'Sandbox', 'Grand Theft Auto' ...) might be approached by the same interpretation. Though the game 'Mine Craft' does not represent any specific reality, it is a computer game world that ensures a dissimilar logic and aesthetic than the actual world. If 'Grand Theft Auto' is a hyperreal representation of Los Angeles; a copy that prevents its original; then 'Mine Craft' might be perceived as a copy deprived of an original. Assumed there are levels of representation in 'Mine Craft'; objects such as the sun, pigs, and trees perform moderately as per they are real objects; however the coherence with the real world is fragile. The insufficient devotion of aesthetics and the world's surreal logic advocate that this is a copy; a copy that does not require glancing at an original, such as excessively does the 'Grand Theft Auto'.

During conversation about the virtual, repeatedly the notion of simulation is exposed. Because it communicates the various aspects of the virtual: as representation or as existence, the virtual as a game, then the virtual being founded on the real. A simulation is a lively replica of a part of reality; envisaging some of the comportment of this part; it is a system that envisages the comportment of another system (Frasca 2003, Grau 2003, Lovén 2001, Robinett 1992). The various parts of the replica, besides the interplay amid these parts imitate the conforming features of the real world. Seemingly, this is evocative of representation, where the indicator implies the indicated. Though, a simulation performs according to events and courses; envisaging a consequence that conforms to what might occur in real courses; and then represents that for the spectator (Zeltzer, 1992). A simulation of a star explosion or else a crash of a car in a computer game demonstrate this; objects such as roads and cars are mathematically determined in the model, and interactions as gravity is determined amid objects. The consequence; a supernova residue or else a car crashed; is then represented, visualized, for the user. Referring to Aarseth (2007), this differentiates simulation from representation, and computer game from a narrative. A narrative is merely a representation whereas a game is a lively model and its representation. The virtual is as well founded on a simulation (Rheingold, 1991); hence, the same argument might be adopted to distinguish amid narratives and virtuality. Benjamin Wooley (1992, p: 69) asserts that the virtual is: "A

mode of simulated existence resulting from computation”; extending the concept through depicting in what manner a computer simulates a wide diversity of tools, from a drawing pad to a movie studio. It is a credible opinion; since the computer might be perceived as a universal tool replacing and simulating other tools; because of programming and algorithms. In daily language we mention virtual bank or else virtual cinematography; on the other hand, this makes the concept so wide in scope that it leans towards dropping its sense. Daily language reflects this; as we have a tendency to use the word online instead of virtual; meant for facilities such as online communities, online shops, and online banks. However, online signifies accessible on the internet whereas virtual signifies an object or an environment that is distinguished via an interactive, simulated existence.

If desired, all the physical’s representation might be withdrawn; no horizon and no vanishing point. The formerly constant laws of space and time have been adequately rendered emptiness and worthless; deteriorate hallucination blunders through the time’s curvatures. And space is not anymore something one travels through, now the space travels through us. Technology has permanently conjured different reality’s representations. Paul Virilio stated that:

“Cyber-space is an accident of the real. Virtual reality is the accident of reality itself (...) It no longer occurs in matter, but in light or in images (...) thus, the accident is in light, not in matter. The creation of a virtual image is a form of accident. This explains why virtual reality is a cosmic accident. It’s the accident of the real.”

The production of virtual images is a crash site; where a disbelief of broadcast media and print, particularly television, indicates an overall criticism of representation. Virtuality asserts to have succeeded the screen’s mediation, and the inactivity/command of the televisual device. Where concern about the diminutive and measurable persistent representations of science appear to merge in the computer’s binary logic, virtuality positions itself within the innovative territories of artificial intelligence, biotechnology, and chaos theory, as per a part of a widespread scientific move that would restore the organic to the mechanistic, and the body to the mind. This move is coherent with modernist motivations of omitting the gap amid viewer and viewed, indicator and indicated, representation and real. The transference from a process of manipulating representation to manipulating ontology necessitates utter dedication. This sort of:

“Representational thinking”; as Heidegger terms it; generates a procedure of encircling the deterioration of matter to measureable, quantifiable, and probable terms. Matter is perceived as a standing reserve, an assortment of quantifiable resources set and awaiting exploitation. The human kind come to be the manager of the standing reserve, the quantity of everything; consequently, confronts existence such as his compose. In the same way the diagram or Renaissance map diminished the three-dimensional world to a two-dimensional representation, virtual reality diminishes this two-dimensional assortment of coordinates to a numerical sequences made of just two binaries. Incidentally, the architectural dissertation is a good assistant; since, alike the rhetoric of virtuality, it repudiates the gap amid reality and representation, designating naturalness and presence, where actually merely mediation is. Evolving sorts of representation will elaborate; as a result of the fundamental mingling that generate mutually adequate and inadequate juxtapositions of multiple fields. This circumstance might conceivably be best assumed as surrealism implanted within the daily. The manner that it will influence the architecture/culture mix is a thematic existence taken up under a thematic termed hypersurface, and might be what outcomes from the requirements of the virtual dimension.

Concluding, for utmost theorists, the role virtuality performs is so protracted that it incapacitates us from differentiating between representation and perception, copy and original. As adduced, in virtual space, objects do not seem as independent entities, reachable over sensory perception, but rather occur as obviously copied and represented. It is the odd consequence of mediatized technology to produce situations as duplication. On one hand, the representationalist comprehension of virtuality is builds upon the rationalist conception of space. On the other hand, the perspectivist option as a criticism of the nationalist conception of space, intended at the phenomenological depiction of space by means of virtual spatiality.

Virtual environments are simulations; just as a map, they habitually emerge as duplicating real worlds, situations, and bodies, then they end up adopting a life of their own. Throughout the development they start to deviate, either when it is comprehended that a map cannot integrally represents a real landscape, or when they are valued impeccable more than untidy materiality. Virtual environments turn out to be significant when they deviate from the real, or when the real is disregarded in pursuance of the

virtual at a state where they are more real than real, as stated by the theorist of the mockeries of late 20c cultures, Jean Baudrillard. Consequently, virtuality ought to be considered independently; since it is not, to any further extent, a modest replication of the real.

The drives of these mutual adoptions differ, affecting both the roles and the characters of the consequential objects. Some virtual spaces are made as rapid, cheap antecedents to construction of their material counterparts; accordingly they perform the role of expectation for the profit of architects and their clientele. The intention is to simulate as meticulously as conceivable the experience of the predictable material construction; over and done with an electronic version that play the role of an auxiliary to the material construction. In this case, the electronic version might be assumed as a counterfactual provisional; or in other cases; for instance Kent Larson's electronic realizations; merely as a substitute realization of the design consuming diverse ways; abundant alike a musical composition from the medieval period performed by contemporary instruments, or even in radio or film. Contrariwise, digital realizations that are made from standing physical ones are dependent on their material antecedents. They perform roles much similar to measured drawings or pictures, permitting appropriate examination from other positions, and conserving snapshots of specific instants. Some might ensure merely material realizations, some might ensure simply electronic realizations, and some might ensure both. If material realization is envisioned, then the digital model ought to properly react to physical limitations and the convenience of predicted materials and construction procedures, however if merely electronic realization is envisioned, then the fewer restraining logic of virtual space is used.

Furthermore materiality in virtuality is experienced through senses, however; the senses in a virtual environment are limited because of technology. Therefore the people experience materiality differently and consequently experience the space differently.

4.3.2 Senses

The manner computers infiltrate daily life; enable perceiving the displacement of materiality as a general phenomenon. We are all about to occupy both the virtual and the real worlds, hereafter Toyo Ito's prominent assertion that architects ought actually design for participants conveyed with two bodies; a virtual and a real one: "We of the modern age are provided with two types of bodies (...) The real body which is linked with the real world by means of fluids running inside, and the virtual body linked with the world by the flow of electrons". Basically these two bodies are not disjointed; nevertheless they are components of what establishes today's physical presence.

As described by Grimshaw (2014, p: 602): "The real world is multisensory". The perception of the world is achieved through concurrently all the senses. The interaction amid the senses might be significant. Hence; virtual environments should take into consideration all the essential sensory stimuli; that are occurring in the real world; while trying to generate similar perceptual reactions from the person; such as if he or she were actually present in the real scene which is depicted. Or else, some real world phenomena will be absent in the virtual environment; conducting to different knowledge acquisition than what it is requisite in reality.

Though feel; and particularly touch; is progressively integrated in virtual environments, taste and smell are rarely involved. The sense receptors in the human body; are more developed and numerous; than what technology offers, in the virtual environments, which limits the senses, affects the human perception, and consequently the spatial experience in virtual environments. Grimshaw stated that:

"A human has about 20 different types of feel senses, the most common of which are heat, cold, pain, and pressure or touch receptors. Some areas of the body contain more sensors than others, making these areas more sensitive to feel. Haptics in virtual environments is a large, active, multidisciplinary field. However, current haptic devices suffer from a number of limitations. In particular, they have limited feedback capabilities compared to the human's tactile sensory system." (2014, p: 602)

"Senses such as visual, audio, temperature, and motion can be encoded as digital streams in a straightforward manner, and for the most part their capture and delivery are very well understood. Smell and taste, on the other hand, are substantially more difficult to manage. This is simply a result of the medium that smell and taste use, that of molecules. Smell and taste is the result of a biochemical reaction between human receptor and a binding site on a molecule, though in truth it is far more complex than this." (2014, p: 606)

As stated above by Grimshaw, some of the senses in virtual environments are well

enough comprehended and reproduced; for instance audio, visual, motion and temperature. Nevertheless, the smell and taste senses are much more complicated to be reproduced in a virtual environment. However, the smell sense in virtual environments is very crucial, as it intensifies one of the virtual environments main ambitions, presence: “Results from preliminary studies have shown that the introduction of smell does indeed increase the user’s sense of presence in the virtual environment” (Dinh et al. 1999; Zyburra and Eskeland 1999). And for the taste sense, it is related to the smell sense in virtual environments: “Taste is very closely related to smell, with smell contributing as much as 75 to 95 percent of taste” (Grimshaw, 2014, p: 608).

