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Parametric Hospital Design

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Index

Abstract

This thesis explores how parametric design can be used to enhance hospital architecture, with a focus on complex healthcare facilities. The thesis consists of a literature review that examines the theoretical foundations and current applications of parametric design in architecture. It also includes a case-study analysis of hospitals that have used parametric design, such as the Erasmus Medical Centre in Rotterdam, OLVG West hospital in Amsterdam, and Royal Children's Hospital in Melbourne. The analysis evaluates the benefits and challenges of incorporating parametric design in healthcare architecture, such as improved efficiency, flexibility, and patient experience. The results of this research can provide valuable insights to architects, hospital administrators, and policymakers seeking to enhance patient care and experience through innovative design practices.

This leads to the following research question for this thesis:

Considering existing research and case studies, what novel contributions can parametric design bring to the field of hospital design?

The methodology for this thesis is as follows:

1. Literature review
2. Case-study analysis
3. Data collection
4. Data analysis
5. Conclusion

This thesis provides a comprehensive overview of the potential and challenges of using parametric design in architecture and hospital design. The first chapter highlights the benefits of parametric design, such as increased efficiency and sustainability, while acknowledging the need for more programming and defining. The second chapter delves into the complex factors that shape hospital design and how architecture can improve the patient experience. The third chapter analyses case studies to showcase the potential of parametric design in creating functional, sustainable, and restorative hospital environments that positively impact the healing process.

The study concludes that parametric design has the potential to transform the future of architecture and healthcare facilities. However, its successful implementation requires the development of adequate tools for generating and modifying architectural forms interactively. The interviews with two architects from IAA Architects confirm the growing interest in parametric design in architecture and the need for suitable design tools. Overall, the thesis provides valuable insights for architects and designers seeking to create innovative and sustainable environments that promote the well-being of patients and staff.

Introduction

This thesis investigates the potential of parametric design to improve hospital architecture, focusing on complex healthcare facilities. Through a literature review and case-study analysis of hospitals designed with parametric design, this thesis aims to identify the benefits and challenges of incorporating this design approach in healthcare architecture.

The literature review explores the theoretical foundations and development of parametric design, as well as its current applications in architecture. The focus is on the potential benefits of parametric design in healthcare facilities, such as improved efficiency, flexibility, and patient experience.

The case-study analysis will investigate hospitals designed with parametric design, including the Erasmus Medical Centre in Rotterdam, OLVG West hospital in Amsterdam and Royal Children's Hospital in Melbourne. The analysis will examine how parametric design tools were utilized in the design and construction of these hospitals and assess their impact on the final design.

The findings of this thesis aim to contribute to the ongoing discussion of the role of parametric design in healthcare architecture, particularly in terms of improving the quality of care, patient experience, and overall functionality of hospital facilities. This research will be beneficial to architects, hospital administrators, and policymakers interested in innovative design practices that enhance patient care and experience.

Research question

To transform the subject matter into a research question that can be addressed in this thesis:

Considering existing research and case studies, what novel contributions can parametric design bring to the field of hospital design?

To answer this research questions, sub-questions will be used to divide the thesis:

1) What design options does parametric design provide?
2) What is a good hospital design?
3) How was parametric design used for case-studies?
4) What do professionals from the field think about parametric design?

Hypothesis

This thesis proposes that the implementation of parametric design in hospital architecture can improve various aspects of hospital design, such as program design, efficiency, and testing. However, the thesis acknowledges that not all parts of hospital design can be accomplished by parametric design alone, as the atmosphere and overall aesthetic require human emotion and creativity.

Literature review:

Here the used sources from the bibliography will be explained and summarised.

Parametric design for Architecture:

Architects utilize computer-aided design (CAD) to visualize their ideas and designs. Parametric design, a rapidly growing aspect of CAD, allows architects and designers to specify key parameters of their model and interactively make changes. These changes are then automatically reflected throughout the rest of the model, saving valuable time and allowing for exploration of multiple solutions to a problem. Furthermore, this tool may inspire architects and designers with new ideas that they may not have considered previously.

This book offers a comprehensive guide to various parametric, generative, and algorithmic techniques for generating geometric and topological solutions in a range of situations. The guide includes explicit, step-by-step tutorials and can be applied to any parametric environment. The book also showcases the concepts using scripting languages from some of the most powerful 3D visualization and animation design software systems, one of the most popular open-source Java-based scripting environments, and a brand new language specifically designed for parametric and generative design.

