The Fold and Folding Theory as a Conceptual Design Agent in Folding Architecture

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ABSTRACT

In today's design world, 'the fold' currently appears as an appealing concept or trend, mainly in terms of its aesthetic or structural values. However, 'the fold' also has a philosophical depth. The main problem this study addresses is related to the fact that, there is very little research done related to this theoretical aspect of the fold and far less research is done on the potential of the fold and the folding theory as a conceptual design agent for folding architecture. In his regard, this study looks at this potential, through a qualitative inquiry, with a case study research design approach.

Firstly, the subject of the 'fold', its close concordance to the 'origami' paper folding technique, and its physical resonances such as structural and geometrical are introduced. Secondly, through Deleuze, who is famed as the 'fold' philosopher, the 'fold' is described from this original interpretation of philosophy. As a last step, the study looks at the incarnation process of the fold, from being a concept as a sense, into a physical/spatial phenomenon in architecture and interiors. As a basis for analysis, the work of Sophia Vyzoviti and her conceptual volumetric forms supporting Deleuze philosophy of 'fold' were used. These were matched with the works of two famed architects in the field of 'folding architecture'. As a result, this thesis showed that when trying to understand the 'fold', it is insufficient to deal with merely the aesthetic values of the fold, especially in terms of architectural space design.

Keywords: The fold, folding, folding theory, folding architecture, case study research.

ÖZ

Kıvrım, günümüz tasarım dünyasında şu an birçok ürün ve mekan tasarımına ilham veren bir kavram olarak yer almaktadır. Ancak, çok kez, kıvrım, bu ürünlerin tasarımı ve üretimi söz konusu olduğunda, estetik veya strüktürel değerleri nedeni ile tercih edilmekte, ve bir felsefeye ilham vermiş boyutu ile ele alınmamaktadır. Bu çalışma, kıvrımı her boyutu ile irdeleyerek, teorik bir kavramdan mekana, nasıl dönüştüğünü nitel yöntemli vaka çalışması ile ortaya koymaya çalışır.

Tez, ilk aşamalarında, kıvrımı bir şekil ve mekan organizasyonuna hayat veren nesne olarak betimlerken, ikinci aşamasında, kıvrımın filozofu olarak bilinen Deleuze'un yardımı ile, felsefenin özgün yorumlarında kıvrımı anlayarak ortaya koyar.. Çalışmanın bel kemiğini bu felsefik çıkış noktasından hareketle ele alan Sophia Vyzoviti ve onun yapmış olduğu hacimsel modeller oluşturur. Bu modeller, hangi vakaların seçileğine ışık tutarken, ayni zamanda analiz için gerekli ek anahtar kelimelerin belirlenmesinde de önemli bir altlık oluşturur. Sonuç olarak, bu tez, kıvrımın sadece estetik değerleri ile ele alınmasının yetersiz olduğuna, onun felsefik değerleri ile anlaşılmaya çalışıldığında, özellikle mimari mekan tasarımı açısından, kavramsal bir zemin ve zenginlik oluşturabileceğini örnek projeler (durum çalışması) üzerinden ortaya koyar.

Anahtar Kelimeler: Kıvrım, Kıvrımlanma, Kıvrım mimarisi, Örnek durum çalışması.

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It never would be possible to reach this step without the aid and tolerance of my dear supervisor Asst. Prof. Dr. Münevver Özersay. She was always with me like a teacher and above that like a friend, sympathetic always unable to express in few words. It was like feeling in a safe place during the conversations all the time.

I would like to appreciate all people who never allow me to feeling down, hopeless and disappointed. And my special thanks goes to my beloved spouse who is one of these amazing people who never allowed me to feel alone with his supports and efforts at every stage.

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INTRODUCTION

This introduction chapter starts with explaining the background to the study and then, continues with introducing the problem, the research objective and methodology. Following this, the limitations of the thesis are stated.

1.1 Background to the Study

What rises from the fold issue at first sight is the ability of a surface's being folded or the act of overlapping. Or, in a simple argument, fold is a crease or a pleat, a hinge between two surfaces, which are in different directions.

When looked from this perspective, a huge amount of both online and offline literature is widely spread in front of the eyes of the researchers. The literature, based on this above-mentioned description of the fold and act of folding covers real-life examples of mainly the design domains such as, structural, façade, furniture, and lighting/fixtures designs etc. As keywords, mostly the terms like "fold art", "origami technique", and "origami inspired designs" and alike are used.

Parallel to this, furniture or industrial product designers inspired by the simple elegance of the fold and folding, are creating incredibly beautiful and functional interior objects, which are mostly based on concepts such as "flexible", "convertible", "adjustable" and "portable". As can be seen from the examples

presented in the following paragraphs, these are indeed very aesthetic and unique object designs.

Example 1: "Flat form 322" – Interior Installation as a Part of an Exhibition

In 2010, the founder and sole practitioner of the "Fold Theory" design company Tobias Horrocks, who is also well known as the cardboard architect, cooperated with the Kristian Aus, industrial designer, to design an interior environment, which exhibited both architecture and object. The assembling, which was set up for the purpose of the Victorian State of Design Festival, took part in the "Look. Stop. Shop" exhibition by temporarily transforming the interior spaces of a retail shop called Design Dispensary and was named as Flat form 322.

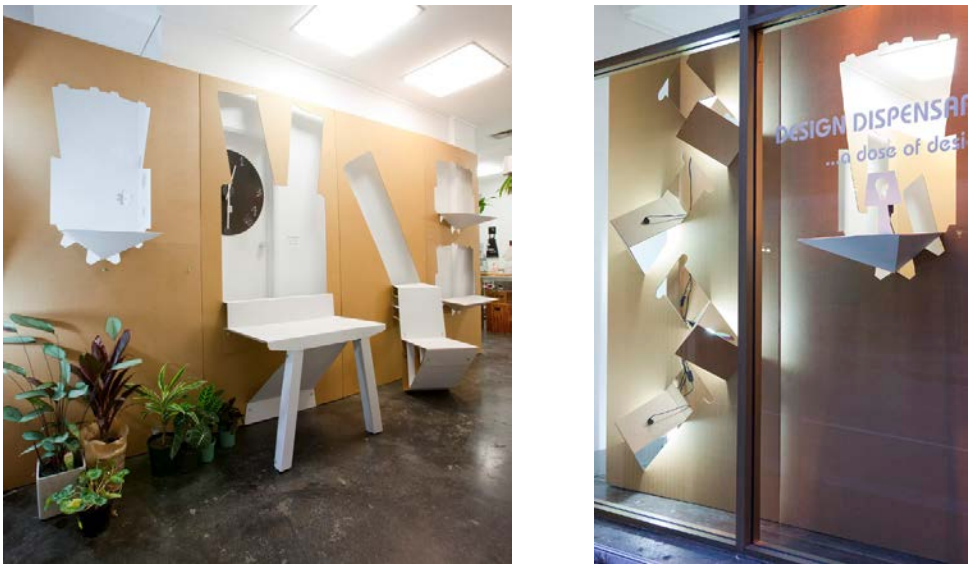


Figure 1: Flat form 322.
URL1

The architect/designers of this installation, in relation to the fold and folding promoted their exhibition with the following concept: "Interiors and products have a limited life span. Do you design for longevity and hope your designs don't

prematurely end up in the skip? Or go with the flow and accept that change is inevitable?

Example 2: "The Oru Series" – Geometric Furniture and Decorative Objects

The multidisciplinary designer Aljoud Lootah, who is situated in Dubai, makes geometric furniture called "The Oru Series", for the launch of her furniture collection at Design Days Dubai in 2015. The collection consists of not only geometric furniture but also decorative objects that take both their inspiration and name from the very old art of origami folds, which originated in Japan. Hence the name "Oru", Japanese word, which means 'to fold'. Through Origami in Japanese culture, Lootah wanted to experiment by using the simple patterns and folds in her designs, by trying to transform simple folded shapes into objects with function. Each piece of her work is made of teak wood and the plans include sharp lines and edges simply like folded paper. According to Lootah, the idea behind is to show that it is possible to create aesthetically appealing functional 3D forms, merely by folding a flat 2D sheet.

Figure 2: "The Oru series".
URL 2.

Example 3: Awol Trends – Origami a category under Technology Influencers

Awol Trends is a site, an open source for designers, which focuses on providing inspiration through a curated database, put together also by designers. The site tracks

design trends in Architecture, Transportation, Furniture, and Fashion etc. categories for several years and releases new ones each week.

Out of many trends (Proportion, Form, Surfacing, User-centric, etc.), which are introduced on this inspiring site, “Origami” takes place as a trend category under the one named as “Technology Influencers”. On the website origami is presented as an “artistic genre” with the following words: “The art of paper-folding originated in China and Japan hundred years ago, and has evolved into a masterful artistic genre.

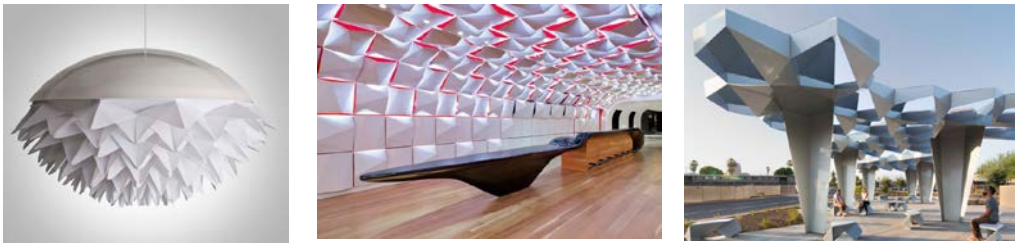


Figure 3: Examples from Awol trends database
URL 3.

According to this website, modern designers look beyond the novelty of this ancient folding method of turning a 2D pattern into a 3D form to breathe new life into many design categories.

Example 4: Kitchen Space of the Komb House – by Karim Rashid in Cairo.

Karim Rashid, who is one of the most well-known designers of our times, as designed the kitchen space of the Komb House, in Cairo with an “origami” unit.

Figure 4: Kitchen and dining space of the Komb house by Karim Rashid
URL 4.

The ‘origami’ unit includes a concealed fridge, and ovens. The freestanding island also is in the origami spirit of the unit and has a built-in induction hob, sink and garbage chute. The dining table and its chairs all create an atmosphere in the same style.

1.2 Problem and the Research Problem

All the examples presented above in part 1.1 demonstrated the wide usage of the fold and folding, which are of great interest and inspiration to interior designers and architects. At the same time, they show that there is an absence of the description of a conceptual approach, which goes beyond the substantial manifestation of the fold and folding action. In other words, the lack of sources which are gathering both aspects of ‘fold’ as a physical form of fold and its profound meaning as a theory of fold is palpable in the literature.

Hence, the problem this study addresses is also related to the fact that, the fold itself and the act of folding is, in the eyes of the young designers reduced to a mere ability of a surface’s being folded or overlapped. In many cases, on the surface, it is simply just a crease or a pleat, a hinge between two surfaces, which are in different

directions. In other words, the folding theory remains as a hidden part within the definitions of the fold summarized as a physical entity.

However, according to some literature regarding to the term of “Fold”, there is an immense philosophy behind this word (Deleuze, Foucault, 1988). In fact, this philosophy is always containing the physical act of fold in it. According to this approach “Fold” is considered as a physical touchable action and “Folding” as an unfathomable philosophy containing particular meanings such as “horizontality”, “curvilinearity”, “no priority”, “unfolding” etc.

Contemporary architecture propounded an innovative section in the territory of architecture and design in the late 20th century; it is termed as ‘conceptual architecture’. An essentials subject in this category is theory and concept. By the end of 20th century Gilles Deleuze, the French thinker and philosopher, has conveyed concept of folding in philosophy and released thoughts in altered domains such as, cinema, language and to the scope in architecture.

In regards to architecture, folding theory was firstly mentioned in 1990. The vast majority of the eminent architects like Peter Eisenman, Zaha Hadid, Frank Ghery even the modernist architects like Philippe Janson were interested in the theory of fold. They established diversity and complexity of different combines in a soft and flexible stratification rather than the sense of unity or opposition mixtures. These caused an interlacement of factors and forces with a soft and flexible interweave. In the work of these architects, the characteristic of these factors were preserved like the land layers, forced and deformed by the earth pressure but each single layer having its own feature.

Concept is mentioned as a key point of modern architecture; designer’s concern is to introduce their thoughts in order to reflect their ideas in the dialect of structure, body and space. In spite of the fact that concept is for the most part a composed declaration of one's thoughts with certain hypothetical foundations, the way toward communicating it in different fields of expressions, writing and furthermore architecture is challenging; thus these days it is appeared as conceptual architecture and theoretical art.

The case of “the fold” indicates the challenging association existing amongst architecture and philosophy. And a theoretical framework is an approach to make any practice expressive in a professional point of view and how it will be translated relies upon the impression of the audiences, the genuine human in this present reality. Concept is a way to achieve this.

1.3 Research Objective

In year 2000, John Rajchman released an essay, in which he reflected folding in Peter Eisenman’s projects with the following words:

"It can happen, as in the Baroque, that an architectural invention is enveloped in a larger event, implicated in a larger question that arises in our space, complicating it and our vision of it. A formal trait in architecture may then become part of the crystallization of something unknown that is knocking at the door, something unforeseen that we can only experiment with or play within our seeing, our thinking, our creations" (Rajchman, The Deleuze Connections, 2000).

Rajchman consequently infers that the formal characteristics of folding in architecture could be identified with a search for another origination and

comprehension of spatial connections and methods for conception architecture in the 21th century.

On the other hand, Greg Lynn defines folding as a “combination of irrelevant factors in a homogenous environment”, like the phenomenon of the sedimentary layers, where each single layer has its own feature but in an equal composition, folded, twisted simultaneously and at the same time keeps up the characteristic of each layer (Lynn, 1995).

In the light of these facts, this study aims at focusing on ‘the fold’, ‘folding’ and ‘folding theory’ as a conceptual agent in design. It hopes to develop an in-depth understanding of the possibilities of these and what they convey to or through folding architecture. In this sense, the main research question of this study is shaped as follows:

- What does the possibility of the fold convey to or through folding architecture, more than the undeniable formal examining of the fold?

Consequently, the sub-questions of the study can be stated as follows:

- In which terms the “Fold” is demonstrated as a “Theory”?
- How does this philosophy support the physical form of fold?
- How does the “Fold” theory appear like “Fold” in physical form?

It is thought that, an attempt to answer these questions will help to “unfold” an overall meaning derived from the role of the fold as a bridge between theory and architecture.