The senses play a vital role in the human perception in real environment; consequently, in the virtual environments. The senses are the tool with which the human comprehend and feel the space around him or her, and so experience it. Nevertheless, technology and more precisely the haptic devices, is still in a state of infancy, which results in a gap in the human’s sensual perception, affecting the virtual spatial experience. The senses in virtuality are merely one of the many limitations caused by technology, and affecting the spatial experience of virtuality.

4.3.3 Limitations

As mentioned before, technology presents many limitations, however the current phase of technological advancement should not be considered as conclusive.

Since the printing press to the internet, the effect and impact of the media have been resolute and distinct through developments in technology. Likewise, the architectural history has been inextricably associated with the introduction of new materials and the advance in engineering science, engendering constant novelty in the techniques of construction. Such as society shifts from the mechanical to the electronic engineering period, interrogations concerning the significance of the material object and its life cycle, then of the manner that individual human identity is revealed over the use and production of physical objects, are correspondingly major in discussions about the media and about architecture. Technology is essential to the production of things, however currently it is perceived as proposing a notable potential; meant for

dematerialization of the physical environment, or no less than an appropriation of the physical field, via infinitely simulated computer stations.

To sustain his appeal toward a phenomenological comprehension of architecture Juhani Pallasmaa stated that: "The architecture of our time is turning into the retinal art of the eye (...) Instead of experiencing our being in the world; we behold it from outside as spectators of images projected on the surface of the retina". Such as buildings lose their flexibility and link with the perception and language of the body, they come to be confined in the withdrawn realm of vision. This, Juhani Pallasmaa expresses as a problem of: "Our culture at large", which: "Seems to drift towards a distancing, a kind of chilling, de-sensualisation, and de-eroticization of the human relation to reality". All these aspects have acted in contradiction of the intellectual reliability of an architectural discourse, about the legitimacy of physical experience and material constituent in architecture. The diminished depth of field is an aspect of a dematerialized architecture missing cultural constituent. Such architecture intended to please first and foremost the standards of the two-dimensional visual image presented in magazines, brochures, and on television, instead of the physical experience of embodiment; functions inside the environment of the media more efficiently than that of the physical environment of everyday sequences. Hence materiality, alike nearly all aspects of our environment, is considerably a cultural production.

Computer-based design usually seems to disregard the architectural material aspects; on a computer screen forms appear to float freely without limitations, except those conveyed via the program and via the designer's imagination. The advance of digital design is usually perceived as a challenge to one of architecture's crucial aspect; the physical aspect of building technologies and construction, its materiality. Though, the current phase of computer-based design might not be setting conclusive principles; as digital architecture is still in its early stages, assumptions about the temporary aspects it proposes should not be considered as decisive. Its current leaning in the direction of a certain immateriality, nay its frequent eloquent approach to materiality may perhaps be transitory. Materiality will perhaps endure as a major aspect of architectural production; away from being challenged by the generalization of the computer and the advance of virtual worlds. Moreover it's conceivable to wonder whether the computer usage; with its web extensions; denotes a considerable retreat from the traditional aspects of

architectural representation. However the abstraction innate in architectural representation does not automatically denote a diminished materiality in its production. According to the architects influenced by Vitruvian, nothing was more material than the light performance on the different edges of a building. Almost in every discussion about computer productions; beginning from images to web-based worlds; the term virtual occurs alongside with an allegation of dematerialization; that unquestionably confronts real reality and virtual reality. Recapitulating the inquiry of materiality, the situation might be summarized asserting that whereas design relates to the realisms of the built environment, this relationship residue equivocal. Once more, designations and drawings arouse an assortment of material derivatives instead of an accurate, unequivocal, and distinctive material reality. The dilemma of architectural design manifests on architectural representation, the more definite the physical effect envisioned, the more abstract the representation, as if this major tension is converted into equilibrium amid abstraction and materiality. These physical changes will likewise affect the apprehension of space. Movies such as the Matrix, Minority Report, or Johnny Mnemonic have envisioned changes in the apprehension of conventional space conveyed about through the advance of sophisticated interfaces amid conventional and digital space. The concept of augmented or enhanced reality advocates a different materiality; made conceivable through the hybridization of the digital and the physical, whereas this hybridization is not completely developed, some aspects of materiality displacement are by now perceptible.

The movies the lawnmower man and Johnny Mnemonic were created at approximately the same time (1992 respectively 1995) and they both used the leading-edge computer graphics of that period, the restricted rendering abilities contribute the images an immateriality impression. The mise-en-scène of the environments in virtuality is an assortment of shapes and colors, rather than of shadows and textures as in a realistic world built. This is an example of how the virtual world depiction involves numerous topologies as engineered space, immateriality, and surrealism. It is as well a depiction comprising production design and a visual style directed by the technical restrictions of computer graphics at the time. Materiality is very associated with touch, however, in movies or literature it is not possible to represent touch directly, it has to be communicated or displayed, for instance displaying objects that pass via each other;

Stephen Baxter often describes in his novels how virtual objects pass through actual objects, usually associated by descriptions of how the virtual disperse into voxels or pixels in a way that is akin to how virtual characters disperse in Tron legacy. In his narrative, Baxter correspondingly proposes that this sort of ethereal indisposition can be considered as disconcerting and have to be, consequently, proscribed conferring to upcoming etiquette protocols.

There are two apparent major approaches; to interpret for the user in the development of a virtual environment; that involve the virtual environment philosophy. There are virtual environment by means of a substitute of the real world, and virtual environment by means of an interface of the computer. Virtual environments might be generated as the real world substitute representations; then acquainted techniques, knowledge, models, and standards might be applied as appropriate. Hence; there are many challenges with this approach. One is; the significance of such notions as perception and spatial awareness in the real world is very vague (E.G., Flash & Holden, 1998), consequently much further in a virtual world. Another is; though the software might offer a compelling representation of corresponding perceptions in the real world, the factors that people requisite to experience the virtual environment now intervene with this corresponding. In addition; there is still substantial confusion about the fundamental psychological processes and mechanisms implicated in the experience of virtual environments; besides, whether and in what way these could be comparable to those in the real word. For instance, the sense of presence and is its correspondent to or linked to awareness? (Zahorik & Jenison, 1998). The other approach is to approach the virtual environment as merely another environment; if conceivably richer; computer interface, then apply as appropriate the acquainted techniques, knowledge, models, and standards. However; again there is many challenges with this approach; an enhanced comprehension of human behavior is required within the designed virtual environment.

Tim Taylor deals with the query of whether virtual worlds might be programmed with the Neo-Darwinist laws of reproduction, genetic difference, and competition for restricted resources such that compound virtual organisms might then emerge from evolutionary courses. This is an issue of unconstrained development; Taylor ascertains many complications with current and past models that have indicated that such an objective remains evasive. Taylor claims that; instead of emphasis on separate

organisms, we ought to emphasize on the association amid environment and organism. The organism should be completely embodied in the world's medium; the better the level of embodiment, the better the improvement of the organism. Zabel determined six dimensions of the art of virtual worlds which; in their inclusive usage; differentiate such art from previous forms that; ever since the Renaissance; have gradually shifted toward a process of artistic production deprived of bodily production: interaction, immersion, artificial agency, vagueness of identity, networked collaboration, environmental flexibility.

The authors predict a period when virtual environments will merge with the data of the real environments and generate a hybrid reality that might be alien than we might presume. Starting with Offing Heim's (1998, p: 221) definition of virtual worlds' virtuality:

“Virtual reality is a technology that convinces the participant that he or she is actually in another place by substituting the primary sensory input with data received produced by a computer (...) when the virtual world becomes a workspace and the user identifies with the virtual body and feels a sense of belonging to a virtual community.”

Ropolyi (2001, p: 178) argues that: “Some kind of presence is a necessary condition for any kind of reality and virtuality”; however, he asserts it is not sufficient to merely be present in a virtual environment; he attaches worldliness as an additional precondition to be immersed in virtuality. In order for any representation to be adopted as a person's embodiment, worldliness would necessitate; for example; that representations of other users should as well be involved and present in clear common activities. Virtuality attempts to generate a synthetic view of reality, then as well to infuse it with this concept of worldliness. Lauria (1997) proposes that though we do not presume precisely where the technology is taking us, it definitely is a great: “Metaphysical test bed”. The digital representation of a person present in a virtual environment should be capable of reproducing the experience of the person wherever it includes its worldliness. The progress of cinema required decades, since the first experience of film, as one examined Edison's Kinetoscope in the 1890s. Cinema ripened and developed to be prevailing only in the 1930s through the upsurge of the stars, and studio system drove via well-crafted stories projected using color and sound. The main hint we might determine from the cinema accomplishment; is production standards generate human standards. If the

virtual environment experience might be perceived rather underwhelming in the present day, we might however wake up to a crucial moment when it is crystal clear that: “The medium has made it”.