This accessible and concise book is an excellent resource for students and practitioners who want to experiment with parametric techniques.

Architecture and the Modern Hospital:

The hospital building type in the twentieth century played a significant role in the transformation of public health and the expectations of lifespan more than any other building type. The modern hospital architecture has influenced knowledge about health and disease, as well as perceptions of bodily integrity and security, from the scale of public health to the individual level. Despite this, the architectural history of these hospitals is poorly understood and forgotten globally.
This book aims to shed light on the rapid evolution of hospital design during the twentieth century. It analyses how architects and other specialists reimagined the modern hospital and how new approaches to architectural design enabled the vast expansion of medical institutions during the century. Additionally, it highlights the emerging political conviction that physical health would become the cornerstone of human welfare.

Strategies for parametric design in architecture:

The emergence of a new specialist design role, the parametric designer, is revolutionizing the construction industry. This thesis aimed to establish a detailed understanding of the tasks related to this new specialism and to develop a set of considerations that should be made when undertaking these tasks. The author analyses published work that focuses on the application of parametric technology and originates from practice, as well as a series of case studies involving the author as participant and observer in the context of contemporary practice. Based on this analysis, a series of strategies for the parametric designer are identified and discussed, highlighting the opportunities presented by this new role in the design process.

Parametric design: a review and some experiences:

This article addresses the lack of progress in the development of computer-aided design tools for generating architectural forms in an easy and interactive way. Despite the extraordinary development of computer-aided tools for presenting architectural projects, architects still predominantly use traditional means of production. The author argues that the principal limitation of current modelling tools is the lack of appropriate instruments to modify the model interactively once it has been created. This article aims to present recent developments that may be incorporated into architectural design tools in the near future, together with some critical remarks about their relevance to architecture.

Methodology

The methodology for this thesis is as follows:

1. Literature review: A comprehensive review of existing literature on parametric design in healthcare architecture will be conducted to explore its theoretical foundations, development, and current applications. The focus will be on the potential benefits of parametric design in healthcare facilities, including improved efficiency, flexibility, and patient experience.

2. Case-study analysis: A case-study analysis will be conducted on hospitals designed with parametric design, including the Erasmus Medical Centre in Rotterdam, OLVG West hospital in Amsterdam and Royal Children's Hospital in Melbourne. The analysis will examine how parametric design tools were utilized in the design and construction of these hospitals and assess their impact on the final design.

3. Data collection: Primary data will be collected through interviews with architects. Secondary data will be collected through documentation of the hospital design and construction process, as well as previous research and case studies on parametric design in healthcare architecture.

4. Data analysis: The data collected through the literature review and case-study analysis will be analysed using thematic analysis to identify key themes and patterns related to the potential benefits and challenges of incorporating parametric design in healthcare architecture.

5. Conclusion: The findings of this thesis will contribute to the ongoing discussion of the role of parametric design in healthcare architecture, particularly in terms of improving the quality of care, patient experience, and overall functionality of hospital facilities. Ultimately, this thesis aims to promote the use of parametric design in healthcare architecture as a means of improving healthcare facilities.

Chapter 1: Parametric design

For this chapter, parametric design will be researched and discussed. Parametric design is an emerging approach to architectural design that involves the use of computational tools to generate and manipulate complex geometries. This design approach has been gaining popularity in recent years due to its ability to improve the efficiency and sustainability of a building design.

For parametric design, software programs such as Grasshopper and Dynamo are frequently utilized. With these programs, parameters can be connected through programming. What makes parametric design unique is that the designer must define not only the parameters but also the logical operations. (Jabi, 2013) Essentially, parametric design will do precisely what the designer wants since they have defined it themselves.

There are four reasons why it can be interesting to establish a parametric model:

- Design: For complex shapes, a parametric model can be useful in quickly generating a 3D model.
- Production: For many repetitions of the same kind of calculations, parametric models can speed up the production process.
- Optimization: If a complete model is parametrically made for constructions, this can be useful for optimization studies. This allows for the optimization of a construction.
- Flexibility: Flexibility is highly valuable during the design process. There is still a lot of uncertainty at the beginning of a project. A parametric model is very useful in case of changes, avoiding the need to repeat the same operations.

