University of HUDDERSFIELD
University of Huddersfield Press

Fields: journal of Huddersfield student research
Available open access at: https://www.fieldsjournal.org.uk/

FIELDS Journal of Huddersfield student research

Calligraphic Architecture: Stroke to form, space and surface.
How does Arabic Calligraphy influence the design process of Zaha Hadid in her creation of architectural forms?

Hammad Haider
The University of Huddersfield, Queensgate, Huddersfield HD1 3DH, England

ARTICLE INFO

Article history:
Received 19 October 2020
Received in revised form
21 February 2021
Accepted 19 April 2021

Keywords:
Zaha Hadid
Arabic Calligraphy
Architectural Concept
Design Process
3D Design
Form Finding
Drawing
Islamic Architecture

ABSTRACT

This design research explores the connection between two rather diverse art forms; Architecture and Arabic Calligraphy. From the intricate art and science behind designing buildings to the decorative inscriptions of one of the most historical calligraphic mediums in the Arab World. This article uses the work of star architect Zaha Hadid as a vehicle to help visualize this relationship of Architecture and Arabic Calligraphy. Arabic calligraphy combines a cultural language with the language of geometry. The fluidity of Arabic script offers countless possibilities for designing calligraphic expressions varying its use from ornamental design to Architecture. This research focuses on how Arabic Calligraphy may have influenced the design process of Zaha Hadid, allowing her to produce her fluid architectural designs. In return, this study will unfold into creating new valid diagrammatic forms based on calligraphy. This personal exploration will begin with a simple Arabic calligraphy form and gradually, through the use of sketches, paintings and 3D graphics, will develop into a conceptual architectural form that can be seen as a space to be inhabited. The profound connection between Arabic calligraphy and the work of Hadid can be debated, but it definitely shares similarities, hence providing a topic for discussion.

Zaha Hadid (1950 – 2016)

Author's Motivation

This design research stems from the author's passion for the art of Arabic Calligraphy. The author practices Arabic Calligraphy in their free time and this type of calligraphy has a deep connection to their faith and culture. As an individual currently engaged in architectural study, this research opportunity was a perfect chance for the author to bring together many aspects of their design philosophy and aim to link them together in an insightful manner.

Introduction

Arabic Calligraphy and its geometrical properties have a wide spectrum of uses; some of which are less known than others. The connection with architecture is one that isn't expressed with great depth and is perhaps not always obviously realised, but Zaha Hadid was an architect who did revitalize this link to a certain extent, with her fluid and organic designs. Her cultural roots, along with her knowledge of the Arabic language, may have, to a certain extent, had an impact on her design process.

This design research explores the question,
'How does Arabic Calligraphy influence the design process of Zaha Hadid in her creation of architectural forms?' The method used by Zaha Hadid is one that stands out due to its poetic and unusual way of constructing a design form; it almost seems like a seed that is planted and then nourished with various nutrients (i.e. the various tools) until the point where it extends into the sky.

The aim of this design-based research is to trace the steps utilized by Hadid in her design process and

develop hypothetical architectural forms that encapsulate a variety of fluid spaces. Here the focus is on the concept design stage rather than a finalized building form. This will be supported by evaluating Hadid's buildings through analytical diagrams/images and making a valid link to the dimensions of Arabic Calligraphy. The journey of a simple calligraphic element to the final building design could assist in structuring the article into stages of development. Once an appropriate study of existing work has been done and a structured process has been established, a series of diagrams, drawings, sketches and models will then be created in order to obtain an insight into this way of working.

Literature Review

In order to construct viable design research it is essential to analyze existing texts which talk about the cross over between architecture and Arabic calligraphy. Gaining a clear understanding of how Zaha Hadid approached architectural design and the process she utilized to drive her ideas into existence is important in order to further support this research.

Arabic Calligraphy as a Design Tool

The catalyst for this design research is the use of Arabic Calligraphy, so it is essential to understand its roots in the Muslim/Arab World as well as to gain an insight into its current use in the modern age. Within Islam, Arabic Calligraphy is regarded as a vital decorative and embellishment tool due to the absence of figurative art, and its uses range from ornamental design to Architecture. In Islamic Architecture, Arabic Calligraphy and geometric motifs seamlessly flow through the interior of sacred buildings (Blair, 2006) providing a visual representation of religious texts, as seen here in the interior of the Hagia Sophia (Fig 1).

Figure 1: Interior of the Hagia Sophia marked with Thuluth Arabic calligraphy in Circle Panels (Aramco ExPats. 2019)

A number of calligraphy scripts have been developed over time from the Kufic (Simplified Rectangular Style) to the Thuluth script (cursive/ornamental) each with their own experimental qualities.

As described by two researchers, 'Calligraphy integrates a cultural language with the language of geometry and combines sacred meaning with creative making (Moustapha & Krishnamurti, 2001).' Arabic Calligraphy has a robust visual structure and visual order, and it has shown in its numerous applications an ability to regenerate itself (Al-Shiekh, 2016). The prime quality of a calligraphic structure is its continuity and rhythmic flow. Throughout the development of its scripts, this quality remains embedded into its physical properties. According to Ramesh Krishnamurti (Moustapha & Krishnamurti, 2001), this element of fluidity offers vast opportunities for designing calligraphic expressions, because even a single word can be transformed and produced in a number of ways to suit different motifs. By tradition, the process of producing Arabic Calligraphy focuses on horizontality and a two-dimensional surface instead of a three-dimensional form and a vertical order. Arabic calligraphy is extensively used as a two-dimensional surfacing tool on sacred architecture in Arab Culture, but the task is to successfully translate these visual calligraphic forms into three-dimensional objects that can be located in real context (Al-Shiekh, 2016). This research by Bassam Al-Shiekh focuses on the translation from Calligraphic expressions to visual structures and architectural spaces that are formulated around algorithms which are in turn created via experimental computational studies (Fig 2). He devises a parametric calligraphic machine that produces and correlates calligraphic images, surfaces and reality.

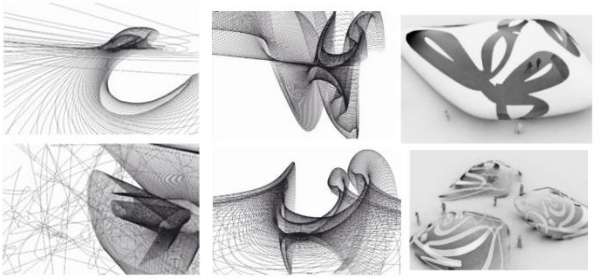


Figure 2: Al-Shiekh's three-dimensional calligraphic experiments to produce forms and surfaces (Al-Shiekh, 2016)

Hassan Massoudy (Iraqi painter and calligrapher) considered by the French writer Michel Tournier as the 'greatest living calligrapher' (*Caravanes, Vol. 1, Phébus, 1989*), claims that 'We have all inherited many valuable aesthetic aspects from classical Arabic calligraphy, such as its elegant character, round shapes and linked letters which give the words the appearance of a perfect body enhanced by the measured proportions of length and width ' (Massoudy, 2013). When working on his art Massoudy imagines his calligraphic structures as sculptures soaring into the sky, whilst greatly defying the atmospheric pressure and pull of gravity. When we look at the Arabic alphabet, we can observe that it may have had an impact on how Hadid designed her works. Hassan Massoudy's Arabic calligraphy artwork and harmonious strokes (Fig 3) share some resemblance to Hadid's initial acrylic paintings.

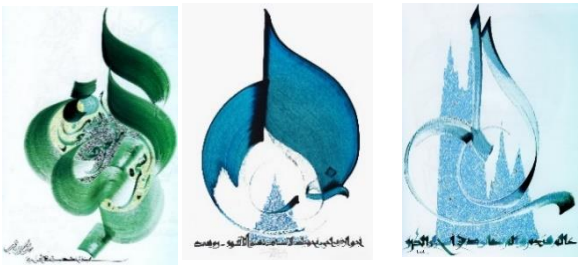


Figure 3: Examples of Hassan Massoudy's Arabic Calligraphy Paintings (Massoudy, 2016)

Hadid's Inspiration , Early Works and Paintings

Hadid made use of drawing and painting to initially visualise her future projects. It allowed her to be almost free in exploring various possibilities, leading her to adopt designs which employed fluidity, dynamism, fragmentation and abstraction. As Robin Evans put into words, 'Architects do not build, they draw' (Evans, R. 1986), so in this technologically fast developing field, her collection of early drawings are rather valuable in understanding her thought process. Her drawings and paintings were showcased at an exhibition in London's Serpentine Sackler Gallery (2016) and later curated into a book named *Zaha Hadid - Early Paintings & Drawings* (2016). These early beginnings (Fig 4) of her designs were rarely seen, from sketchbooks to works on paper and canvas as well as several proposals for competitions – all of which come together to produce a rather thorough portfolio of work and highlight certain aspects of the many stages preceding construction.

Fig 4: Zaha Hadid's Early Drawings as seen at London's Serpentine Gallery (Serpentine, 2016).