Well-crafted storytelling is at the core of each good multimedia product, and at the soul of each human culture. The further we generate places that carry both good characters and production standards in a story with an introduction, body, and conclusion; adding a little humor or suspense, and emotional music, the further we will be certain of where we are and why we are there. This is particularly accurate; if the users ensure some control over the telling of the story. Fast development in 3D rendering and sensing hardware, will permit innovative borders of real time interaction. Motion tracking, face, real-time apprehension of information from landscapes and geographical information databases, and high-fidelity physics containing fluid dynamics will generate virtual environments with fine granularity of detail, and high realism.

Whereas the ontological reproduction of physical objects in virtual environments is not conceivable, some physical phenomena might be. A phenomenon is a noticeable pattern or else event; alike a repeating high-pitched sound or a thunder-flash. Although computers do not ensure the causative power to create physical objects, they do ensure the causative power to create certain kinds of physical phenomena; precisely phenomena that are made of sound or light. It is conceivable since the system of the computer is equipped with sufficient output devices (speakers and monitors), that have the causative power of creating diverse auditory and visual phenomena. Therefore, they are capable of ontologically reproducing certain light physical objects alike: colors, shapes, images, and sounds. Accordingly, while an orchestra in a virtual environment plays the Toccata and Fugue in D minor of Bach, it actually produces a real performance of Toccata and Fugue in D minor. Likewise, while a circle is drawn in a virtual environment, the outcome is a real circle; since it is determined, mathematically by means of a phenomenon made of points in a plane, and not by designation as a physical object with mass and weight. Computers are as well able to reproduce ontologically that, normally exist by way of physical objects; however that do not necessarily exist in physical form.

It now appears such as if; the real has absorbed the virtual, while the entire idea was to simply esteem the reality of their difference. However; it is now conceivable to

comprehend their difference in a different way; via returning to the difference amid the non-sensuous and the sensuous. It is conceivable to comprehend it; specifically in modal terms; not by means of dissimilar in opposition spaces, neither by means of real as opposed to virtual. However by means of dissimilar ways of actually belonging to the same event: dissimilar ways of existence in the performance; well restrained in a relationship of anxiety; to saliently figural effect. Experience is even now a span of possible, it is self-prosthetic. Technology and art are stretching the regime of the existence of the body, of learned and natural artifice, previously extended in active responsibility in generating the virtual reality of daily lives. The body's existence is naturally devious; moreover, it contributes to an unbalanced self that is an easy quarry meant for manipulating methods stimulating the hunt of countless possibilities. Consequently, diminishing the human subject to an object left without freedom, in the chain of consumption and production. The recently digitized phenomena were noticeable with numerous features of primary realities, and required a different identifying term. The virtual object was now a useful object, even reproduced as per a three-dimensional object, however now produced in a digital environment. The historical linguistic absurdity, strong presence diminished to nearby invisibility, tracked by delicate presence, correspond the overall absurdity of current virtuality.

5. POTENTIALS OF VIRTUALITY IN SPATIAL EXPERIENCE AND MATERIALITY

5.1 ENHANCING ARCHITECTURAL SPATIAL EXPERIENCE

Virtual reality is introducing architecture to a completely new approach of perceiving, occupying, and designing space. The background for virtual reality is already established; trompe l'oeil⁵; binocular vision ... are all examples that through consuming the accessible technology of the specific period, tried to engender three-dimensionality, and incorporate two-dimensional rendering with built architectural space. The reciprocal impact amid virtual reality and its historical antecedents engenders what is designated as the architecture of images; moreover virtual reality is distinguished by the liveliness of the medium and the interaction amid representation and viewer. While comparing present virtual reality environments to previous representation methods, the integration with built architecture is the only difference.

Bergson then Deleuze, succeeding Guattari, advocates that the virtual is the form of reality involved in the occurrence of new possibilities; it is the reality of change: the event. If the virtual is change as such, this instantly generates numerous complications for any field of practice concerned by engaging the concept, since in any actually certain condition it might merely appear as a form of abstraction. Consequently the virtual is not confined in any definite form implicit through things or conditions of things; it travels in the passage from one form to another.

The challenge that the virtual presents for architecture occurs in its uniform nature more than in its abstractness. The solution might be topology since it accords with permanence of change; it consumes forms in their own variation. Certain contemporary architects were captivated by topology since it renders form dynamic, which has significant impacts on both the design process then the built form it generates. The topological turn involves a change in the actual object of the architectural design process; the formal source is carried into change tracked by the architect. The common

⁵ Trompe l'œil: (Noun, French) style of painting in which things is painted in a way that makes them look like real objects.

image of the architect vanished; the independent artistic representative illustrating forms from an abstract space of platonic preexistence, and deviously releasing them into the concrete of daily existence which is thus raised. The activity of the architect turns out to be less epic and the abstract more tangible, meant for the architect to track the identical procedure that the form tracks. The architect converts into an explorer of formative continuousness, a tracker in an abstract domain of propagative deformation. The job of the architect is by some means catalytic, not any longer orchestrating; an opposing position as defined by le Corbusier in an early proclamation: "The goal of art is to put the spectator (...) in a state of an elevated order". The main concern of the topological turn is to catalyze innovation and occurrence instead of uttering universalized fixation. Abstract spaces are not any more neutral displays for picturing what has previously been seen by the eye, they should be actively designed to incorporate an extent of ambiguity. As an outcome, the space of abstraction becomes active, instead of simply pre-picturing. Virtual forces of deformation are currently occupying the abstract space of design, with which the architect should incorporate forces, to which he or she should produce so as to generate innovation. The design process acquaints certain independence, an existence by itself.

Since architecture evokes all the body senses, it denotes one of the most auspicious grounds for virtual reality application. When the architectural experience is converted into space, henceforth the notion of virtual reality comes to be eloquent. Being is a compound designation. By way of a central metaphor within the concept of being, space alike dilemma delivers resources for compromise, carrying enough abstruseness to permit the discourse to glide amid a copiousness of mythic and real spaces, among for example, the imagination space; the accurate physical three-dimensional space; celestial space; outer space, and screen space. The authority of space figures in the options it involves: being there; dwelling; phenomenal plenitude; unmediated presence; immersion, all drops in its field. Without space there might be no notion of presence within an environment, neither might there exist the reliability which is conceivable through being in the world. Virtual offers the physicality of interactive environments, and the warm space of cyber companionship. Positioning itself within the innovative fields of chaos theory; biotechnology, and artificial intelligence, by means of part of a global scientific transferal that would take back the organic to the mechanistic, the body

to the mind.

The previous thirty years have witnessed the propagation of non-places; megalithic office blocks; the insipid shopping malls; indistinguishable airports; gated communities; theme parks; (...) ; areas that instead of places functions as symbols, engaging the user in an anxious mode of virtual little-referring to any real location or time. The body converts to an absorbent surface, ornamented by symbols and perforated by the instructions and inscriptions of culture; we have signed in a new odd stage in the condition of human, in an era of technological rise. Hence innovative technologies are radically changing the manner we interact with and perceive our environments. The virtual dimension acutely inspects the influence that immersive and digital technologies have on the approaches of artists; designers; and architects, to conceptualize then represent both virtual and real spaces.

For instance, disappearing architecture: perceives architecture such as a quantum object, in which virtual and real space are consistently superposed. Certainly the conception of spaces alike is not innovative; however, what makes the difference in the quantum object perception is a great scale instrument of displacement, where the virtual is flawlessly implanted in the real. Such environments should be envisioned as, a pervasive great computer, further than the desktop phase, implanted in the world. On the upcoming phase is an architecture which incorporates this infrastructure to perceive buildings by way of quantum objects, objects capable of being accurately in two conditions at once. It is an unseen architecture that makes various parallel virtual worlds seeable, architecture as a permitting stage. One of the innovators of the digital era, William J. Mitchell, provides an eloquent analysis of this change in perceiving architecture: “A world governed less and less by boundaries and more and more by connections requires us to reimagine and reconstruct our environment and to reconsider the ethical foundations of design, engineering, and planning practice”. This thesis is expected to be such as an advance endeavor at mutually; re-perceiving and re-approaching, along with adapting the architectural practice to the new environment. An architecture that does not advocate any specific types of spatial experience nevertheless, permits them all; an unpretentious boundary amid the real and the virtual. A place of

‘production désirante sans cesse’⁶, a place of constant novelty and variation, or else a place as Elizabeth Grosz stated: “Related to other spaces but with no place of its own”. The challenge for architects nowadays is to consume these assets to perceive buildings such as good no places, encouraging constant novelty and variation in each of us from psychological restrictions (identities). Kas Oosterhuis asserts: “As humans we must learn to relate to the dynamics of super-fast real-time computational processes”. Declares Ole Bouman: “For this new spatial effect Physical space is no longer strictly necessary, although duplication has its attractions”. Such approaches to architecture, relates the innovative global infrastructure to actual places and functions; through implanting the virtual in the real, and flawlessly merging into daily life. Henceforth, challenging familiar spatial types, and then offering various actions that an individual can involve in wherever whenever, engendering new spatial experiences. It has raised architectural challenges to generate spaces that assure significant human requirements, amaze and satisfy, in efficient new means. Virtual offer to architecture a completely different way of experiencing space, a exceptional experience to each person, elucidating the sense of adjacencies; scale; context; and whole feeling of space.