There is still some hesitancy regarding the application of parametric design in daily projects. This is mainly because parametric design is still very new and requires a different approach. More programming and defining is necessary. (Jabi, 2013)

The added value of parametric design is that the process is very accurate; it adheres exactly to predetermined rules. There will be no human errors in the process, and programming codes can be used in other projects. Furthermore, more design possibilities will be explored, and these possibilities will be better optimized. The only disadvantage is that more work must be done beforehand.

Design freedom will also be safeguarded since the architect has control over the model. Values must be input by the architect; this does not happen automatically. By making these values increasingly precise, the model becomes more refined until the desired result is achieved.

Parametric designer

Parametric design introduces a new role, that of the parametric designer, which entails specific tasks. To grasp the function of a parametric designer, we need to examine the activities involved in this role. The initial definition of parametric design task is broken into two parts; creating the model and exploring the design space. Creating the model requires developing the problem description, which is an iterative process. (Hudson, 2010) The design process is initiated by some initial ideas that suggest a form of abstraction. By concentrating on relationships and control methods, a parametric model is formulated and analysed. Exploring the problem space necessitates determining parameter values and generating potential alternatives, which are then evaluated. The designer then revisits the original problem description and either adjusts it based on their findings or fine-tunes specific variables and creates the next alternative. Parametric design provides an opportunity to acquire a more comprehensive understanding of the problem, addressing the challenges of architectural design problems. (Hudson, 2010)

The second identified opportunity is that the parametric model can facilitate design exploration. However, the extent of this benefit is contingent upon the designer's comprehension of how the parametric model organizes the problem space. There are vast numbers of alternative design solutions. The design exploration therefore takes place in a part of that space which is very small. (Woodbury, 2006)

Discussions are currently underway regarding the most appropriate point in the design process to apply parametric design. Two distinct approaches have emerged. The first suggests that parametric design should begin as early as possible and can help the development of a design. The second proposes that the parametric model is restrictive in the breadth of possible exploration and that it should be developed after early design phases. (Hudson, 2010)This contrary viewpoint also serves as a critique of parametric design, arguing that the hierarchical model structures facilitate a greater depth of exploration at the expense of breadth.

Parametric design applications

Complex Geometries:

Parametric design provides architects with the ability to generate complex geometries that are difficult to achieve using traditional design methods. With parametric design, architects can create complex forms, such as curved surfaces, intricate patterns, and organic shapes, using algorithms and mathematical parameters. (Hudson, 2010) This design approach enables architects to explore new design possibilities and create unique architectural designs that are visually striking and innovative.

Building Performance Optimization:

Parametric design provides architects with the ability to optimize building performance by using algorithms and simulations to analyse various design options. With parametric design, architects can evaluate different design solutions and select the one that best meets the building's performance requirements. This approach can help architects to optimize the building's energy efficiency, lighting, ventilation, and other performance parameters, resulting in a more sustainable and efficient building.

Sustainability Enhancement:

Parametric design enables architects to enhance sustainability in their designs by using algorithms and simulations to analyse the environmental impact of their designs. With this approach, architects can evaluate the impact of their designs on energy consumption, carbon emissions, and other environmental factors. This approach can help architects to identify design solutions that minimize the building's environmental impact, resulting in a more sustainable and eco-friendly building.

Collaboration Facilitation:

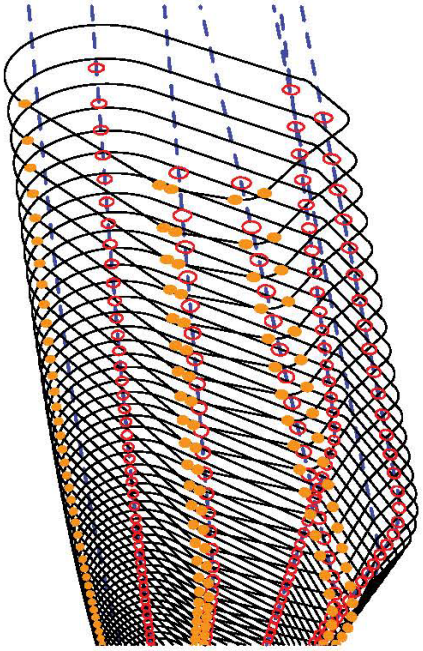
Parametric design provides architects with the ability to collaborate more effectively with stakeholders, including clients, engineers, and contractors. With parametric design, architects can create 3D models that can be easily shared and modified, allowing stakeholders to provide feedback and suggest design changes. This approach can help architects to develop designs that meet the client's requirements while also addressing the technical and engineering constraints of the project.