1.4 Research Methodology

As mentioned earlier, the current literature addresses only the physical aspects of the fold and act of folding. It provides many cases from the world of design, many structural solutions and innovations. Some literature concentrates on the geometry and algorithms of the fold and fold patterns. So, there is a need to study fold and folding in order to build conceptual links for future study as well as to identify strategies that successful architects have dealt with folding theory in and through their work for further experimental design practices. In that sense, it is necessary to understand better the philosophical dimensions and spatial reflections in the works of the people who have been involved in experimenting or using folding theory in their architectural practices.

For this purpose, this study is designed as an in-depth qualitative case study, which explores the context and essence of folding architecture in order to illuminate its conceptual and pragmatic dimensions. In other words, this thesis is based on a qualitative case analysis that describes and interprets the architectural qualities embedded in several cases where folding theory was implemented.

The vast majority of the data is gathered from various origins in the field of architecture and philosophy; considering certain keywords, which are essentially the fold, folding, folding theory and folding architecture. These sources were in most cases translated or re-translated under the extent of the thesis. Deleuze theory of the fold, created the conceptual backbone of the study and the works of Peter Eisenman and Zaha Hadid were identified as specific units of analysis.

The available documentation on the architectural works of these cases was then juxtaposed with the volumetric models of Vyzovity (2004), who transferred Deleuze theory of the fold into physical reality through ivory material.

Consequently, the data was analysed through description of the cases and themes of the cases (which were the qualities of folding architecture). With the purpose of visualizing the understandings of the thesis the data was presented in tables, where images of these models were matched with the photos of the real architectural forms or spaces.

1.5 Limitations to the Study

As mentioned previously, this study is an attempt to discover the hidden part of the fold and folding concept in the field of Architecture and Interior Architecture. To obtain this aim, there are only two main sources of information. One is Deleuze philosophy of fold and the other one is a Vyzoviti's volumetric models of Deleuze's idea of fold. Consequently, this study draws theoretical roots only from these two valuable sources. It then compares these with the actual architectural creations of two famed architects Peter Eisenman and Zaha Hadid, who are also the two only world accepted architects/designers, who themselves publicly in one way or another related themselves to the Deleuzian theory of fold.

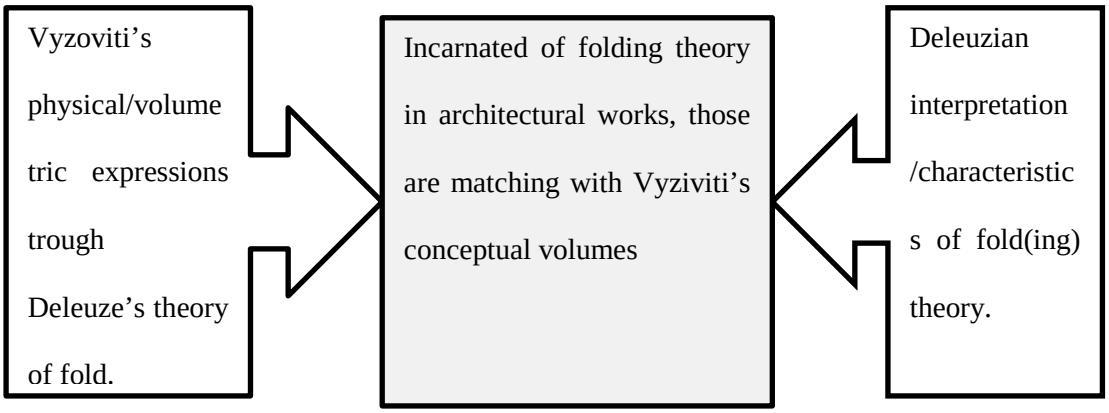
Peter Eisenman is also a famed name in the field of folding architecture, and in most of studies related to fold and folding theory, he is given as a reference. Zaha Hadid, on the other hand, is famous with her curvilinear lines, smooth volumes and unfolding forms, which directly relate to the theory of fold in real settings.

As a researcher it was interesting to discover if all these connected forms identify as a framework of theory and if they can be applied to the folding idea as a kind of

design agent or concept to her works. Additionally, her projects were chosen, since they provided a scale range that could be discussed in the whole domain (range) of design: from architecture, to interior Architecture and even interior space elements like furniture and lighting. In terms of research, this meant being able to analyse everything together and continuously; connected in different layers but in a same movement, which is matching exactly with the general meaning of folding and unfolding concept(s).

What additionally also limits this study is the choice of projects amongst all of the produced work of these two architects. Only the projects that were determined as visually matching with the Vyzoviti's conceptual volumes, for chosen as cases studies (data samples) for the purpose of this study.

Table 1: General configuration of the study



The figure above, explains the logic of these limitations in summary. So, in short, it can be mentioned that, in this study only the following projects were selected as data samples: The ones that belonged to the two named architects in this field, which at the same time had strong similarity to the intermediate conceptual forms presented

by Sophia Vyzoviti (2004), architect and researcher in the field of ‘Folding Architecture’.

Chapter 2

CHARACTERIZATION OF ‘THE FOLD’

Considering Origami and its influences on both architectural and interior design (and even furniture design) lead the study to review the structural, geometrical and technical aspects of ‘fold’ in the field of geometry, folding techniques, patterns and structure. In other words, in order to understand the characterization of a fold, it is necessary to investigate its’ geometry and actually how the fold, folding action initiates the change of a paper surface into a volume; with a single imperative: keeping up the continuity of that surface/material.

Another way to understand the formation process of fold as a matter and action; is through the study of origami folds and their basic folding techniques. Origami paper folding is the most notable type of folding mentioned so far in literature (Trautz & Cierniak, 2011). At the same time, as an act, origami folding is the ancient Japanese craft of making collapsed shapes from a single sheet of paper (Buri & Weinand, 2008). In the followings parts, taking origami and origami folding as a baseline; the geometry of the fold and its physical potentials for turning a surface into a volume will be explained. Consequently, folding techniques and algorithms will be introduced and lastly how these lead to spatial organizations and structures will be studied.

2.1 The Fold and it's Geometry

The online Visual Thesaurus Dictionary (www.visualthesaurus.com) gives the noun definition of the fold as: "an angular or rounded shape made by folding". It further gives synonyms through examples: "A fold in the napkin", "a crease in his trousers", "a plication on her blouse", "a flexure of the colon", "a bend of his elbow". All these examples give a clear notion of what one can imagine for the physical appearance of the fold in its simplest existential form.

According to studies related to geometry of fold, general geometric shape depiction of fold could be supposed as a schematic form as below: (Donath, 1964).

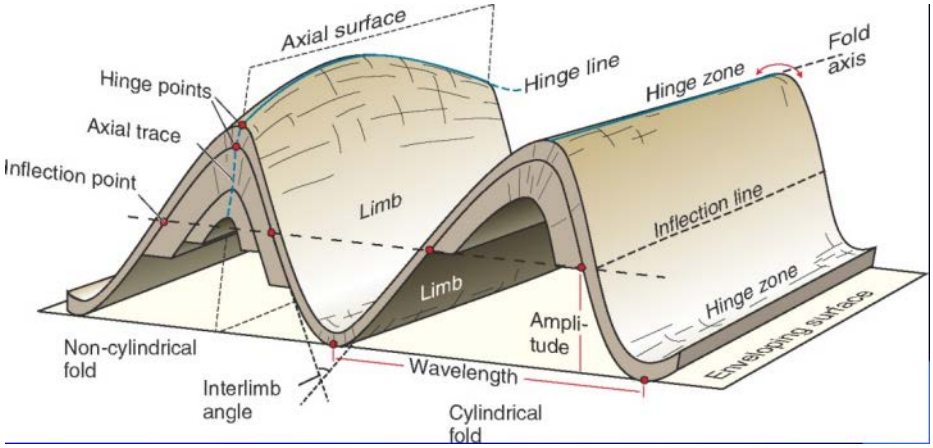


Figure 5: Fold shape and orientation

The limbs of a fold connect with hinge from its two sides, and hinge point is extreme curving that is positioned in the middle of the hinge sector. Also, hinge line is the line that is equal in three dimensional hinge point.

Fold axis is the hinge line seems as a direct line and axial surface links the hinge line of more than two folded planes.

The axial line signifies the crossing among the axial surface and the plane. Also according to the figure 5, where a changing in curving of fold limb happens, the inflection line (point) will appear. Enclosed angle by double fold limbs is the interlimb angle, and the enveloping plane is the curved level to separate hinges of a pleated layer.

Going back to the basic definition of the fold according to online Visual Thesaurus Library, it is necessary to express another important point. Interestingly, the word 'fold' already as a noun, is in a secondary meaning also defined as "the act of folding". So, it can be stated that, the fold as a matter, as a subject, includes in itself, a dimension of a verb; in other words an action. So, the fold is by nature, multi-layered and has overlapping meanings 'unfolding' in its origins. How, this nature of the fold and folding evolves further through different algorithms into patterns and structures will be explained under the next heading. What is meant here with the word 'algorithm' is 'a set of rules that lead to the specification of how to solve some problem' (Visual Thesaurus, 1998-2017).

2.2 Folding Techniques and its Algorithms

As already mentioned above, it is important to see the details of the fold geometry and actually how this geometry makes possible the folding action, which then initiates the change of a paper surface into a volume. In this way, through this change, it can be observed that, the paper's transformative inceptions are quite straightforward activities that can be expressed simply by verbs such as "fold, score, cut, pull up-down, rotate, twist… compress and unfold" (Vyzoviti, 2004).

Another way to understand the formation process of fold as a matter and action; is through the study of origami folds and their basic folding techniques. Origami paper folding is the most notable type of folding mentioned so far in literature (Trautz & Cierniak, 2011). And basic origami techniques are hence one possible channel to develop an in-depth understanding for the creation of the folding patterns and structures. Here, firstly, these techniques will be introduced, then how these lead to the creation of a volume from a surface will be examined, and finally how these are interrelated to spatial organizations and structures will be demonstrated.

2.2.1 Basic Origami Techniques

Depiction of elementary origami skills which are applying to create the origami symbols contains simple layout of basic folds sorted according to way of being folded.

- Valley and Mountain Folds

  Essentially, two countenances situated on a same crease edge can be flat, or can be folded. This is defined by the view of mountain and valley folds. At the point when the dihedral edge is bigger than pi, the wrinkle is a mountain fold, if littler; the wrinkle is a valley overlap. In the equivalent circumstance, the wrinkle is flat. This is shown in the figure underneath.

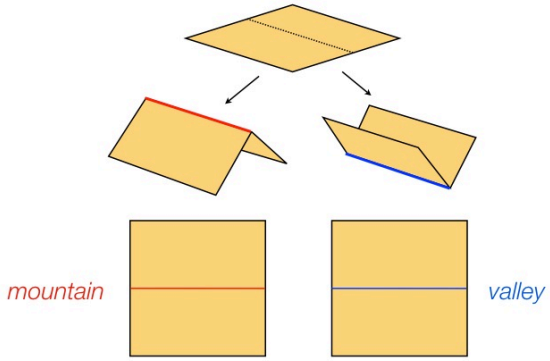


Figure 6: Valley and Mountain folds - (Kenneway, 1997)

- Pleats Folds

  The origami crease folds are made with at least two parallel collapsed lines in a zigzag arrow. The overlap lines are shaped by the valley and mountain crease.

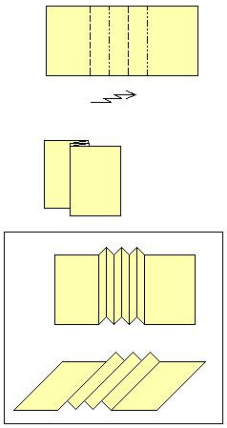


Figure 7: Pleat fold - (Kenneway, 1997)

- Reverse Folds

  Reverse folds happens when a tip is folded where layers are folded along a valley and mountain crease.

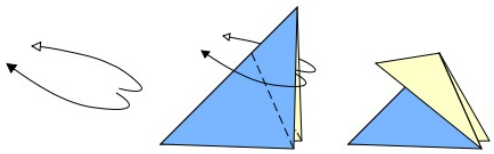
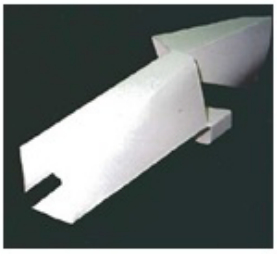


Figure 8: Reverse fold (Kenneway, 1997)

2.2.2 Transformation of a Surface into a Volume

Vyzoviti by using ivory carton displays the ways of folding transformation of a single surface into a volume, which is one of the comprehensible references for understanding how a single sheet of any flexible material could be transformed into a three dimensional volume through simple or complicated fold acts and how this can be perceived as a physical function in architecture (2004). In the following pages the schematic fold acts and how these introduce a transition from Deleuze's theory of fold into visual conceptual volumetric forms by using ivory material according to Sophia Vyzoviti will be presented.

Table 2: Paper as a surface to volume, (Vyzoviti, 2004)

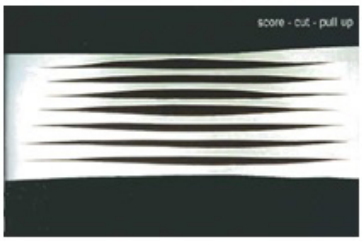
 Score-crease-press-fix	 Score-crease-fix	 Score-cut-fold-hinge
 Score-cut-unfold-knot	 Cut-rotate-wrap-hinge	 Cut-rotate-pierce-hinge
 Cut-fold-wrap-hinge	 Fold-cut-wrap-hinge	 Score-cut-fold-hinge

Score-cut-fold-hinge

Score-crease-fix

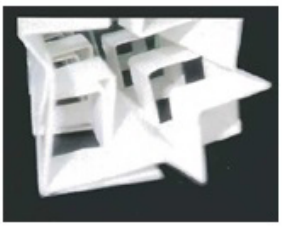
Score-cut-fold-hinge

Score-cut-fold

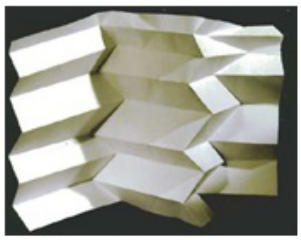


Score-cut-pull up

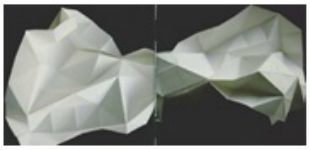
Score-cut-unfold-enfold-hinge



Crease-cut-fold-extrude-hinge



Fold-crease-pleat



Score-crease-fold-compress

These schemes are a demonstration of how the transition process displays the transformation of matter to function, or material to meaning. And all these conduce to create variety of folding patterns and accordingly a genesis of folding structures and spatial organization.