5.2 CASE STUDY

This thesis settles stating that, the immateriality of virtuality is a challenge to the materiality of architecture, nevertheless, virtuality offers a great potential to improve and enrich the architectural spatial experience. Founded on this potentials of virtuality, and using the game engine UnrealEngine, a gamic project was developed to examine this hypothesis.

Real and virtual spaces are coherently superposed; the virtual is seamlessly embedded in the physical. What is virtuality offering is to make this parallel virtual world visible, generating architecture as an enabling platform. Virtuality has the potential to extend the range of experiences than an individual can engage in. Through illustrating the overall feeling of space, it produces a unique experience to each person; and consequently offers an entirely new way of experiencing space. Furthermore; since

⁶ Production désirante sans cesse: (French) A constantly desiring production.

spatiality is a main component of games, it was significant to use the engine of the games to develop the project. Games are fundamentally apprehensive with spatial representation and conciliation. Hence, gamers experience real space differently, and thus use it differently. Games became a part of our present, the digital spaces frequently experienced by gamers, is changing the concept of space. By establishing the project on the potentials that virtuality offers, and by consuming the expertise of interaction, immersion, and spatial fun of the games, the project is expected to provide support for the hypothesis.

The purpose of virtual reality is to make possible, a sensorimotor and cognitive activity, for a person in a digitally created artificial world, which can be imaginary, symbolic, or a simulation of certain aspects of the real world. The approach adopted in developing the project is the simulation. Virtual reality makes it possible to stimulate the phenomena; which is in this project materiality; differently, a realism that goes beyond the reality. We thus obtain a simulation of the real world, which is enhanced by more adequate, though unreal, representations of physical phenomena or objects. Furthermore, an immersion into an alternate reality point of view; which can be either perceiving an alternate world, or perceiving the normal world with a different point of view as it is intended in the project. To generate a successful experience both mental and physical immersion should be achieved. The physical immersion is going to be done over using a fully immersive head mounted display, and measured by how much can the user perceive; hear, see, touch; the real world around him, during the immersion. And the mental immersion; or else presence, the feeling of being there; is going to be measured by how much near to reality was the behavior of the user in the virtual reality environment.

The development process of the project is parallel to the development of virtuality, from a representation to a reproduction; simulation emphasizing materiality aspects. Henceforth, the project started with a simple low definition 2D plan; which is one of the most significant architectural representations to understand the space organization, and then developed gradually to a virtual reality model. Toward selecting a suitable architectural case for the project, the following criteria were specified: The architect should be a significant figure working with materiality. The building should have an interesting scenario and landscape suitable for a virtual reality gamic project

environment. The building should arouse a significant experience, a strong spatiality, and materiality.

5.2.1 The Real ‘Material Zumthor’

The project selected for developing Virtual Zumthor, is the Steilneset Memorial. The project’s site; a vast horizontal empty land; is suitable for a virtual reality game environment. The witchcraft history of the area produces a very interesting scenario. The well build concept of the project ensures a strong spatial experience. And as a final point, the selection and usage of materials generates the aspects of materiality that Virtual Zumthor aims at experiencing. Since the project ensures and provides all the required elements; from space to materiality to experience; suitable for observing and experiencing the virtuality effects on architectural materiality and consequently on its spatial experience. The Steilneset Memorial was selected to be modeled and developed into a gamic project.

The real site of the project is in Vardø, once ago a lively fishing village with a port full of boats; nowadays, a treeless island. The landscape is infertile, vast, has a dominating horizontality and no scale. The land, clouds, and water generate continually varying images. The overall colors are pale; the sea is with an icy, hard, grey color flogged to vivid foam by the wind. The vegetation is few and scattered; tiny flowers, moss, lichen, and grass. The project’s history is rooted on the events occurring from 1600 to 1692 in Finnmark. 91 persons – 14 men and 77 women - were founded guilty of witchcraft, and convicted to death by fire. In the beginning of the 17th Century, the witch mania after infecting nearly all of Europe, attained this small fishing community and ripped it apart. Equipped with concessions and allegations, the diseases, accidents, complications and mistakes of a rural tough existence were instead assigned to 91 unfortunates, all of whom were assumed to have made a secret deal with the devil. The memorial was created to this persecution’s victims by Peter Zumthor and Louise Bourgeois. At the beginning of their collaboration Louise Bourgeois suggested to Peter Zumthor to visit the location to begin the design. Zumthor (2006) says of the half-deserted, deteriorating port:

"I was impressed by how many houses were dark (...) I was walking around and I saw these buildings with lights placed in the windows as a sign that someone is at home. I thought that very beautiful. I saw some fish racks and the wide horizons. It's important to me this horizontality of the landscape. And, when I woke up in the morning, I had the idea."

After the visit he had the idea of assigning a window with a small lamp to each of the victims; which stares out onto the landscape, and illuminates at night. The project combines 91 illuminated windows in a longitudinal narrow walkway, which leads from a framed view to another, suspended in wooden scaffolding, floating over the ground. Zumthor devoted his design to paper -watercolors-, Louise Bourgeois saw it in New York, and shortly returned with her idea of a fire installation, conveyed by a small sketch, and clarified in words. It took Zumthor a while to comprehend that her idea was not intended as an alternative; but rather, as another part of the memorial. Bourgeois required from Zumthor to design an architectural shell for the fire installation, and make the two self-comprised buildings generate a single whole. Consequently, the memorial developed to a composition involving two buildings: a dot and a line.

The Louise Bourgeois' installation comprises a steel chair, over which dance five noisy jets of fire, confined in a concrete cone that has a splintered rough edge, and on stands 7 outsized telescoping mirrors. This installation is sheltered by way of 17 blackened glass panels that spiral round it, mirroring the landscape, and permitting the flames inside to gleam through them. The wooden scaffolding is a construction comprising 60 frames to provide a loadbearing structure for the long textile space. The textile space which is the longitudinal major space of the memorial is soft; its color is dark inside and light outside, it waves with the wind. The membrane is composed of a Teflon-coated, fiberglass weave. The 91 windows are small opening with a silver metal frame, fixed on the textile walls, waving along with the fabric when the wind flows. A bare light bulb with noticeable wires is suspended in front of each opening. The Memorial is a 125 meter long wooden gallery. At each end of the structure, there is a wooden gangplank, leading to an entrance with a steel door. The interior is dark, painted in tar, with a ribbed ceiling. The gallery is a 5 meter wide corridor with oak flooring, and joined with the pin wood timber frame by steel rods, thus it doesn't touch the fabric membrane.

To evaluate the virtual experience of Virtual Zumthor, the real experience offered to the visitors of the project, is going to be used as a reference. Visitors have steady steps; nevertheless, the walls are in motion, weaving and trembling with heavy breezes. In the

adjacent black spiral austere shaped box, the 7 oversized mirrors reflect and distort the flames, similar to a condemning jury faces. Zumthor describes this antagonistic impact saying: "The fire is multiplying (...) It's like you're in the fire", the main aim of Zumthor was to create emotional spaces.

"To create not just a beautiful space but a space that touches me, that has emotional impact. As a boy, when I saw memorials of generals on horses I thought they were so boring. I tried to do everything possible here not to have a general on a horse, but an emotional space that brings you as close as possible to the historical dimension".

Zumthor has stated: "What I learned early in my life is that the atmosphere created by architecture is informed by the way it surrounds the human body with physical presence (...) Architecture is something experiential, something that starts with the emotions".

Zumthor states that: "memories like these contain the deepest architectural experience that I know". Therefore, the architectural experience of Zumthor is primary associated with the tactile. Since, according to Zumthor, memories; mainly those from childhood; are assumed to reside in the realm of the origin, or essence of architectural experience. Words like hallucination, simulacra, and illusion are employed in the most derogatory senses. And the loss of reality, intimacy, rootedness, and authenticity is mourned. What is suggested is a coming back to the tactile; henceforth, reestablishing the lost values. Tactility turn out to be related to the nearest, the simplest, and the most instant features of the experience of human. Michael Benedikt claims that in our high-tech; "media-saturated environment"; in which the distinction is required; amid what is unreal and what is real; is vague: "buildings (...) play the important role of providing people with benchmark examples of what reality is and what the experience of reality feels like." (2001, p: 84-86).