Example case-study

Blackfriars Tower is a prominent high-rise building located on the south side of the river Thames in London, United Kingdom. The project was undertaken with Ian Simpson. Completed in 2014, it stands at 52 stories high and offers stunning views of the city skyline. The tower is primarily a residential development, with a total of 227 luxury apartments ranging from one to three bedrooms. (Simpson Haugh, 2019)

The building's architecture is sleek and modern, with a glass facade that reflects the surrounding cityscape. It was designed by award-winning architects Wilkinson Eyre, who are known for their innovative designs and sustainable building practices. The tower features several amenities for residents, including a fitness centre, a private cinema, and a 24-hour concierge service.

The problem statement was effectively articulated during the application of parametric methods, encompassing both the geometric approach and design objectives. The first parametric task was to implement a small geometry rationalisation which was achieved by reducing geometry to simple elements. In this case the curves that the floor edges were composed of were simplified from conics to an arc. (Hudson, 2010) All subsequent geometry was determined based on offsets from these edges. Each floor was defined by points that formed a facade grid, reflecting the centrelines of the mullions. Offsets from the facade grid defined the surface geometry required for visualisation. (Hudson, 2010) Images produced as a result of this process were employed in the planning inquiry to demonstrate that modifications to the design had been implemented. Additionally, the model generated other visual representations that served as the basis for the architects' two-dimensional drawing set.



Chapter 2: Hospital design

The upcoming chapter will centre on the challenges that architects encounter when designing a hospital. However, before delving into the topic, it is essential to clarify the nature of an architectural design problem.

Architectural design

In architectural design, the problem cannot be comprehensively stated at the outset of the process. (Lawson, How Designers Think – The Design Process Demystified, 2006) Describing architectural problems presents a challenge, as it may result in an infinite set of potential solutions. In architectural design, solutions are attained through a negotiation process between the problem description and its corresponding solution. In architecture, the ability to select the right problem to solve is necessary for success. (Lawson, Design in mind, 1994) All design problems are solved by searching a large space of possibilities. (Simon, 1975) The spaces in which solutions or problems are located are known as solution or problem spaces, and these spaces exist within the task environment or context.

Provided that the nature of architectural problems is well understood, they can be viewed as problem-solving tasks. This involves creating a problem description and applying a specific process or method to develop solutions. Architectural problems are often deemed ill-defined and emerge through a back-and-forth process between problem description and solutions. The problem description establishes a multidimensional problem space, within which the designer searches for solutions by generating alternatives that are tested against the requirements outlined in the problem description. In order to tackle the design task, it is essential to consider how to fragment and represent the problem. These tasks can reveal previously unknown aspects of the problem, making it more manageable.

Architecture and the Modern Hospital

"Architecture and the Modern Hospital" is a book written by Julie Willis, an architecture professor at the University of Melbourne. The book is a comprehensive examination of the history of hospital design in the modern era, beginning in the 19th century and concluding in the present day.
The book consists of nine chapters, each of which examines a different aspect of hospital design. The first chapter explores the historical context of hospital design, looking at how hospitals evolved from being places of confinement and punishment to institutions focused on healing and medical treatment. Subsequent chapters examine the role of architecture in the design of hospital buildings, including issues such as patient privacy, staff efficiency, and infection control. The book also looks at the impact of technological advancements, such as the development of the elevator and air conditioning, on hospital design.

One of the key themes of the book is the role of architecture in shaping the patient experience. The author examines how hospital design can contribute to the healing process, creating spaces that are calming and conducive to recovery. This includes the use of natural light, views of nature, and the incorporation of artwork and other visual elements into the design of hospital spaces.

The book also looks at the social and cultural context of hospital design, examining how hospitals reflect broader societal trends and values. This includes issues such as the role of gender in hospital design, and the impact of changing attitudes towards health and wellness on hospital design.

Overall, "Architecture and the Modern Hospital" is a comprehensive examination of the history and evolution of hospital design. The book is well-researched and well-written, providing readers with a detailed understanding of the complex factors that have shaped hospital design in the modern era. The author's focus on the patient experience is particularly noteworthy, and the book is a valuable resource for architects, healthcare professionals, and anyone interested in the intersection of healthcare and design.

Chapter 3: Case-studies

A few case-studies have been examined to determine the possibilities and potential parametric designing can bring to architecture and the design of a hospital. The case studies are: Royal Children's Hospital in Melbourne, Erasmus Medical Centre in Rotterdam and OLVG West hospital in Amsterdam.

