RESEARCH REPORT

RESEARCH REPORT

ARCHITECTURE & CHILDBIRTH

THE POSITIVE INFLUENCE OF ARCHITECTURE ON WOMEN DURING LABOR, DELIVERY, RECOVERY AND POSTPARTUM

RACHELLE DE GEUS

AR3AD110 DWELLING GRADUATION STUDIO:
DESIGNING FOR HEALTH AND CARE

MASTER THESIS, TU DELFT

RESEARCH TUTOR: BIRGIT JÜRGENHAKE
STUDENT NUMBER: 5248736

DATE: 25/06/2024

Figure 1. "Illustration of a new mother"
- Author's own illustration

Keywords

architecture, birth environment, LDRP, women-centered care, (environmental) needs, biophilic design

Abstract

Under the influence of negative experiences, childbirth can be harmful and have negative effects on women's (mental) health. One of the factors affecting women's experience of childbirth is the physical environment. Unfortunately, contemporary maternal healthcare facilities are often designed from a highly-regulated and medicalized maternity care perspective, instead of a woman-centered design approach. In order to comply with women's (environmental) needs and to create a more women-centered design approach, design guidelines have been formed based on literature study, fieldwork including semi-structured interviews, and case studies. Using these guidelines, the architectural environment could contribute to a positive experience, improving health & well-being, for women during the stage of LDRP* in a maternal healthcare facility.

**an acronym for labor, delivery, recovery, and postpartum*

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 personal fascination

Over the past decades, we have taken tremendous steps toward becoming an efficiency-driven society with an endless amount of possibilities. Everything is within hand's reach and the sky seems to be the limit. Unfortunately, this mentality of wanting to be efficient more often seems to be taking its toll. People all around us struggle with burnout, mental health issues such as depression, and all other health issues that this high-pressure society is bringing us. This graduation studio, designing for health and care, allows me to explore the influence of architecture on health(care) and how we as future designers can help people with health issues or prevent health issues through our designs.

Looking back at the past years, I have often found myself designing for people in need or health-related topics. As my final design project, I want to use this opportunity to yet again design for a health-related topic and hopefully contribute to a healthier living environment. This time, I have chosen to research the (mental) health of women, specifically women who are pregnant and/or have given birth. As I have seen in my close circles, healthy childbirth can be a very amazing experience as well as a very overwhelming experience. Feelings of extreme joy and stress go hand-in-hand. Within this society, it is not surprising that new moms can feel very overwhelmed with the birth of their new baby or even develop postpartum depression. As designers of the built environment, we know the influence architecture can have on people and their health. I therefore hope to learn and discover more about the positive contribution architecture can have on the (mental) health of women who are pregnant and/or have given birth.

1.2
problem statement

the (lack of positive) influence of architecture on women during labor

Childbirth is considered to be one of the most significant experiences of a woman's life with a powerful psychological importance (McKelvin, Thomson, & Downe, 2021). Unfortunately, under the influence of negative experiences, childbirth can be harmful and have negative effects on women's (mental) health. As authors Esfeh, Kazemi, and Shamsaie write in their paper about a soothing labor environment, stress and anxiety that arise from these negative experiences are associated with negative effects such as an increased need for sedatives during labor, prolonged labor, and impaired mother-child attachment (Esfeh, Kazemi, & Shamsaie, 2020). A negative birth experience does not only physically influence these women, Nielsen and Overgaard write in their paper about women's birth experiences that a negative birth experience may also have a lifelong psychological impact in the form of post-partum depression, PTSD symptoms, and increased fear of childbirth (Nielsen & Overgaard, 2020). The Timbos Instituut, a Dutch scientific research institution, states that based on the number of births in the Netherlands and the prevalence of postpartum depression, it is estimated that 23,000 women who are pregnant and/or have given birth in the Netherlands develop postpartum depression every year. These numbers therefore make postpartum depression the most common condition among new mothers (Trimbos Instituut, n.d.).

"23,000 women who are pregnant and/or have given birth in the Netherlands develop postpartum depression every year"

- (Trimbos Instituut, n.d.)

The factors affecting the experience of childbirth involve a number of interrelated psychological and physiological processes, that are influenced by social and organizational context. The third and final context that profoundly affects women's birth experience, and health and well-being during childbirth, is the physical environment (Esfeh et al., 2020) (Nielsen & Overgaard, 2020). Sarah Joyce's research paper, named '*Wait and transfer, curate and prosume: Women's social experiences of birth spaces architecture'*, mentions the same statement: "The birth environment can help or hinder physiological birth and influence a woman's level of satisfaction with birth" (Joyce, 2021). With the statements of these research papers, it is clear that the physical environment and architecture take part in women's experiences and effects during childbirth.

Within the stage of LDRP; an acronym for labor, delivery, recovery, and postpartum, formulated by Esfeh, Kazemi, and Shamsaie (Esfeh et al., 2020), women come in contact with various types of physical environments. The environments can vary from their own homes to birth centers to the hospital. A study done in 2021 by Eenvandaag and Ouders van Nu, shows that 42% of the women give birth in first-line care, whereas 21% of the women give birth at home and 21% of the women give birth in a birth center or at the hospital. The other 58% of the women give birth in the hospital and cover the second-line care (Lubbe, 2021). This concludes that in The Netherlands, 79% of the women experience childbirth in other physical environments than their own homes.

Unfortunately, a problem seems to occur with these physical (birth) environments. Joyce describes that contemporary maternal care facilities and hospital settings are designed from a highly regulated and standardized maternity care perspective, based on building regulations, and evidence-based- and medical design, instead of a woman-centered design approach. Moreover, she concludes that 'regulatory design guidance for maternity facilities still deliver similar birth spaces to those first created post-war when childbirth moved wholeheartedly into hospitals' (Joyce, 2021).

"The birth environment can help or hinder physiological birth and influence a woman's level of satisfaction with birth"

- (Sarah Joyce, 2021)

In addition to this, personal experience and conversations that have been done up till now give similar kinds of results. A simple question that I asked my sister, who just gave birth herself, was about the physical environment of birth centers. The birth centers describe themselves as home-like maternity facilities, but contrary to what they advertise, my sister was very clear in not choosing to give birth there because of their highly regulated and standardized maternity care atmosphere. She said: "They try to make it feel home-like by just hanging up a painting and putting a colorful chair in the corner of the room". Furthermore, a personal visit to birth centers and hospitals gave the same kind of results. Simply looking at the corridors of these facilities showed either corridors that were dark and lacking natural daylight, or corridors that were sterile, white, and crisp, just as for the rooms; it was all lacking from a home-like atmosphere (fig. 2, fig. 3).

Authors Nielsen and Overgaard researched similar problems and solutions regarding the highly regulated and standardized physical environments of women during the stage of LDRP. They researched adapted patient-centered birth environments in hospitals which gave women associations to a recognizable home-like environment, which seemed to make the women adapt more easily to the room and to the transition from home to hospital. Providing solutions to counter these highly regulated and standardized physical environments and tackling the lack of home-like environments is a great addition, emphasizing the previously mentioned fact that 79% of the women come in contact with these physical environments. Unfortunately, this is one of the few cases wherein solutions for women-centered care are provided, and although developments seem to have been made over the past years within maternal care facilities, such as newly built Mother and Child centers in hospitals, does it seem that the problem that Joyce described is still accurate and the developments are scarce. All earlier mentioned research papers stating the influence of the physical environment on women during childbirth, a similar problem or solutions concerning the birth environment, have been published within the past three years. Moreover are the research papers interior-oriented, and minimally include nature-inspired design methods such as biophilic design, which has proven to have the ability to reduce stress, improve our well-being and expedite healing (Browning, Ryan, & Clancy, 2014).

This concludes that whether it is a maternal care facility in the form of a birth center or a hospital, the same problems seem to be coming back. The results show that the possibilities for women during the stage of LDRP are small and the gap between their homes and a maternal care facility, where 79% of the pregnant women are essentially assigned to, is substantial. The highly regulated and standardized maternity care settings hereby take the overhand, provide interior-related improvements at most and lack health-improving nature-inspired design approaches. It is therefore important to research the possibilities physical environments and architecture could provide for maternal healthcare facilities to women during the stage of LDRP.

Figure 2 and 3. "Photographs of corridors at a maternity ward"
- Author's own photographs

1.3
theoretical framework

The theoretical framework of this research forms the foundation of what this research is built upon and contains two main sources. The first part of the framework is based on the research paper written by Jane Hyldgaard Nielsen and Charlotte Overgaard, earlier mentioned in the problem statement, named '*Healing architecture and Snoezelen in delivery room design: a qualitative study of women's birth experiences and patient-centeredness of care*'. Nielsen and Overgaard's paper forms the base of the theoretical framework and covers important principles like hospital design, birth environment and -experience, and patient-centered care.

Before elaborating on Nielsen and Overgaard's study, does it seem helpful to consider the bigger picture of their research. Their study seems to have common ground with other studies in the reason for doing and/or the aim of the research, which confirms the necessity of this research topic. The aim of Nielsen and Overgaard's study was to explore women's experience of the birth environment since it profoundly influences experiences, health, and well-being. Nielsen and Overgaard used the principles of healing architecture and Snoezelen, which provided knowledge of how building and interior design affects the senses, such as users' pain experience and stress levels, to design an alternative delivery room to examine women's experiences compared to a standard delivery room (Nielsen & Overgaard, 2020). Addressing women's feelings of pain and stress, amongst the (lack of positive) influence of the birth environment, are important parts of the research which seems to be part of the common ground amongst other researchers and studies.