5.2.2 'Virtual Zumthor' Project

Virtual Zumthor is the reproduction of the Steilneset Memorial by Peter Zumthor and Louise Bourgeois. The gamic project is intended for adding the virtual dimension, emphasizing materiality, and its effects on architectural spatial experience. The user will experience a 1/1 scale reproduction of the memorial, gradually in 4 different levels; each level with higher material definition. The trial of Virtual Zumthor was experienced by architects; interior architects; professors and students, from architecture or/and interior architecture department. The concept of Virtual Zumthor focused on offering the following points:

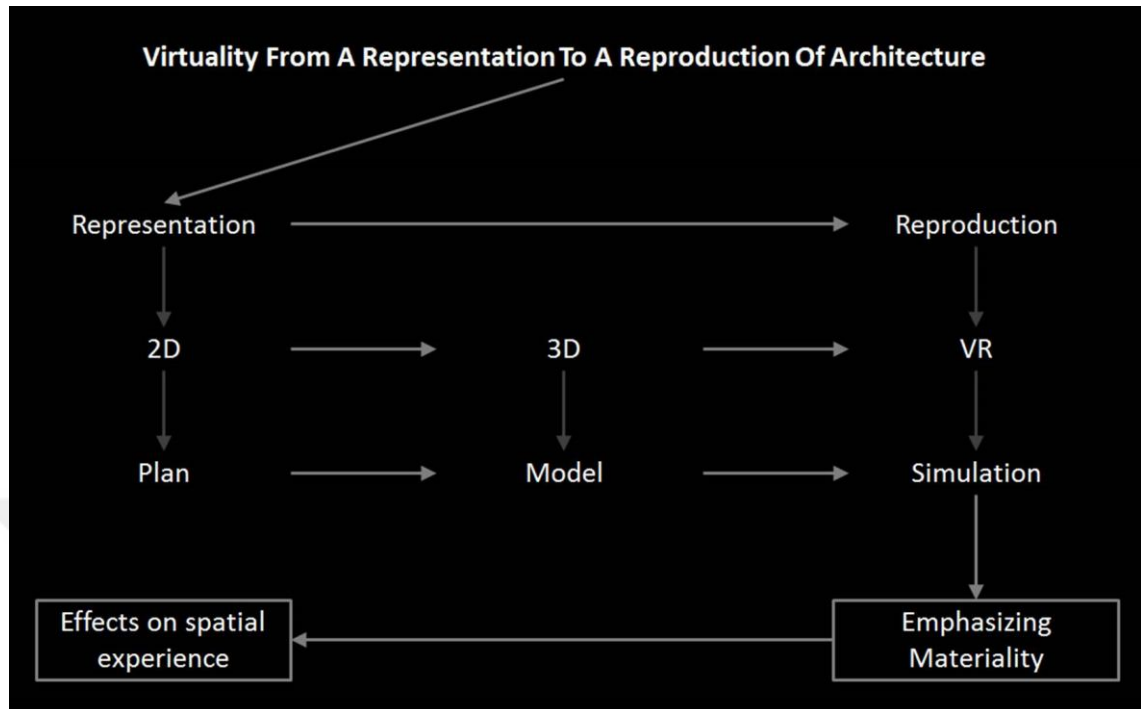
- a. An extension to the human body experience.
- b. Adding a virtual dimension to the human spatial experience.
- c. Reflecting and enhancing the variety of human spatial experience.
- d. A navigational choice; yet, at the same time a coherent experience.
- e. Experiencing materiality, and its effects on architectural spatial experience.
- f. The user plays an active role; both implied and implicated in the construction and composition of the experience.

The concept of Virtual Zumthor

The concept is based on the development of the relationship between architecture and virtuality. The development process (Table 5.1) started by a simple representation; which is a 2D plan of the architectural project, then a 3D model that acquainted gradually materiality aspects; taking as a reference the graphic display options (listed below) from the architectural drawing programs (AutoCad – Revit - ...):

1. Wireframe
2. Hidden line
3. Shaded
4. Consistent colors
5. Realistic
6. Ray trace

Table 5.1: Development process of Virtual Zumthor



Materiality in the game engine

As materiality is the main phenomena in Virtual Zumthor, it was significant to study the options and the limitations that a game engine offers. The game engine that was used to develop Virtual Zumthor is UnrealEngine.

In UnrealEngine the material is itself considered as an asset; that might be accorded to a mesh, to control the appearance of the scene. On the other hand, at a high level, it is more appropriate to approach the material as the applied paint to an object. However, both of the approaches are misleading; as literally, a material is what defines the surface type of the object; from which it appears to be made.

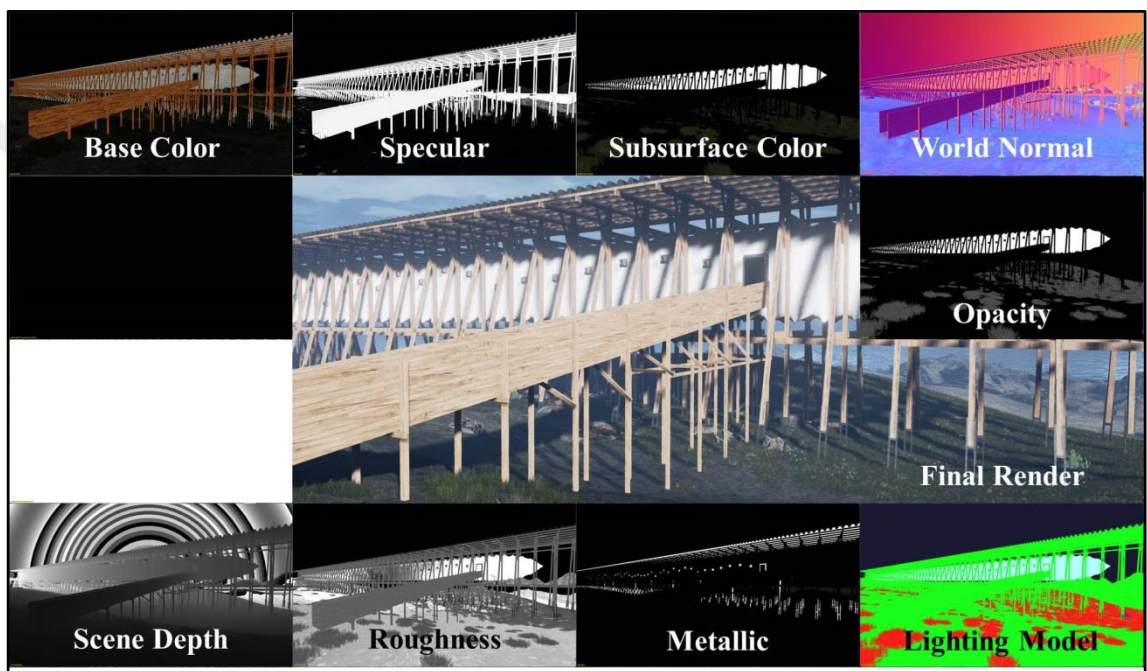
The method used to develop materials in Virtual Zumthor is called: Physically Based Shading. As defined in the official website page of Unreal-Engine⁷: “This means that rather than defining a Material using arbitrary properties (such as Diffuse Color and Specular Power), you instead use properties more easily relatable to the real world. These include: Base Color, Metallic, Specular, and Roughness”.

⁷ Docs.unrealengine.com. (2016). Physically Based Materials. [online] Available at: <https://docs.unrealengine.com/latest/INT/Engine/Rendering/Materials/PhysicallyBased/index.html> [Accessed 28 Sep. 2016].

Materiality aspects in the game engine (Figure 5.1)

1. Base Color
2. Roughness
3. Metallic
4. Specular

Figure 5.1: Materiality options in the game engine



“Base Color (Figure 5.1): simply defines the overall color of the Material. It takes in a Vector3 (RGB) value and each channel is automatically clamped between 0 and 1. If taken from the real world, this is the color when photographed using a polarizing filter (polarization removes the specular of nonmetals when aligned).

The **Roughness** (Figure 5.1): literally controls how rough the Material is. A rough Material will scatter reflected light in more directions than a smooth Material. This can be seen in how blurry or sharp the reflection is or in how broad or tight the specular highlight is. Roughness of 0 (smooth) is a mirror reflection and roughness of 1 (rough) is completely matte or diffuse. Roughness is a property that will frequently be mapped on your objects in order to add the most physical variation to the surface.

The **Metallic** (Figure 5.1): literally controls how "metal-like" your surface will be. Nonmetals have Metallic values of 0, metals have Metallic values of 1. For pure surfaces, such as pure metal, pure stone, pure plastic, etc. this value will be 0 or 1, not anything in between. When creating hybrid surfaces like corroded, dusty, or rusty metals, you may find that you need some value between 0 and 1.

The **Specular** (Figure 5.1): should not be connected and left as its default value of 0.5 for most cases. It is

value between 0 and 1 and is used to scale the current amount of specularity on non-metallic surfaces. It has no effect on metals.”⁸

Materiality Limitations in the game engine

Considering the limitations some hardware and software limited the materiality aspects in the game engine, listed as follow:

- a. **Motion Sickness:** The headset in virtual environments does not take into consideration the natural human behavior.
- b. **Quality:** The game motor is still in a state of development.
- c. **Hardware / Software:** They are in a very rapid development, however not yet sufficient. Nvidia graphic-card / Intel processus / Cry engine - Unreal engine – Unity engine.
- d. **Performance:** To produce a comfortable visual experience for the mind, minimum 90 frames per second is required; conversely, more it is near to reality more the quality diminishes.
- e. **Simulations:** Such as; explosions, destruction, water movement ... is not very realistic.
- f. **Geometry:** The polygons number is limited; consequently the details level is low. The tessellation (displacement - illusion) is a solution yet with limited applicability.
- g. **Lighting:** For the static lighting; the calculations are well proceeded; nevertheless, if the lighting is applied to an object, then later the object is moved, the lighting will not be uploaded; hence, all the calculations should be repeated. The dynamic lighting is available; however, with limited applicability, and its quality is less than the static lighting.
- h. **Materials:** The features of a material; such as the texture, the micro details; ...; is created via an illusion of details using normal map.

According to the concept of Virtual Zumthor and the materiality aspects in the game engine; options and limitations; the levels of Virtual Zumthor were developed as described in the (Table 5.2).