The Royal Children's Hospital

Doctors John Singleton and William Smith founded the The Royal Children's Hospital in a small house located at 39 Stephen Street in Melbourne to address their grave concerns about high infant mortality rates in the city. The hospital treated over 1,000 children in its first year. (Trove, 2023)

In 2005, the Victoria State Government announced plans to construct a new 340-bed facility for the Royal Children's Hospital adjacent to the current site. The Babcock & Brown-led consortium, in collaboration with Billard Leece Partnership and Bates Smart Architects, won the redevelopment bid.

The Royal Children's Hospital has been designed based on evidence-based principles of architecture, reflecting evolving healthcare practices, user expectations, and environmental responsibility. The hospital is infused with nature, creating a restorative environment for patients, staff, and visitors. The design promotes safety, respect for children, and deinstitutionalization of the hospital genre. The architectural approach of the hospital is inspired by the native bushland setting of Royal Park. The campus masterplan includes a central street that connects public gardens to the north and southwest. The buildings are oriented towards the park, allowing for light-filled landscaped gardens around the perimeter, enhancing the connection between children and nature. The narrow footprints of the clinical buildings provide natural light to all corners of the hospital, and the natural slope of the site allows the facilities to link to the park at three different levels. (Architecture and Design, 2013)

The Royal Children's Hospital in Melbourne is an excellent example of how parametric design was employed to create a highly functional and sustainable building. The use of parametric design allowed the architects to model the hospital's complex geometry, which involved a sweeping organic form made up of coloured 'leaf' blades. (Bates Smart, 2011) The blades were fabricated in curved panels and provide protection from the sun while creating an identity for the new hospital. The technique also enabled the designers to optimize natural daylight and views to parkland, which is an essential element of the RCH's healing environment.

Moreover, parametric design helped to create the star-shaped inpatient building with more than 80 percent of the rooms having park views. The approach was used to generate a campus master plan that connected the new public gardens to the north and southwest, breaking away from the city grid and allowing light-filled landscaped gardens around the full perimeter of the building. (Bates Smart, 2011)

Erasmus Medical Centre in Rotterdam

Erasmus University Medical Centre, situated in Rotterdam, Netherlands, is home to the faculty of medicine of Erasmus University and is affiliated with it. It is the largest and most authoritative scientific university medical centre in Europe, holding a top position in clinical medicine, with a ranking of #1 among the top European institutions, and a #20 position in the world, as per the Times Higher Education rankings. It is also the largest of the eight university medical centres in the Netherlands, with the highest turnover and number of beds. Improvement and innovation in the care of today and the health of tomorrow; that is one of the philosophies of the Erasmus MC. (EGM Architecten, 2013)

Erasmus Medical Centre (EMC) in Rotterdam, Netherlands, is a renowned medical institution that houses multiple medical disciplines and research facilities. It is a large and complex building, covering an area of 200,000 square meters and accommodating 15,000 employees. (Vroom, 2018) The design of the EMC building is a product of parametric design, a methodology that employs algorithms and computer programming to create complex geometries and structures.

The use of parametric design allowed the architects, EGM Architecten, to create a complex, organic shape that reflects the complex functions and disciplines housed within the building. The building is characterized by its undulating curves, which create a dynamic and fluid appearance that contrasts with the orthogonal shapes typical of traditional hospital design.

Parametric design also enabled the architects to optimize the design for efficiency and sustainability. The complex shape of the building was optimized for energy performance, with a facade that adapts to the orientation and solar shading requirements of each part of the building. The building's energy consumption is monitored and controlled by a building management system that adjusts heating, cooling, and lighting based on real-time data. (Vroom, 2018)

Overall, the use of parametric design for the EMC building resulted in a striking, efficient, and sustainable design that reflects the cutting-edge research and medical practices housed within the building.

OLVG West hospital in Amsterdam

The Onze Lieve Vrouwe Gasthuis, now known as the OLVG location Oost, was founded in 1898 by the Zusters Onder de Bogen as a Catholic hospital. In 1994, the Protestant Prinsengrachtziekenhuis became part of the organization. In 2013, the Onze Lieve Vrouwe Gasthuis merged with the Sint Lucas Andreas Ziekenhuis, and the legal merger was completed in 2015 (AT5, 2015). The names of the hospitals remained the same, and most departments initially remained intact. As of October 15, 2015, the hospitals continued under the common name OLVG, and the names Onze Lieve Vrouwe Gasthuis and Sint Lucas Andreas were replaced by OLVG location Oost and OLVG location West.