As mentioned in the problem statement, has research shown that 79% of the women experience childbirth in other physical environments than their own home, whereby the environments are often medicalized and highly regulated (Joyce, 2021). Esfeh, Kazemi, and Shamsaie write that since most of the environments where childbirth takes place are equipped based on a medical perspective on childbirth to provide medical care, can the entry of women into these unknown environments be associated with anxiety and stress for the women. They hereby describe that these medical-equipped places 'may suggest a health-threatening condition in one's mind exacerbating the anxiety and stress of the parturient' (Esfeh et al., 2020). In the research about Sensory design in the birth environment, authors Bellini, Macchi, Setola, and Lindahl write that pregnant or laboring women engage with spaces that define childbirth through 'medical norms'. They describe that 'a "normal" hospital childbirth experience exposes women to many healthcare design concepts, for example, a crisp, clean aesthetic of hygiene, standardized spaces not adapted to her needs, and layouts designed for effective use of equipment and staff time' (Bellini, Macchi, Setola, & Lindahl, 2023).

It goes without saying that these research papers on the topic of birth environments and experience have a similar base which their research is built upon. Nielsen and Overgaard's elaboration on this research topic resulted in five design principles, which 'added evidence on the positive influence of hospital environment design on patients' psychological and physical well-being and thereby the psychosocial outcomes of care' (Nielsen &

Overgaard, 2020). The five principles, as seen in Figure 4, include the design differences between a standard- and an alternative delivery room and its corresponding improvements that cover the topics of ***1. Guiding focus of the physical birth environment, 2. Visual and auditory stimuli, 3. Interior, furniture and equipment, 4. Privacy, and 5. Light.*** These design principles derived from the precursor to Nielsen and Overgaard's study, a study protocol named *'Study protocol for a randomised trial evaluating the effect of a "birth environment room" versus a standard labour room on birth outcomes and the birth experience*', whereby an interprofessional design team including midwives, a zookeeper, a design psychologist, a wellness expert, a game developer, an architect and a theatre set-designer, designed a birth invironment room 'of the future'.

Together with the literature research of this study protocol, four important elements for the birth room emerged: "The room has to be home-like and to bring nature into the room; it has to promote the partner's active support role and the woman's mobility during labour, and it has to be flexible, so it is possible for the couple to create and personalise their own birth environment on arrival, during labour, and during the birth of their infant" (Lorentzen, Andersen, Jensen, Fogsgaard, Foureur, Lauszus & Nohr, 2019). These elements have translated themselves into the five design principles and the design itself, used by Nielsen and Overgaard in their study. The five design principles, including Nielsen and Overgaard's overall study, will therefore serve as a base for this research to investigate women's experiences and needs through literature study, fieldwork including

	Alternative delivery room	Danish standard delivery room
GUIDING FOCUS OF THE PHYSICAL BIRTH ENVIRONMENT	Promoting feelings of well-being, freedom, and control.	Medical safety
VISUAL AND AUDITORY STIMULI	Snoezelen-inspired audial and visual scenery on three walls providing positive distractions	The woman may bring own sound device
INTERIOR, FURNITURE, AND EQUIPMENT	Nordic contemporary style furniture resembling private home environment	Traditional hospital furniture and equipment, including lounge chair
	Traditional hospital labor bed and necessary equipment covered or placed less visibly	Traditional hospital labor bed as central feature of room
	Bathtub	Bathtub may be available
PRIVACY	Single occupancy, private bathroom	Single occupancy, often private bathroom
LIGHT	Overhead light off unless needed for assessment purposes	Overhead light controlled by staff, usually on unless the woman is sleeping
	Dimly lit scenario projections controlled by woman and her partner	

Figure 4. "Table of key characteristics of alternative and standard delivery rooms"
- Author's own illustration, based on Nielsen and Overgaard's research

Besides the five design principles of Nielsen and Overgaard's study, another important aspect of this research is about the use of nature-inspired design elements. Nielsen and Overgaard use a few nature-related elements in their study, such as 'visual stimuli', as seen in Figure 4, whereby nature scenes are projected on the walls of the birth rooms. The study protocol which was used for the development of their design, also mentions that they also used nature-based materials in the furniture of the rooms (Lorentzen, et al., 2019). Although Nielsen and Overgaard's study, amongst other research papers, uses some nature-related elements in their research, designs, or solutions, is their overall use of nature-inspired elements quite minimal. Prior mentioned in the problem statement, are the research papers hereby often interior-oriented, and is the inclusion of nature-inspired design methods such as biophilic design minimal or non-existent. For this reason, the theoretical framework will be zoomed out from maternity care- and interior-oriented setting to a broader- and nature-related perspective. To get a better understanding- and to create a foundation on the influence of architecture in healthcare architecture and healing design, the book named *'14 patterns of biophilic design; Improving health & well-being in the built environment'*, by Browning, W.D., Ryan, C.O., and Clancy, J.O., will be used. This book covers important biophilic design principles that can reduce stress, improve cognitive function and creativity, improve our well-being, and expedite healing (Browning et al., 2014). Out of the fourteen design principles that are appointed in this book, six principles have been chosen that offer stress reduction and positively influence emotion, mood, and preference, which, based on the literature used in the problem statement, seem to be important factors for women during the stage of LDRP. The principles cover the topics of ***1. Visual connection with nature, 2. Non-visual connection with nature, 3. Thermal and airflow variability, 4. Presence of water, 5. Dynamic and diffuse light, and 6. Material connection with nature*** (fig. 5). Research about these six patterns of biophilic design will most likely provide new and additional information about nature-inspired design principles that could contribute to women's health and well-being in a maternal healthcare facility. Together with Nielsen and Overgaard's research, amongst additional literature, will design guidelines be formed. With this basis, women's experiences in maternal healthcare facilities will be researched, as well as existing cases of (maternal) healthcare facilities.

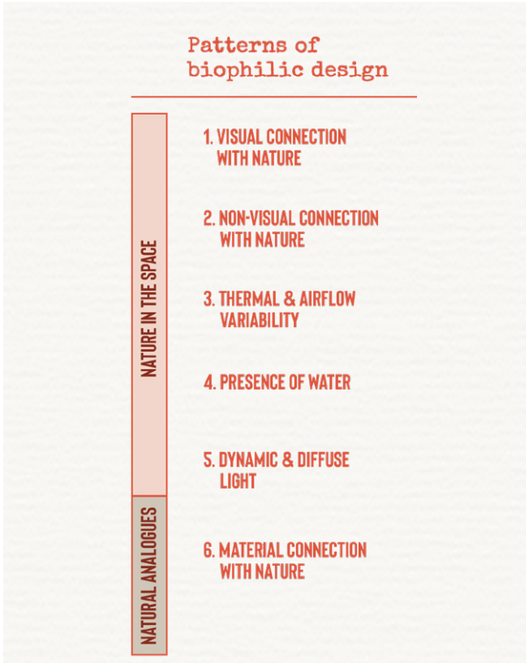


Figure 5. "Table of the six most important patterns of biophilic design"
- Author's own illustration, based on Browning, Ryan, & Clancy's research

1.4 hypothesis

This research hypothesizes that a women-centered design, based on the current experiences of women during the stage of LDRP in a maternal healthcare facility, together with a healing-design approach, form design principles and/or a design that battles negative experiences and effects on birthing women. In other words, the design principles and/or the design contribute to a positive experience and an improvement in health & well-being in a maternal healthcare facility. It tackles the problem of highly regulated and standardized maternity care settings and stimulates a more home-like birthing environment whilst being in a healthcare facility.

1.5
research question

What kind of architectural environment could contribute to a positive experience, improving health & well-being, for women during the stage of LDRP* in a maternal healthcare facility?
**labor, delivery, recovery, and postpartum*

1. What are the (environmental) needs of women during the stage of LDRP in a maternal healthcare facility?
2. What kind of nature-inspired design principles could improve women's health & well-being in a maternal healthcare facility?
3. How do women during the stage of LDRP perceive their (architectural) environment in contemporary maternal healthcare facilities?
4. How are the (architectural) environmental needs of women during the stage of LDRP currently visible in the maternal healthcare facilities?

1.6
definitions/framework

Definitions

- LDRP: An acronym for labor, delivery, recovery, and postpartum
- Maternal healthcare facilities: Facilities in where childbirth can be professionally assisted, such as birth centers and hospitals
- Environmental needs: Needs regarding women's physical birth environment, involving spatial, architectural, and interior -and furniture related needs

Framework (in- and excluding)

- Literature study will be based of research in western- and first world countries
- Fieldwork and interviews will be based in The Netherlands
- The research is women- and patient-centered, partners, staff, or other parties will only be included in the research if it contributes to the women-centered point of view
- Literature study will mainly be focussed on first-line care and low-risk births. However, fieldwork and interviews will not be specified to gain an overall knowledge of women's experiences

Figure 6. "Illustration of a woman in labor"
- Author's own illustration

1.7
methodology

In order to answer the main- and sub-questions, various types of research methods will be carried out in this research. The research methods that will be used include literature study, interviews, fieldwork whereby research methods such as observing and sketching will be done, and case study research. The interviews and fieldwork will require prior preparations and planning such as preparing interviews and accessory mediums, scheduling appointments, and discussing possibilities with the hospital staff.

Literature study

The first type of research method that will be done is a literature study. The literature study will provide the necessary background to my research and will involve researching, reading, analyzing, and evaluating different types of scholarly literature such as books and articles. Research papers, like the papers earlier mentioned in the problem statement and theoretical framework, will hereby be used, concerning the topic of hospital design, birth environment and -experience, and patient-centered care. In addition to that will literature study be done concerning topics of perception and biophilic design. If needed, the literature study will be strengthened with additional facts and figures provided by official records and resources. Exact information about the literature can be found in the 'theoretical framework' section and in the bibliography. The literature study will provide answers to the first-, second and third-sub-questions.