2.2.3 Algorithms of Folding Patterns

The paper fold is an impellent artefact, unsteady and evolving. It exposes the hints of the action that brings it into being: scores, creases or entry points attracted to the

surface of the paper. The paper folds unfolded, turn into a guide of its beginning procedure. Reiterative paper folding exhibits advance starting instinctive reactions into essential methods: triangulation, stretch framing, stratification of fold, folds inside folds, or examples like strips, spline bends, spirals, or wanders. Control of paper surface in request to deliver volume constitutes a curriculum program of action. Paper fold generative changes are organized in successions. The progressions of alteration are considered as coming about to the paper fold artefact as a hereditary algorithm of fold (Vyzoviti, 2004). The fundamental algorithms of fold patterns are also characterized as Origami pattern folds. “The fundamental origami folds incorporate valley and mountain folds, reverse folds, pleats, compress folds, and sinks. The quantity of essential folds is little; however they can be consolidated in an assortment of approaches to make complex designs” (Hemmerling, 2010).

Origami folding examples are categorized in many congregations of folds in terms of grouping of invert and accordion connection just to a confounded origami shell forms. Also tessellation of folds according to the crease types creates different kinds of origami patterns. In spite of numerous definitions for origami patterns, three of them are most remarkable for the origami researchers and hence are presented below.

Yoshimura Pattern (Diamond Pattern)

The type of crease of Yoshimura pattern is repetitions of a diamond pattern in a folded cylindrical deformation which is obtained from extensional twisted forms. In short, for a cylindrical shell, the Yoshimura-patterns repetitions of folds are in a cylindrical format but not always with a continuous folding arrangement (Tachi & Tomohiro, 2010).

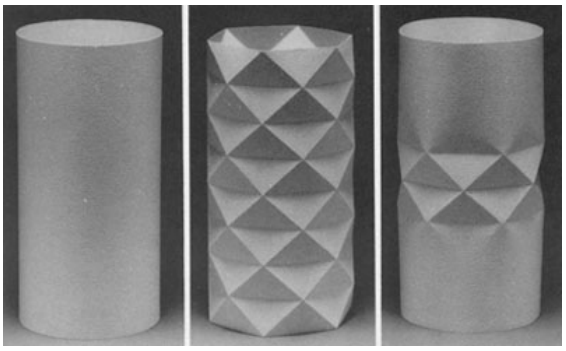


Figure 9: Yoshimura pattern for axially compacted cylinder (Tarnai 1994).

The Miura Fold

The Miura fold is a type flat form, strict origami model, which comprises of a blend of essential fold which has a solid hardness in one bearing and a frail opposition in the other. Miura Ori is a zigzag based mathematically folded sheet, keeping various zigzag creases. Each Miura Ori unit holds two V-shaped lines next to one concave and convex valley and mountain folds or vice versa from the opposite side (Eidini & Paulino, 2015).

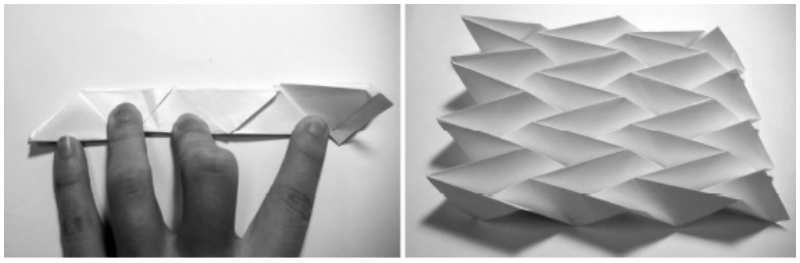


Figure 10: Miura folds (Nishiyama, 2012)

Diagonal pattern (helical triangulated cylinder)

According to research which is about the geometry of folds a distingushing feature of cylindrical diagonal pattern happens when the diamond pattern twists along a helical cylinder (Kobayashi, Kresling, & Vincent, 1998).

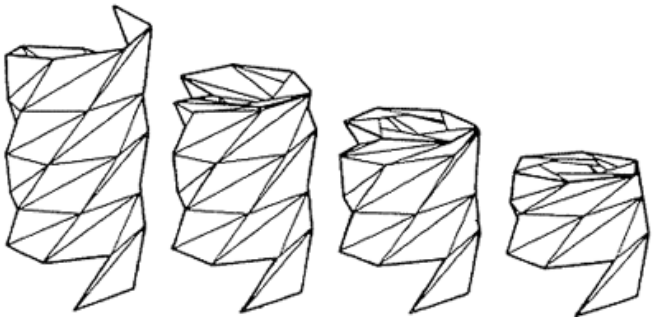
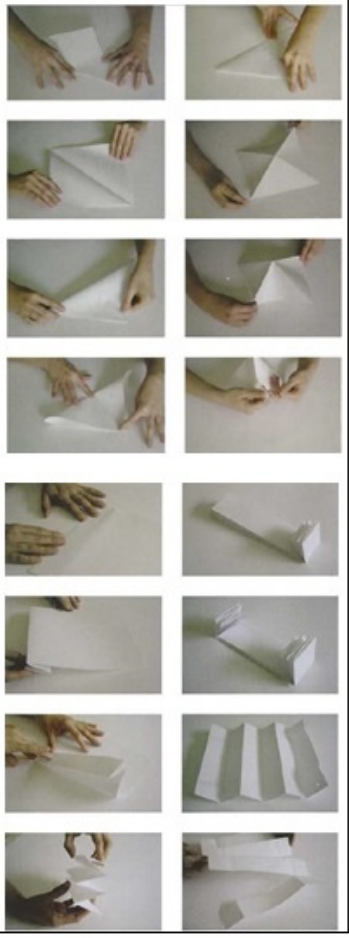
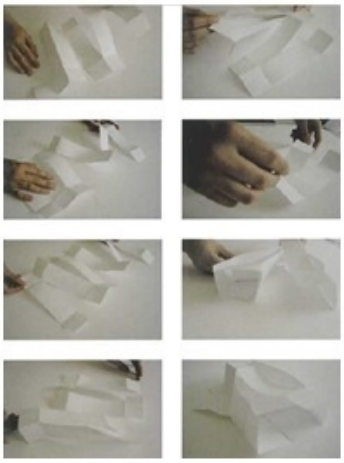


Figure 11: Folding structure of diagonal cylinder.
(S.D.Guest, S.Pellegrino, December, 1994)

As Vyzoviti says, it is important to discover the paper crease algorithm as morphogenetic component. Where generative arrangements, enlarged strategies, unfolding change mapping, educational plans and inventories of changes can as be perceived a definition of the algorithm of paper fold. She emphesises the paper overlap can be viewed as an occasion, characterized by Leibniz (Deleuze, 1992) as an extention, where the items venture into an endless arrangement of fluctuation containing neither a last term nor a point of confinement. Here are some transition algorithms defined by Vyzoviti in the year 2004, as schematic features to display how these reformation occures to generate folding patterns. These are presented in Table 3, which is on the next page.

Table 3: Folding pattern generations.

Conic section, Wraping	Generative sequence	Direct folding and cutting
		

The following paragraphs explain that how endless possibilities of paper folding explore a movement of folded forms from a simple surface to spatial fabulous applications in geometric reformation.

2.3 Spatial Organization and Structure

Since the specialty of paper folding is emphatically identified with geometric standards, origami has got a significant measure of numerical review. Hence the learning of geometric principles has become a fundamental condition for the advancement of architecture in terms of the design field and also in the acknowledgment procedure of what beginning from the underlying structure

discovering, geometry directs the project through the improvement of the shape, the execution of parameters in regards to assembling furthermore, collecting conditions in the acknowledgment procedure (Hemmerling, 2010).

Folds are three dimensional and spatial structures; they have a place with the auxiliary frameworks. The word folded structure characterizes a folded type of development, containing structures inferred from components that frame a folding structure by the common aspects in space (Sekularac, Ivanovic Sekularac, & Tavarovic, 2011).

According to Vyzoviti the ambition is to see and organize the space between the fold as genuine space, not yet as virtual type of conceivable building or as a unique geometric space however as space which can be accepted as a dynamic program; smooth space that should be involved with a specific end goal to be figured (Vyzoviti, 2004). The way toward folding a flat surface into a volumetric, three dimensional demonstrations include three imperative perspectives for the building plan, creation and also, execution. Above all else, folding paper speaks to a classical plan procedure to fabricate geometric prototypes, which is possible to view as an augmentation of measurements from the flat portraying to a volumetric displaying. In that regard folding as a procreative procedure in compositional plan is extremely exploratory, non-straight and process orientated. It’s spatial and fundamental (Hemmerling, 2010).

Spatial arrangements can be viewed as physical parametric prototypes that respond to outside pressures and conditions inside with endless changes to accomplish the most ideal adjustment of frame, organization and material. In the same field the

morphogenetic procedure of folding consequences in a profoundly versatile and performative plan demonstrate that gives an extreme level of flexibility for the architects. Design ideas that take into record the factors of development and manufacturing and also the spatial potentials of these folding methodologies are regularly in view of a profoundly basic approach (Hemmerling, 2010).

The case beneath, demonstrates the spatial folding of a pattern and comparative practical structures in the Yokohama Terminal by Foreign Office Architects (FOA).

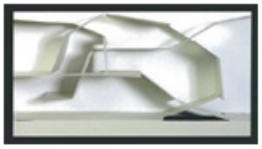
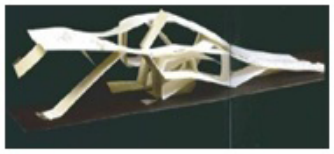
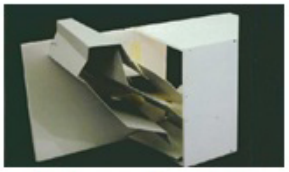
Figure 12: Paper folded model (left) and roof structure (right) of the Yokohama terminal by Foreign Office Architects.

In the folding procedure of surface wrapping wrinkles get and convey tension and compression. Basic patterns generally experienced in the advancement of paper folding procedures are triangulated surfaces of expanded inconstancy. For instance, the fishbone pattern is a main structural pattern deriving from the field of origami paper folding, a regular configuration inclined to maximum variability (Vyzoviti, 2004). Paper folding is derived from organizational diagrams of interlacement, entanglement, and stratification. Vyzoviti shows this layout by using ivory material in a schematic organization diagrams: (Table 4).

- Continuity
- Connectivity
- Loop
- Crossing
- Oblique Ground
- Blurred boundaries
- Entanglement
- Interlacement
- Stratification
- Serial variation

These conceptual volumetric forms are created by combination of two or more mentioned layouts derived from Deleuze philosophy of ‘fold’ embodied by Vyzoviti through using ivory material.

Table 4: Vyzoviti’s spatial organization diagrams

 Entanglement-Connectivity	 Continuity-Crossing	 Loops-Crossing
 Entanglement-Compression	 Interlacement-Continuity	 Interlacement-Stripes
 Stratificatiob-Oblique ground	 StressForming-Enclosure	 Entanglement-Continuity
 Stratification-Skin	 Continuity-Serial variation	 Continuity-Serial variation

There are diverse methods for building folded structures as far as their structures and the utilization of altered materials they are prepared of are concerned. In light of the exploration and examination of the formal capability of the folded configurations the categorization of folded structures are completed in terms of form and geometry.

“The term folded structure characterizes a folded type of construction, containing structures made of planes and structures made of sticks which make a fold frame by their common relationship in space. Some authors likewise call a folded structure the origami construction.” (Sekularac, Ivanovic Sekularac, & Tavarovic, 2011).

Folded structures have a long convention in development. A typical case for an application is shed rooftops for creation or stocking structures. The identity of folded structures is the extra inflexibility because of the latency presented by raising the surfaces. In this work, Origami folding is stretched out to an auxiliary scale and application. Adjusted techniques are produced and broke down to create an assortment of doable designs (Haasis & Weinand, 2009).

Based on geometric figures, folded structures can be parted into:

- Folded plate surfaces;
- Folded plate frames and;
- Spatial folded plate structures.

These are illustrated on Figure 13, which is presented in the next page.

“Folded structures in the space are like two parallel planes connected together with the common highest and lowest points. Outline folded structures signify to constructional set in which the components of each fragment of the folds commonly involve a casing spatial shape. This sort of folded structure is spatial association of at least two creases in the plane. Spatial folded structures are the kind of structure in which that a spatial practical set is shaped by joining commonly the components of a folded structure” (Sekularac, Ivanovic Sekularac, & Tavarovic, 2011).

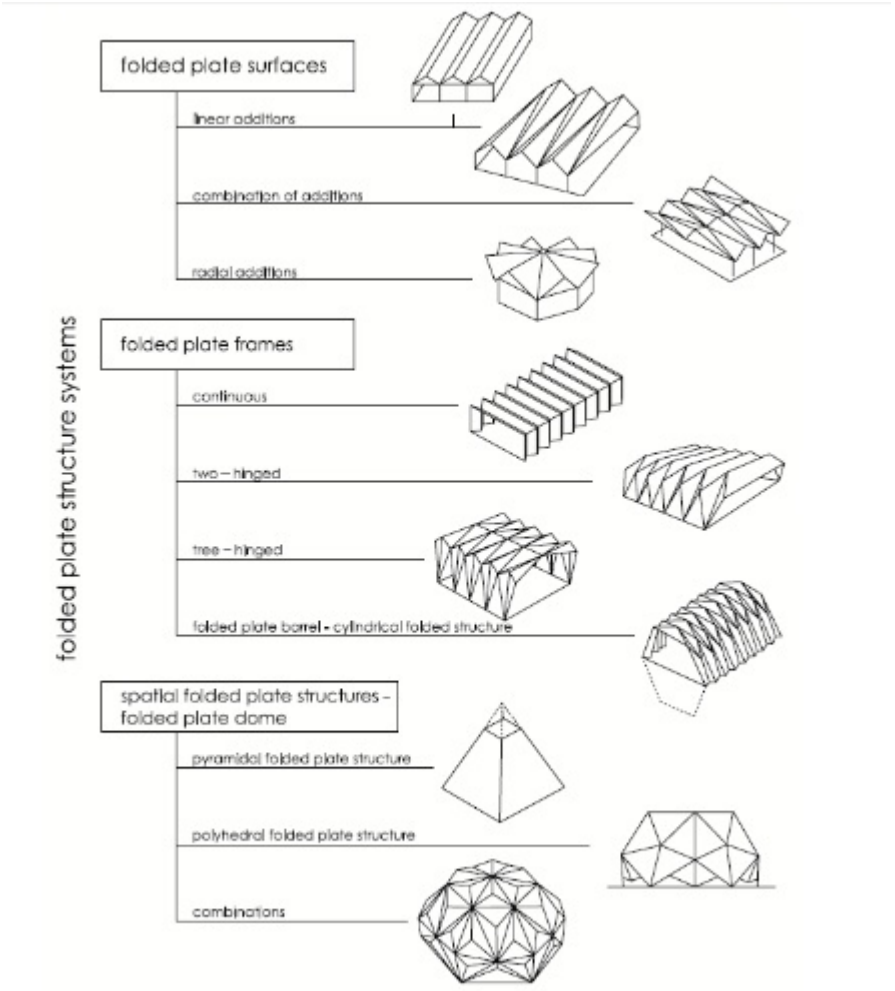


Figure 13: Folded plate structure systems (Sekularac, Ivanovic Sekularac, & Tavarovic, 2011)

Folded structures effects the conduction of load and bearing of depending of folded structures. In light of these factors they can be divided in to:

- Linear folded plate structure
- Radial folded plate structure
- Spatial folded plate structure

The figures illustrating this information are on the next page.