Zaha Hadid in her initial experimental work was greatly inspired by Russian avant-garde artist Kazimir Malevich along with abstract movements and calligraphy scripts. It was through this study of such work that she developed abstraction as a principle to explore and create space (Hadid, 2016). She further stated that painting in an abstractive way is a clearer way to explore space, form and the spatial and organizational arrangements than mere drawing (Michaud, 2011). In her interview with Alvin Boyarsky (the Director of Architecture Association), Hadid repeatedly emphasised that the abstractive art movements in the early Twentieth Century like Futurism, Cubism, and Suprematism took certain ideas from primitive and figurative art which are rooted in Arabic and Chinese calligraphy, African art, and geometric design (Hadid, 2006; Didero, 2012). Consequently, these avant-garde art movements were the main inspiration for new architectural movements such as constructivism and deconstructivism. Hadid found that the sketching hand was a literal option to employ fluid dynamism in an industry that is now primarily driven by digital design and enhanced manufacturing capabilities (Hadid, 2010).' Patrick Schumacher explains how Hadid's curved gestures, shaped by Arabic calligraphy, allowed her paintings and drawings to reflect the notion of deconstruction and fragmentation in space (Schumacher, 2002). When we thoroughly examine Hadid's sketches and formal drawings, whilst reading through her detailed project descriptions, we can find many spaces and buildings with clear links to Arabic calligraphy (Bittar, 2006).

Calligraphy's influence on the work of Zaha Hadid

Zaha Hadid was an Arab, Muslim woman and UK based architect whose works are a blend of Iraqi identity, culture and modern thoughts (Aref, 2011; Woods, 2008). The creation of architectural form; the process of transforming a mental image into a visual plan, is a semantic chain that holds the creator's cultural richness. In his thesis from the perspective of semiotics on Zaha Hadid's work, Cengiz Tavşan explains how linguistic patterns are one of the main branches of any culture that have a self-conscious role in shaping human thoughts (Tavşan, 2018). This concept was also touched upon by Rem Koolhaas at the Architectural Association in London, who observed that his Arab architecture students like Hadid were able to make certain curved gestures more easily - he suggested this had a lot to do with Arabic Calligraphy and culture (Hadid, 2006). Whilst studying in London at the AA after completing mathematics from the University of Beirut, Hadid noticed that 'there was a connection with the logic of maths to architecture and the abstraction of Arabic Calligraphy (mentioned in her interview with Blueprint's Herbert Wright)' (Hadid, 2014). When mentioning this aspect to the press she described it as a fertile subject for researchers to investigate, with consideration given to generating forms and surfaces based on contemporary design elements that employ algorithmic means. Hadid in her interview explained further that 'geometry and mathematics have a tremendous connection to architecture - even more so now with the advanced computer scripts used in many of our designs. This relates a great deal to my Arab identity in terms of algebra, geometry mathematics and calligraphy' (Hadid, 2015).

Patrick Schumacher in his written works explains how 'one of Hadid's audacious moves was to translate the dynamism and fluidity of her calligraphic hand directly into equally fluid tectonic systems' (Schumacher, 2004, p.17). This shows a sheer interest in producing designs that followed the logic of calligraphy, and in creating continuous spaces that were comfortably functional for its occupants. From her initial designs, Hadid used her calligraphic skills to shift from perspective and isometric projections to literal deformations of space. The evident curvilinear shapes of Hadid's designs mimic the cursive flow of Arabic calligraphy (Alshiekh, 2016). As a result of using curved lines and fluid surfaces Hadid was known as the "queen of the curve".

As a general view, Hadid's works do not spread any ideological message, and the similarities highlighted are possibly due to her cultural origins. To respond to the critics who refer to Hadid's works as fragmented and detached is perhaps to recommend a deeper study of the Arabic Calligraphy art, because thereafter there appears to be a greater coherence in Hadid's works, which seems to be very symbolic (Tavşan, 2018). Arabic Calligraphy in its practice and use has a soul as well as an outer attraction, and this relates very closely with Hadid's designs which give a sense of comfort and wellbeing when viewed from the public's perspective, whilst also having a striking presence in the wider built environment.

Methodology

This design-based research uses a method of analysis and exploration to answer the proposed question. Firstly, a few of Zaha Hadid's works are selected and analysed as precedents using a combination of early drawings, paintings, models and final imagery to envision a possible connection. This analysis of each building will be correlated with Arabic Calligraphy examples that use similar geometric qualities. Thereafter using the research gathered a timeline/flowchart of Hadid's design process and evolution will be devised, accompanied with useful primary and secondary imagery.

Using this base, the research will then proceed to create a hypothetical architectural form from a simple Arabic Calligraphy stroke. This translation will be shown through a series of hand strokes, sketches , paintings and CAD diagrams using the Rhino software (Rhinoceros 3D, Version 5.0). The end result should be something that allows for reflections and interpretation with regards to this unique design process.

As a whole view, this study is split into two main segments; the first one being the analysis and examination of the work of Zaha Hadid and the second being the personal design development of conceptual architectural forms. This methodology aims to provide a cohesive package of research in order to arrive at a clear conclusion.

Arabic Calligraphy Geometry & Scripts

Ibn Muqla (885-940 A.D.) who was born in Baghdad, the same as Hadid, codified the six scripts which later became the foundation for the practice of Calligraphy. He restricted Arabic Calligraphy scripts' proportions to six main styles which included the Thuluth script. The rhombic dot, the

Alif (ا), the circle and the similarity system form the prime rulings of Calligraphic proportions. These changes in script then supported the development of the Kufic script (Elmansy 2014).
The following design research and exploration will focus on two Arabic calligraphy scripts, and these are the Kufic and Thuluth script. This is to provide a contrasting approach to architectural form finding.

Kufic

The Kufic script (Fig 5) was developed in Kufa, Mesopotamia (Iraq) in the 17th Century AD and was therefore the first script used by Arabic Calligraphers to write the manuscripts of the Qur'an. The script is thick, square, angular with long vertical lines meeting horizontal ones perpendicularly and it is void of diacritical marks. It is distinctively different from the other scripts marked by its overall highly vertical appearance and a dynamic forward movement when reading. These characteristics ultimately affected the usability of Kufic and made it better suited for Islamic tiling and architectural decorations of palaces, mosques and institutions (Alshahrani, 2008).

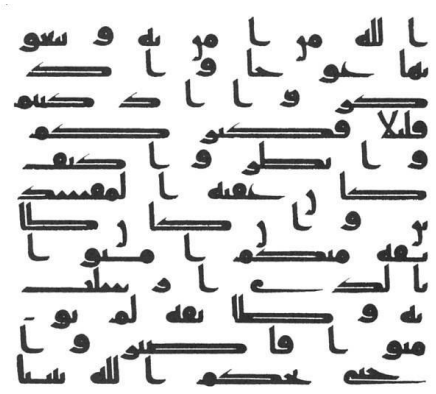


Figure 5: Example of the Kufic Script
http://arabiccalligraphy.org/resources/Kufic-09-tn1200.jpg

Thuluth

The Thuluth script (Fig 6) was developed in the Abbasid Dynasty (11th century) and was later polished by calligrapher Seyh Hamdullah in the Ottoman Dynasty (Elmansy, 2014). Thuluth, which means 'one-third' was named after the ratio of curved to straight lines within the script. Its curved, intersected and pointed letter-heads created its popularity as an ornamental script for headings and titles (Alshahrani, 2008). Notable features of this style are the inclusion of vowel signs and ornamental frills that are used to beautify the script, and a combination of sharp, hair-thin out-strokes that curve slightly upward in a small loop. The letters are usually large but very compact, high ascenders are written with a slight tilt towards the left, and round shapes predominate the texture (Afshar, 2016). The Thuluth script is marked by its clear structure and readability, which make it suitable for a number of purposes, even today. Therefore, it was used in the Holy Qur'an and in architectural decorations in many regions of the Islamic Empire.

(Afshar, 2016)

Figure 6 : Example of the Thuluth Script
http://abuhannansyatirah.blogspot.com/

Analysis of Works

In the following segment, there is a selection of projects designed by Hadid, each one being a different building typology. This is to show a link to calligraphy from a wide spectrum of structures. Furthermore, besides each project is a drawing that relates the form to a specific letter or phrase in the Arabic Calligraphy script.

Case Study 1: Vitra Fire Station (1990-1993)

Being one of Hadid's first built design projects, the Vitra Fire Station in Weil-am-Rhein, Germany , is envisioned as a prime element in a linear landscaped zone ; an extension of the linear patterns found in the nearby vineyards and fields. The diagonally intersecting concrete planes help to define the street that invades through the complex, and this signifies Hadid's earliest attempts to transform abstract line drawings into a functional architectural form (Archdaily, L.Fiederer, 2018).

Building Image	Hadid Sketch	Calligraphy Link
		

Figure 7 (Left): Vitra fire station Figure 8 (Centre): Initial sketch Figure 9 (Right): Author's Own

This building can be described as being 'movement frozen' with the illusion of exploding into action unexpectedly (Hadid, 1993). Furthermore, as can be seen from its early drawing it is made up of lines that are repositioned and rotated in various angles and this relates to the shape of the letter Alif (ا) when replicated.