Interviews

To further support my research, various semi-structured interviews will be conducted. For this research method, approximately 5 women will be interviewed who have given birth in a maternal care facility within the past year or the coming month wherein the fieldwork takes place. The participating women must have self-selected to take part in the interviews, received maternal healthcare in a maternal healthcare facility, and those under the age of 18, those known to be vulnerable, or women requiring an interpreter for the interview will be excluded. The maternal care facility wherein the women have given birth could be a birth center or a hospital.
Due to the unknown moment of time that childbirth takes place, will the interviews be done during the fieldwork in a hospital and in a birthcenter with women who will be assigned and willing to be interviewed at that moment of time.
The interviews include a various amount of pre-setup questions whereby topics such as women's (spatial) needs, environmental (birth) experiences, perception, and memory will be researched. The interview will start off with the request to explain what women remember most of the place where their child was born, followed by other questions regarding the mentioned topics. With the help of images of other researched and more optimized birthplaces, I will encourage the participants to think about the needs in a maternal care facility that were important to them or even explain what elements were missing. Overall, I will help the participants explore and translate their birth experiences during the stage of LDRP, their memories, perceptions, and needs.
In addition, partners, staff, or other parties will be interviewed if it contributes to the women-centered point of view or adds information to the knowledge gained by interviewing the women concerned.
The interviews will provide answers to the third subquestion.

Fieldwork

In addition and as a part of the interviews, fieldwork will be done in a hospital at the maternity ward and in the birth center. Research methods such as observing and sketching will be done during this fieldwork. Observation will be the main research method, whereby people and their behavior, expressions or noticeable comments will be observed. The main focus will hereby be on women during the stage of LDRP, to ensure it is a women/patient-centered research. The observations will mostly be done in combination with the interviews, whereby women's behavior, expressions, or maybe important comments will be sketched and written down. The fieldwork will hereby provide answers to the third subquestion.

Case studies

To find out what design strategies have proven to be efficient, or based on the literature study, interviews, or fieldwork have proven to be inefficient, case studies of maternal care facilities or other healthcare facilities that relate or add value to the research will be researched. The case studies will be researched through analysis of floor plans, the program, pictures, and articles. Design guidelines that derived from the first three subquestions will hereby be used as a base to research the case studies' qualities or lack of women's environmental needs.

The following case studies will be researched:

1. Ikazia Hospital (Mother and Child center); a hospital in Rotterdam, The Netherlands, with a recently renovated Mother and Child center. The focus will be on maternity wards and other maternity-related spaces
2. Birth Center Sophia (within Erasmus MC hospital); a hospital in Rotterdam, The Netherlands. The focus will mainly be on the birth center itself, whereby the joint maternity wards of Erasmus MC will be researched briefly
3. EKH Children Hospital, a children's hospital in Samut Sakhon, Thailand, designed by Intergrated Field

The case studies will provide answers to the fourth sub-question.

1.8 research diagram

PROBLEM STATEMENT

Under the influence of negative experiences, childbirth can be harmful and have negative effects on the women's mental health, such as postpartum depression which is the most common condition among new mothers. One of the factors affecting women's experience of childbirth is the physical environment. A problem that seems to occur is that contemporary maternal healthcare facilities are designed from a highly-regulated and standardized maternity care perspective, instead of a woman-centered design approach. Research has shown that 79% of the women in The Netherlands come in contact with these highly-regulated and standardized maternity care facilities, which provide little interior-related improvements at most and lack of health-improving and nature-inspired design approaches.

RESEARCH QUESTION

What kind of **architectural environment** could contribute to a **positive experience, improving health & well-being, for women during the stage of LDRP*** in a **maternal healthcare facility?**
*labor, delivery, recovery, and postpartum

SUB-QUESTIONS

What are the environmental needs of women during the stage of LDRP in a maternal healthcare facility?

What kind of nature-inspired design principles could improve women's health & well-being in a maternal healthcare facility?

How do women during the stage of LDRP perceive their (architectural) environment in contemporary maternal healthcare facilities?

How are the (architectural) environmental needs of women during the stage of LDRP currently visible in the maternal healthcare facilities?

METHODS

Literature study will involve researching, reading, analyzing and evaluating different types of scholarly literature such as journals an articles.

Semi-structured interviews will be done with women who gave birth in a maternal care facility. The interviews will be complemented through interviews with staff or partners.

Fieldwork will be done whereby research methods such as observing and sketching will be used.

Case studies will be researched of maternal care facilities or other health care facilities that relate or add value to the research.

OUTCOME

Design guidelines / Preliminary design

CHAPTER 2

RESEARCHING THE ENVIRONMENTAL NEEDS OF THE TARGET GROUP

What are the environmental needs of women during the stage of LDRP in a maternal healthcare facility?

2.1
maternal healthcare

Maternal healthcare is an important and indispensable part of our healthcare system. A study by the Central Agency for Statistics (CBS) in 2020 showed that the Netherlands counted 17,59 million inhabitants, whereof 8,74 million men and 8,84 million women, meaning 50,3% of the population is female (Centraal Bureau voor de Statistiek, n.d.). Within the female population, a small percentage of the women remain childless. The Central Agency for Statistics hereby shows that women of the generation born in 1965, who were 55 years old in 2020, 18% remained childless (Centraal Bureau voor de Statistiek, n.d.). Researcher Renske Verweij of the University of Groningen speaks of the same kind of numbers in 2019, saying: "In the Netherlands, approximately 17% are childless" (BNR Webredactie, 2019). Besides the small percentage of women that remain childless, studies of Nederlands Jeugsinstituut show that in the Netherlands alone, 166.891 women have given birth in the year 2022 (Nederlands Jeugdinstituut, 2023). Although the graph below (fig. 7) shows that the number of babies born every year is decreasing slowly, can it be concluded that the majority of the female population have a child at least once in their life, with an average of more than 80%, and do the studies show that the average of births over the past 13 years is 173.000 births every year.

Number of (born-alive) births (2010-2022)

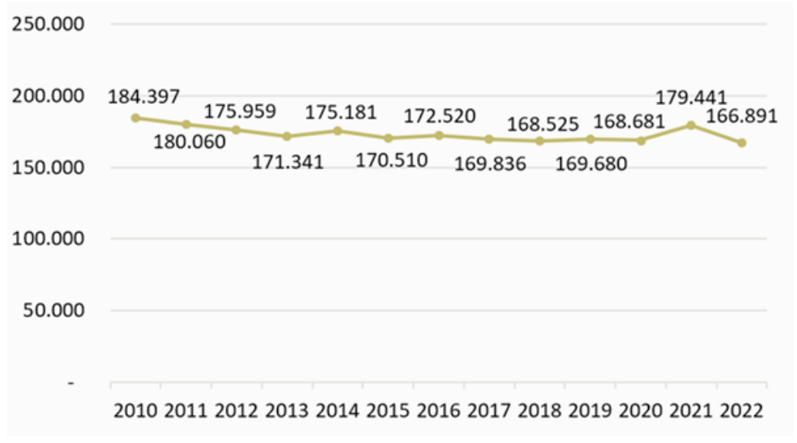


Figure 7. "Graph of the number of births"
- *(Nederlands Jeugdinstituut, 2023)*

It is clear that the majority of women come in contact with the experience of childbirth at least once in their lives. As earlier mentioned in the problem statement, childbirth is considered to be one of the most significant experiences of a woman's life with a powerful psychological importance (McKelvin et al., 2021). Unfortunately, under the influence of negative experiences, childbirth can be harmful and have negative effects on women's (mental) health. One of the factors that profoundly affect women's birth experience, and health and well-being during childbirth, is the physical environment (Esfeh et al., 2020) (Nielsen & Overgaard, 2020). Within the stage of LDRP; an earlier mentioned acronym for labor, delivery, recovery, and postpartum, formulated by Esfeh, Kazemi, and Shamsaie (Esfeh et al., 2020), the established average of 173.000 women in the Netherlands come in contact with various types of maternal healthcare environments every year.

The types of environments women come in contact with during the stage of LDRP depend on multiple factors. The first factor is the type of care the women are in need of. Within the Dutch guidelines of healthcare institutions such as hospitals, different levels of care have been established: First-line care, second-line care, and third-line care. The first-line care is the first level of care within our healthcare system that is freely accessible without a referral from a general practitioner. Childbearing women are hearby free to choice their desired birth location. The second-line care includes care for which you need a referral, often provided by a general practitioner or another kind of doctor. This level of care includes specialist medical care provided by medical specialists in hospitals and other specialized healthcare institutions. Lastly can third-line care be provided, which is highly specialized care that is often provided by academic medical centers. If care in the first- or second-line care has proven to be inadequate, patients will be referred to the third-line care (Valentijn, 2023). What these levels of care contain with regard to maternal healthcare environments will be discussed in the following chapter about typologies.

Another factor that influences the choice of childbearing women is the living situation. As mentioned above, women are free to choose their birth environment within the first-line care. However, the living situation of the women determines if they are allowed to give birth at home at all. Midwifery practices mention in their information on home births that giving birth at home is not allowed when having birth in a room higher than the first floor, if there is no bed with a height of at least 70 to 80 centimeters, and other variable factors such as having a spiral- or a very steep staircase (Verloskundige Centrum Breda, n.d.). Another noticeable requirement is that flats or apartments that are above the second floor and do not have access to an elevator, are also not allowed as a place of birth unless having very optimal conditions (Verloskundigen Veenendaal, n.d.). Although there are no studies found on the relation between the living environment of women and the desired place of birth, could it be interesting to research if there might be a relation between low-income neighborhoods which often contain more flats, and the ability to (not) give birth at home.

The final factors that could influence the place of birth are unforeseen factors. Although women form a birth plan wherein they plan their place of birth, is there always a possibility that unforeseen factors influence and change the planned place of birth. Women can for instance have an unexpected medical indication that forces them to give birth in a hospital after all, and labor can happen unexpectedly whereby the place of birth is no longer within reach. The woman's choice of location does hereby not always coincide with the actual place of birth.