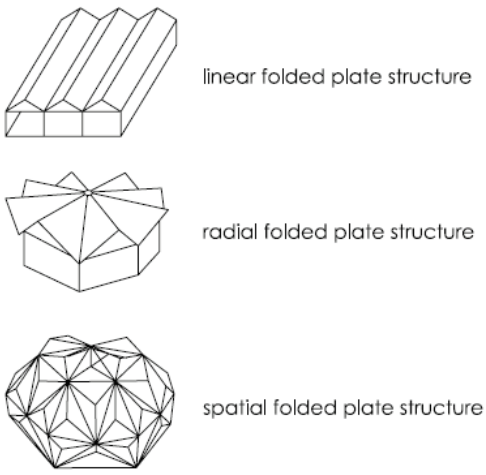


Figure 14: Spatial folded structure (Sekularac, Ivanovic Sekularac, & Tavarovic, 2011)

All things considered emerge tetrahedron or pyramid-formed collapsing with a polygonal premise. The patches are facetted.

Figure 15: a) Longitudinal rigid, b) rigid facetted, c) longitudinal kinematic folding

Many folding standards are made by Origami-arithmetic and exchanged to different orders. For design and structure of fold, Origami remains as one the most essential folding motivation.

Before moving to Chapter 3, all the different aspects and information which are related to the form of fold or in other words to the characterization of fold are summarized below as Figure 16.

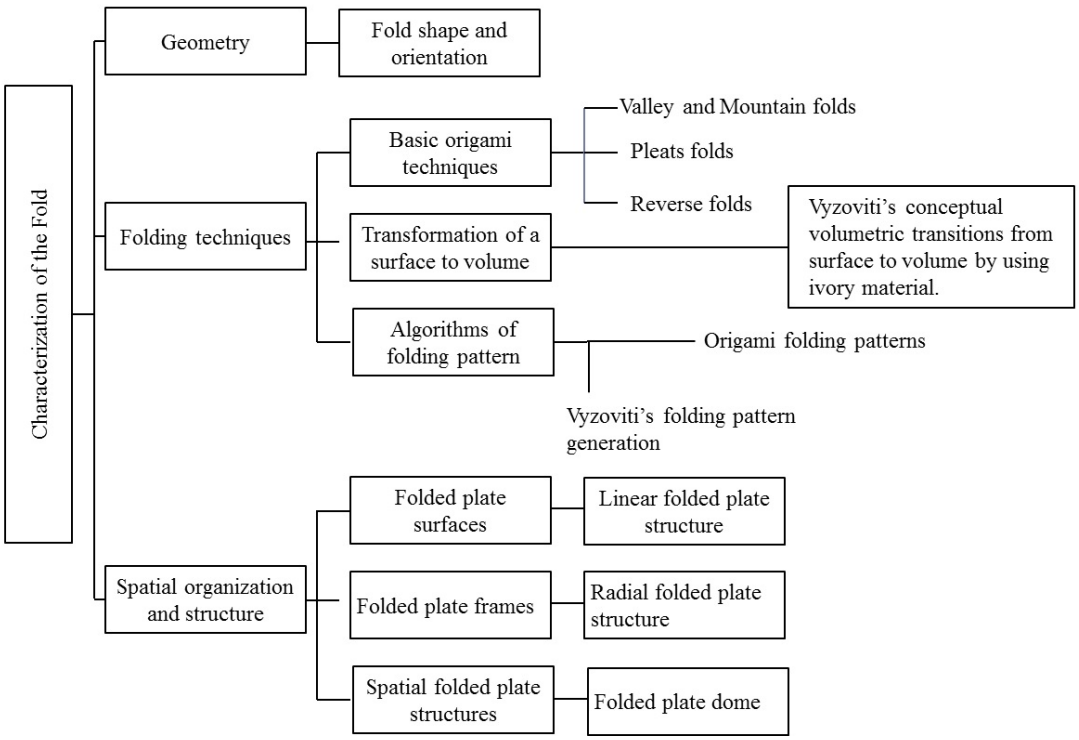


Figure 16: Visual summary of chapter 2.

This chapter was attempted to figure out 'fold' as the physical point of view regarding to form, patterns and spatialization of the 'fold'.

In continue, in the next chapter, the other side of 'fold' will be focused on: as a philosophical facet. Accordingly in Chapter 4, these two sides of the 'fold' will be matched based up-on Deleuze interpretation of the 'fold' and Vyzoviti's transitions from the theory to physical form of 'fold' in the field of 'folding architecture'.

Chapter 3

FOLD AS A CONCEPT AND THEORY

In order to achieve the general comprehensive idea of 'the fold', it is needed to consider fold characterizations as theoretical foundations and the background of the fold as a concept. In this sense, this chapter will first explain fold as a concept, with its philosophical origins; then explicate the theory of fold according to Deleuze; and finally, it will relate these two to folding architecture.

3.1 Fold as a Concept

Fold was a phenomenon of interest already back in earlier centuries. For example, Leibniz's who was an eighteen century's mathematician and thinker, thoughts of fold was impacted by improvements in particular, the transferring from imitation "synthetic", to logical "analytic", geometry and the idea of eternity. Johannes Kepler (German mathematician), demonstrated that there is a clear extent amongst the space proportions and numeric proportions of geometrical figures. "For example, in systematic geometry, a circle is considered as a vast number of triangles transmitting from the middle, or as an interminable-sided polygon. The basic thought here is that connections generate the little parts specific for the entirety" (Murray, 2011).

"To Leibniz this theory included a discontinuity in light of the fact that these littler parts or units were themselves free wholes like the perfect figures of manufactured geometry" (Deleuze, 1992). For the determination of this interruption, Leibniz envisioned "these relations or littler parts were subdivided into vastly littler

fragments and that these infinite parts were thusly identified with each other by boundlessly little sums" (Deleuze, The Fold,Leibniz and the Baroque, 1992). This principle is what was termed "Infinitesimal Calculus" which has driven from Leibniz's "Principle of Becoming".

Leibniz expresses "everything on the planet is a moment graduation of something else". This is regarding to the unlimited relativeness of everything to each other. Nothing is simply independent by itself; relatively this is a phase of "being, a becoming". As instance, a 3D square, in this origination, is a horizontal in movement; "a plane is a line in movement", and the "line, a point in motion". The element of this unbounded congruity is the thing that Leibniz named the "Monad". The Monad is the littlest unit of "being, or becoming". The entire world comprises exclusively of Monads, and each "Monad" holds the whole world inside it. The Monad being a straightforward substance can't get a handle in general world yet sees it just mostly, from its particular point of view (Garber, 2009).

Accordingly, the world is enfolded or in other words enveloped inside every Monad, in a contracted frame, and therefore, the world is agreed by the unfolding of each "Monad". In this structure, the character of each "Monad" is particular by the individuality of each other "Monad". Everything is boundlessly related, and self-comparative in this returned structure. There are limitless folds inside the folds. Though Leibniz concentrates on "Monads", the units of becoming, philosopher and architect Gills Deleuze (1975), endeavours to eloquent this "becoming, the unfolding of world" from every "Monad". The move he makes is from an exchange of "Monads" to a dialog of "folds". Every one of the properties credited to the "Monad", Deleuze exchanges to the "fold", Deleuze states:

"The fold is not separated into parts but divided to infinity in smaller and smaller folds."

Additionally, the universe is wrapped of “folds” inside the “folds” limitlessly. This unfolding of “Monad” to “fold” by its own particular definition is the contracted probability of the “Monad”. In other way, the “Monad [fold] unfolds” with a specific end goal to communicate in a specific shape.

To determine what ‘Monad’ is and how it appears in the physical features of folded surfaces, it can be helpful to imagine ‘Monad’ as an ‘atom’. If an ‘atom’ is a single unit of every components of substance, according to Deleuze the ‘fold’ is a single unit of continuous unfolding actions (Deleuze, 1992). Same as ‘atom’ which is not visible, the ‘Monad’ is not observable in the folding and unfolding arrangements.

Figure 17 which now is presented below shows the relationship between the Deleuze and Leibniz way of thinking as related to the ‘fold’ and ‘monad’.

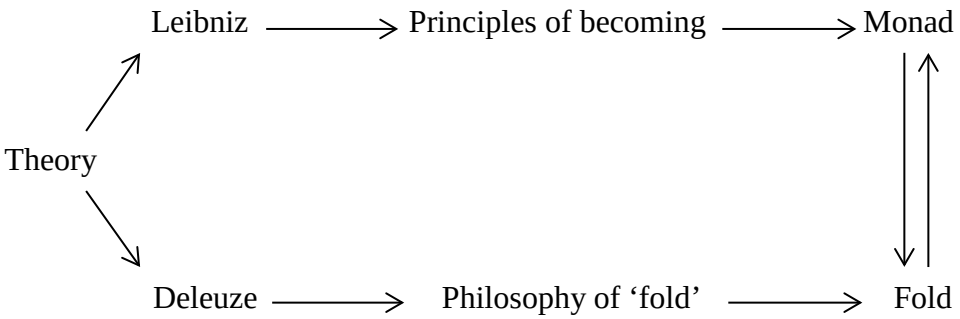


Figure 17: Deleuze and Leibniz way of thinking

For Leibniz, vastness is the term used to determine the intermittence of being. So also, Deleuze demands that the main real formal introduction of the fold is vastness

or infinity. The longing to show that endlessly appears to be psychoanalytically suggestive. The desire for the boundless might be identified with a concern in to particular limitation. Fold has a kind of self-recursive enfolding of itself into the universe in the expression of the unfolding (Brott, 2009).

“In all its restatement, the crease shows up as two fundamental things: the fold as self-comparability, which suggests recursion; the fold surrounded by the fold, and in turn, the fold as continuous discontinuity” (Brott, 2009).

Folding as a generative procedure in architectural configuration is basically exploratory: agnostic, non-direct and bottom up. The concern lies on the morphogenetic procedure, the sequence of changes that influence the design object. Looking at this as an open and dynamic progression where the design develops with alternative periods of disequilibrium, it displays the capacity of folding as an outline generator by phase alteration, that is, basic thresholds where subjective changes happen (Vyzoviti, 2004).

Imagine the immaculate type of fold, an elastic sheet folds over itself so that two inverse finishes of the sheet are made to confront each other. As the surface is adaptable, the fold doesn't show up as a wrinkle yet rather as a smooth persistent shape. But what is the fold? To fold accurately means to “double over upon itself”. The demonstration of doubling is here translated as both to double the number and, thusly, to create double, as it twins or doppelgangers. Before there was just a single area, the level sheet, now it can distinguish two spots, either side of the crease. So doubling performs originally as doubling by two. But this doubling in numeral is not a simple matter of increasing by two fold; the sheet doesn't create a second piece.

Rather, the doubling happens as a divergence, a breaking from one region into two (Brott, 2009).

3.2 Theory of Fold

Folding philosophy was initially mentioned by French philosopher and architect Gills Deleuze in 1975. Deleuze's philosophy was based on questioning the modern insights and structuralism. Deleuze has mentioned in his book, Anti-Oedipus Capitalism and Schizophrenia (1983) that folding is thousands of layers next to each other, everything together, no priority, no predominance and everything is horizontal. In other words, according to this philosophy there is no priority in the world; there is no infrastructure and superstructure; folding is based on multiplicity and plurality.

According to Deleuze, folding means rejecting the verticality, classification and hierarchy; therefore, it is compatible with the horizontality. Folding architecture can be considered as a new aim in contemporary architecture. Contemporary theory of design has seen the reasoning of Gilles Deleuze rise inside the setting of architectural discourse and the inquiries of space. Words like 'Smooth' and 'Striated Space', 'the Fold' are regularly being agreed around any contemporary architectural discussions. Particularly the idea of the fold permits Deleuze to consider creatively about the generation of subjectivity, and eventually about the conceivable outcomes for, and production of, 'non-human' types of "subjectivity". In fact, the fold is an assessment of typical interpretations of subjectivity, those that believe a simple interiority and exteriority (appearance and soul, or surface and deepness).

In his book, A Thousand Plateaus (1979), Deleuze first investigated his idea of the qualification amongst smooth and striated space, going before his theory of the 'fold'. The book reflects Deleuze's expanding inclination with the subject of connection. In

his later book entitled, Le Pli or The Fold: Leibniz and the Baroque (1988) Deleuze consider this new spatial domain by investigating Gottfired Leibniz's idea of the fold. The mathematician, Leibniz, first thought about matter as explosive. He contended that the littlest component in the maze of the constant is not the point but rather the fold.

In the book called “The Fold Leibniz and the Baroque” (1992), Deleuze states,

“… A continuous labyrinth is not a line dissolving into independent points, as flowing sand might dissolve into grains, but resembles a sheet of paper divided into infinite folds or separated into bending movements, each one determined by the consistent or conspiring surrounding… A fold is always folded within a fold, like a cavern in a cavern. The unit of matter, the smallest element of the labyrinth, is the fold, not the point which is never a part, but a simple extremity of the line.” (Deleuze, 1992, p. 6).

As Deleuze continues to explain in this book, the fold is never to be agreed as a solitary occurrence but instead it is to be viewed as a populace of many folds. Indeed, even its antonym "unfolding" is not to be comprehended as the inverse of the fold as the dialect may propose but it takes after the fold up to the accompanying fold. It is itself a numerous of the fold (Deleuze, 1992, p. 6).

Deleuze additionally characterizes the fold not as one of a metric or dimensional change yet one that can work as a level of advancement and contrasts.

“Folding-unfolding no longer simply means tension-release, contraction-dilation, but enveloping-developing, involution-evolution… The simplest way of stating the point

is by saying that to unfold is to increase, to grow; whereas to fold is to diminish, to reduce, and to withdraw into the recesses of a world. Yet a simple metric change would not account for the difference between the organic and the inorganic, the machine and its motive force. It would fail to show that movement does not simply go from one greater or smaller part to another, but from fold to fold. When a part of a machine is still a machine, the smaller unit is not the same as the whole." (Deleuze, 1992, p. 7).