⁸ Docs.unrealengine.com. (2016). Physically Based Materials. [online]Available at: <https://docs.unrealengine.com/latest/INT/Engine/Rendering/Materials/PhysicallyBased/index.html> [Accessed 28 Sep. 2016].

Table 5.2: Levels description

Levels	Materiality aspects				
	Surface	Form	Color	Surface Characteristics	Movement
1 (Figure 5.2)	*				
2 (Figure 5.3)	*	*			
3 (Figure 5.4)	*	*	*		
4 (Figure 5.5)	*	*	*	*	
5	*	*	*	*	*

Note about the levels: The first level was not developed; since it will cause a strong motion sickness to the user, and the fifth level was not developed; because of the limit in time.

Figure 5.2: Virtual Zumthor - Level 1 – Surface

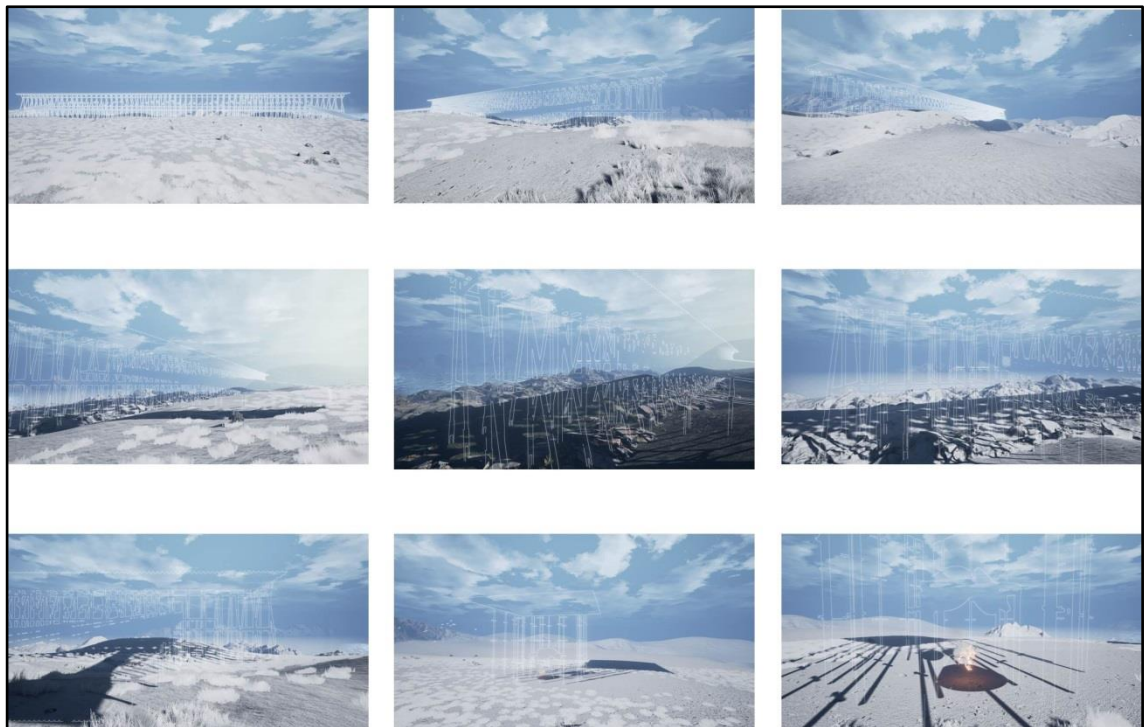


Figure 5.3: Virtual Zumthor - Level 2 - Surface & Form

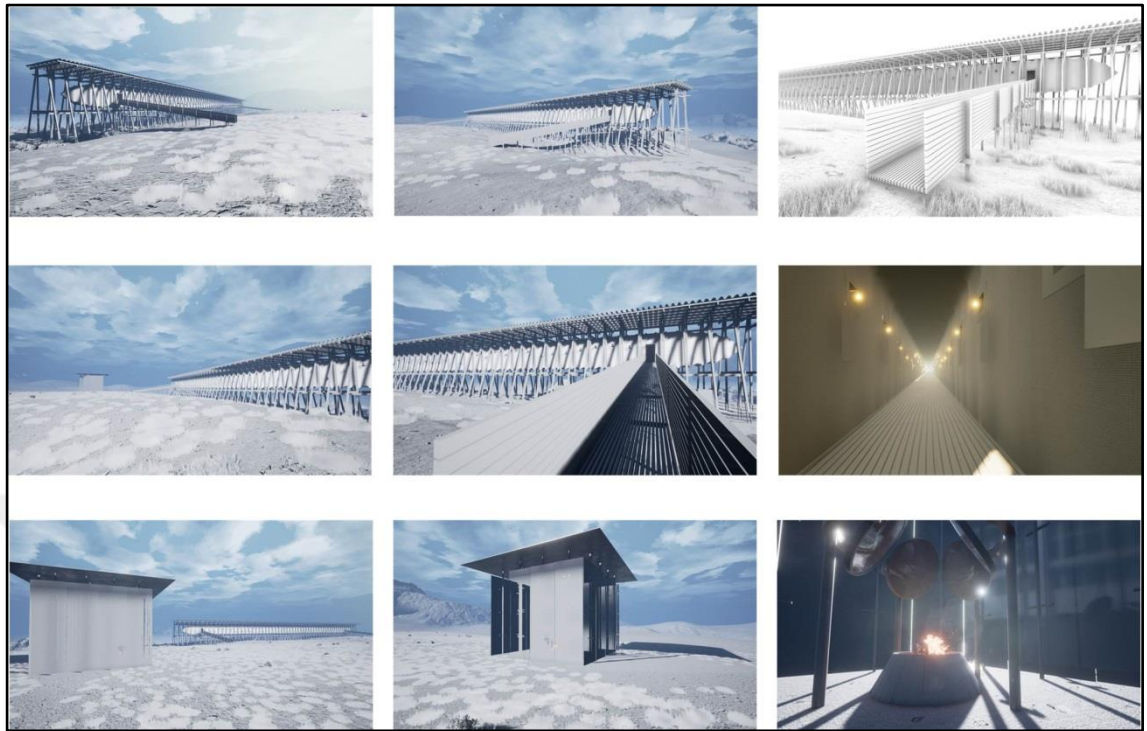
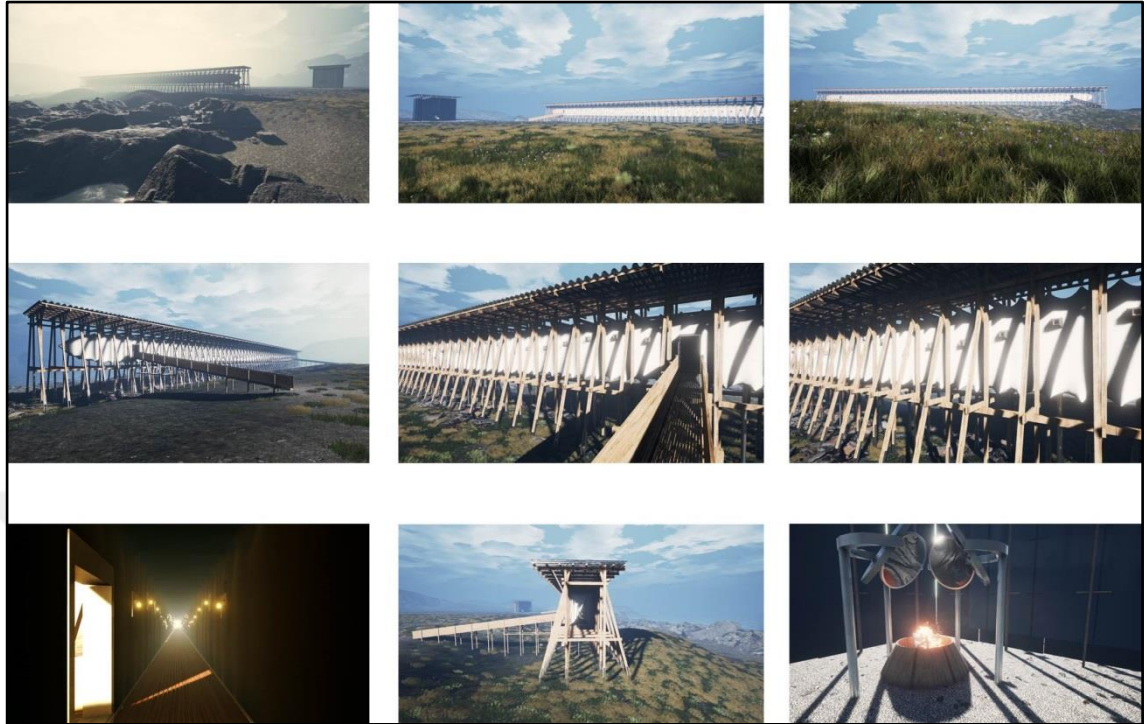


Figure 5.4: Virtual Zumthor - Level 3 - Surface & Form & Color



Figure 5.5: Virtual Zumthor - Level 4 - Surface & Form & Color & Texture



The questionnaire development for the trial of Virtual Zumthor

To analyze how the people experience space in virtuality, and to understand the effects that materiality has on that spatial experience, concepts of architectural phenomenology was introduced then adapted to virtuality. The questionnaire was developed through combining; concepts of Relph's levels of insiderness and outsiderness⁹, for experiential involvement, with Pallasmaa's example of phenomenology¹⁰; to bring out primary feelings evoked by architecture, as well as the literature research done in the previous chapters of the thesis. Accordingly; the questionnaire (Figure 5.6 & Figure 5.7) was divided into six parts:

Part 1: Presence questionnaire

Part 2: Phenomenological questionnaire

Part 3: Immersion questionnaire

Part 4: Materiality effects questionnaire

⁹ Check the thesis chapter n: 3.1.2. Insiderness and Outsiderness.