2.2 typologies

Women who are within the stage of LDRP can come in contact with different types of maternal healthcare environments. There are three types of maternal healthcare environments where women can give birth, depending on the type of care they are in need of, which vary from their own homes, a hospital, or a birth center.

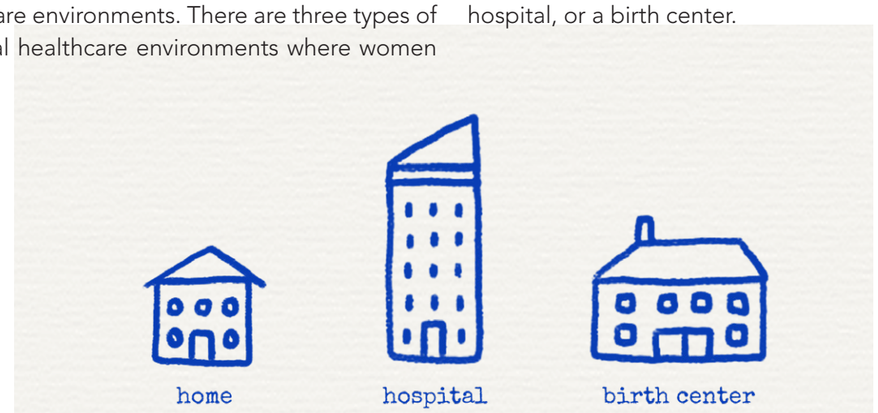


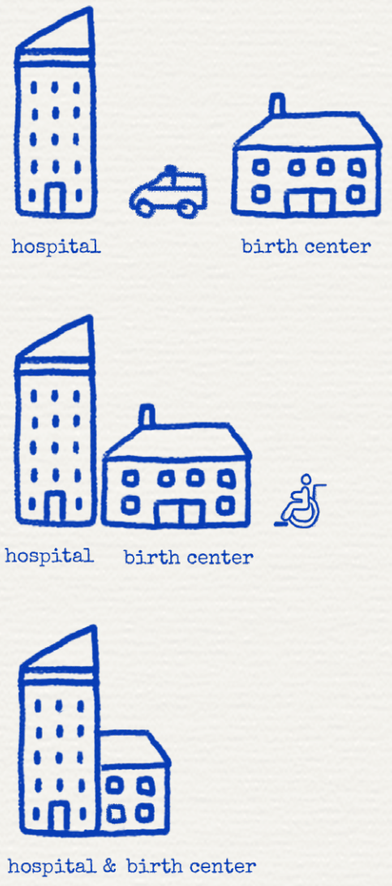
Figure 8. "Illustration of three types of maternal healtcare"
- Author's own illustration

Within the first-line care of maternal healthcare, women who are pregnant and/or have given birth can come in contact with various types of physical environments since they are free to choose their desired location of birth or post-partum care. The environments vary from their own homes to birth centers to the hospital. Having birth in the hospital is often referred to as 'giving birth as an outpatient'. Within the second- and third-line care of maternal healthcare, women are inevitably sent to the hospital within the stage of LDRP. For some women in the last stages of LDRP, the stages of recovery and postpartum, the required care can be given from a birth center or their own homes.

A study done in 2021 by Eenvandaag and Ouders van Nu, shows that 42% of the women give birth in first-line care, whereas 21% of the women give birth at home and 21% of the women give birth in a birth center or at the hospital. The other 58% of the women give birth in the hospital and cover the second- and third-line care (Lubbe, 2021). This concludes that in The Netherlands, 79% of the women experience childbirth in other physical environments than their own homes.

Compared to other Western- and first-world countries, the Netherlands stands out by having a percentage of 21% regarding home births. The Dutch Centre for Intangible Cultural Heritage mentions the following: "Although it is possible to give birth safely at home in some Western countries, such as Flanders, Great Britain or Canada, this is only done on a large scale in the Netherlands" (Kenniscentrum Immaterieel Erfgoed Nederland, 2021). Giving birth in a hospital is hereby more common in other Western- and first-world countries. Jeffrey Ecker, maternal-fetal medicine physician at Massachusetts General Hospital and contributing editor of the Harvard Health Blog, describes that by the second half of the 20th century, hospital birth had become the norm in most Western countries. "Hospital birth offers monitoring and interventions, many of which saved the lives of mothers and babies. At the same time, births became increasingly — and some would say unnecessarily — medicalized" (Ecker, 2016).

This medicalized maternal healthcare was earlier referred to by Joyce in the problem statement as 'facilities designed from highly regulated and standardized maternity care perspective'. A less medicalized alternative as a place of birth seems to be a birth center. In a scientific evaluation of care in birth centers in the Netherlands, carried out at the request of the Minister of Health, Welfare and Sport, between 2013 and 2016, is a birth center described as the following: "A birth center is a 'midwifery managed' birth location other than at home, where low-risk pregnant women can give birth under the responsibility of a first-line care obstetric professional. The birth center has a home-like atmosphere and design, with facilities that can support the physiological course of childbirth. If there is reason for transfer, the second-line (gynecologist or pediatrician) takes over the responsibility of care from the first-line (obstetrician or general practitioner)" (Projectgroep Geboortecentrum Onderzoek, 2016). Birth centers are also referred to as 'birth hotels' or 'maternity hotels'. In birth centers and hotels, maternity care is provided for all stages of LDRP, whereas a maternity hotel only provides postpartum care. This research will be focused on birth centers (or so-called birth hotels) since they provide care for women during all stages of LDRP. In contrast to hospitals and women's homes, birth centers have three typologies: A detached birth center, an adjoined birth center, and an integrated birth center. The Projectgroep Geboortecentrum Onderzoek describes the typologies as follows:



Detached birth centers

Birth centers can be located (sometimes far) outside the hospital site or are located in a hospital without an obstetrics department, and are therefore detached. When referred to second- or third-line care, the woman must go to the hospital by car or ambulance.

Adjoined birth centers

Birth centers can also be located on the site of/or within the walls of the hospital, separated from the obstetrics department. When referred to second- or third-line care, the woman can be moved in a bed or in a wheelchair.

Integrated birth centers

Another typology is birth centers that are mainly multidisciplinary oriented and consider their birth center as an opportunity to realize integrated maternity care.

Figure 9. "Illustration of the typologies of a birth center"
- Author's own illustration

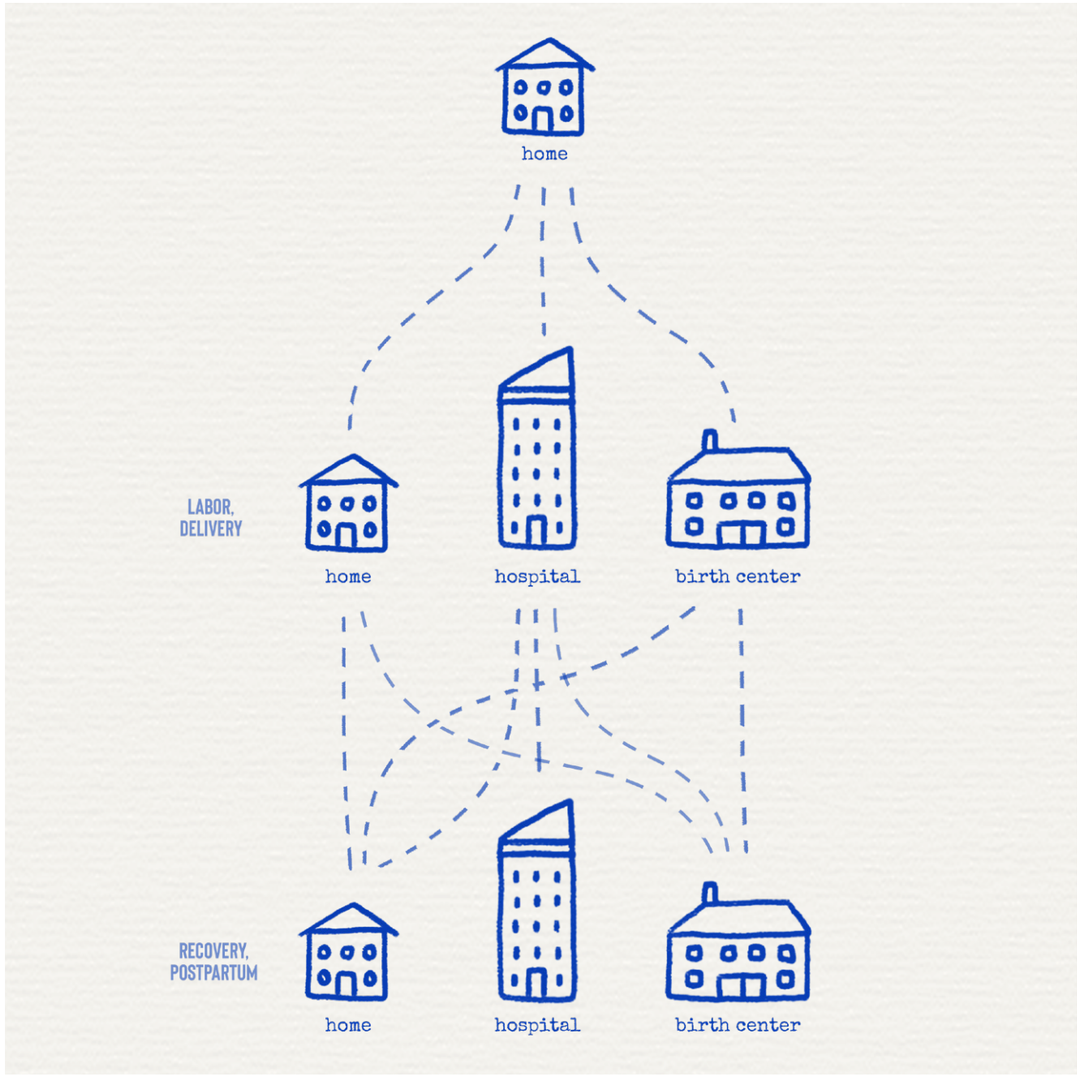


Figure 10. "Illustration of the possible maternal care locations within the first-line care"
- Author's own illustration

Based on the women's choice of location(s) and the factors that might influence the eventual place of birth, can women within the stage of LDRP; labor, delivery, recovery, and postpartum, transfer to a different location and a different kind of care. The stages of LDRP can be split up into two main stages which can involve different locations. The first stage is labor and delivery which covers childbirth itself, the second stage is recovery and postpartum which covers the maternal care that is given after childbirth. The illustration above shows how first-line care women can transfer to another location within the stage of LDRP, whereby they can stay in their desired location for both main stages, or transfer to a different location for maternal care in the second stage. An example that can be drawn from the illustration is women who gave birth at home but like to have maternal care in a birth center afterward. The illustration is specified to first-line care only without medical interventions. Within the second- and third-line care, or first-line care with medical interventions, women are mostly bound to a hospital and sometimes have the option to transfer to a birth center or their homes for maternal care after childbirth.