Folding, considered as a method for presenting another idea of space and time inside the scene of "spatial boundaries". Spatiality as a "becoming" with no outer measures or ends, inside an intricate repetition, no longer confined to imitation (Rajchman, October 2000). Fold can lead to remark inquiries of figure/ground content, not making a division of figure/ground (Le Corbusier and the Piloti) but when a predictable and reversible trade can happen. These instabilities make the capability of a variety of folding and unfolding a re-reading of architecture of becoming, which happens autonomous of scale.

"The fold is the general topology of thought… 'Inside' space is topologically in contact with the "outside" space… and brings the two into confrontation at the limit of the living present." (Deleuze, 1988).

The fold is Deleuze's form of connection. For Deleuze, the greater part of the universe is a procedure of folding and unfolding the outside – which makes an inside that is not an inside developed self-governingly from the outside world however only a multiplying of the outside (Joncas, 2013).

Subsequently, the fold is the form of connection that takes after the general standards of a Deleuzian idea: open-ended and exhaustive, non-restricted and endless, exterior and infinite. An idea with significant potential for this discourse is Gilles Deleuze's translation of the Baroque fold. In his book (1988), Le pli, Leibniz et le baroque, (in English, The Fold: Leibniz and the Baroque), the French philosopher mentioned to the continual changes and disintegration into eternity as communicated in folded objects from the Baroque period.

In applying this thought to our time, Deleuze settled, "The new status of the protest no longer discuss its condition to a spatial shape as it were, to a connection of form matter but to a provisional modulation that infers as much the beginnings of a nonstop variety of matter as a consistent improvement of form" (Koutroufinis, Prominski, & Spyridon, 2009).

As showen by the title of Deleuze's book, the German philosopher and researcher Gottfried Leibniz was his fundamental reference in building up a contemporary idea of the fold. Leibniz attempted to accommodate the fold realism of request with the radical dynamization of the universe, endeavouring to catch the limitlessness of normal procedures inside the idea of the fold.

In outline, Deleuze theory of fold can be summarized as below:

1) Open-ended and in-exhaustive, e.g. continuously have the possibility to vary and develop regardless of a specific consistency of operation.

2) Non-selective and boundless, e.g. each application is imaginative, generative, and a continuous procedure and along these lines dependably permits backup ways to go

to be taken, as in each completion empowers counter-realizations Deleuze's inclination of potential to the feasible.

3) Exist in exteriority to each other and are accordingly boundless, e.g. a general manage of Deleuze's metaphysics is that the connection between two terms itself is a third term, so there is nothing “necessary” or “intrinsic,” just determinants inside contrasting sizes of endlessly (Joncas, 2013).

3.3 Folding in Architecture

The idea of 'folded space' where formerly unrelated features are efficiently integrated within a continuous, but in a heterogeneous mixture seems to offer contemporary architects with an alternate idea to the concentration of Modernism. In architecture the idea of the fold or folded space has been expressed through a various sorts of formal, spatial and programmatic explanations by various architects and architectural engagements in the 20th and 21th century. The origins of the idea can still always be outlined to the literatures of the French philosopher Gilles Deleuze (Willemse, 2009).

Deleuze's thoughts with respect to the fold were enthusiastically taken upon design theory soon after the underlying French distribution of *Le pli. Leibniz et le baroque* (1988). Examples contain *Unfolding Frankfurt* (Kohso,1991) with John Rajchman’s contribution, “Perplications” (Rajch man 1991), *Architectural Design*’s special matter *Folding in Architecture* (1993) rewritten by Greg Lynn, and Charles Jencks’s *The Architecture of the Jumping Universe* (1995) in which he portrayed another worldview for architecture.

Despite the fact that Deleuze once in a while deals with straightforwardly with design as a topic, his utilization of suggestive spatial dialect with terms including “the fold”, “planes of immanence”, “deterritorialization”, and “monadology” have enlivened planners and designers to investigate what his theory may offer the teach. The most clear of these investigations can be sorted as the, aesthetic, structural, and spatial potential outcomes of Deleuze's philosophical ideas. The Other investigations have been more concerned with investigating Deleuze's rationality in connection to inventiveness, procedure, and the applied limits of the discipline (Holden, 2007).

Folding is the capacity to incorporate irrelevant components inside another, continual blend. Variability is the capacity to change because of a circumstance that happens by shot. A meeting of specific impacts at a point in time makes the result of an event conceivable. All things considered, the nature of the event changes when any taking part component is adjusted. The rationale of impermanence depends on both an interaction of nearby powers and outside powers. Both nearby powers and outer strengths shape the identity created through variability and in this way the mutable blend ends up strikingly stable through reasoning of viscosity. In viscous fluid, inner firmness is in same proportion to external gravities. Internal firmness is reached through internal interrelation between several items of the mixture. Then again, outer bond is shaped in response to outside weights, viscous liquids along these lines advantage from the capacity to withstand stress without shearing. Rationale of curvilinearity suggests a dynamic contribution with outer strengths in the folding, curving, and bending of shape (Lynn, 1995).

It’s the fold potential of being bended and shape the curvilinear forms and unfolding spatial organizations, as a conceptual models which are identified by Vyzoviti (2004)

by using ivory material and additionally comparable strong structural undertakings by wonderful architects such as Zaha Hadid , Peter Eisenman, Frank Gehry and etc, who are managing folding reasoning in their activities.

Likewise as indicated by Willemse contemplates on investigating folded space (2009), a folding cross lines could make uncertainly among borders, rather than determined limits of isolation or partition. A few folds could make an obscuring of solid/void, inside/outside, and space to space edges, along these lines re-conceptualizing the traditional architectural ideas of spatial associations and partitions.

According to Vyzoviti, considering the crucial for the comprehension of the advancement of the discourses on the overlay into a routine with regards to folding architecture the qualities are presented below:

1. “The Fold: the endless work in progression, not how to settle but how to continue, to bring to infinity.
2. The interior and the exterior: the unending fold isolates or moves amongst material and soul, the façade and the shut room, within and the outside.
3. The high and the low: being isolated into folds, the fold incredibly develops both sides along these lines linking the high and the low.
4. The unfold: not as divergent to the fold but equally the persistence of this act.
5. Textures: as confrontation of the material, the way a material is folded establishes its texture.
6. The paradigm: the fold of the texture must not cover its formal expression” (Vyzoviti, 2004, p. 133).

The characteristics present by Deleuze invigorated the reasoning of a group of architects. Accordingly the fold has developed architectural substance, demonstrated tectonic attributes and can be supplied as design knowledge. The characteristics of the new architectural object developing in the re-definition of the function are contended below in a set of intentions:

1. “Extension: the objects as an endless series, sequential variability.
2. Multiplicity: the object as a lattice of elements, possible interactivity.
3. Curvilinearity: articulation, diagonal state, wrapping of surfaces and non-Euclidean geometries.
4. Stratification: layering and interfacing between denying architectural features.
5. Continuity: topological properties of surfaces and organizational standards.
6. Fluidity: interlacement of borders, uncertain delineations and sectors of probability” (Deleuze, 1992).

Briefly, according to all clarifications that are derived parallel to the simple physical appearance of fold, is the amazing meaning of fold as an infinite, continuous, fluid interlaces and layered concept, that was considered by the famed theoreticians and philosophers such as Gills Deleuze (1975), Leibniz (1676) and Foucault (1961).

By referring to these contents contemporary architects start to apply it in their projects to create folding-unfolding architectural patterns, which in the next chapter will be considered.

Here, in the figure below, the keywords that represent the thinking of Deleuze and Sophia Vyzoviti in terms of fold and folding theory are summarized for the purpose for bridging these terms with the analysis that will be done through the chosen cases.

Chapter 4

THE SPATIAL EXPRESSION OF THE FOLD

This chapter explains the relationship between the fold, folding, the concept of fold and the form of fold; based on what was discussed in the previous chapters in regards to the theoretical delineations and other aspects such physical form and geometry, and how the meaning of fold appears in the physical feature, how the concept of folding merges to appearance and structure and incarnates in the projects as a spatial architectural forming.

4.1 Method of Research

As already mentioned in Introduction chapter, under the heading 1.4; this study is a qualitative case study, which makes an in-depth exploration of the relationships between the fold theory, its context and folding in architecture in order to understand its different qualities and meanings. It is a case analysis based on several cases where folding theory was implemented.

According to the previous chapter and visual summary of information regarding to folding concept presented by Deleuze and Vyzovity, this chapter is going to discuss how a theory or meaning is able to **incarnate** into a physical form of substance and consequently to an architectural phenomenon.

The focus on the word “incarnation” conveys that there must be an intermediate tool or material to make this conversion or transition from a meaning or concept to an actual physical phenomenon.

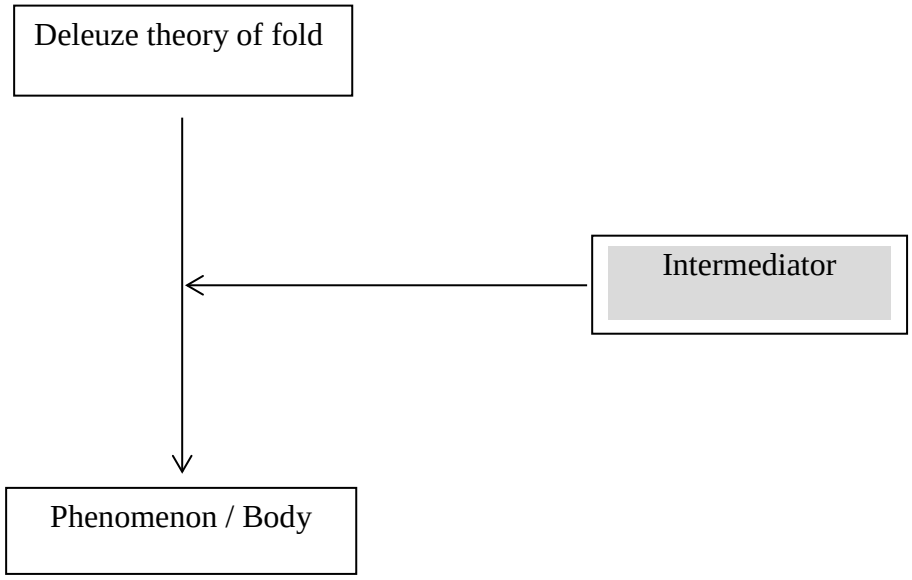


Figure 18: Incarnation of a concept of ‘fold’ to build/form/construct.

In the previous chapters, the two factors of philosophy and both their characterization and conceptualization were mentioned. In this chapter, the projects, which match with the conceptual forms of Vyzovity and philosophical aspects of Deleuze in the field of folding Architecture, will be analysed as sample case studies.

The schematic analysis diagram in next pages could be useful to understand the way how the analysis/examinations of selected projects were made.

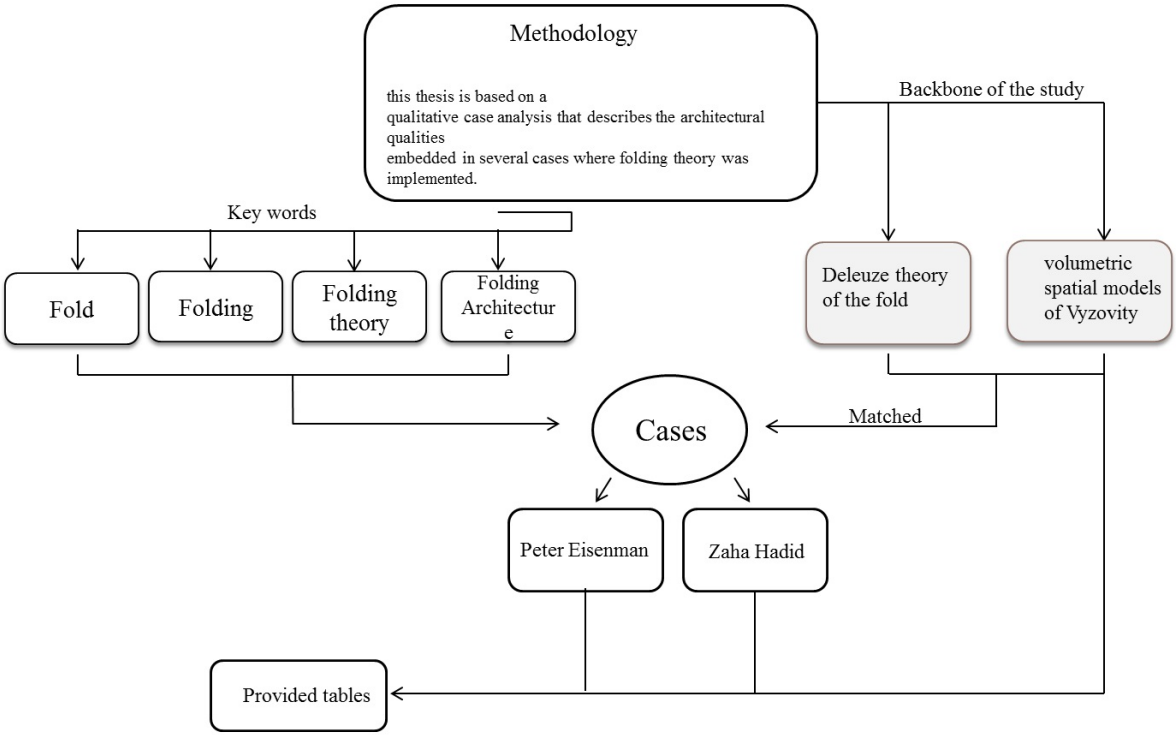


Figure 19: Methodology diagram.

4.1.1 Selection of the two Cases: Peter Eisenman and Zaha Hadid

Deleuze theory of the fold and Vyzoviti's volumetric spatial models provided the conceptual themes for further analysis based on the selected works of Peter Eisenman and Zaha Hadid, who were identified as the two most significant names in the field of architecture, using the theory of fold as the conceptual foundations in some of their important projects. (These projects are introduced in the next part of the thesis).

From the beginnings of the research process, Peter Eisenman came to the fore-front very obviously due to his own references to both Deleuze and folding theory in relation to his projects. So, selection of Peter Eisenman, as a specific data sample and 'case' for further detailed study was based on very clear argumentation. For the researcher, it was very important to find supportive data in parallel to the meanings

and understandings derived from the Peter Eisenman case. Due to the lack of direct reference from other architects, the choice of some other cases, which met the selection criteria (matching the conceptual framework of Deleuze theory of fold), proved to be more difficult. Nevertheless, one specific data from literature survey gave a strong argumentation for the possible inclusion of Zaha Hadid and some of her work to the data sample platform. This specific information was related to her conceptual explanation of her work called 'Arum' and its connection to folding theory.