The Onze Lieve Vrouwe Gasthuis had 555 beds in 2010 (OLVG, 2010), with the main location situated in Oosterpark. This information is relevant to understanding the historical development and current structure of the OLVG hospital system, which may inform potential future research on healthcare management, organizational behaviour, and hospital administration.

A floating cloud has recently been installed in the atrium of the OLVG hospital in Amsterdam-East, housing a hypermodern and future-proof hybrid operating room. (EGM Architecten, 2022) This is the first of eight new operating rooms that EGM architects will be building for OLVG in the coming years. Despite the daily flow of visitors and staff in the hospital, the new operating room was constructed in the central hall with minimal disruption to patient care. This was a complex puzzle in terms of design, technology, sustainability, and logistics. (Geist, 2022)

The use of parametric design has enabled to solve this puzzle, as the design process is based on mathematical algorithms that can be adjusted and refined as necessary. This has allowed the architects to create a hospital that is perfectly tailored to the needs of its patients, staff, and visitors. Additionally, parametric design has allowed for greater flexibility in the design process. Changes can be made quickly and easily, without the need to start from scratch, allowing the hospital to adapt to changing circumstances and requirements.

Chapter 4: Application in the field

Interviews

For this thesis, two architects from IAA Architects were interviewed to investigate the potential of parametric design in the field of architecture. The purpose of the interviews was to identify the problems and opinions regarding the use of parametric design in the working process. The transcripts of the interviews are included in the sources chapter, where they are summarized and analysed to identify agreements and differences between the architects.

The working process of the architects varies depending on the project and client. However, modelling is often done using Sketch-Up, which allows for easy modification of models and provides a lot of design freedom. (Architecten, 2023) Revit, on the other hand, is considered too precise for designing purposes. Typically, models are created during the VO phase of a project to create images, impressions, and starting floor plans.

The architects see many new possibilities for the future of architecture, including the increasing use of parametric design. They expect design tools, such as 3D printing, to continue to improve and become more widespread in the industry.

Article Javier Monedero

In his 2000 article, Javier Mondero expressed his opinion on the development of computer-aided tools in architecture, particularly with regard to parametric design. While there has been an increase in the use of computers to present or communicate architectural projects, the development of tools to assist in creating these forms has not progressed at the same rate. Mondero notes that the lack of adequate tools for generating and modifying 3D-models is a fundamental limitation in the design process. This is particularly important in design activities where the designer is constantly modifying aspects of the model, going back and forth between different solutions. Mondero argues that it is a mistake to propose integrated design methods using expert systems and artificial intelligence without first addressing this fundamental limitation.

Mondero's article highlights the importance of developing adequate tools for generating and modifying architectural forms in an easy and interactive way. Without these tools, architects are forced to rely on traditional means of production, using computers as little more than drafting tools. While there may be differences of opinion on the reasons for this situation, Mondero's argument emphasizes the need to focus on developing the right tools to assist in the design process, rather than trying to advance too rapidly with integrated design methods.

Conclusion

In the concluding chapter of this thesis, the research question that guided this study will be answered. Specifically, the research question is:

Considering existing research and case studies, what novel contributions can parametric design bring to the field of hospital design?

In conclusion, the chapters provide a comprehensive understanding of the potential and challenges of parametric design in architecture and hospital design. The first chapter emphasizes the benefits of parametric design in improving the efficiency and sustainability of building. While acknowledging the need for more programming and defining, the added value of accuracy, lack of human errors, and increased design possibilities make it a valuable approach for architects. The second chapter explores the multidimensional problem space that architects encounter when designing a hospital, with a focus on how architecture can shape the patient experience. The book "Architecture and the Modern Hospital" by Julie Willis is presented as a valuable resource for understanding the complex factors that have shaped hospital design in the modern era. Finally, the third chapter analyses several case studies to determine the potential of parametric design in hospital design, demonstrating how parametric design can be used to create functional, sustainable, and restorative hospital environments that positively impact the healing process and promote staff productivity.

Overall, the chapters illustrate how parametric design has the potential to transform the future of architecture and healthcare facilities. By utilizing parametric design, architects and designers can generate complex geometries, optimize building performance, enhance sustainability, and create restorative environments. However, the implementation of parametric design also requires the development of adequate tools for generating and modifying architectural forms in an easy and interactive way. With the continued evolution and improvement of parametric design technology, we can expect to see more architects and designers embracing this approach to achieve their design goals.