2.3 (environmental) needs

Based on the research on maternal healthcare and its typologies, it becomes clear which environments women during the stage of LDRP (can) come in contact with. It is furthermore important to research the women's corresponding (environmental) needs in maternal healthcare facilities, to get a better understanding of what these facilities consist of or should contain. The research paper written by Jane Hyldgaard Nielsen and Charlotte Overgaard, earlier mentioned in the theoretical framework, named '*Healing architecture and Snoezelen in delivery room design: a qualitative study of women's birth experiences and patient-centeredness of care*', will be used as a base to build the research upon about women's environmental needs. Nielsen and Overgaard's paper covers important principles like hospital design, birth environment and -experience, and patient-centered care (Nielsen & Overgaard, 2020).

Prior mentioned in the problem statement and theoretical framework, is that it goes without saying that multiple research papers on the topic of birth environments and experience have a similar base on which their research is built, similar to the problems previously mentioned in the problem statement. The birth environments women during the stage of LDRP come in contact with are highly regulated and medicalized, which are therefore not adapted to the women's needs but moreover adapted for effective use of equipment and staff time, which altogether can result in negative experiences and negative outcomes such as pain, stress, and anxiety (Joyce, 2021) (Bellini et al., 2023) (Esfeh et al., 2020). Although all previously mentioned papers have different approaches to the problem and perhaps have different outcomes, does there seem to be a common aim to tackle these highly regulated environments and the aim to create a more patient-centered or 'women-friendly' environment. With this in mind, women's needs will be investigated through a literature study based on Nielsen and Overgaard's study, amongst other studies.

Although nature-inspired elements may be part of women's needs as well, will this element be researched separately in the following chapter about biophilic design, since the use of it is currently minimal in existing research such as in Nielsen and Overgaard's study. The nature-related elements that are present in existing research will be included in this research about women's (environmental) needs. Nevertheless, to get a better understanding- and to create a foundation on the influence of architecture in healthcare architecture and healing design, will there be zoomed out from maternity care- and interior-oriented settings, like in this chapter, to a broader- and nature-related perspective, which will be done in the following chapter.

As established are maternal healthcare facilities generally dominated by a medical paradigm. Bellini, Macchi, Setola, and Lindahl mention that such environments for birth are considered to be difficult to adapt to women's physical and psychological needs. Maternal heathcare facilities are therefore required to respond to women's desires for more salutogenic and satisfying birth experiences (Bellini et al., 2023). Nielsen and Overgaard explored this topic by researching women's birth experiences in an alternative delivery room, inspired by principles of healing architecture and Snoezelen. The design for the alternative delivery room was formed by the earlier mentioned study protocol that served as a precursor for their research, which eventually led to five key characteristics that are used in Nielsen and Overgaard's research that describe the design differences between a standard- and an alternative delivery room and its corresponding improvements that cover the topics of ***1. Guiding focus of the physical birth environment, 2. Visual and auditory stimuli, 3. Interior, furniture, and equipment 4. Privacy,*** and ***5. Light.*** The corresponding table and images can be seen below (fig. 11 and fig. 12).

	Alternative delivery room	Danish standard delivery room
GUIDING FOCUS OF THE PHYSICAL BIRTH ENVIRONMENT	Promoting feelings of well-being, freedom, and control.	Medical safety
VISUAL AND AUDITORY STIMULI	Snoezelen-inspired audial and visual scenery on three walls providing positive distractions	The woman may bring own sound device
INTERIOR, FURNITURE, AND EQUIPMENT	Nordic contemporary style furniture resembling private home environment	Traditional hospital furniture and equipment, including lounge chair
	Traditional hospital labor bed and necessary equipment covered or placed less visibly	Traditional hospital labor bed as central feature of room
	Bathtub	Bathtub may be available
PRIVACY	Single occupancy, private bathroom	Single occupancy, often private bathroom
LIGHT	Overhead light off unless needed for assessment purposes	Overhead light controlled by staff, usually on unless the woman is sleeping
	Dimly lit scenario projections controlled by woman and her partner	

Figure 11. "Table of key characteristics of alternative and standard delivery rooms"
- Author's own illustration, based on Nielsen and Overgaard's research

Figure 12. "Images of the alternative and standard delivery room"
- (Lorentzen, et al., 2019)

The five design principles function as a base and give clarity to which physical elements improve women's experiences of a delivery room or a maternal healthcare environment during the stage of LDRP. In addition to this, Nielsen and Overgaard formulated three main themes about women's main experiences and feelings which give a better understanding of why these five physical elements benefit a women's experience. Through the lens of these three main themes, referred to as ***1. Emotional support, 2. Involvement of partner,*** and ***3. Physical comfort***, women's psychological and physiological experiences will be researched. These themes will further explain the needs of women during the stage of LDRP and hereby clarify the five design principles.

Overall, Nielsen and Overgaard write that women's experiences of giving birth in the alternative delivery room were positive, and the birth environment was well adapted to the women's needs. This was mainly because the alterations of the delivery room offered a stress- and anxiety-reducing transition to the hospital setting, which is as mentioned before, a common problem amongst the often medicalized and highly regulated birth environments. The alternative delivery room also offered physical comfort, contributed to the family's needs, and created comfort regarding their partner's well-being (Nielsen & Overgaard, 2020).

1. Emotional support

The first important theme that further explains women's psychological and physiological needs and their experiences in an alternative delivery room is the theme of emotional support. Nielsen and Overgaard write that "on the whole, women reported an immediate feeling of being welcome on first entering the delivery room" (Nielsen & Overgaard, 2020). This feeling appeared to be closely associated with the home-like environment that was provided in the delivery room. The environment hereby also created feelings of emotional support, comfort, and the reduction of stress, which made women adapt more easily to the room and to the transition from their home to the hospital as well. "A possible explanation for this might be that a comfortable and familiar environment is known to promote feelings of safety, confidence, and a sense of self and to have a strengthening effect on women's physiological functioning and emotional well-being". (Nielsen & Overgaard, 2020). These outcomes are confirmed with a similar statement by Bellini, Macchi, Setola, & Lindahl, saying that women's perceptions of comfort and sense of well-being impact the birth experience and consequently the birth outcomes (Bellini et al., 2023). The positive influence of a home-like environment is substantial and hereby an important element within one of the five design principles; *1. Guiding focus of the physical birth environment.*

Moreover, Esfeh, Kazemi, and Shamsaie write that the simulation of home conditions reduces the need for painkillers during childbirth and leads to a more positive view of the mother, such as by watching television during labor pains (Esfeh et al., 2020). Other interior-related elements derived from Nielsen and Overgaard's research, which contribute to the home-like environment, are Nordic contemporary-style furniture resembling a private home environment, as well as covering up or placing the hospital labor bed and the necessary equipment, such as medical equipment, less visibly (Nielsen & Overgaard, 2020). These elements can all be found within principle *3. Interior, furniture, and equipment.*

Another simulation of home conditions is nature-(inspired) elements such as natural landscapes (Esfeh et al., 2020), plants, and nature-based elements such as wood materials (Lorentzen, et al.). These elements will be integrated into a newly introduced design principle, referred to as *6. Nature-(inspired) elements*, since the influence of nature-inspired and/or biophilic design form a base of this research and will be researched as well in the following chapter.

Another important element within the theme of emotional support is the role of/and the relationship with the midwives. In the Netherlands, all low-risk births are led by certified midwives, who support both medical and psychosocial needs. Nielsen and Overgaard's research showed that the alternative delivery room also influenced the midwives' practices and engagement with the couple. The women in their study emphasized the midwife's ability to small talk, which was caused by the presence of audial and visual stimuli in the room. Bellini, Macchi, Setola, & Lindahl mention in their research about sensory design that sensory attributes of birth spaces, such as the stimuli mentioned above, can enhance comfort, feelings of well-being, and, to some extent, clinical outcomes (Bellini et al., 2023). These stimuli are often views of nature and sounds, which also offer calming feelings and can be found within the principles *2. Visual and auditory stimuli and 6. Nature-(inspired) elements.*

The last element within emotional support that contributed to positive connections with the midwives was the amply spaced room and the available physical facilities, such as a relaxation area with a sofa bed, chairs, and a coffee table. These elements gave the women a sense of emotional support since it allowed the midwife to retreat and offer a private space for the couple while remaining available to them (Nielsen & Overgaard, 2020). Bellini, Macchi, Setola, & Lindahl also write about the positive outcomes of the same kind of elements, mentioning that spaciousness, flexibility, and quality spaces gave maximal emotional and physical freedom (Bellini et al., 2023). These elements can be found within principles *1. Guiding focus of the physical birth environment, and 3. Interior, furniture, and equipment.*