Case Study 2: Bergisel Ski Jump (2002)

The Bergisel Ski Jump was designed by Zaha Hadid between 1999 and 2002. It towers above Austria's woodland in Innsbruck, and can be seen as vital reference point to avid skiers. Its sweeping lines and minimalist aesthetic create a sense of graceful, high-speed motion, reflecting the dynamic sensation of a ski jump in a monumental structure that stands above the historic centre of Innsbruck and the mountain slopes around. It is this spirit of motion that informs the flowing form of Hadid's design, which embodies the dynamic nature of the sport it was built to facilitate. Hadid referred to the building as an 'organic hybrid'. A combination between a tower and a bridge; between a vertical and a diagonal (Hadid, 2012).

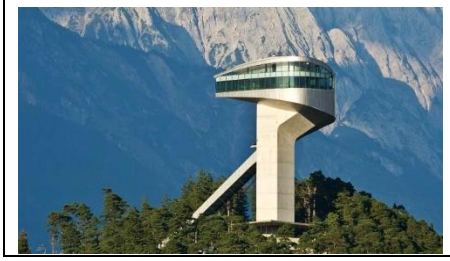
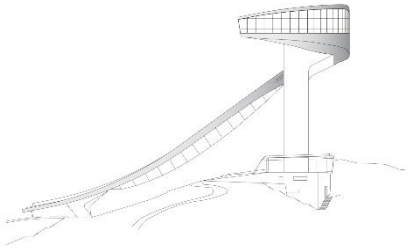
Building Image	Elevation	Calligraphy link
		

Figure 10 (Left) : Bergisel Ski Jump (2002)
Figure 11(Centre) : Elevational drawing of the ski Jump
Figure 12 (Right) : Author's own

Within this design the letter Alif (ا) can be seen as the structural support for the ramp which in itself be formed upon the letter Ain (ع).

Case Study 3: MAXXI Museum (2009)

The MAXXI museum in Rome relates quite closely to its surrounding urban context, and the structure of the design is oriented along two urban axes. On the one side you have the horizontality of the former military barracks and on the other is the taller residential buildings - so this museum tries to make this balance between both. The reinterpretation of these two geometric structures within the proposal generates the surprising geometric complexity of the campus. Sinuous lines harmonize the overall scheme and facilitate flows across the site. In Hadid's constant attempt to create a landscape, a series of cavernous spaces drawn with a free, roving line. The resulting piece gives the visitor a sense of exploration (Fairs, 2009).

Building Image	Hadid Sketch	Calligraphy Link
		

Figure 13 (Left): The MAXXI seen from above in Rome
Figure 14 (Centre): Concept sketch of the MAXXI
Figure 15 (Right): Author's own

The design features repeated and overlapping lines that are adjacent to one another with several instances or curved corners and this can be attributed to the phrase بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ (In the name of Allah, the Beneficent, the Merciful).

Case Study 4: London Aquatics Centre (2011)

The concept used for the London 2012 Olympic Aquatics Centre was the fluid geometry of water in motion, creating spaces and a surrounding environment in sympathy with the river landscape of the Olympic Park (Hadid, 2012).

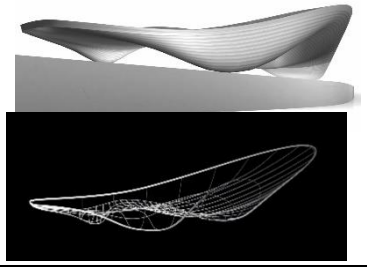
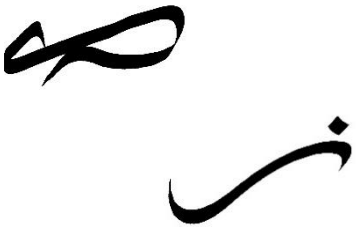
Building Image	Concept Diagrams	Calligraphy Link
		

Figure 16 (Left): Photograph taken upon Author's visit
Figure 17 (Centre): CAD drawings
Figure 18 (Right): Author's own

The form or conceptual image of Hadid's Aquatic Centre can be likened to that of the Kaaf (ک) or Zaa (ز) when simplified. The cursive nature of the script means that it is able to stretch and be written in a rather freeform perspective.

Case Study 5: Glasgow Riverside Museum (2011)

The design flows from the city to the river, symbolizing a dynamic relationship in which the museum is the voice of both, and the transition from one to the other, while actively encouraging connectivity between the exhibits and the wider environment. The design is a sectional extrusion, open at opposing ends along a diverted linear path (Hadid, Z. 2017). Thus the museum positions itself symbolically and functionally as open and fluid with its engagement of context and content.

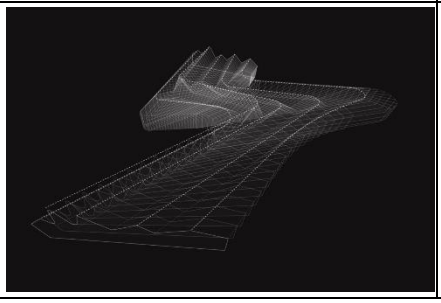
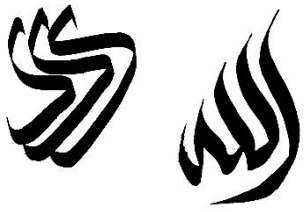
Building Image	Concept Drawing	Calligraphy Link
		

Figure 19 (Left): The Museum as seen from above
Figure 20 (Centre): CAD experimental diagram
Figure 21(Right): Author's Own

The fluid flow of this building design is clearly apparent from the aerial image. The repetition of lines combined with the coordination of external profiles can be likened to many Arabic Calligraphy compositions, some of which are shown in the table above. Similarly the curved gesture formed by the building footprint dictates the circulation or organization of activities within the museum and this again has commonalities with calligraphy where you can see how each letter has been started and completed.

Case Study 6: Heydar Aliyev Center, Azerbaijan (2013)

The Heydar Aliyev Center in Azerbaijan establishes a fluid and continuous relationship between its interior and its immediate plaza. The building envelope is devoid of any straight lines, making it appear as a geological from in the urban context. Comprising of elaborate forms, including folds, branches, ripples and variations, the surrounding plaza is made into an architectural landscape that serves to welcome and embrace visitors and direct them to different interior levels. As they approach, the arc-shaped passageways and curved strips of lighting give an impression that these spaces continue into infinity, which again conforms to the element of continuity often found in the composition of calligraphy. As Bekiroglu (Project designer and architect for the Baku Center) says 'Our ambition was to achieve a surface so continuous that it appears homogenous' (Bekiroglu, 2013).

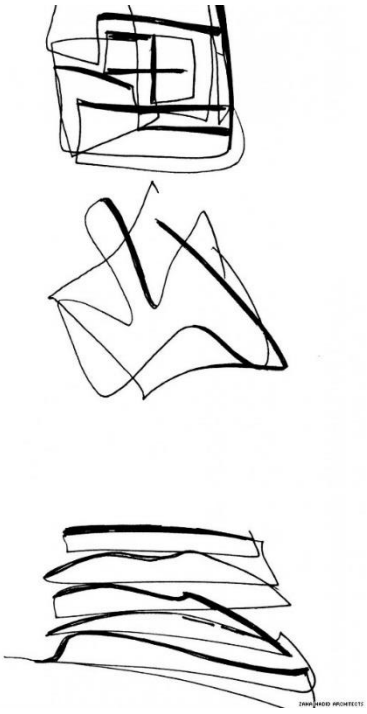
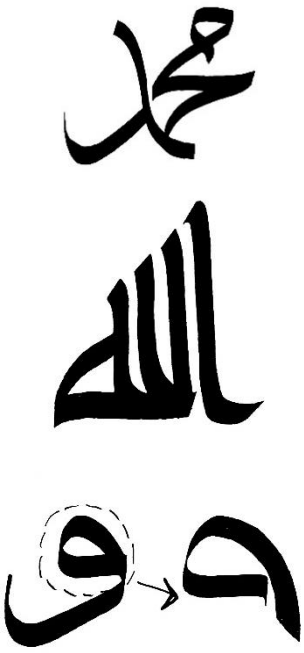
Building Image	Concept Sketches	Calligraphy Link
		

Figure 22 (Left): Views of the exterior and interior
Figure 23 (Centre): Conceptual sketches
Figure 24 (Right): Author's Own

This building in the heart of Azerbaijan can be described as being one of Hadid's design classics. The project offers a great addition to city's existing urban fabric whilst being a means of connectivity and a landmark within Baku. Here the design relays several qualities of Arabic Calligraphy in both its external and internal features. The outer skin of the building or the enveloping form can be likened to the word محمد 'Muhammad' as shown above. Similarly, when viewed from the other side, the building's external leaf with its layered members can be compared to the word ٱللَّٰه 'Allah (God)'. Inside, the Heydar Aliyev Centre unfolds as a work of art with each space having an aura of its own. Once again an example of Arabic Calligraphy sharing some resemblance can be seen in the corridor or walkway shown in the 3rd image, and that particular shape can be likened to the Arabic letter waw (و).