¹⁰ Check the thesis chapter n : 3.1.1. Phenomenology.

Part 5: Virtual experience questionnaire

Part 6: Background information questionnaire

Each part is mentioned below followed with an explanation of its development:

Part 1: Presence questionnaire (3.2.1 Presence)

At which level you felt?

- a. As if you were really in the memorial.
- b. As if your true location had shifted into the memorial.
- c. As if you were physically present in the memorial.

Part 2: Phenomenological questionnaire (3.1.1 Phenomenology & 3.1.2 Insideness and Outsideness)

Describe your experience: How do you feel / How do you perceive space / What does the memorial signifies to you ... (At each distance level from the memorial)

a. Far & Outside

Expected answers: Existential Outsideness - A feeling of separation from space, the space felt like unpleasant and unreal, distancing and isolating - The space provoked the user imagination – The memorial appeared as a point of reference.

b. Outside & Around

Expected answers: Objective Outsideness - The space is perceived as; an object apart from the user; that might be studied - The space provoked the user curiosity.

c. Exit & Outside

Expected answers: Incidental Outsideness - The space became the background, or mere setting for activities (Landscape).

a. Entrance & Inside

Expected answers: Empathetic Insideness - The user is trying to be open to the space and to understand it more deeply, becoming more interested in experiencing the space.

b. Under & Inside

Expected answers: Behavioural Insideness - A situation of deeply felt secondhand involvement with space. The user is transported to space through imagination, and trying to relate his/her experience to memories.

Part 3: Immersion questionnaire (3.2.2Immersion)

1. How natural was your movement and behavior?
2. Did the sounds / hearing affect your experience?
3. Did the visual / seeing affect your experience?

Part 4: Materiality effects questionnaire (4.3.2Senses)

The materiality effects questionnaire was asked and discussed with the user during and after every level, because materiality is the main phenomenon to be examined in the trial. And to comprehend how much the materiality aspects affected the spatial experience of the user, highlighting the perception through senses, mainly the touch and vision.

In every level:

1. Did the absence of the touch sense affect your experience? If yes, how much?
2. How much did the changes of material definition affect your experience?
3. How well could you examine and comprehend materials?
4. Which materials did you recognize? Explain how?
5. How much near to reality was the VR experience?

Part 5: Virtual experience questionnaire

1. How much did the virtual experience satisfy your expectations?
2. Do you think a virtual architectural visit is compatible with a real visit?

Innovative methods of representing the world: offering different representational options and experiences; immersive virtual environments.

Different experiences: changes in the experience of space, which have consequences on the ways in which we experience our place and ourselves in the world.

Innovative notions about the relationship amid biological body's and technological media: challenges to conventional differentiations amid the artificial and the human, technology and nature, media as technological prostheses and body, the virtual and the real.

Rather than a text-based experience intended for connecting and finding bits of information, the objectives of the immersed user will comprise the sensory pleasures and visual of spatial exploration. The human body experience is extended by means of virtual reality. Furthermore, the virtual notion is not merely considering head-mounted display systems, but as well the ways in which experiences of space and body are mediated in a virtual space. There are some actual complications with the use of communications concepts founded in discourse to technologically mediated communications. Ambiguous, these complications initiate unconceivable expectations of computers, expectations that raise a gap amid what we may expect, and what we experience in computer-based interface. Often, this gap is filled via expectations drawn from yet a different methodological field; artificial intelligence. The user of virtual reality is a viewer whose: “Station point is inside the projection of an image, transformed from a monocular and stationary point of view into mobile agency in three dimensional space” (1998; p: 182). What derive all these assessments of the significance of virtual reality is a pressure on the immersive experience, which delivers transference in vision from its reliance upon the spatially situated human eye, to its production through technologies and machines. Common to these efforts to designate the immersive experience of virtual reality, lays the crucial idea of passing through a picture or the surface of an image, to move in the actual space that is represented on the surface. Commonly, this is uttered as stepping through Alberti’s window.

“Importantly, the relationship between player and system/game-world is not one of clear subject and object. Rather, the interface is a continuous interactive feedback loop, where the player must be seen as both implied and implicated in the construction and composition of the experience”. (Newman 2002: 410).

Part 6: Background information questionnaire

1. Did you experience a virtual reality environment before?

Yes / No / How many times

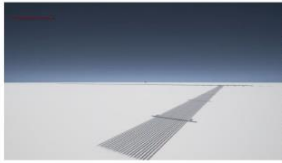



2. Did the real environment distract your virtual reality experience?

Yes / No / Some time

3. Were you comfortable with the display and control devices?

Yes / No / Some time.

Figure 5.6: Questionnaire as given to the participants in the project trial

			
Level 1	Level 2	Level 3	Level 4

Questionnaire:

1. At which level you felt?

As if you were really in the memorial : Level

As if your true location had shifted into the memorial : Level

As if you were physically present in the memorial : Level

2. Describe your experience: How do you feel / How do you perceive space / What does the memorial signifies to you ... (At each distance level from the memorial)

Far & Outside:

.....

.....

.....

Outside & Around:

.....

.....

.....

Under & Inside:

.....

.....

.....

Entrance & Inside:

.....

.....

.....

Exit & Outside:

.....

.....

.....

Figure 5.7: Questionnaire as given to the participants in the project trial (continuum)

In the memorial in the VR environment: (in each level)

3. *How natural was your movement and behavior?*
.....

4. *Did the sounds / hearing affect your experience?*
.....

5. *Did the visual / seeing affect your experience?*
.....

6. *Did the absence of the touch sense affect your experience? If yes, how much?*
.....

7. *How much did the changes of material definition affect your experience?*
.....

8. *How well could you examine and comprehend materials?*
.....

9. *Which materials did you recognize? Explain how?*
.....

10. *How much near to reality was the VR experience?*
.....

11. *How much did the VR experience satisfy your expectations?*
.....

12. *Do you think a virtual architectural visit is compatible with a real visit?*
.....

13. *Did you experience a VR environment before?*
Yes / No / How many times

14. *Did the real environment distract your VR experience?*
Yes / No / Some time

15. *Were you comfortable with the display and control devices?*
Yes / No / Some time

Name & Surname:

Age: Faculty: University Year:

Virtual Zumthor trial outcome

Because of the limited time accorded to try Virtual Zumthor, 6 trials were accomplished.

Figure 5.8: Virtual Zumthor Trial



Figure 5.9: Questionnaire development during the experience



Figure 5.10: Level 1 as seen by the participant during the trial



Figure 5.11: Level 2 as seen by the participant during the trial



Figure 5.12: Level 3 as seen by the participant during the trial



Figure 5.13: Level 4 as seen by the participant during the trial



Majority of the participants were using the head set mounted system for the first time to experience a virtual environment; therefore, they felt a strong motion sickness, which affected the trial of all available levels and completion of all parts of the questionnaire. At the first levels, the participants were more concerned about understanding their body movement and adapting to the virtual environment, than about experiencing the space or even trying to comprehend it, and responding efficiently to the questionnaire.

Table 5.3: Profile of the participants

Participant n:	Age	Field	Profession
1	22	Interior Architecture	Student
2	20	Interior Architecture	Student
3	26	Architecture	Master Student
4	24	Architecture	Master Student
5	25	Architecture	Master Student
6	23	Architecture	Student

The significant responds that were given by the participants, and that helped in evaluating the gamic project Virtual Zumthor is:

Part 1

Level 3 & 2: Was answered by minority. (1-2 participants)

Level 4: Was answered by all the participants. (7 participants)

Some participants started having a feeling of presence in Virtual Zumthor from the second level, while others did not feel any presence feeling till the fourth level.

At the last level of the game (Level 4) the participants felt the strongest presence in Virtual Zumthor, because of the realistic effect that fulfilled their expectations about the spatial experience, as they felt that there is no missing information or aspect of materiality, but that everything is defined, distinct and clear to be comprehended.

Part 2

a. Far & Outside

“Freedom, the unknown, alienation. The environment looked infinite. I felt that the building will put pressure on me”. (Participant 1)

“I understood the distance, and how small and big everything is”. (Participant 2)

"I got the sense of the landscape, and how is the memorial located in". (Participant 3)

"The unknown, I did not feel related". (Participant 4)

"I felt so alone, so much silence and quite. I perceived the memorial as a long beautiful journey, and a focal point that I would like to explore". (Participant 5)

b. Outside & Around

"Hesitated, curiosity, the space did not feel welcoming". (Participant 1)

"I was able to better grasp the identity of the memorial and the site". (Participant 3)

"Outside of the black box building I felt very disturbed from the fire's sound, and outside of the longitudinal building I felt very curious about the interior". (Participant 4)

"I perceived the space as something have changed or happened". (Participant 5)

"I wanted to walk around as well as far away from the building to explore the vast space". (Participant 6)

c. Under & Inside

"I wanted to go out. I liked the openings, because it presented an escape, as well as a link to the outside. The walkway inside is very long; exaggerated". (Participant 1)

"I really felt the sense of the space inside, and under I felt the weight of the building". (Participant 3)

"I did not feel comfortable inside. I perceive the space as a place of torture and suffer". (Participant 5)

d. Entrance & Inside

"Curiosity, excitement, hesitation, contrasts in the feelings. The black box felt more open simple clear and comfortable than the long walkway". (Participant 1)

"The entrance highlighted the space experience". (Participant 3)

"The entrance and inside of the longitudinal building felt very smooth and nice; however, the entrance of the black box building was like getting inside of a maze, and very disturbing ". (Participant 4)

"The entrance to the black box building felt very disturbing because of the high walls and the fire's sound". (Participant 5)

e. Exit & Outside

"Happy to exit". (Participant 1)

"It was very releasing to go out of the memorial". (Participant 3)

"I felt happy while going out from the longitudinal building, but while going out from

the black box building I felt relieved". (Participant 4)

"I felt relieved when I went out of the building". (Participant 5)

However the answers of the participants were sometimes contradicting, it demonstrates that they attained the deep feeling and experience of space, that Peter Zumthor wanted to transfer through the memorial; even though, the environment and the memorial were virtual and not real.