2. Involvement of partner

The second theme that explains women's psychological and physiological needs and their experiences in an alternative delivery room is the theme of the involvement of their partner. Nielsen and Overgaard write that overall, women's experiences were positive about their partner's role during the stage of LDRP, which was an important element for their psychological state of mind. The two key features that contributed the couples to feeling equal, as well as strengthening to work together, and easing anxiety, were having enough qualitative space for the partner and the presence of a sofa bed. Enough space for the partner, alongside the sofa bed, was highly valued since it increased the comfort of the partner while also offering a physical and psychological 'space' for both of them (Nielsen & Overgaard, 2020). Bellini, Macchi, Setola, & Lindahl conclude the same by stating the following: "An intimate space can promote a calm environment and support the relationship with the partner and the ability to work together" (Bellini et al., 2023). These elements are important to support women's needs during the stage of LDRP and can be found within principles *1. Guiding focus of the physical birth environment, and 3. Interior, furniture, and equipment.*

3. Physical comfort

The final theme that will be researched to understand women's psychological and physiological needs and their experiences in an alternative delivery room is the theme of physical comfort. Physical comfort is an important aspect for women during the stage of LDRP and was obtained by several elements, which were positive distractions. For some women, the previously mentioned visual and auditory stimuli positively captured their attention. This positive distraction was helpful to cope with their pains during labor and their sense of control. An additional element that contributed towards positive distractions, a sense of comfort ,and being in a safe environment, were the options that were given for the room lighting. Nielsen and Overgaard write that the ability to self-control the lights, dim lights in different areas, and a dimmed scenario projection (visual stimuli) hereby contributed to women's

Figure 13. "Illustration of a pregnant woman and midwife in a delivery room"
- Authors own illustration

physical comfort (Nielsen & Overgaard, 2020). Dynamic lighting and luminous colored screens also contribute to creating a more homelike and comfortable space, which impacts the birth experiences in a positive way and creates feelings of security (Bellini et al., 2023). These elements can be found within principle *5. Light*.

Lastly, the previously mentioned elements within the principle of *3. Interior, furniture, and equipment*, such as the relaxation area with sofa bed, chairs, and coffee table, helped the women and their partners to explore different spaces for relaxation or the relief of pain. Another important element was the presence of the bathtub, which gave women the possibility to relax, seek relief from pain, or give birth. The furniture also made the women and their partners move around more freely (Nielsen & Overgaard, 2020). Research about creating a better birth environment, written by Mary Newburn and Debbie Singh, hereby mentions that women found it helpful to have enough space to walk and move around. The amount of space encouraged women to freely choose the type and place of birth they wanted (Newburn & Singh, n.d.). This element is previously mentioned in principle *1. Guiding focus of the physical birth environment*, as part of an amply spaced and flexible room.

Additional elements

In addition to the elements mentioned above, are there some other elements that did not directly fit into the three main themes that described women's experiences and needs. Nevertheless, these elements are visible in Nielsen and Overgaard's five design principles, or described in other studies, proving to benefit women's experience during the stage of LDRP. The first element belongs to design principle *4. Privacy,* which is the single occupancy rooms including a private bathroom. Although the majority of hospitals and other maternal healthcare facilities seem to often offer single occupancy rooms, are there still some maternal healthcare facilities that offer rooms up to four persons per room, such as in Radboudumc in Nijmegen, The Netherlands, and Maasstad Hospital in Rotterdam, The Netherlands (Radboudumc, n.d.) (Maasstad Ziekenhuis, n.d.). Maasstad Hospital mentions that a women's partner is not allowed to stay over for the night in case the woman sleeps in a multi-person maternity room. An important need for women during the stage of LDRP hereby gets dismissed during the night, which is the importance of the involvement of their partner, regardless of the time of day. It is therefore important to let this element be present within the five design principles.

Lastly, an architectural element that contributes to women's orientation and well-being, is the natural daylight that can be obtained from windows. Specifically, windows that open towards the outside, as described by Bellini, Macchi, Setola, & Lindahl. The possibility to regulate (natural) light is a very important aspect, since soft light is necessary during birth, while brighter light is more desirable after birth (Bellini et al., 2023). This element can hereby be found in principle *1. Guiding focus of the physical birth environment.*

Conclusion

It can be stated that overall, women's environmental needs derive from their needs for emotional support, the involvement of their partner, and the need for physical comfort. These needs are connected to physical design elements which can be found within the five design principles of Nielsen and Overgaard, and are transformed into a diagram which is visible in Figure 14. Other design elements that derive from women's needs during the stage of LDRP, based on further literature study about biophilic and fieldwork to personally explore women's experiences, will be added to this diagram.

(GUIDING FOCUS OF THE) PHYSICAL BIRTH ENVIRONMENT **1**

- Home-like environment *(Emotional support)*
- Amply spaced and flexible room *(Emotional support, physical comfort)*
- Space for partner *(Involvement of partner)*
- Windows

VISUAL AND AUDITORY STIMULI **2**

- Snoezelen/ inspired audial and visual scenery on walls providing positive distractions *(Emotional support, physical comfort)*

INTERIOR, FURNITURE, AND EQUIPMENT **3**

- Nordic contemporary style furniture resembling private home environment *(Emotional support)*
- Television *(Emotional support)*
- Traditional hospital labor bed covered or placed less visibly *(Emotional support)*
- Necessary- and medical equipment covered or placed less visibly *(Emotional support)*
- Relaxation area with sofa bed, chairs, and coffee table *(Emotional support, physical comfort)*
- (Sofa) bed for partner *(Involvement of partner)*
- Bathtub *(Physical comfort)*

PRIVACY **4**

- Single occupancy rooms, including a private bathroom

LIGHT **5**

- Overhead light off unless needed for assessment purposes *(Physical comfort)*
- Dimly lit scenario projections controlled by woman and her partner *(Physical comfort)*
- Dimmed light in relaxation area her partner *(Physical comfort)*
- Dynamic lighting and luminous coloured screens *(Physical comfort)*

NATURE-(INSPIRED) ELEMENTS **6**

- (Static) natural landscapes *(Emotional support)*
- Plants *(Emotional support)*
- Nature-based materials *(Emotional support)*
- Snoezelen inspired audial and visual (scenery on walls providing positive distractions *(Emotional support), phyisical comfort)*

Figure 14. "Diagram with design principles and guidelines"
- Authors own illustration

CHAPTER 3

RESEARCHING HEALTH & WELL-BEING IMPROVING NATURE-INSPIRED DESIGN PRINCIPLES FOR A MATERNAL HEALTHCARE FACILITY

What kind of nature-inspired design principles could improve women's health & well-being in a maternal healthcare facility?

3.1
healing architecture

Through the lens of Nielsen and Overgaard's design principles, amongst the additions of other research papers, women's needs during the stage of LDRP in a maternal healthcare facility have been researched in the previous chapter. Since the use of nature or nature-inspired elements has not been mentioned extensively, will this chapter be dedicated to researching the influence of healing architecture, specifically biophilic design, to get a better understanding of what nature-inspired design principles could improve women's health and well-being in a maternal healthcare facility.

The initial basis of healing architecture can be found in the 80's, whereby environmental psychologist Roger Ulrich conducted a clinical-based research that proved a room with a view on nature to improve a patient's post-operative recovery. Another event that shaped our understanding of healing architecture was the development of patient-centered care, also emphasized in Nielsen and Overgaard's research, by the Planetree Organization. Alvaro Sosa's research named 'Healing Architecture and Evidence-based Design' mentions that their research and findings brought architectural solutions that evoked feelings of home, welcomed the patient's family and friends, and valued human beings over technology (Sosa, 2020).
Based on this initial basis, the concept of healing architecture has developed itself through the years and has evolved into many great and effective examples that are visible in current contemporary architecture. A considerable example is by Charles Jencks, co-founder of Maggie's Centres, whereby healing architecture is applied in buildings made to support and help anyone who has been affected by cancer. He mentions that "architecture does matter for health, as placebo or to evoke hope for those in need" (Sosa, 2020), believing that architecture at Maggie's Centres can help improve cancer patients' health (The Guardian, 2010). Sosa writes that other authors define healing architecture as more than a placebo, referring to it as "the supporting factor in the human healing process" or more extensively, "the planning approach that recognizes architecture as a variable to support the physical and mental well-being of staff, patients, and relatives" (Sosa, 2020).
In author Sosa's research on Healing Architecture and Evidence-based Design, Sosa created a list of environmental factors and variables of healing architecture proven to influence human health and well-being. One of the factors mentioned is the topic of nature, based on 'Biophilia Hypothesis', a book by Stephen R. Kellert and Edward O. Wilson, suggesting that there is an instinctive bond between human beings and other living system (Sosa, 2020). Biophilia, also referred to as biophilic design within the built environment, will therefore be researched. This will be done through the lens of *'14 patterns of biophilic design; Improving health & well-being in the built environment'*, by Browning, W.D., Ryan, C.O., and Clancy, J.O, to research what nature-inspired design principles could improve women's health & well-being in a maternal healthcare facility.