From the buildings analysed above, one can see how Arabic Calligraphy can be matched in terms of both the appearance and arrangement. It can also be seen that Hadid embodied similar techniques in many of her buildings and was not constrained to only a specific typology or location. As a general view the buildings tell a tale of careful design, one that shows a symbolic narrative.

Patterns & Links

Arabic Calligraphy is a form of line composition that is based on the creative taste of the artist. There is a great amount of freedom in drawing the work and the illustration of the lines then express the intended concept of the artist/calligrapher (Tavşan, 2018).

From the examples shown previously it can be said that Hadid translated the dynamism of her rapid calligraphic sketching with the use of French or ship curves, often hard-lined in several widths, into a coherent architectural drawing that could then be perceived as a geometrical base for an actual building (Hadid, 2016).

Hadid's curvilinear design contours show some resemblance to the cursive flow of Arabic calligraphy, and this connection is made even clearer when they are studied side by side.

Similarities:

- Both calligraphy and Hadid's design can be noted to have many strengths with regards to form, including: having the ability to stretch or compress components, the ability to adjust well into small or large spaces and having varying relationships between lines and curves. They're also full of dynamism, flexibility and rhythm, along with embodying an essential element of scale (Al-shiekh, 2016).
- Both have the ability to adapt to many moods and purposes.
- Both adhere to continuity where Arabic calligraphy flows through the interior surfaces of domes and walls, and onto the carpets within, establishing this continuity. Hadid's designs incorporate continuity in the building's form, interior and approach.
- Both have a sense of creative tension, the collision of freedom with stated boundaries, where the flexibility of the form merges with the implementation of strict rules.
- Both calligraphy letters and Hadid's conceptual and architectural forms can be restated and reconfigured in many probable ways due to the written and visual makeup of each medium.
- Both the adaptability of the visual language of Hadid's designs and the written language of Arabic Calligraphy allow for the designing and stretching of letters/elements in any direction which then creates a rather beautiful work of art.
- Both Hadid and Arabic Calligraphy artists follow similar rulings in their use of space and surfaces.
- Within Hadid's early sketches and strokes we find curves and curvilinear compositions that have their own degree of fluidity, dynamism and poise and this is similar in the case of Arabic calligraphy letters where each of them carry a unique quality that forms the basis of words and sentences.

As Eric Owen Moss (LA based Architect) stated, 'Calligraphy is aesthetic, not only in terms of how you see but how you think and feel and understand, because the form is elemental in the formation of culture and its association with language. Calligraphy contains a structure that represents a coherent, intelligible world. Can architecture confirm that?' (Moss, 2013). By observing calligraphy and architecture, we can select several elements that could well be used universally in both cases.

Qualities & Characteristics

After stating some of the possible similarities, it is essential to determine which qualities in calligraphy can transform into architecture:

- Fluidity of Strokes
- Sequence of Strokes
- Motion
- Energy
- Solid & Void
- Continuity of Space
- Layers
- Proportion
- Scale
- Gesture
- Balance
- Texture
- Materiality
- Rhythm
- Philosophy/Purpose
- Emotion
- Mass
- Structure
- Decoration & Embellishment
- Emptiness
- Subtleness
- Speed/Velocity
- Abstraction

Identifying the Process

As a result of the analytical research and examination of some of Hadid's works, along with her thoughts behind her design process, a guide or list of steps has been devised to map out the probable journey from a calligraphic stroke to a conceptual building form. It is a more condensed description of the tools and steps taken. As mentioned previously this could be one of many routes used by Zaha Hadid. The list is shown on the following page:

(1) Defining subject to be transformed

- Selecting a starting point i.e. words or letters in the Arabic language that suit the intended project function.
-
- Form Pattern: Choosing one of the many calligraphy scripts available from the more fluid Thuluth to the Geometric Kufic. Decision influenced by nature of site, type of client and project brief.

(2) Stroke Simplification

- Arabic Calligraphy letters simplified into a clear line drawing to allow ease of translation into lines and curves.

(3) Strokes Disassembly

- Disassembling the calligraphic form into several components as intended geometry to be built.
- Numerous experimental sketches are produced comprising of lines and curves of varying thickness. These are not yet fully resolved but play with the use of form and space.

(4) Applying Hadid's Techniques (Liberation stage)

- Reconfiguring the existing geometry to find new ways of representing space.
- Steps of fragmentation & abstraction, defying gravity, landscaping the project, play of light, layering and fluidity.
- Use of acrylic paintings & further drawings to visualise form in a more abstract and fictional manner.

(5) Movement & Function (Back to Logic)

- After trying various ways to optimise functionality of form, the geometry is then rationalised further into a form that can be read as a building in reality.
- Use of physical models to better realise this development.

(6) Extent to which it is embedded within the context

- Adjusting the form to suit the context, site forces, micro-climate and topography.
- Use of CAD imagery to easily make changes and resolve design into a buildable form.

(7) Interior Spaces & Surfaces

- Resolving interior passages to allow for fluid connections between the inside and outside.
- Applying calligraphic textures to surfaces.

(8) Final Form

Example of Design Process – MAXXI Museum

Stroke Simplification & Disassembly – Concept
Stage 2 & 3

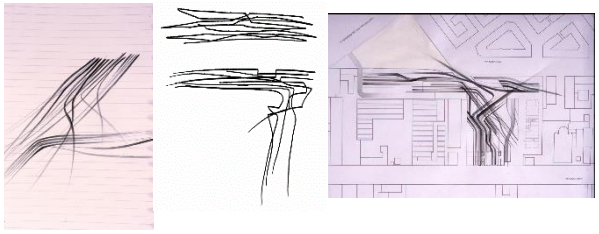


Figure 25: MAXXI early concept drawings. (Hadid, 2003)

Application of Hadid's techniques and Embeddedness with context - Abstract paintings
Stage 4

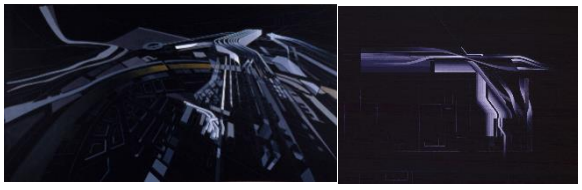


Figure 26: Conceptual paintings for the MAXXI (Hadid, 2004)

Movement & Function - Use of Physical Models
Stage 5

Figure 27: Physical models for the MAXXI (Hadid, 2006)

Formal Spaces & Final Form - CAD Drawings
Stage 6 & 7

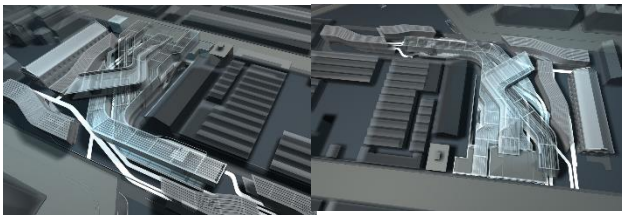


Figure 28: MAXXI museum CAD model (Hadid, 2006)

Design Brief:

Arabic Calligraphy and Architecture revolve around spaces and composition, both in a two dimensional and three dimensional manner. The next stage will involve analysing strokes, lines and forms in Arabic Calligraphy, and then proceeding with the creation of a new conceptual building form. This form will itself be a version of 3 dimensional calligraphy whilst having the ability to function as a piece of architecture.

Steps to be taken to translate calligraphy into an architectural form (both Thuluth & Kufic script):

(1) Define the subject to be translated i.e. specific Arabic letter(s) in the Thuluth/Kufic Script
(2) Simplify the letter shape with thin and thick lines
(3) Deconstruct shape into abstract and intersecting lines
(4) Explore conceptual form through diagrams
(5) Illustrate the drawing through acrylic painting with a sense of place
(6) Apply Hadid's Techniques and Movement/Function
(7) Add a brief context/setting and interior spaces
(8) Produce CAD images to illustrate resolved conceptual architectural form

Step 1: Defining the Subject to be Transformed - Thuluth Script

The subject in use will be two Arabic Calligraphy Letters in the Thuluth script which are the Zaa (ز) and Haa (ح). These are the equivalent of the 'Z' and 'H' which are the initials of Hadid's name.

Below is the process of creating each letter in both type of scripts.