The interviews with two architects from IAA Architects confirm the future use of parametric design. The architects reveal new opportunities and possibilities for the future of architecture, including the use of parametric design. However, they also acknowledge that the working process is highly dependent on the project and client, and that certain design tools may not be suitable in all situations. The study underscores the need for adequate tools to generate and modify architectural forms interactively, as highlighted in Mondero's article. Once the right tools are available, parametric design can be fully utilized in architecture.

In conclusion, this thesis provides valuable insights into the potential of parametric design in architecture and hospital design. They contribute to the body of knowledge on this topic and inspire designers and architects to adopt parametric design principles for creating functional, sustainable, and restorative environments. As we move forward, it is important to continue exploring the possibilities of parametric design and developing the necessary tools and techniques to fully realize its potential.

Reflection

Parametric design for hospitals is an interesting and innovative approach to architectural design that offers a range of benefits, including improved efficiency, sustainability, and flexibility. This thesis has allowed me to delve into the topic of parametric design and its application in the context of hospital design. Through my research, I have gained a deeper understanding of the principles and concepts of parametric design to generate and manipulate complex geometries.

One of the most significant insights I have gained through this research is the potential for parametric design to optimize building performance in hospital design. Architects can evaluate different solutions and select the one that best meets the hospital's performance requirements.

Overall, my research into parametric design for hospitals has been a fascinating and eye-opening experience. I have gained a deeper understanding of the principles and concepts of parametric design and its potential applications in hospital design. I hope that my research will contribute to the growing body of knowledge on parametric design and its potential applications in the field of architecture.

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Interviews transcripts

1)
Interviewee: Architect at IAA Architects
Interviewer: Tim Bielevelt

Tim: “Welcome to this interview, let's get started. First of all, I would like to mention this interview is of course anonymous. I would like to ask what your job description is and how long you have been working at IAA Architects."

IAA architect: “I have been working at IAA Architects for almost twenty years now. I started in 2001. My work is mainly in the field of architecture and a piece of management is involved. I am also a partner at IAA.”

Tim: “Very clear. Now I wanted to ask more about my research. What does the initial phase of a project look like?”

IAA architect: “In principle, we give complete freedom at the initial stage of the project for designers to choose which method they want to use to make a design. It is therefore not a fixed protocol and there is no fixed program such as Sketch-Up. In practice we actually work in all kinds of packages in the preliminary phase up to and including the DO phase actually.”

Tim: “So there is actually no fixed way or way of working in the preliminary phase?”

IAA architect: “No, not really, in the beginning you are still looking for different things. Such as putting your functions away or making relationship diagrams. You still want to try and search a lot and a program like Sketch-Up works very well for this, it's a bit more intuitive and works more intuitively. Sketch-Up is not as dimensionally reliant and works much faster to produce presentable images."

Tim: “Are there any complications in the design process and the to the DO phase?”

IAA architect: “Yes, you notice that also on the client side that they are not always ready to look closely at the layout in the VO phase, as a result of which they will change a lot in the DO phase. They start looking seriously at the design at this phase of the project. It is therefore also important to already have the VO design completed and ready to discuss and go through with clients.”

IAA architect: “We are increasingly inclined to share knowledge of the architectural use. So that starting the DO phase is also much easier and many things have already been discussed in the VO phase. Then you can bring everything closer together. We tend to try to get knowledge much earlier in the process.

Tim: “That sounds really good! How do you see the design process changing in the field?”

IAA architect: “There will soon be a new generation of architects at work who work with other tools, for example with Revit. I can also imagine that the future architects can also use a little more dexterity and speed to achieve better results. On the other hand, I also see a whole current development within architecture. That go one step further towards the parametric story. So that design is much more programmed than that it is drawn. I also think that it will increasingly play a role

in our design process and in optimizing a design. I have sometimes wondered if there ever was an architectural firm without a sketch roll. It could be, but I don't really believe in that anymore. In the past a little more, but now less."

Tim: "Yes, this is a very convenient way of working. Could you talk more about your experience with parametric designing?"

IAA architect: "I believe that in the future we will increasingly move towards the parametric designs. And the ever-improving design of the BIM model. Also that more specific elements are added to the model. So the model will contain more information than before. We already started using models more for management and maintenance phases. I also believe that we will increasingly build and design in a circular manner. We now model how a building is put together, but we don't model how we can take it apart and put together in a different way. There are so many things that will be possible in the future, all very interesting."