3.2
biophilic design

It is established that childbirth is experienced through a number of interrelated psychological and physiological processes, influenced by the physical environment, among social and organizational factors (Nielsen & Overgaard, 2020). Negative effects that can derive from negative experiences with childbirth have been mentioned earlier in the research, and differ from anxiety and stress, which are associated with many other unpleasant and difficult outcomes such as an increase in the need for sedatives during labor, a lifelong psychological impact in the form of post-partum depression and an impaired mother–child attachment (Esfeh, Kazemi, & Shamsaie, 2020) (Nielsen & Overgaard, 2020). In the book about '*14 patterns of biophilic design; Improving health & well-being in the built environment'*, authors Browning, Ryan, and Clancy write that much of the evidence for biophilia, or biophilic design, can be linked to research in one or more of the following mind-body systems; cognitive, psychological and physiological systems. Focussing on the psychological and physiological processes, which are key in women's experience of childbirth, the authors write the following:

> "Psychological responses encompass our adaptability, alertness, attention, concentration, and emotion and mood. This includes responses to nature that impact restoration and stress management. For instance, empirical studies have reported that experiences of natural environments provide greater emotional restoration, with lower instances of tension, anxiety, anger, fatigue, confusion and total mood disturbance than urban environments with limited characteristics of nature."- *Browning, Ryan, & Clancy, 2014*

> "Physiological responses encompass our aural, musculoskeletal, respiratory, circadian systems and overall physical comfort. Physiological responses triggered by connections with nature include relaxation of muscles, as well as lowering of diastolic blood pressure and stress hormone (i.e., cortisol) levels in the blood stream." - *Browning, Ryan, & Clancy, 2014*

These statements show that negative effects that derive from negative experiences within childbirth, such as stress and anxiety, as well as the previously mentioned need for emotional support and physical comfort, can be reduced and supported with biophilia. Authors Browning, Ryan, and Clancy write that overall, biophilic design can reduce stress, enhance creativity and clarity of thought, and improve our well-being and expedite healing (Browning, Ryan, & Clancy, 2014). In order to explain and use biophilic design within the built environment, 14 patterns of biophilic design have been formed by the authors. The 14 patterns are divided into three nature-related categories: ***1. Nature in space, 2 Natural Analogues, and 3. Nature of Space***, and have been proven to support one or more of the following main categories: ***1. Stress reduction, 2. Cognitive performance, 3. Emotion and mood enhancement and the human body.***
Based on the research done in the previous chapter and the foundation of the six design principles that have been made, six patterns of biophilic design will be researched and will be added to the newly introduced design principle *6. Nature-(inspired) elements*. Four out of the six patterns of biophilic design cover both the topics of *1. Stress reduction* and *3. Emotion, mood & preference*, which are the two most important topics for women during the stage of LDRP. In addition to this, the other two patterns of biophilic design cover one of the topics, and since they are already present within the six design principles, will they be researched briefly as an addition to the literature. The six patterns of biophilic design are as follows (fig. 15):

	Patterns of biophilic design	Stress reduction	Emotion, mood & preference
NATURE IN THE SPACE	1. VISUAL CONNECTION WITH NATURE	Lowered blood pressure and heart rate	Positively impacted attitude and overall happiness
	2. NON-VISUAL CONNECTION WITH NATURE	Reduced systolic blood pressure and stress hormones	Perceived improvements in mental health and tranquility
	3. THERMAL & AIRFLOW VARIABILITY	Positively impacted comfort, well-being and productivity	Improved perception of temporal and spatial pleasure (alliesthesia)
	4. PRESENCE OF WATER	Reduced stress, increased feelings of tranquility, lower heart	Observed preferences and positive emotional responses
	5. DYNAMIC & DIFFUSE LIGHT	Positively impacted circadian system functioning Increased visual comfort	
NATURAL ANALOGUES	6. MATERIAL CONNECTION WITH NATURE		Improved comfort

Figure 15. "Table of the six most important patterns of biophilic design"
- Author's own illustration, based on Browning, Ryan, & Clancy's research

1. Visual connection with nature

This first pattern of biophilic design is referred to as 'a view to elements of nature, living systems and natural processes' (Browning, Ryan, & Clancy, 2014). Browning, Ryan, and Clancy write that this pattern evolved from research on visual preference and responses to views of nature, and showed a positive response in the reduction of stress, more positive emotional functioning, and improved concentration and recovery rates. The reduction of stress is related to both experiencing real nature and seeing images of nature. Within this pattern, design considerations and examples have been formed, which could give guidance in translating the pattern into applicable biophilic design principles. Relevant design considerations are that real nature must be prioritized over simulated nature; and simulated nature over no nature. In the case of healthcare facilities, where the use or view of real nature is not always possible, is it important

to at least use a digital medium to simulate nature. Other considerations are that spatial layouts and furnishings should be designed to uphold desired view lines and to hereby avoid obstructing visual access when seated. Lastly, visual connections to even small instances of nature can be restorative, even when the floors, walls, or desired location is limited. Relevant examples can be seen in the figure below:

1. Relevant examples

NATURALLY OCCURING

Natural flow of a body of water
Vegetation, including food baring plants

STIMULATED OR CONSTRUCTED

Mechanical flow of a body of water
Koi pond, aquarium
Green wall
Artwork depicting nature scenes
Video depicting nature scenes

This biophilic design pattern has similarities and above all additions, to the already present design elements '(static) natural landscapes' and 'plants', which can be found in design principle *6. Nature-(inspired) elements*. These elements will be replaced with the current discussed pattern 'visual connection with nature', since it covers this topic in a broader context. This design pattern also contains similarities with design principle *2. Visual and auditory stimuli*. However, since it is the foundation of what this research is built upon will this category be retained as it is.

2. Non-visual connection with nature

The second pattern of biophilic design is referred to as 'the auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes' (Browning, Ryan, & Clancy, 2014). In other words, this pattern uses elements that are reminiscent of being outdoors in nature, like sounds, aromas, and textures. Browning, Ryan, and Clancy write that the research of this pattern showed a positive response in the reduction of stress hormones and improvements in mental health and tranquility. Design considerations that can establish a strong non-visual connection with nature are the prioritization of nature sounds above urban sounds and the integration of non-visual connections with other aspects of the design. Furthermore is it beneficial to connect visual and non-visual design elements to maximize positive health outcomes. Relevant examples can be seen in the figure below:

2. Relevant examples

NATURALLY OCCURING

Fragrant herbs and flowers
Flowing water
Natural ventilation (operable windows)
Textured materials (stone, wood, fur)

STIMULATED OR CONSTRUCTED

Digital simulations of nature sounds
Highly textured fabrics/textiles that mimic natural material textures
Audible and/or physically accessible water feature

This biophilic design pattern mostly has additions to the already present design principles and will be added as an element within design principle *6. Nature-(inspired) elements*. This design pattern also contains similarities with design principle *2. Visual and auditory stimuli*. However, since it is the foundation of what this research is built upon will this category be retained as it is.

3. Thermal & airflow variability

The following pattern of biophilic design can be characterized as 'subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments' (Browning, Ryan, & Clancy, 2014). The authors write that the research about this pattern showed a positive response in comfort, well-being, and productivity. Design considerations that give guidance in translating the

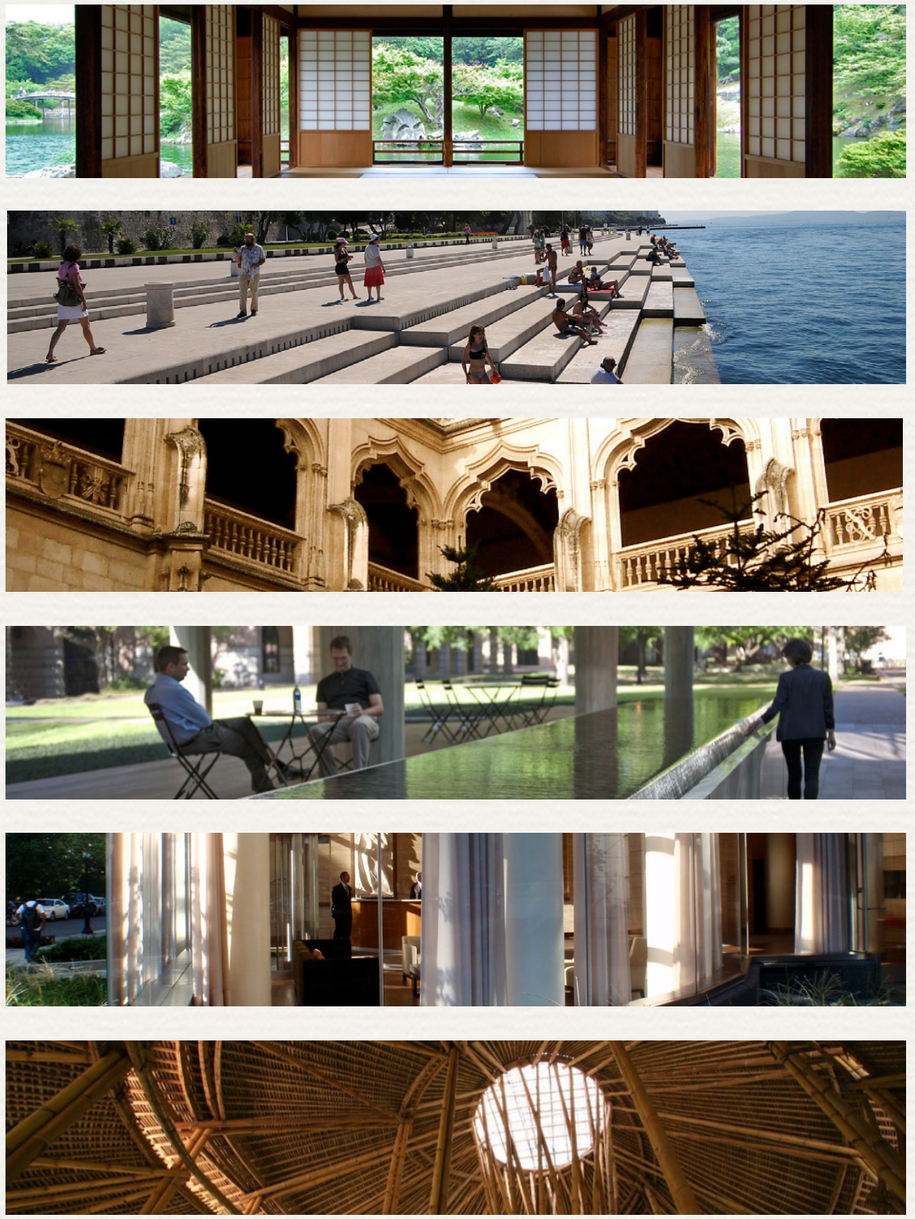


Figure 16. "Images of biophilic design examples"
- (Browning, Ryan, & Clancy, 2014)

pattern into applicable biophilic design principles, are integrating airflow and thermal conditions into materials and mechanical ventilation, obtaining thermal comfort, and designing features that allow users to easily adapt and modify their perceived thermal conditions of their environment. Relevant examples can be seen in the figure below:

3. Relevant examples

NATURALLY OCCURING

Solar heat gain
Shadow and shade
Vegetation with seasonal densification

STIMULATED OR CONSTRUCTED

Systems controls
Window glazing and window treatment
Window operability and cross ventilation

This biophilic design pattern gives new insight into design principle *6. Nature-(inspired) elements,* and will therefore be added as a new design element.