'Arum' is the name of the installation and exhibition of Zaha Hadid Architects at the 2012 Venice Architectural Biennale, which was held under the theme "Common Ground", which referred to the "reassertion of the existence of an architectural culture, made up not just of singular talents but a rich continuity of diverse ideas united in a common history." With Arum Zaha Hadid Architects not only pay homage to the historical lineages – actually fold(ing) s - of collective research but also gets into dialogue with the work of today's contemporary architects and researchers. Zaha Hadid is well known for her earlier work being inspired by Russian Suprematism. And the pleated metal structure, which was designed for the biennale was derived from the work of German architect Frei Otto, who was the key-person paving "the way for material-structural form-finding processes".

Figure 20: Venice Biennale 2012- Zaha Hadid
URL 5.

Peter Eisenman is one of the famed architects who linked the theory of fold with the modern architecture in the recent period of 20th century and who on-going to apply the theory of fold and all the includes in the architectural aspect. Peter Eisenman as one of originators of folding philosophy in terms of architecture deliberated the phrase " weak form "which as a form with the ability of being flexible and matching with the form of its container. He specified to some catchphrases and expressions for example "monad", "pleats of matter" and "folds in the soul" and etc. His studies based on folding architecture are the theoretical emphasis for Deleuze's philosophy of fold (Corbo, 2015).

On the other hand, Zaha Hadid is distinguished for her unfolding creative, displacement and distortion, organic, topographic and fluid patterns. Her projects are chosen due to ability to follow the concept in whole domain of landscape, architecture, and interior architecture and sometimes in interior elements such as lighting and furniture.

“Only rarely does an architect emerge with a philosophy and approach to the art form that influences the direction of the entire field such an architect is Zaha Hadid…” Bill Lacy, Architect. Zaha Hadid’s projects are mostly formed in horizontal extensions, folding lines and curvilinear surfaces that moves horizontally from outside to inside whole together and contains a concept of folding, pleating, wrapping and continuity.

4.1.2 Selected Projects - Data Sampling

For all of the above mentioned cases and data were collected from reliable sources such as their official websites, regarding to the selected projects.

Regarding Peter Eisenman the deliberated issues were most significant on three of his works and hence these were selected as sample projects for in-depth study.

- Church of the Year 2000, Rome, Italy 1996
- City of Culture, Galicia, Spain
- The Staten Island Institute of Arts and Sciences

As in regards to the work of Zaha Hadid; her remarkable project, Hayder Aliyev Centre in Baku Azerbaijan, which was according to literature (ArchiTeam, 2016) inspired from folding – unfolding theory was selected as a sample project for further investigation. In this work of Zaha Hadid, one of the aspects of the folding theory dominantly overlaps with the architectural qualities she emphasizes. This aspect is the approach to a definition of the ‘interior’ that cannot be separated from the ‘exterior’. For the theory of folding, keeping this connection of the interior-exterior is an expected manifestation.

Zooming 'in':

In continuation to the earlier selections, it was considered as essential to zoom 'in', into the interior dimension of folding in architecture in order to gain further insights without separating the interior from the exterior. For this purpose, Peter Eiseman's Greater Columbus Convention Centre was selected for analysis in terms of its interior features. In a similar logic, Zaha Hadid's Maxxi National Museum, was selected to zoom 'in'.

Below, all these selected projects are summarized:

Peter Eisenman:	The significant cases: • Church of the Year 2000 • City of Culture • The Staten Island Institute of Arts and Sciences Zooming in to the "in" dimension: • Greater Columbus Convention Center
Zaha Hadid:	The significant case: • Hayder Aliyev Center Zooming in to the "in" dimension: • MAXXI National Museum

4.1.3 Method of Analysis

After selection, these projects were specified according to the similarity factor to Vyzoviti's conceptual spatialization of folding patterns, schematic actualization layouts and spatial organization of folding theory by using ivory material. (These were already introduced earlier in the thesis in pages 9-10.) After this step, they were analysed according to (Vyzoviti, 2004)'s consideration on essential dialogues and its schematic perspective of incarnation of folding concept with regards to folding architectural developments and also the characteristics presented by Deleuze

regarding to theory of fold and will be presented in tables as a visual analysis in the next pages Figure 21 shoes the logic behind the analysis process.

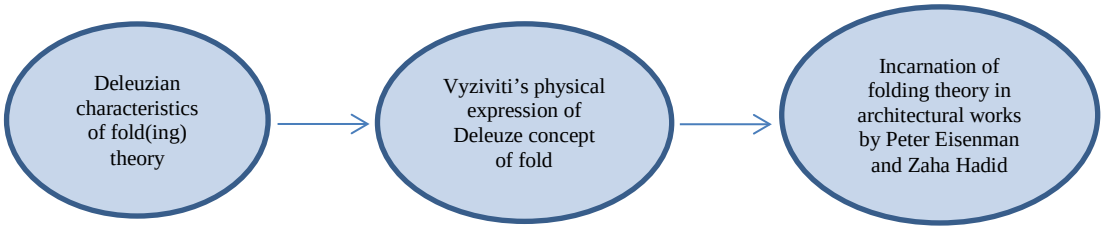
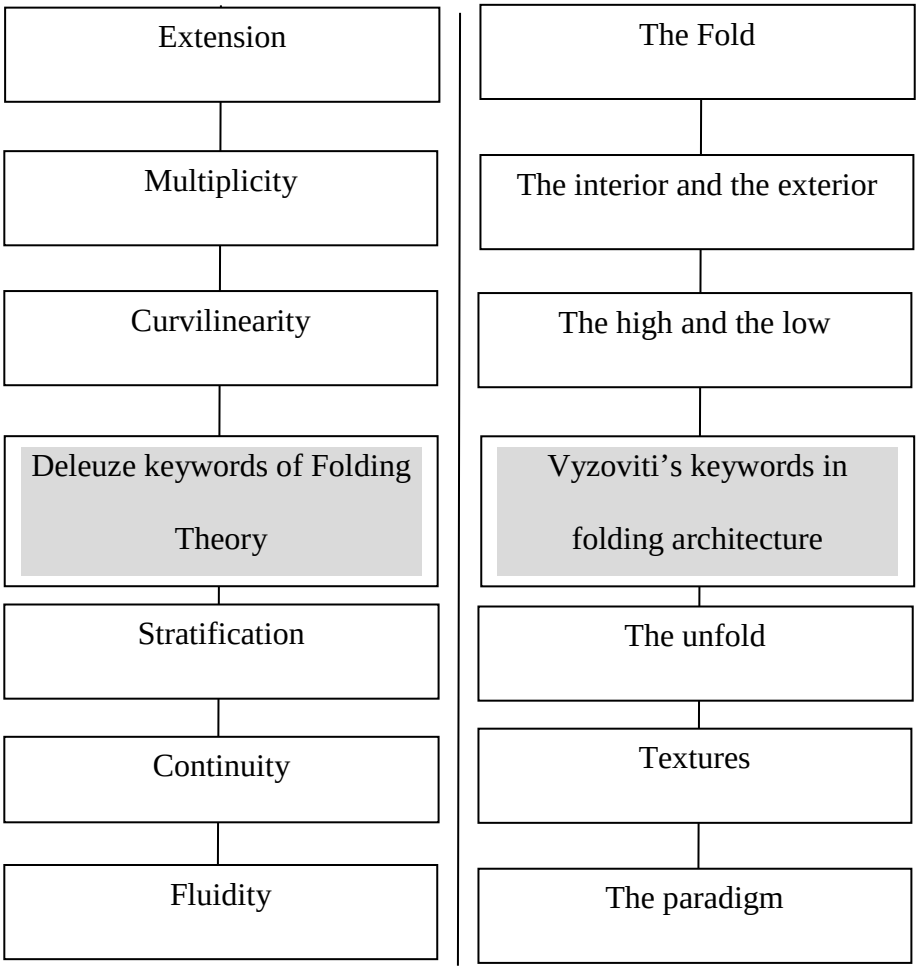


Figure 21: Method of analysis.

The architectural works were analyzed in terms of the existence or appearance the keywords that were indetified in the writings of Deleuze and Vyzoviti. The table below is a visual summary of these keywords.

Table 5: Specified keywords by Deleuze and Vyzoviti



4.2 Explanation of Significant Sample-Cases and their Analysis

Firstly, the above-mentioned significant cases will be introduced and explained one by one. Secondly, the tables where they are analysed will be presented. The tables/analysis was done according to the architectural qualities, which were mentioned in the theory of the fold according to Deleuze. As a reminder, they are listed below:

- Table 6: Criteria Analysis of Church of the Year 2000, Rome, Italy 1996
- Table 7: Criteria Analysis of City of Culture, Spain, 1999
- Table 8: Criteria Analysis of The Staten Island Institute of Arts and Sciences, New York, 1997-2001
- Table 9: Criteria Analysis of Hayder Aliyev Center, Baku Azerbaijan, 2013

4.2.1 Peter Eisenman: Church of the Year 2000

- Location: Rome, Italy
- Year: 1996
- Status: Unbuilt, Competition Model

The consecrated place visited by explorers as a congregation includes a one of unique areas in the authentic background of the headway of religious place. This project reflects the social move and its effect on the architecture of this place, right now, for this specific capacity. The iconography of this church depends on two corresponding thoughts. One is the closeness and distance between the idea of pilgrimage and the concept of media and the other one is a new connection of human being, God and nature (ArchiTeam, 2016).

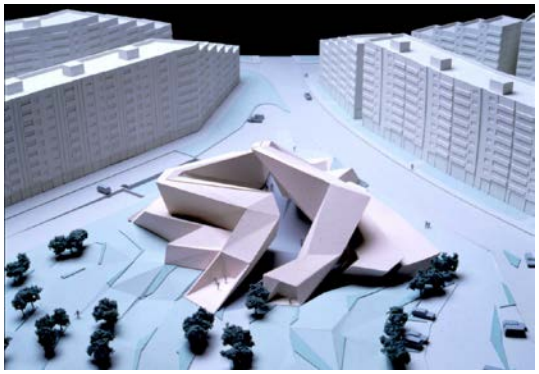


Figure 22: Church of the year 2000- Peter Eisenman
URL 6.

As Peter Eisenman states (1999), the liquid crystal is the most exact state of between in nature, that speak to the continuous mutilation of a unique precious stone stage to a realistic state, which is a between stage in the atomic request sometime recently it comes to the isotropic or fluid stage.

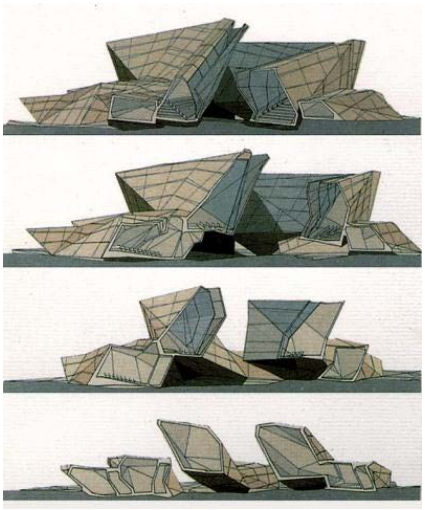


Figure 23: Church of the year 2000- Peter Eisenman
URL 7.

The layout presents to another part of the liquid crystal that of numerous layers and covers, inspired from theory of fold rising from ground in several layers integrating together and viewed as the deformation of a few unique layers. These all are presenting in the developing type of the project. The shape of church is perceivable as rising from ground to heaven to infinity, like a mediator among nature and physical reality to infinity (Eisenman, 1999).

Table 6: Criteria analysis of church of the year 2000, Rome, Italy 1996

4.2.2 Peter Eisenman: City of Culture

- Location: Santiago de Compostela, Spain
- Client: Fundación Cidade da Cultura de Galicia
- Project Year: 2011
- Status: Built

In his project, City of Culture, Eisenman planned a building structure based on folding concept; the coherence of lines and figures from the inside to outside and further more from the setting of the city guide is the visual delineation.

Curved outlines create the fundamental shape that is obvious in outside same as lines that characterize the inside spaces; the direction of these lines and headings that is leading to the eye. Curvilinearity of the structures both inside and outside makes a consistent connection amongst interior and exterior.

Figure 24: City of Culture, interiors.
Photos: Roland Halbe
URL 8.

The fold delivers a separation of the persuasive distinction amongst figure and the ground; this procedure prompts creating a space that Deleuze named as "smooth space". "Smooth Space" is in the opposed to "striated space"— an allocated of advancement which denies free development. "Smooth space" alludes to a lanscape

or environment in which that Deleuze and Guattari clarify: “Smooth space is filled by events or haecceities, far more than by formed and perceived things. It is a space of affects, more than one of properties. It is haptic rather than optical perception. Whereas in striated forms organize a matter, in the smooth materials signal forces and serve as symptoms for them”. He said that the framework stays in its place and the four dividers dependably exist, however in actuality the folding of space surpassed them.With all the new ideas Eisenman trusts that it is impractical to relate the three-dimensional reality of folded space with visualization of space with a two-dimensional representation, 1994.

Figure 25: City of Culture, Peter Eisenman
URL 9.

This building makes a perspective as identical and physical development for the spectator, this is the point at which Eisenman says the fold is a picture of thought and furthermore it can be deciphered as folding hypothesis in architecture to build a perspective of three dimensional images from the ideas of designers.

“Architecture will continue to stand up, to deal with gravity to have four walls. But these four walls no longer need to be expressive of mechanical paradigm. Rather the walls could deal with the possibility of these other discourses, the other effective

sense of sound, touch and of that light lying within the darkness” (Eisenman, 1994, p. 150).

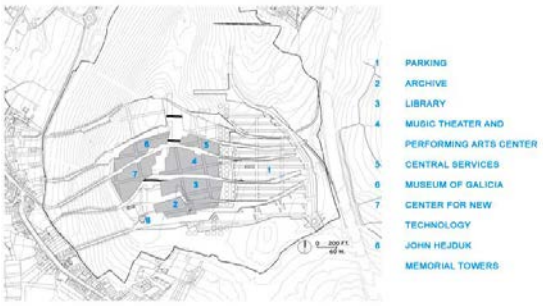
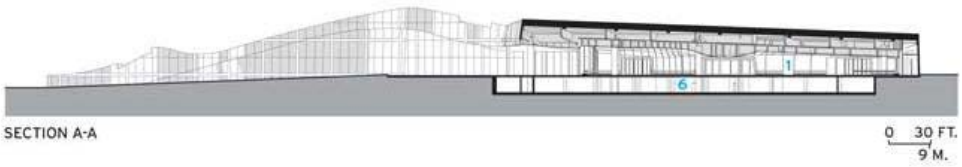
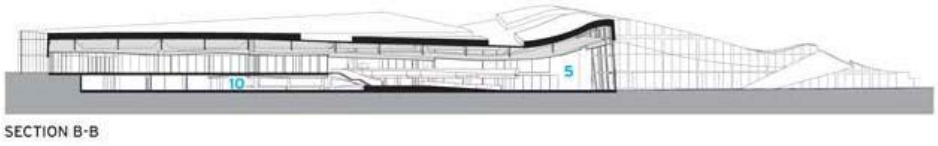


Figure 26: Site plan, City of Culture
URL 10.