Step 1: Defining the Subject to be Transformed - Kufic Script

Zaa (ز) – 'Z' Haa (ح) – 'H'

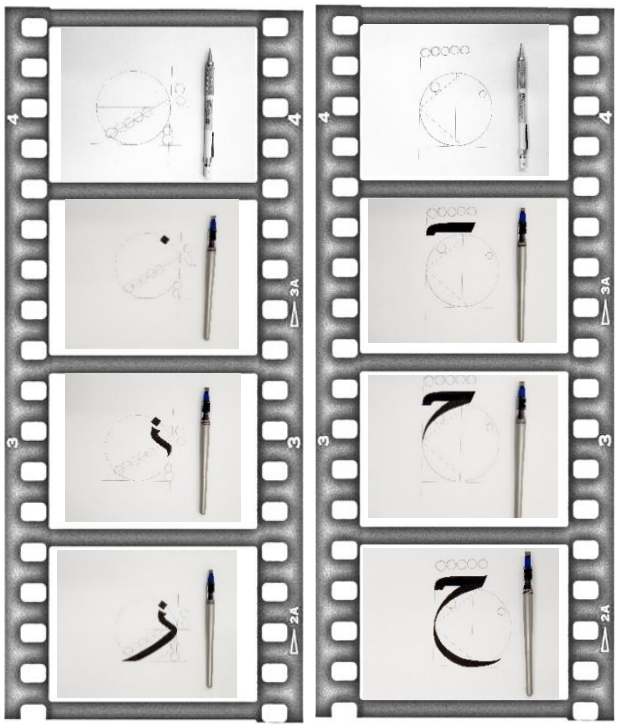


Figure 29: A process of creating the letters in the Thuluth script. (Author's Own, 2020)

Zaa (ز) – 'Z' Haa (ح) - 'H'

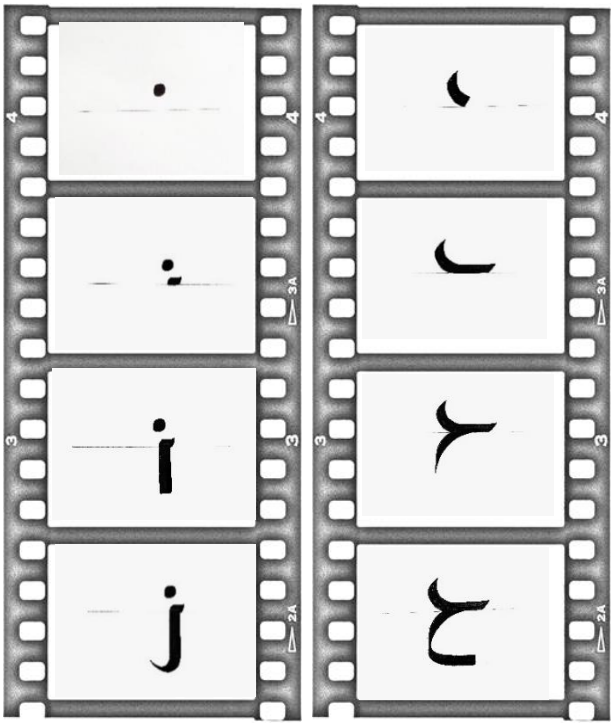


Figure 30: A process of creating the letters in the Thuluth script. (Author's Own, 2020)

Step 2: Simplifying the letter shape with thin and thick lines - Thuluth

Variations of Each Calligraphy Letter

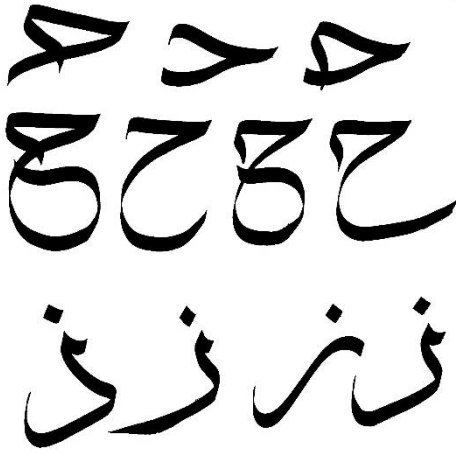


Figure 31: Thuluth Individual letters. (Author's Own, 2020)

Variations of Combined letters

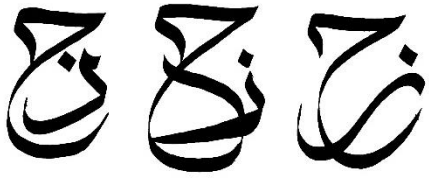


Figure 32: Thuluth Combined letters. (Author's Own, 2020)

Simplifying strokes

Figure 33: Simplification of the Strokes. (Author's Own, 2020)

Step 3: Deconstruct shape into abstract and intersecting lines - Thuluth

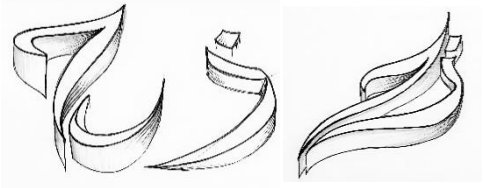


Figure 34: Thuluth Experimental sketches 1. (Author's Own, 2020)

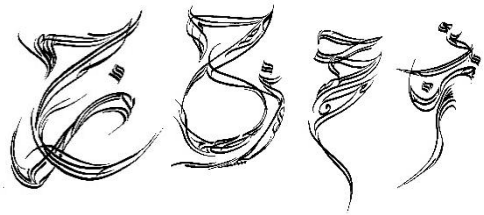


Figure 35: Thuluth Experimental sketches 2. (Author's Own, 2020)

Step 2: Simplifying the letter shape with thin and thick lines – Kufic

Variations of Each Calligraphy Letter

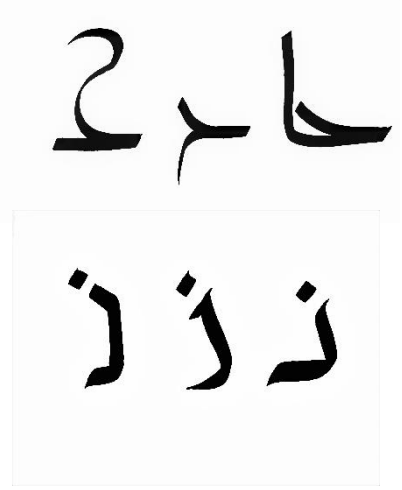


Figure 36: Kufic Individual letters. (Author's Own, 2020)

Variations of Combined letters

Simplifying strokes

Figure 38: Simplification of the Strokes. (Author's Own, 2020)

Step 3: Deconstruct shape into abstract and intersecting lines - Kufic

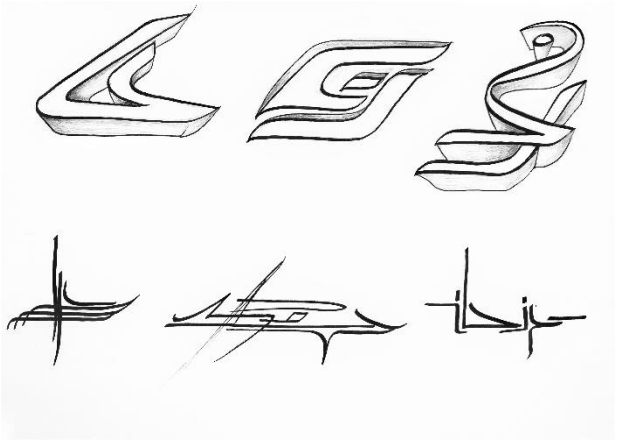


Figure 39: Kufic Experimental sketches 1. (Author's Own, 2020)

Shown here and on the previous page are various drawings that involve the calligraphic strokes being disassembled and slowly formulated into a range of forms that could well be used to initiate the design of the final concept form.

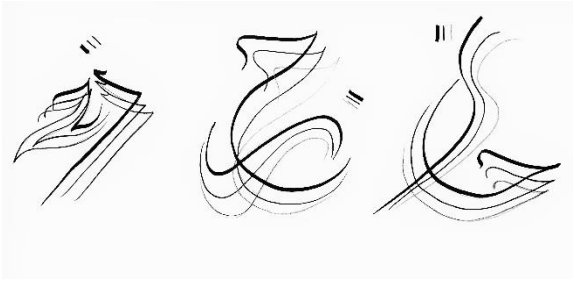


Figure 40: Thuluth Experimental sketches 3. (Author's Own, 2020)

Figure 41: Thuluth Experimental sketches 4. (Author's Own, 2020)

Step 4: Further exploration of conceptual form - Thuluth

Using various tools with the same stroke (Thuluth) to produce different profiles - Rhino 3d

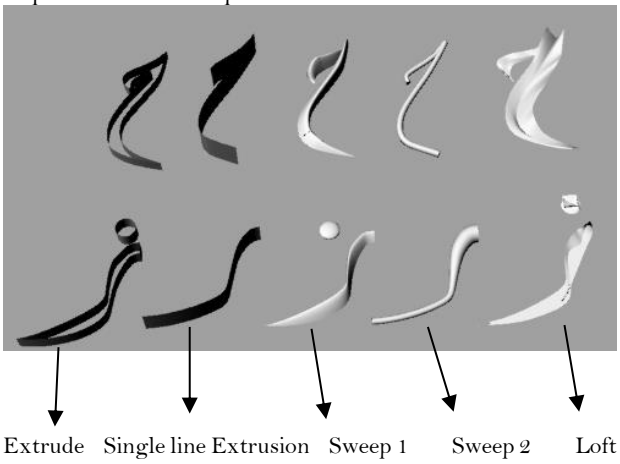


Figure 42: Use of Rhino 3D to experiment with a selection of tools (Author's Own, 2020)

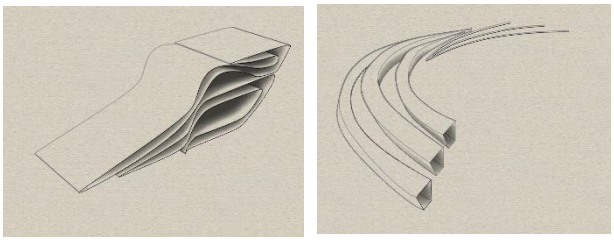


Figure 43: Exploring form and arrangements. (Author's Own, 2020)

Similarly here the roots of the Kufic script have been used to create 3D/2D forms and interventions which will be part of the experimentation and development of an idea. These sketches are yet to be elaborated upon and employ elements of free-form and line marking.