Part 3

1. All of the participants felt that their movements is natural, comfortable and near to reality; especially after getting familiar with the virtual environment and the headset display.
2. All of the participants were affected by the sounds; as it helped them understand the atmosphere and the space better, and get more involved in the experience.
3. All of the participants were very much affected by the visual; "Without the visual, they would be no experience". (Participant 3)

Part 4

1. In the first level, the participants were not concerned about the touch, as the environment did not give them much information to raise their curiosity, and since they were still trying to adapt to the virtual environment. In the other levels, as the definition of materiality was increasing, as their touch sense was more curious about the feel of the materials. In the last level, 3 of the participants felt that the touch sense would not add anything as the visual is very satisfying, while the other 3 felt that if they could touch they would have felt the material and the atmosphere of the project better.
2. More the material definition was increasing; more the participants were involved in the experience. As they could have stronger feelings and deeper experience, understand the memorial better, feel more its atmosphere, understand its concept, and feel it more near to reality.
3. The participants had difficulties to identify materials in the first levels; as the definition was low, and they could not get much information from the experience; however, they tried to fill in the gaps with the background information, and knowledge they have. More the definition of materials increased; more the participants were able to comprehend, and identify the

materials correctly. In the last level, all of the participants were able to identify easily all the materials.

4. All of the participants were able to identify the traditional materials; as wood; since in the early levels. But the identification of the other materials; such as, glass and metal; was hard and completely identified only in the last level. The absence of the touch sense did not prevent the participants from comprehending and examining the materials; however, the visual sense played a very essential, key, and dominant role in identifying materials.
5. With every level; as the materiality definition was increasing; as the participants felt more near to reality. In the first level they felt the experience very far from reality, and at the last level they felt the experience very near to reality.

Part 5

1. All of the participants were 80 % satisfied from the virtual experience.
2. All of the participants think that a virtual experience is very near to a real experience; however, not compatible because of the missing senses in the experience.

Effects of participant's profiles on questionnaire responses

In general, the answers to the questionnaire, of the participants from architecture field, were different than the answers of the participants from interior architecture field. The perception, comprehension, approach and experience of Virtual Zumthor were dissimilar.

Concerning the first expressions and feelings expressed by the participants it was of awe and amazement, as well as a fun at the first levels then it developed into curiosity.

Participants from architecture field were more concerned about the environment, the scale of the memorial, its general dimensions, its shape and form, its location in the site, the relationship amid the longitudinal walkway and the black glass box installation (5.2.1 The Real 'Material Zumthor'), the structural system of the longitudinal walkway, and the visual aspects of materiality (its form, dimensions, color) more than its touch or type. Majority of the information, feelings and sensations; that affected the spatial experience of the participants; from architecture field; were gained from far, outside, around and under the memorial.

Considering participants from interior architecture field, they were more concerned

about the views the environment is offering, the dimensions of the interior space, the inner volume of the memorial, the dimensions of the corridor and the height of the ceilings, the openings and the lighting, the connection amid the longitudinal walkway and the black glass box installation (5.2.1 The Real 'Material Zumthor'), and about the visual aspects of materiality as well as its touch, feel, type and the atmosphere it creates. Majority of the information, feelings and sensations; that affected the spatial experience of the participants; from interior architecture field; were gained from around, under and inside, entrance and exit of the memorial.

Interpretations and evaluations on the questionnaire outcomes

Even though the participants from architecture field and from interior architecture field had different ways of experiencing the space, and however their answers were expressed differently, the outcome was alike. The analyzes of the questionnaire results were grouped and related to four quotes, each quote referring to the significance of the outcomes grouped under it.

- a. Sense of loneliness and silence:** "A strong architectural experience always produces a sense of loneliness and silence" (Pallasma, 1986, in Nesbitt, 1996, p: 452): In the first level, while the users were trying to adapt to the virtual environment, they all expressed a feeling of loneliness and silence. For some, the feeling diminished gradually from a level to another, while others, had the same feeling in every level.
- b. Memory, imagination and the unconscious:** Based on readings of Edmund Husserl; Martin Heidegger; and Gaston Bachelard, Pallasma formulates a theoretical position about experience's reliance on memory, imagination, and the unconscious: Majority of the users, while they were trying the project, they were speaking about some of their memories, trying to relate it or compare it to the experience they were having. And some tried to use their imagination, and the background information they have in mind, to understand the space, the materials, the environment, and the building function and structure.
- c. Perception through imagination:** "The quality of architecture does not lie in the sense of reality that it expresses, but quite the reverse; in its capacity for awakening our imagination" (Sykes, 2007, p: 245): The users intensely used their imagination, and relied on it. While trying to understand the space and to

figure out what is inside, under, around, or behind the building. What are the function, the structural system, the materials, the environment, and the story behind the building?

- d. Spatial experience components:** “In experience we found a combination of the biological and the culturally derived, the collective and the individual, the conscious and the unconscious, the analytical and the emotional, the mental and the physical” (Nesbitt, 1996, p: 453): Those briefly summarize the aspects; which the users who participated on the project trial; mentioned to express and communicate their spatial experience and the materiality effects on that.

New aspects emerging from the trial outcomes

However the immaterial aspect of virtuality and the missing senses in the virtual environments; because of the technological limitations; virtuality in Virtual Zumthor challenged the familiar spatial categories by extending the variety of experiences offered to the participants. Through filling the gap in spatial experience; engendered by the missing senses; by other factors affecting the spatial experience; such as memories, imagination and background information; Virtual Zumthor offered a unique spatial experience to each one of the participants. Virtuality offers to architecture an entirely new way of experiencing space; referring to Pabst¹¹; virtuality offers a unique experience to each person, illustrate sense of scale, adjancies, context, and overall feeling of space and time. Concluding, Virtual Zumthor supported the hypothesis:

The immateriality of virtuality is a challenge to the materiality of architecture, nevertheless, it offers a great potential to improve and enrich the architectural spatial experience.

Real and virtual spaces are coherently superposed; hence, the material and the immaterial are coherently juxtaposed. The virtual is seamlessly embedded in the physical; therefore, we should think about architecture that makes numerous parallel virtual worlds' visible: “We should imagine these environments as an omnipresent supercomputer of the beyond-the-desktop-era embedded in the world (...) Architecture as an enabling platform” (Beigl, M., Flachbart, G. And Weibel, P., 2005, p: 13-14).

¹¹ Josh Pabst. "Virtual Reality: Coming to an Architecture Office Near You" 06 Apr 2015. ArchDaily. Accessed 29 Sep 2016. <<http://www.archdaily.com/616251/virtual-reality-coming-to-an-architecture-office-near-you/>>

6. CONCLUSION

Virtual Zumthor revealed that, while many materiality aspects are missing in the virtual environment; due to technological limitations; other aspects rise. For instance; dreams; memory, imagination and background acquainted knowledge. And fill in the gap; engendered via the missing aspects; to attain the satisfactory experience required from the body and mind of the subject.

Virtual spatiality might involve in its experience another dimension; that emphasizes the mental perception more than the physical perception, resulting in engendering original experiences. Therefore, the effects of imagination, dreams, memory and background acquainted knowledge on virtual spatial experience should be examined. The way virtuality treats the body, redefines its perceptions. Hence, a phenomenological approach to virtuality is required and significant.

If the traditional assignment of architecture is that of designing the physical material environment, the incorporation of virtual worlds within the real built space turn out to be a design concern, not from a common technological perspective, but rather with a different attitude defending virtuality as a potential to expand architectural spatial experience.

Virtuality has much potential to expand the architectural spatial experience. Henceforth, far from a technological approach, we might think of further virtuality applications in architecture, considering new associations amid virtuality and architecture.

Virtual Zumthor trial demonstrated that, it is a fertile base to study about the architectural materiality and spatial experience, in virtual environments, through a phenomenological approach, comparing it to real experiences.

Due to limitations of time, Virtual Zumthor had been moderately developed until the fourth level, and the number of trials had been limited. However, the gamic project Virtual Zumthor won a competition; organized by the Crytek VRFirst BAU Lab at Bahcesehir University; and has been accepted for incubation. Henceforth, further studies planned for this topic is going to be accomplished with support of the Crytek VRFirst BAU Lab. The gamic project is going to be fully developed by the help of a professional team, and the tests and trials are going to be made by a larger team and more participants.

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