1	CITY OF CULTURE EXHIBIT	7	MECHANICAL
2	OPEN TO BELOW	8	REFERENCE ARCHIVISTS
3	ARCHIVE EXHIBITION	9	GENERAL CATALOGING
4	CENTRAL COOLING	10	SCHOLARS CENTER
5	READING ROOM	11	ARCHIVE EXHIBIT
6	ARCHIVE STACKS	12	CITY OF CULTURE SHOP

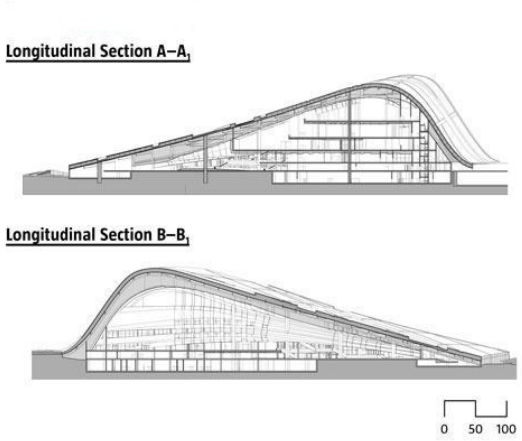


Figure 27: Longitudinal section, city of Culture
URL 11.

Three arrangements of data prepared the wonderful location of Cultural Centre of Galicia. Regardless, the medieval street design of Santiago topographically overlies on the plan of slope site above the city. Next is an advanced Cartesian lattice is placed above this medieval course. Third, with the computer modelling programming, the slope topology is permitted to mutilate the double level geometries, subsequently producing a topological plane, which relocates antiquated and modern in a synchronous grid at no other time seen. Arrangement of the three grids conduce visible development during the walking in the site.

“The lines that begin from the foundation up and again they are landing down and convert to the ground line, they make the image of stature ground; the matrix lines are appeared in the casing of height subtle elements and all the exertion has been made to make a dynamic space by applying uninterrupted structures and lines” (Kloppenburg, 2016).

The project contains six building which are considered in three sets: the Museum of Galicia and the International Art Centre; the Library of Galicia and the Galician

Archives and the Centre for Music and Performing Arts and the Central Services building. Guests' encounters of any given building will be influenced by its link to its quick accomplice. The Caminos, or person on foot boulevards, between the structures likewise open onto an open square, which is circumscribed by the six structures and components scene and water components. The biggest building standing 42.5 meters high is the Performing Art Theatre. The statures of the all parts of the building climb in sensitive curves that seem to imitate the condition of the top with their total rooflines, which are all clad in stone and set apart with the frameworks (Eisenman, The City of Culture, 2011).

Table 7: Criteria analysis of City of Culture, Spain, 1999

4.2.3 Peter Eisenman: Staten Island Institute for Arts and Science

- Location: Staten Island, New York
- Client: The Staten Island Institute of Arts and Sciences
- Project Year: 1997-2001, Status: Unbuilt

Peter Eisenman takes an interest in opening the linkages amongst diagram and writing. As opposed to looking for an arrangement of correspondences through which investigative proposes may be clearly displayed, Eisenman build up the dynamic capability of outline to prompt more diagrams (Somol, 1999).

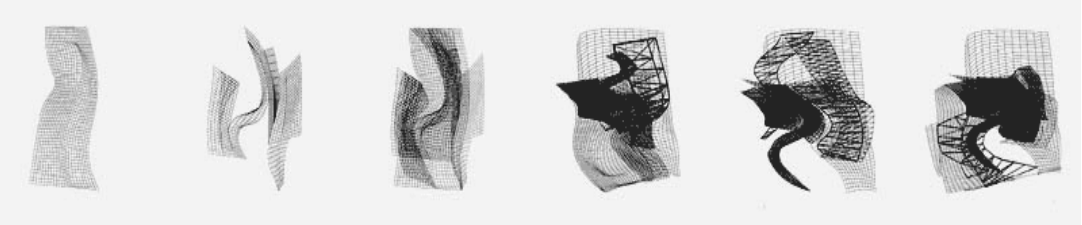


Figure 28: Staten Island Institute, schematic progression
URL 12.

Peter Eiseman's design for the Staten Island Institute of Arts and Sciences takes into concentration a subject that has preoccupied him in latest years: the connection among the history of places with the history of ideas (Muschamp, 2000).

Plans for the centre include these exciting advancements: an Info hall, designated like an electronic town area, with media attractions such as games, projections and other media facilities; a museum, including five parts, serpentine galleries with interpretative presentations, alongside with a library and cafeteria, also with research locations in an industrial documentary centre, for new expansions in high-tech communications.

The centre is located near the ferry terminal building and the transportation systems the centre’s most apparent form is a large round building, created of intersecting, tapering oblongs, twisted which rises 44 feet from ground level. The building skin, slit with openings for skylights. However, Eisenman states that he reaches at these forms by a systematic design process. The process starts by arranging a two-dimensional grid around the site. The grid accepts as the contour of the site's topography. It is then covered with shapes resulting from the transportation systems: ferry lanes, bus ramps, train platforms and so on. These forms are stretched into three dimensions and then packed with the construction's program: library, cafeteria, galleries, offices and all that fits. Again as Eisenman’s way of thinking inspired with the folding theory the potential of existing environment is interfering to shape the volume by several layers which are moving horizontally, twisting, transforming and extending to create the building as a part of landscape all together.

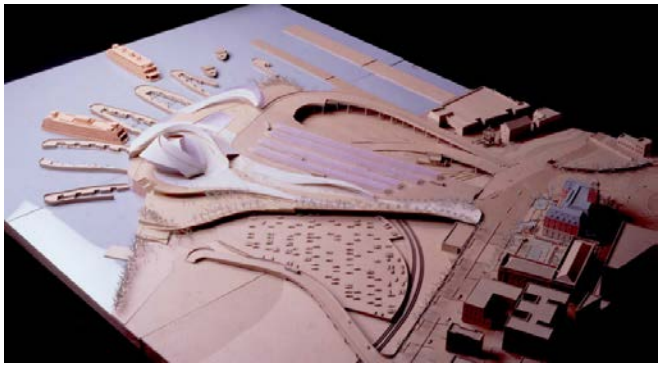


Figure 29: The Staten Island Institute of arts & sciences- Peter Eisenman URL 13.

Table 8: Criteria analysis of the Staten Island Institute of arts and sciences, New York, 1997-2001

4.2.4 Zaha Hadid: Heydar Aliyev Centre

- Architects: Zaha Hadid Architects
- Location: Baku, Azerbaijan
- Project Designer and Architect: Saffet Kaya Bekiroglu
- Client: The Republic of Azerbaijan
- Year: 2013
- Status: Built

“Every night, as the stars twirl over the sky over the city of Baku, one flickering structure appears to drift simply over the Earth's horizon on a stage of light: the radiant bends, taking off circular segments and streaming geometry of the Heydar Aliyev Centre, planned by Zaha Hadid Architects, in the capital of Azerbaijan in a split second recognize this as one of the globe's most current symbols of cutting edge design.” (Fairs, 2014).

Like Azerbaijan itself, which is part amongst Asia and Europe, the new Baku conveys components of both Eastern and Western outline style. Also, similar to a portion of the symbols of design made in the Eastern Hemisphere over the ages, the structure transforms consistently into its environment (Dezeen Author).

"We attempted to obscure the traditional comprehension amongst figure and ground, architecture and city, inside and outside," said Saffet Kaya Bekiroglu, the building planner and draftsman for the Baku Centre. "People in general court, as urban ground, undulates and overlays upwards to make inner spaces, a radical new sort of comprehensive open community space for the city," the planner included(Dezeen Author).

Figure 30: Heydar Aliyev centre.
URL 14.

The court, as the ground surface; open to all as a major aspect of Baku's urban texture, rises to wrap a similarly open inside space and characterize a succession of occasion spaces committed to the aggregate festival of contemporary and conventional Azeri culture. Expand developments, such as undulations, bifurcations, folds, and intonations adjust this court surface into a structural scene that plays out a large number of capacities, inviting, grasping, and coordinating guests through various levels of the inside (ArchiTeam, 2016).

With this motion, the building obscures the ordinary separation between structure and urban scene, building envelope and urban square, figure and ground, inside and outside.

Figure 31: Heydar Aliyev centre / Zaha Hadid ArchitectsHélèneBinet
URL 15.

Among the discussions at London's Architectural Association, Zaha Hadid said the Baku Centre is a piece of a progression of experimental "fluid space" structures. Deconstructive design operates with a rationale of conflict and inconsistency however folding architecture closer views a more fluid logic of network (Lynn, 1995).

Based on Deleuzian theory of fold, everything horizontally connected, matched and no boundaries between elements everything is like fluctuating in space gives a sense of flexibility and matching with surroundings exterior, interiors and converted to furniture with an equivalent motion.

Table 9: Criteria analysis of Hayder Aliyev Center, Baku Azerbaijan, 2013

4.2.5 Summary of the Tables Showing the Analysed Cases

Here, a general summary of the visual analysis of the conceptual representation of the folding patterns compared with the spatial architectural works is presented.

Table 10: Summary of the results.

Analysis criteria (keywords used based on Deleuze and Vyzoviti)	Case: 1	Case:2	Case:3	Case:4
Fold				
Inside and the outside				
Unfold				
Extension				
Multiplicity				
Curviliniarity				
Stratification				
Continuity				
Fluidity				
Entanglement-Connectivity				
Layering				
Stress forming				

In the summary of these analysis patterns it is obvious that most of the characteristics of folding theory are common among the projects, which are containing this theory as a concept. The most significant qualities are relating to layering or stratification,

which contains the meaning of extension, continuity in addition to inside and outside as particular characteristics of theory of fold.

Also, what is interesting in the field of folding theory is some of the cases could be dissimilar to physical appearance of fold. Folding as a concept exists as the soul in solid body of the spatial feature.

4.3 The Infinite Fold and Inside-Outside Discussion

According to previous chapters related to the folding philosophy and the basic means of fold and Deleuzian theory of fold and the fold definition, focusing on interior organizations as a separate part or unrelated section from the whole projects is meaningless. This chapter will attempt to remark some interior classifications integrated with exterior, which are supporting whole concept of folding theory as, inside is nothing than the outside, in a same time.

The American architect, Peter Eisenman's translation of Deleuze's fold is as one of numerous procedures for separating vision, disengaging the order of inside and outside that thwarts vision.

"Folded space articulates a new relationship between vertical and horizontal, figure and ground, inside and out – all structures articulated by traditional vision. Unlike the space of classical vision, the idea of folded space denies framing in favour of a temporal modulation. The fold no longer privileges planimetric projection; instead there is a variable curvature. […] folding […], in terms of traditional vision, […] contains a quality of the unseen. Folding changes the traditional space of vision. That is, it can be considered to be effective; it functions, it shelters, it is meaningful, it

frames, it is aesthetic. Folding also constitutes a move from effective to affective space." (Eisenman, 1994).

"The outside is not a fixed limit but a moving matter animated by peristaltic movements, folds and folding that together make up an inside: they are not something other than the outside, but precisely the inside of the outside."(Deleuze, p.96-97).

Regarding to previous paragraphs the next section will stay through Hyder Aliyev centre with the interior point of view. The heart of the building is found in its advanced and inviting focal amphitheatre; a warm execution space whose inventive utilization of oak to line and shape the inside exhibits modernity in both vision and joinery works. It is a womb like carefully definite oak inside where the consistent ribs of timber draw in richly with the lines of seats.

Figure 32: HeydarAliyev centre / Zaha Hadid Architects
URL 16.

The building has three separate "zones" – a library, perpetual exhibition and an assembly hall with multipurpose bolster spaces. The white inside has the size of a sea

liner with influxes of twisting white mortar encompassing the overhangs as they wrap and curl around the assembly hall.

This space geometrically combines elegantly and flawlessly with the other two territories. This is truly complex dynamic treatment of space – that is predictable all through with the original concept. Precisely itemized and negligible glass balustrades never degrade the sculptural expectation. Lighting is similarly very much taken care of in light of the building aim either at abnormal state as irregular strips or at low level to underscore the rising sculptural dividers.

Figure 33: Heydar Aliyev center / Zaha Hadid Architects, URL 17.

Figure 34: Heydar Aliyev centre / Zaha Hadid Architects
URL 18.

Moreover, fluidity and dynamism of the layers is applied to create incredible natural lighting openings in the ceiling, as well as whole building, combined in the homogenous mixture.

Figure 35: Heydar Aliyev Centre / Zaha Hadid Architects
URL 19.

4.3.1 Zooming in - MAXXI National Museum

- XXI Century Art museum
- Rome, Italy
- Zaha Hadid
- Established in 2010

The MAXXI Museum in Rome by Zaha Hadid, has gotten the Stirling Prize for 2010, The 27,000 square meter centre is Italy's first national open exhibition hall of contemporary expressions and elements two historical centres - MAXXI Art and MAXXI Architecture.

Figure 36: MAXXI national museum
URL 20.

The MAXXI identifies with the urban setting in which it is embedded by re-proposing the horizontal advancement of the previous military garrison huts, contrary to the taller private structures that encompass the site. The principle thought behind the venture is directly identified with the goal of making a working for the introduction of the visual expressions. The site is “wrinkled” by show spaces, the

dividers that cross its spaces, their convergences characterizing inside and outside space. This framework acts away at three levels, the second is the most unpredictable and wealthiest, with it different extensions that associate the building and the displays. Guests are welcome to jump into a thick, consistent space as opposed to standing up to the minimal volume of a confined building (Archdaily Author, 2009).

The inside space, characterized by the dividers of the gallery displays, are secured by a glass rooftop that surges the spaces with regular light, separated between the rooftop trusses. These last strengthen the linearity of the spatial framework and help the verbalization of the different bearings, overlapping and bifurcations of the arrangement of exhibition spaces. The sharpened linearity of the dividers encourages course through the grounds, inside the exhibitions and between the objects in plain view (Archdaily Author, 2009).

Figure 37: MAXXI national museum
URL 21.