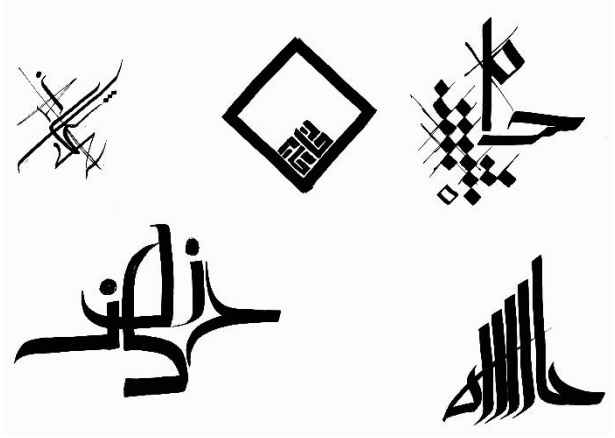


Figure 44: Kufic Experimental sketches 2. (Author's Own, 2020)

Step 4: Further exploration of conceptual form - Kufic

Using various tools with the same stroke (Kufic) to produce different profiles - Rhino 3d

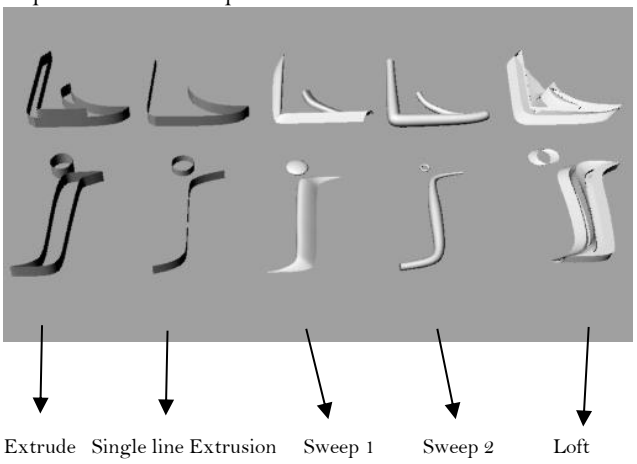


Figure 45: Use of Rhino 3D to experiment with a selection of tools. (Author's Own, 2020)

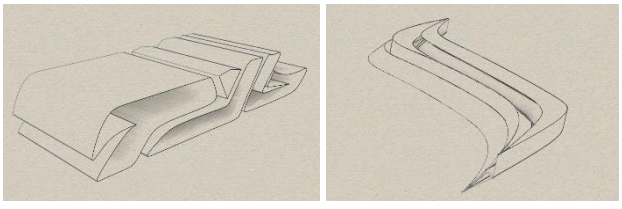


Figure 46: Experimental sketches (Author's Own, 2020)

Step 5: Illustrating the drawing through acrylic painting with a sense of place – Thuluth

Abstract Paintings (Thuluth)

Figure 47: Acrylic Paintings to visualise a certain fluid form. (Author's Own, 2020)

Abstract Painting Exploring use of lines, curves & spaces

Figure 48: Further coloured line painting. (Author's Own, 2020)

Step 6: Application of Hadid's Techniques and Movement/Function - Thuluth

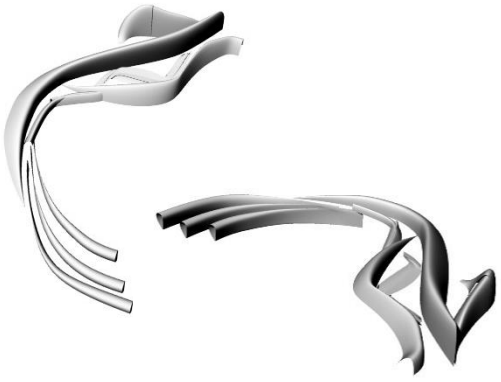


Figure 49: Combination of curves and surfaces. (Author's Own, 2020)

Step 5: Illustrating the drawing through acrylic painting with a sense of place - Kufic

Abstract Paintings (Kufic)

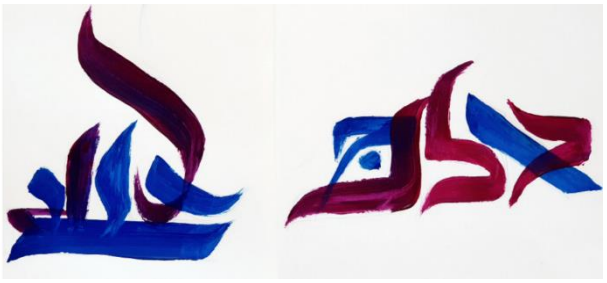


Figure 50: Acrylic Paintings to visualise a certain calligraphic form. (Author's Own, 2020)

Abstract Painting Exploring use of lines, curves & spaces

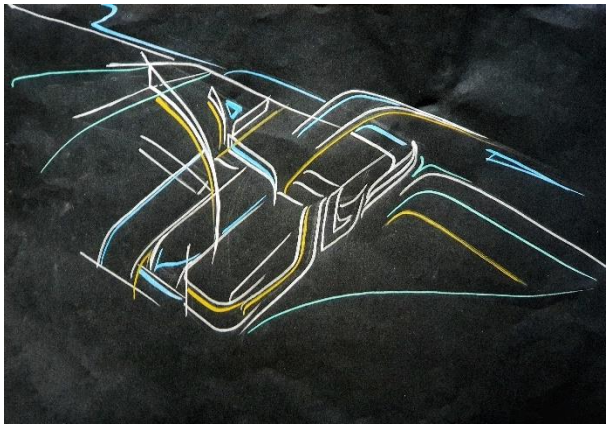


Figure 51: Further coloured line painting. (Author's Own, 2020)

Step 6: Application of Hadid's Techniques and Movement/Function – Kufic

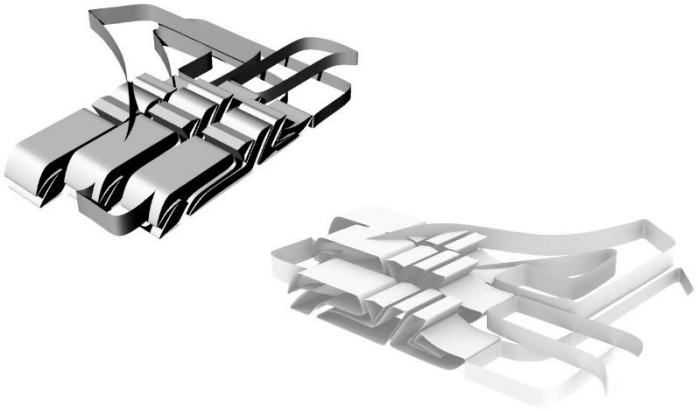


Figure 52: Combination of curves and surfaces from the initial exploration. (Author's Own, 2020)

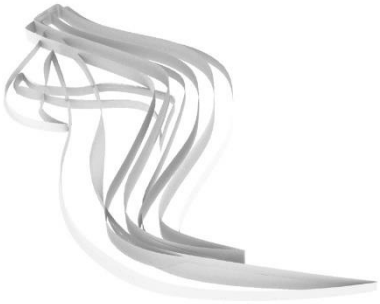


Figure 53: Visualising flow of spaces. (Author's Own, 2020)

Here a more logical form is beginning to take shape. A number of curved forms with different profiles have been combined to create a more seamless mass.

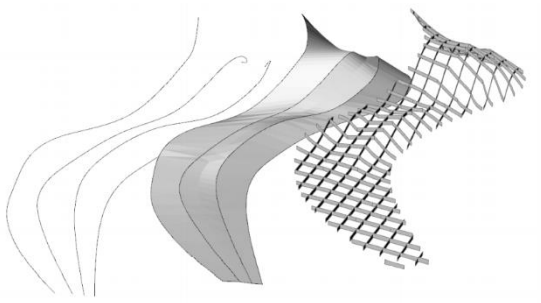


Figure 54: Different types of surfaces. (Author's Own, 2020)

Above is a drawing that differentiates between three surfaces that employ the same form.

The drawing below integrates several surfaces and extrusions to create a form that can be perceived as a vehicle for the final conceptual design output.