IAA architect: "I especially like the parametric design. That we determine starting points and that a computer calculates different options. For example, I might be able to design 4 options in a day, but a computer might be able to design a million options in only 1 hour. That seems very interesting to me and I think it is becoming more popular in the field."

Tim: "Yes, that is indeed very interesting, how do you think this will affect time management at the start of a project."

IAA architect: "Making these scripts will take a lot of time. But the more scripts are created and if we keep that an open source, it can be done faster and faster in the future. In the future it may be that you are no longer designing as an architect. But that you are more directing and directing the process."

Tim: "These were all the questions I wanted to ask. Thank you very much for participating in this interview!"

IAA architect: "No problem, good luck with your research!"

Tim: "Thanks!"

2)
Interviewee: Architect at IAA Architects
Interviewer: Tim Bielevelt

Tim: “Welcome to this interview, let's get started. First of all, I would like to mention this interview is of course anonymous. I would like to ask what your job description is and how long you have been working at IAA Architects."

IAA architect: “I am an assistant designer at IAA Architects. The projects are often led by an architect that has a lot of experience and I have a lot of supporting design tasks with that. I work mainly on VO/DO designs in the projects. So at the initial phase of a project.”

Tim: “Obviously, as you said, you start at the beginning of a project. What does the beginning look like for a project?”

IAA architect: “Of course that depends on the nature of the assignment. Look, if you're dealing with a renovation project, the VO phase looks very different from a new construction project. When working on a renovation project, the VO phase is almost already DO, since the building is already there. Working on a new construction project you start from an empty location and it is very common to design different scenarios. There are still many unanswered questions in the VO phase, which is why it is good to design very broadly so that you can answer as many questions as possible. In the end it is always a combination of all the scenario models I made.”

Tim: "Which programs do you usually work in?"

IAA architect: “At our office we mainly work in Sketch-Up in the SO and VO phase. That is just a super easy program, it works very fast and you don't have to focus on construction problems. So you can just design freely. We also use many different programs to make beautiful drawings or beautiful videos. For example, a colleague renders often videos for us in Lumion. I can also draw in Revit, but I feel like the need is not there. Revit is very restrictive in the initial phase.”

Tim: “Revit is of course a very precise modelling program.”

IAA architect: “Exactly.”

Tim: “Are there any problems you run into in this process?”

IAA architect: “This could sometimes be the client. A client often has no idea how such a process works. It is then important to use the right resources to tell the right story. This process is sometimes quite complicated. You have to develop a certain methodology for this. Especially it is important to realize, how does someone look at what I have made. It is therefore very important to choose the right means to make people understand your design.”

Tim: "So you actually have to look closely at how you can convince the client with your design?"

IAA architect: “Yes, it is extremely important for an architect to see how you can involve everyone in the process. And make sure everyone gets excited about your design. Communication is very important in this. As a starting designer I notice this very much. The important thing is, you don't learn this in school. But I found that out very quickly in practice.”

Tim: “How do you see the design process changing in the field?”

IAA architect: “Parametric design is one very interesting topic which is being used much more in the designing phase. That can lead to very interesting things. Only you need to make sure that the designer continues to design, that the computer does not take over.”

Tim: “Could you talk more about your experience with parametric designing?”

IAA architect: “Parametric design is a super cool tool that architects use to make complex shapes and designs accurately and efficiently. They use the computer to create designs that respond to things like the environment. One of the best things about it is that it's very flexible, which means architects can change their designs quickly and easily if they get new info without having to start all over again. But it's not perfect, it can be hard to fit into normal design processes. It currently is only being used when there is no rush behind a project. The process is currently quite slow, but will improve over time I think.”

Tim: “And how do you see the future in relation to BIM?”

IAA architect: “I notice that a lot is still made by hand. Craft is actually becoming even more important in practice. People value that. I believe also that we will still be making drawings in the future, that we will still be making scale models. I think we will use BIM more and more for design smarts. There will be a lot of new tools to design, but I think the process will stay that way. The tool is not the most important, the design, the goal is and that everyone is satisfied with it is.”

Tim: “These were all the questions I wanted to ask. Thank you very much for participating in this interview!”

IAA architect: “No problem, good luck with your research!”

Tim: “Thanks!”