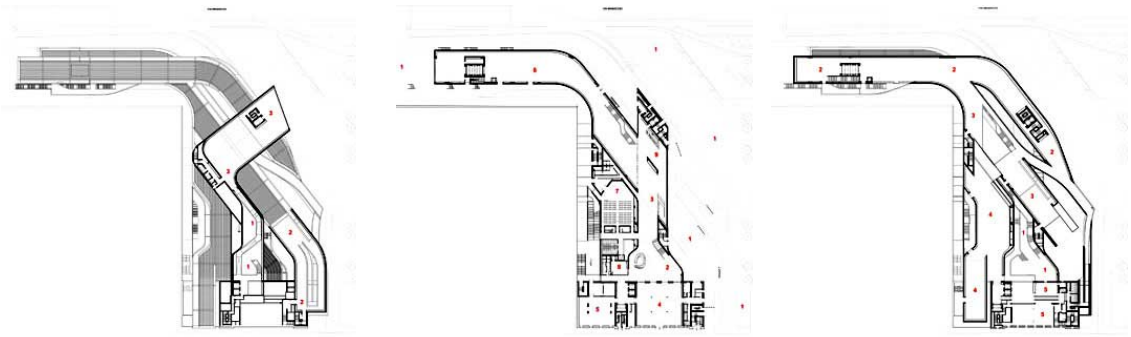
The MAXXI ought not to be viewed as only one building - but rather a few. The thought was to move far from the possibility of "the museum as an object" and towards the possibility of a "field of structures". After many reviews, explorations

developed into the idea of the conversion of lines, where the essential constrain of the site is the walls that always meet and separate to make both indoor and open air spaces. It's no longer only an exhibition hall; however an urban social focus where a thick surface of inside and outside spaces have been interwoven and superimposed more than each other. It's a fascinating blend of exhibitions, flooding a vast urban field with direct appearance surfaces.

Figure 38: MAXXI interiors.
URL22.

The dividers of the MAXXI make real streams and minor streams. The real streams are the displays, and the minor streams are the associations and the extensions. The site has an interesting L-moulded impression that wanders between two existing structures. As opposed to considering this to be an impediment, we utilized it further bolstering our good fortune, accepting it as an open door to investigate the potential outcomes of direct structure by packaging, winding, and building mass in a few

zones and lessening it in others - threading linearity all through both inside and outside.



Ground floor plan First floor plan Second floor plan

Figure 39: MAXXI museum plans.
URL 23.

All these about MAXXI museum supports a significant characteristic of folding theory from outside horizontal orientation to inside anti-duality, anti-centralization, anti-hierarchy, anti-rationalism, anti-metanarrative, flexibility and transfer Software.

According to (Sykes, 2010),“forms of bending, twisting or folding are not superfluous but result from an intensive curvilinear logic which seeks to internalize culture and contextual forces within form. In this manner events become intimately involved with particular rather than ideal forms. These flexible forms are not mere representations of differential forces but are deformed by their environment” (2010).

4.3.2 Zooming in - Greater Columbus Convention Centre

- Columbus, Ohio
- Peter Eisenman
- Year: 1993
- situation : Built

The Columbus convention centre located in Ohio, United States, presents the idea of horizontality. It is situated in the northern centre of the city between the city centre and northern zone. From the sides the main transport links like several layers are surrounded the building. In other hand the transferring data from this centre by electronic links are moving like layers and lines all around the building, Eisenman displays all these layers and coatings in physical appearance in his building by horizontal equilibrium volumes moving align the existing environment around the centre matching with whole atmosphere.

Eisenman states: “The idea of the building is not separated from the location itself, the building raises from the whole environment and layers of transporting and transferring data around. Consequently, it makes itself from its own capacity and atmosphere.”

Figure 40: Columbus Convention centre
URL 24.

The interior of the building is ruled by a focal hub that runs the whole length of the convention centre. Strolling in this fundamental passage, the guest is confronted with long extends of un-planned spaces. Despite the fact that this is maybe intended to go about as a counterpoint the building's bustling outside. Still, this straightforward focal hub enables the working to work great due partially to its basic format.

Inside this principle path, overhangs ignore the space and give watchers irregular perspectives of the building and passers-by.

Figure 41: Columbus Convention centre, passages
URL 25.

In general the outline includes a progression of stretched structures, curvilinear in plan and rectangular in area, which seems to ascend from the site, traverse the display corridor and suddenly end at the section road. Containing two stories of meeting rooms and administration spaces, these structures are expected to be practically equivalent to colossal metal-sheathed links of correspondence. The road heights, made out of turned voids and projections in changing materials, expound upon the parallel.

All stated architectural projects, are named and explained in the previous paragraphs to show that how they are related to Deleuze and Vyzoviti's ideas with the mentioned keywords defined in the related tables for each project. It shows how most of the characteristics presented in the literature could be incarnate in the physical forms as architectural projects to support the conceptual theory behind every single curves or lines to move, wrap, fold or unfold horizontally from inside to outside.

Chapter 5

CONCLUSION

In this chapter, firstly a summary of the study is given. Then, conclusions and recommendations for further research are stated.

At the beginning of the study, the preliminary investigation of the literature regarding the ‘fold’ showed that in most of surveys ‘fold’ is mentioned (merely) as an act, form or shape with its geometric characterizations regarding to patterns of fold or geometry of fold. As a second step, the research continued with the explorations and explanations of origami folds concerning to the types of origami folds, algorithms and patterns. Consequently, as a gap in literature, it was realized that what was not well informed regarding to the concept of ‘fold’ was its theory as a profound, significant matter in the definition of ‘fold or ‘folding’ issue.

As also mentioned in the introduction chapter, the problem of this study was put forward as such: ‘Fold’ is summarized into the surface ability to being folded or wrapped. In general for the young designers or students in the field of Architecture or Interior Architecture, it means just a physical appearance and the other side of it, which is about being a strong concept stays as invisible. However, the fold does have there a philosophical depth, which is worth investigation and has much sensual wisdom.

Hence, it was considered that, this study could be useful for the aim of gathering a set of information focusing on the ‘fold’ issue from the both edges at the same time: one from the edge of being a ‘physical form of fold’ and the other one being the ‘philosophical concept of fold’. From this perspective, the research design aimed to reveal the relationship between these two faces of ‘fold’ by pointing on an intermediate conceptual form which makes the connection between theory as a concept and reality phenomenon as architectural buildings.

Designed as a qualitative case study research, it has attempted to presents this relation as a clear investigation on fold, folding and architecture by focusing on Deleuze description of the ‘fold’ through these steps:

- Finding the architectural design related keywords related to Deleuze description of the fold;
- Identifying worldwide-accepted architects, who use these in their works;
- Identifying the architectural design related keywords derived from the work of Sophia Vyzoviti, who – based on Deleuze worked with three-dimensional models, as volumetric expressions of Deleuze theory of the fold;
- Using these keywords and volumetric models as a selection criterion to eliminate the projects of the chosen architects (The ones which did not overlap with these keywords and models were eliminated);
- Using the selected projects as sample case studies to make a qualitative analysis and achieve the aims of this research.

So addressing the main research question, which was: “What does the possibility of the fold convey to or through folding architecture, more than the undeniable formal

examining of the fold?" it can be stated that; fold possibilities are beyond transforming into a wall, roof and again a wall. Fold contains a deep concept of infinity, horizontality outside- inside unity with no priority and no dominance.

In addition, as an answer to the second and third research questions, regarding to how the philosophy of 'fold' is able to support the physical form or how does the 'fold' theory appear in physical form, based on Deleuze findings, it can be stated that; the fold is never to be approved as a single occurrence but instead it is to be observed as a populace of many folds. And also, it is important to add that, the 'fold' is a sequence of many 'folds' divided to infinity and it can support the smooth curvilinear, connective and layered form of the 'fold' in Vyzoviti's conceptual three dimensional models and accordingly the actual architectural projects in the field of 'folding architecture'.

Finally, it is hoped that in the light of the findings of the present study, in their future works, the students and young designers could perceive and use the fold and folding theory as a conceptual design agent for folding architecture.

At the end of the thesis, also a new question arises. The results of the study indicate that, there is a very rich and essential potential of the fold theory that could be used as a basis or inspiration for many architectural projects. At the same time, as can be seen through the selected cases, the fold theory and its conceptual potential *was* applied and managed to incarnated into an existence beyond its taken for granted state of being just an aesthetic or structurally efficient folded surface or structure in the projects. So, the question is: Why is the folding theory so little used as a

conceptual design agent? Can it be because of the high initial costs that would be required to realize them? So, it is considered that, some further research could focus on this problem and investigate the ways, how it would be possible to use folding architecture and its active space beyond the theory or computer animated spaces to occur in the touchable reality more. Additionally, some researchers could think of or design alternative ways to find and recommend new solutions to reduce this cost. Based on this idea, some other further studies could focus on producing new generation of materials or series of surfaces, which are programmed to not just fold and unfold but to evolve and continuously refold themselves.

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Table 6: Criteria analysis of Church of the year 2000

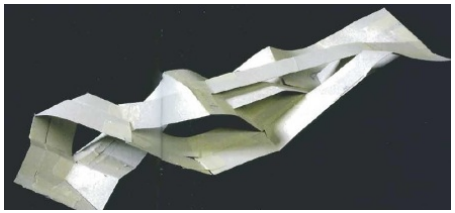
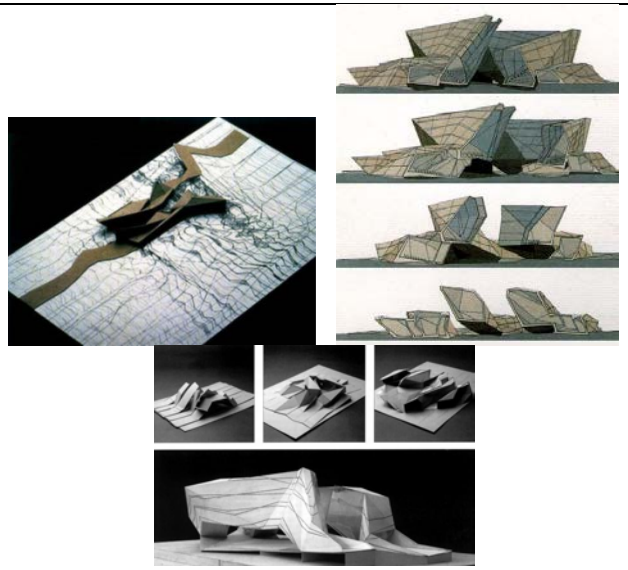
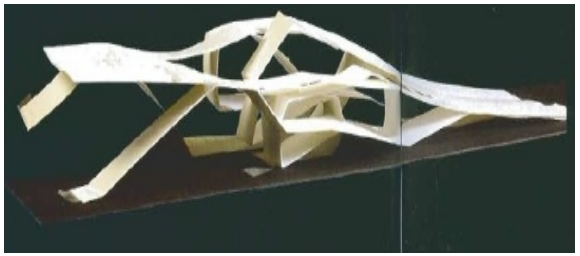
Case 1: Church of the year 2000, Rome, Italy 1996 Peter Eisenman			
	Deleuze and Vyzoviti outline information	Vyzoviti's Schematic actualization layout and spatial organization of folding theory by using Ivory material.	Spatial layout and architectural organization motivated from theory of fold.
	Fold		
	Inside and the outside		
	Unfold		
	Extension		
	Multiplicity		
	Curviliniarity		
	Stratification		
	Continuity		
	Fluidity		
	Entanglement-Connectivity		
	Layering		
	Stress forming		

Table 7: Criteria analysis of City of Culture, Spain, 1999

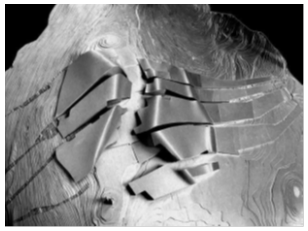
Case 2: City of Culture, Galicia, Spain by Peter Eisenman.			
	Deleuze and Vyzoviti outline information	Vyzoviti's Schematic actualization layout and spatial organization of folding theory by using Ivory material.	Spatial layout and architectural organization motivated from theory of fold.
	Fold		  
	Inside and the outside		
	Unfold		
	Extension		
	Multiplicity		
	Curviliniarity		
	Stratification		
	Continuity		
	Fluidity		
	Entanglement-Connectivity		
	Layering		
	Stress forming		

Table 8: Criteria analysis of Staten Island Institute for arts and science, 1997-2001.

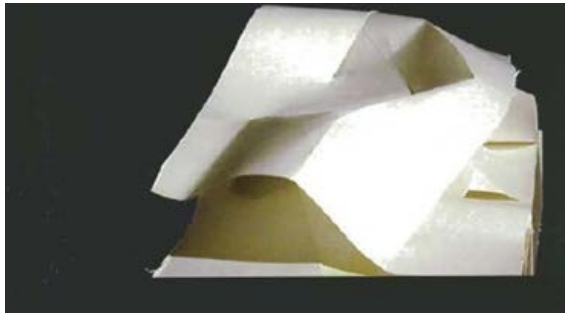
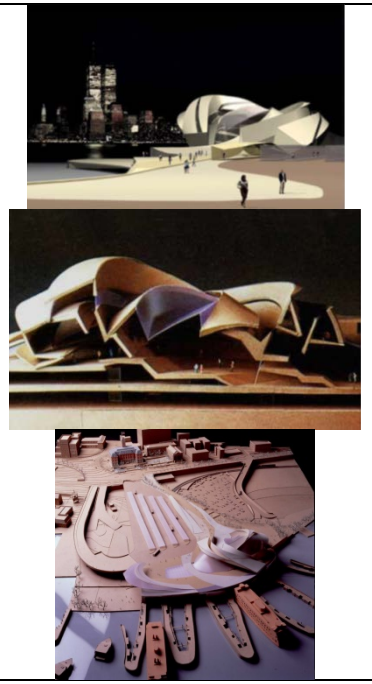
Case 3: Staten Island Institute for arts and science **Date: 1997-2001 Client: Staten Island Institute for Arts and Science**			
	Deleuze and Vyzoviti outline information	Vyzoviti's Schematic actualization layout and spatial organization of folding theory by using Ivory material.	Spatial layout and architectural organization motivated from theory of fold.
	Fold		
	Inside and the outside		
	Unfold		
	Extension		
	Multiplicity		
	Curviliniarity		
	Stratification		
	Continuity		
	Fluidity		
	Entanglement-Connectivity		
	Layering		
	Stress forming		

Table 9: Criteria analysis of Hayder Aliyev center, 2013

	Case 4: - Hyder Aliyev center ZahaHadid, Location: Baku, Azerbayjan		
	Deleuze and Vyzoviti outline information	Vyzoviti's Schematic actualization layout and spatial organization of folding theory by using Ivory material.	Spatial layout and architectural organization motivated from theory of fold.
	Fold		  
	Inside and the outside		
	Unfold		
	Extension		
	Multiplicity		
	Curviliniarity		
	Stratification		
	Continuity		
	Fluidity		
	Entanglement-Connectivity		
	Layering		
	Stress forming		