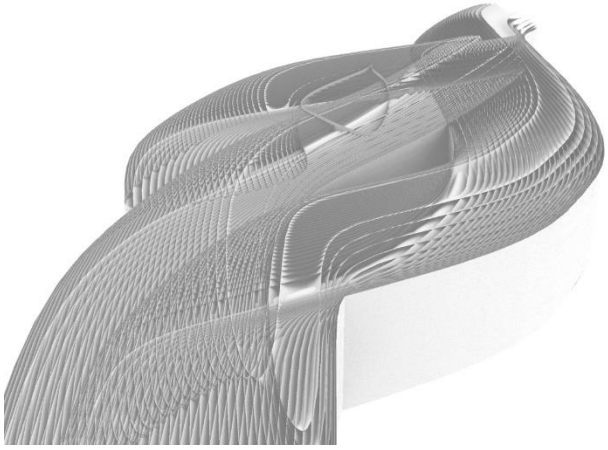


Figure 55: Adding extruded and patterned surfaces to an overall form. (Author's Own, 2020)

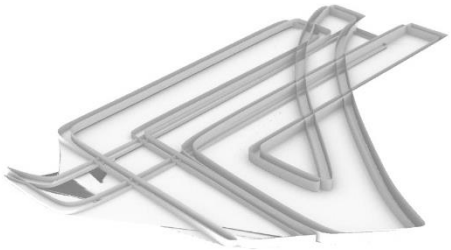


Figure 56: Drawing to visualise the spaces (Author's Own, 2020)

The drawing above illustrates how certain spaces may flow into one another, creating areas of privacy and social interaction, as well as exterior spaces.

Figure 57: Diagram showing the flow of a certain shape. (Author's Own, 2020)

This extruded layered form above represents a section of the proposed design that captures light in the centre whilst having enclosed spaces on the perimeter.

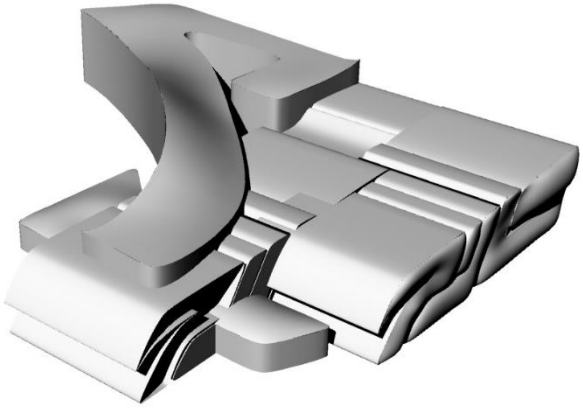


Figure 58: A 3D view of combined form. (Author's Own, 2020)

Step 7: Addition of a brief context/setting and interior spaces – Thuluth

Embedded-ness with context (Thuluth)

Figure 59: Abstract site context (Author's Own, 2020)

The building sits on a proposed site that is an intersection between the land and sea; a location where various forms are in conversation with one another. This fluid form aims to extend from the land into the sea, providing a sort of bridge between two masses. This creates some interesting spaces within the building but also instigates a more dynamic site context. The site surrounding this features curved hedges and green spaces, complemented by paths that seep through and provide an entrance to the building. The illustration is abstractive representation of this idea.

Interior Surfaces (Thuluth)

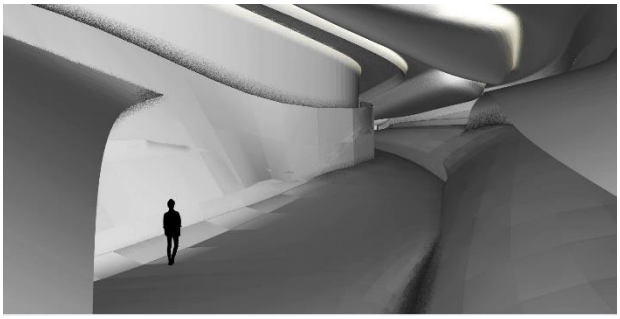


Figure 60: Conceptual interior View. (Author's Own, 2020)

The internal spaces formed through the juxtaposition of lines and curves convey a similar fluid appearance with large vistas across a central public zone.

Step 7: Addition of a brief context/setting and interior spaces – Kufic

Embedded-ness with context (Kufic)

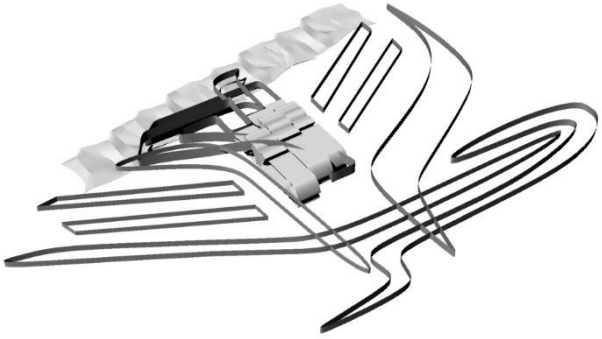


Figure 61: Abstract site context (Author's Own, 2020)

Similarly here the site context features land and sea, along with more restricted site pathways. The building sits in the same central position surrounded by possible avenues of approach and exit, embellished with further landscaping.

Interior Surfaces (Kufic)

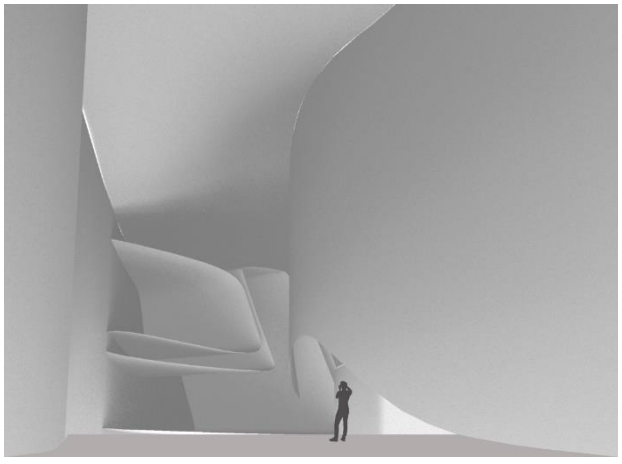


Figure 62: Conceptual interior View. (Author's Own, 2020)

The interior of this conceptual building form displays a similar message with double heighted spaces along with balcony areas, looking down onto a main atrium or public space. In terms of the visual composition, the interior shows the fusion of linear and free flowing lines, creating a very dynamic setting.

Step 8: Produce CAD images to illustrate resolved conceptual architectural form – Thuluth

Figure 63: Overall conceptual form. - Thuluth (Author's Own, 2020)

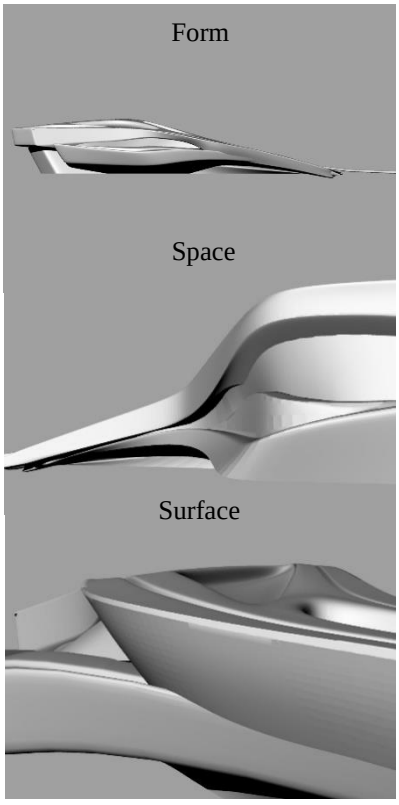


Figure 64: Perspective views of final conceptual form (Author's Own, 2020)

The final conceptual architectural form in the Thuluth script base represents itself as a sculptural asset that evokes the qualities intended for the function and spaces. This sort of building form could become a theatre, cultural centre, or a centre piece for a certain worldwide event. Its form thereafter can be further rationalised and defined more accurately with its interior spaces and technical rationale.

Step 8: Produce CAD images to illustrate resolved conceptual architectural form – Kufic

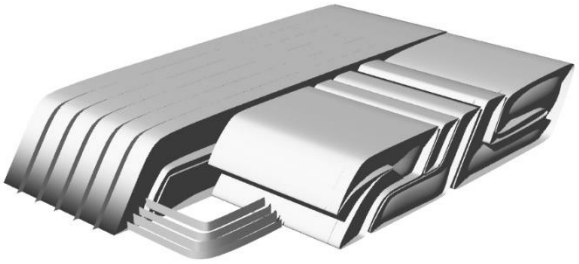


Figure 65: Overall conceptual form. – Kufic (Author's Own, 2020)

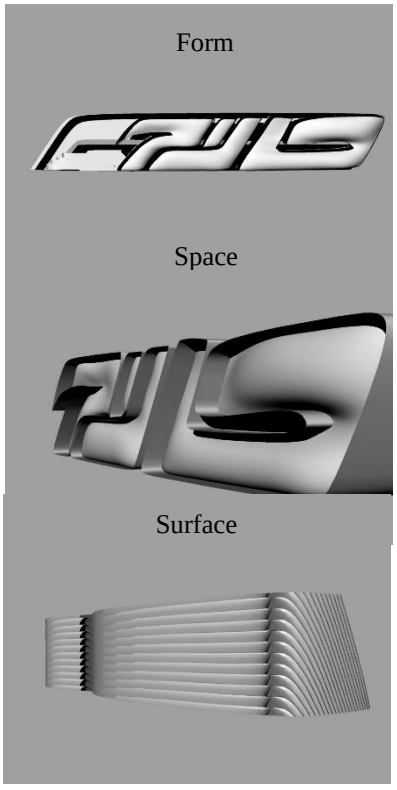


Figure 66: Perspective view of 2nd conceptual form. (Author's Own, 2020)

Consequently this design based on the Kufic script represents a more restricted approach but still uses elements of organic forms and calligraphic composition. The form could well be seen as a civic centre, education facility or a research base. The shapes used here are more controlled and the lines are layered to create a pragmatic form.

Conclusion

This design research aimed to visualise the link between Arabic Calligraphy and Architecture through a study of both the calligraphy scripts and Zaha Hadid's works along with a series of drawings that illustrated a similar process from the Author's point of view. It resulted in a single calligraphic form undergoing a chain of transformations for it to become an architectural conceptual form that can be seen as an entity to be built. This process of evolution based on Hadid's works has brought about some interesting results, from the curvilinear Thuluth building mass to the more rectilinear Kufic form. This personal exploration of form finding helped to provide the author with a greater understanding of how Hadid initiated and progressed with her architectural project, which can be seen as somewhat alien to the usual design generation.

The research introduces Arabic Calligraphy as a versatile design tool that could be used in a variety of ways including religious text, ornamentation and architectural embodiments, as well as being transformed into a surface that is widely used.

The research then went on to analyse a series of Zaha Hadid buildings and listed some links to Arabic Calligraphy with reference to early project drawings. This research prompted the author to realise certain visual and theoretical aspects of the overall design of the projects. This phase of the research also focused on two specific calligraphy scripts and how their contrasting qualities could pave the way for a building mass. The shared characteristics of both Architecture and Calligraphy were later listed.

Later, the study presented the Calligraphic Architecture series undertaken by the author. This part of the research explores the diagrams and various steps and processes used to transform a calligraphy stroke into a conceptual architectural form using Hadid's strategy. The eight possible stages of this process are highlighted in a flowchart and these include, defining the subject to be transformed, stroke simplification, stroke disassembly, application of Hadid's techniques (liberation stage), movement & function (back to logic), embedded-ness with context and interior spaces & surfaces.

In conclusion, the result of this calligraphic transformation and the relevant research done on other projects indicates that Arabic Calligraphy can be used as base to construct and generate an architectural form. Calligraphy may be one of many factors that help mould this design process. Arabic Calligraphy exists as a historical artistic form of writing that has vast possibilities of use, but its pure relationship to Architecture is an area that hasn't been showcased extensively. Nevertheless the work of Hadid does to a certain degree illustrate an embedded influence of calligraphic thought and direction. Therefore this research aimed to elaborate on this key relationship and represent it in concise and visual manner.

Reflection

As a result of the relevant research and the following design graphics, the author was able to develop on existing knowledge with regards to Calligraphic Architecture and also to enhance their skillset in 3D CAD programs like Rhino (Rhinoceros 3D, Version 5.0). This combination of analytical and visual research along with individual exploration assisted in answering the initial question. Further work could be done to better represent this link and experiment with several different forms of calligraphy.

This design process that Hadid used is a source of inspiration for personal future design projects where similar strategies could be implemented to achieve a more vibrant and functional building design.

Acknowledgements

Recognition must be given to the research supervisor and personal tutor Dr Danilo Di Mascio, for the assistance with this design research.

References

ABDALWAHID , A.A.A. (2013). ZAHA HADID FORM MAKING STRATEGIES FOR DESIGN (Research Thesis). Retrieved from www.academia.edu/9556092/ZAHA_HADID_FORM_MAKING_STRATEGIES_FOR_DESIGN

Abdullah, A.A., Said, I.B.S., & Ossen, D.R.O. (2015). Zaha Hadid Strategy Of Design (Research Thesis). Retrieved from www.academia.edu/11824899/Zaha_Hadid_Strategy_Of_Design

Afshar, SA Rosetta. (2016). A brief overview of the various Arabic calligraphic styles. Retrieved from https://www.rosettatype.com/blog/2016/05/24/Arabic-calligraphic-styles

Alshahrani, A. A. A. (2008). Arabic Script and the rise of Arabic calligraphy (PhD). Educational and Applied Linguistics, School of Education, Communication and Language sciences, Newcastle University

Al Shiekh, B.A.S. (2016). ARABIC CALLIGRAPHY AND PARAMETRIC ARCHITECTURE (PhD Thesis). Edinburgh College of Art, The University of Edinburgh, UK

Bittar, D.B. (2012). Inside Arabic Calligraphy From Alef to Zaha: an Artist's View Retrieved from www.academia.edu/3816744/Inside_Arabic_Calligraphy_From_Alef_to_Zaha

Cengiz Tavşan, C.T. (2018). The effect of language patterns on architectural forms (From the perspective of semiotics on Zaha Hadid's works) (Research Article). Cogent Social Sciences, 4:1, 1507085

Elmansy, R.E. Smashing Magazine. (2014). Arabic Calligraphy – Taking A Closer Look. Retrieved from https://www.smashingmagazine.com/2014/03/taking-a-closer-look-at-arabic-calligraphy/

Evans, R. (1986). Translations from drawing to building. AA Files, (12), 3-18.

Fairs, MF Dezeen. (2009). MAXXI_National Museum of the XXI Century Arts by Zaha Hadid. Retrieved from https://www.dezeen.com/2009/11/12/maxxi_national-museum-of-the-xxi-century-arts-by-zaha-hadid/

Gad, A., & Hadid, Z. (2016). Zaha Hadid - early paintings and drawings. London: Koenig Books.

Gharipour, M., Gharipour, M., & Schick, I. (2013). Calligraphy and architecture in the Muslim world. Edinburgh: Edinburgh University Press.

Hadid, Z. (2017). The complete Zaha Hadid. (Expanded and updated [edition].). London: Thames & Hudson.

Hadid, Z.H. (1991). N. 52 Zaha Hadid 1983 1991 (Digital Archive). El Croqius, (52).

Hines, JH DailyO. (2016). In her own words: Zaha Hadid. Retrieved from https://www.dailyo.in/arts/zaha-hadid-artchitecture-public-spaces-pritzker-architectural-prize-design-calligraphy/story/1/9832.html

Hussein, M.F.H. (2016). The Role of Arabic Calligraphy in Forming Modern Interior Design (Degree Dissertation). Canadian Center of Science and Education

J.R. Osborn (2009) Narratives of Arabic Script: Calligraphic Design and Modern Spaces, Design and Culture, Design and Culture v.1 no.3

Massoudy, H. M. (2014). Arabic calligraphy and visual art by Hassan Massoudy. Nuqta.Com. Retrieved from https://www.nuqta.com/kb/hassan-massoudy-arabic-calligraphy-visual-art

McNeel. (2020). Rhino 5 [CAD software]. Retrieved from https://www.rhino3d.com/

Moustapha, H.M. & Krishnamurti, R.K. (2001). ARABIC CALLIGRAPHY: A COMPUTATIONAL EXPLORATION. Retrieved from www.contrib.andrew.cmu.edu/~hoda/Research/papers/calligraphy.pdf

Schumacher, P. (2004). Digital Hadid: landscapes in motion. Basel: Boston

Wright, H. W. (2014, January 31). Zaha Hadid on designing the new Heydar Aliyev Center in Baku. Retrieved from http://www.designcurial.com/news/hadid-on-baku-4169053/

Figures

Figure 1: Aramco ExPats. (2019). Interior of the Hagia Sophia. Retrieved from https://www.aramcoexpats.com/articles/the-art-of-islamic-calligraphy/
Figure 2: Al Shiekh, B.A.S. (2016). Al-Shiekh's three-dimensional calligraphic experiments. Al Shiekh, B.A.S. (2016). ARABIC CALLIGRAPHY AND PARAMETRIC ARCHITECTURE (PhD Thesis).
Figure 3: Massoudy, H. (2015) Examples of Hassan Massoudy's Arabic Calligraphy Paintings. Retrieved from https://www.graphicine.com/2344/
Figure 4: Hadid, Z. (2016). Zaha Hadid's Early Drawings & Paintings Showcased at London's Serpentine Gallery. Retrieved from https://www.architectural-review.com/essays/the-way-forward-in-the-words-of-zaha-hadid/10004605.article
Figure 5: Example of the Kufic Script. Retrieved from http://arabiccalligraphy.org/resources/Kufic-09-tn1200.jpg
Figure 6: Example of the Thuluth Script. Retrieved from http://abuhannansyatirah.blogspot.com/
Figure 7: Hadid, Z. (2000). Vitra Fire Station. Retrieved from https://www.zaha-hadid.com/architecture/vitra-fire-station-2/
Figure 8: Hadid, Z. (1998). Teorema 004: Preliminary sketch, Vitra Fire Station. Retrieved from https://axonometrica.blog/tag/drawings/