4. Presence of water

The fourth pattern of biophilic design is referred to as 'a condition that enhances the experience of a place through the seeing, hearing or touching of water' (Browning, Ryan, & Clancy, 2014). Browning, Ryan, and Clancy write that the research of this pattern showed positive emotional responses to environments containing elements of water, and led to improvements such as the reduction of stress and an improved concentration. There are a few design considerations that can optimize the impact of the presence of water. Relevant considerations are the prioritization of naturally fluctuating water movement over predictable movement and the note to avoid high volume- and turbulence water features which could create discomfort or decrease acoustic quality. Relevant examples of the presence of water can be seen in the following figure:

4. Relevant examples

NATURALLY OCCURING

River, stream, ocean, pond, wetland
Visual access to rainfall and flows

STIMULATED OR CONSTRUCTED

Water wall
Constructed water fall
Aquarium
Fountain
Constructed stream
Reflections of water (real or simulated) on another surface
Imagery with water in the composition

Despite being briefly mentioned as an example in pattern *2. Non-visual connection with nature*, will this pattern be an independent and newly added element within design principle *6. Nature-(inspired) elements.*

5. Dynamic & diffuse light

This pattern of biophilic design is previously mentioned in Nielsen and Overgaard's research and can be found as design principle *5. Light.* Browning, Ryan, and Clancy confirm the positive use of dynamic and diffuse light by stating that 'a space with good light conditions conveys expressions of time and movement to evoke feelings of drama and intrigue, buffered with a sense of calm' (Browning, Ryan, & Clancy, 2014). Since there are no additional considerations or examples for women during the stage of LDRP, will the accumulating elements within design principle *5. Light,* stimulating women's physical comfort, be retained as it is.

6. Material connection with nature

The final pattern is described as 'materials and elements from nature that, through minimal processing, reflect the local ecology or geology to create a distinct sense of place' (Browning, Ryan, & Clancy, 2014). The use of nature-related elements, such as wood materials, has been previously mentioned and has been added as an element within design principle *6. Nature-(inspired) elements,* based on Nielsen and Overgaard's research. In addition to this, the authors of '14 patterns of biophilic design' write that there are some design considerations and examples that may help create a quality material connection. The main suggestion is that real materials should be preferred over synthetic variations since the human eye can tell the difference between real and synthetic materials. They hereby provide some examples which could contribute to better health and well-being in women's birth environments:

6. Relevant examples

DECOR

Accent details made (natural wood grains; leather; stone, fossil textures; bamboo, rattan, dried grasses, cork)
Interior surfaces (veneer, countertops)
Woodwork, stonework
Natural color palette, particularly greens

FORM/FUNCTION

Wall construction (wood, stone)
Structural systems (heavy timber beams)
Façade material
Furniture form
Footpaths, bridges

This biophilic design pattern gives new and additional insights into design principle *6. Nature-(inspired) elements,* and will therefore be added as a design element.

Conclusion

Based on the book *'14 patterns of biophilic design; Improving health & well-being in the built environment'*, and the previously done research, it can be stated that patterns of biophilic design can contribute to people's health and well-being. The six researched patterns have been proven, by Browning, Ryan, and Clancy's research, to reduce stress, enhance clarity of thought, improve well-being, and expedite healing. The research shows that negative effects that derive from negative experiences within childbirth, such as stress and anxiety, as well as the previously mentioned need for emotional support and physical comfort, can be reduced and supported with biophilic design. It can hereby be said that these nature-inspired design principles could improve women's health and well-being in a maternal healthcare facility. The six researched patterns have therefore been added or merged into the diagram, based on the initial five design principles of Nielsen and Overgaard, and together with the given considerations and examples, could function as guidelines to improve women's experience, health, and well-being in a maternal healthcare facility. The diagram can be found on the following page in Figure 17 and all together represent six design principles. With these design principles in mind, women's experiences in maternal healthcare facilities will be further researched in the following chapter.

(GUIDING FOCUS OF THE) PHYSICAL BIRTH ENVIRONMENT **1**

- Home-like environment
- Amply spaced and flexible room
- Space for partner
- Windows

VISUAL AND AUDITORY STIMULI **2**

- Snoezelen/ inspired audial and visual scenery on walls providing positive distractions

INTERIOR, FURNITURE, AND EQUIPMENT **3**

- Nordic contemporary style furniture resembling private home environment
- Television
- Traditional hospital labor bed covered or placed less visibly
- Necessary- and medical equipment covered or placed less visibly
- Relaxation area with sofa bed, chairs, and coffee table
- (Sofa) bed for partner
- Bathtub

PRIVACY **4**

- Single occupancy rooms, including a private bathroom

LIGHT **5**

- Overhead light off unless needed for assessment purposes
- Dimly lit scenario projections controlled by woman and her partner
- Dimmed light in relaxation area her partner

NATURE-(INSPIRED) ELEMENTS **6**

- Visual connection with nature
- Non-visual connection with nature
- Thermal & airflow variability
- Presence of water
- Material connection with nature

Figure 17. "Diagram with design principles and guidelines"
- Authors own illustration

CHAPTER 4

EXPLORING THE TARGET GROUP'S ENVIRONMENTAL PERCEPTION IN A MATERNAL HEALTHCARE FACILITY

How do women during the stage of LDRP perceive their (architectural) environment in contemporary maternal healthcare facilities?

4.1 the perception of space

Before researching women's perception of- and experiences in contemporary maternal healthcare facilities through fieldwork and interviews, would it perhaps be helpful to briefly explore the topic of perception. Since this research also explores the (architectural) environments of women in the stage of LDRP, is it important to get a better understanding of the phenomenological understanding of architecture.

In the research article named 'The Interior Experience of Architecture: An Emotional Connection between Space and the Body', author Keunhye Lee writes that "although there are already many studies on the phenomenological understanding of architecture, these studies rarely discuss the importance of the interior experience of architecture and its connection to the emotional aspects that enrich the quality of architecture" (Lee, 2022). These given aspects of the phenomenological understanding of architecture are especially important for understanding the perception of women in maternal healthcare facilities, given the fact that their (environmental) needs and perhaps their accumulating perceptions derive from their needs for emotional support, amongst other needs, which can be retrieved from their direct physical environment. Overall, author Lee states that it has been emphasized by many theorists and architects that an architectural experience is understood through the eyes and experienced through the entire range of bodily senses and the physical movements of the body. It is hereby said that experiencing architecture is multi-sensory,

whereby the importance of spatial experience is highlighted by engaging with several issues, such as materiality, the body, senses, emotion, and environments. Lee writes that these spatial experiences for example allow people to touch water and stones, or hear the sounds of flowing water. It is therefore important to keep in mind that women's experiences in a maternal healthcare facility is an experience understood through the eyes and experienced through the entire range of bodily senses and the physical movements of the body, especially given the fact that the experience of birth involves a number of interrelated psychological and physiological processes. Above all, the experience of women must not be seen as a solely physical or psychological experience, but as an experience influenced by all kinds of processes and issues, ranging from emotions, senses, physical experiences, and environmental factors.

4.2
fieldwork

The research of the previous chapters has shown the types of maternal healthcare facilities and women's (environmental) needs during the stage of LDRP. Together with the research on biophilic design, design principles have been formed that function as a base for this research. To gain an even better understanding of how women who are pregnant and/or have given birth experience these types of facilities, and to what extent they experience their environment as described in the research, fieldwork has been done in the two mainly used types of facilities; a hospital and a birth center. Together with the knowledge of this chapter, the perception of space, women have been asked about their experience and perception of the (architectural) environment in a maternal healthcare facility during the stage of LDRP. The participants vary from women who are still pregnant to women who have given birth and receive maternity care, whereby the participants vary from having a low-risk birth to a pregnancy and/or birth with a medical indication. Some of the participants voluntarily chose a maternal healthcare facility as their birth location, while others were obligated to give birth in a hospital due to their given medical indication. In addition to this, experiences from midwives, obstetrics nurses, and facility managers have been gathered to give an addition to the women-centered research and gain a better understanding of how women who are pregnant and/or have given birth perceive the (architectural) environment in a maternal healthcare facility. The experiences have been translated into illustrations which display the most important findings, complemented by a brief summary of their experience and view on maternal healthcare facilities.

4.2.1
location one: hospital (maternity ward)

Participant 1

The first participant chose to give birth and receive maternity care in a hospital and was quite satisfied with her experience regarding space, environment, and comfort. She preferred a hospital birth over a home birth, due to the fact that this felt more safe. Although she preferred the hospital environment as a place to give birth, did she mention the importance of a home-like environment within a maternity ward. The combination of both creates a comfortable birth environment in her opinion. Other elements that the participant emphasized were the use of the photo-wallpaper (with a view of nature) instead of a white wall, a wood-like floor which gave her a home-like feeling, having enough space for her partner, the feeling of having enough privacy and the fact that she did not have to change rooms during the stage of LDRP. Elements that were missing from her perspective were good lighting options and the ability to go outside or have a walk around if she would had been in the hospital for a longer period of time. The main keywords of this interview are highlighted in red.

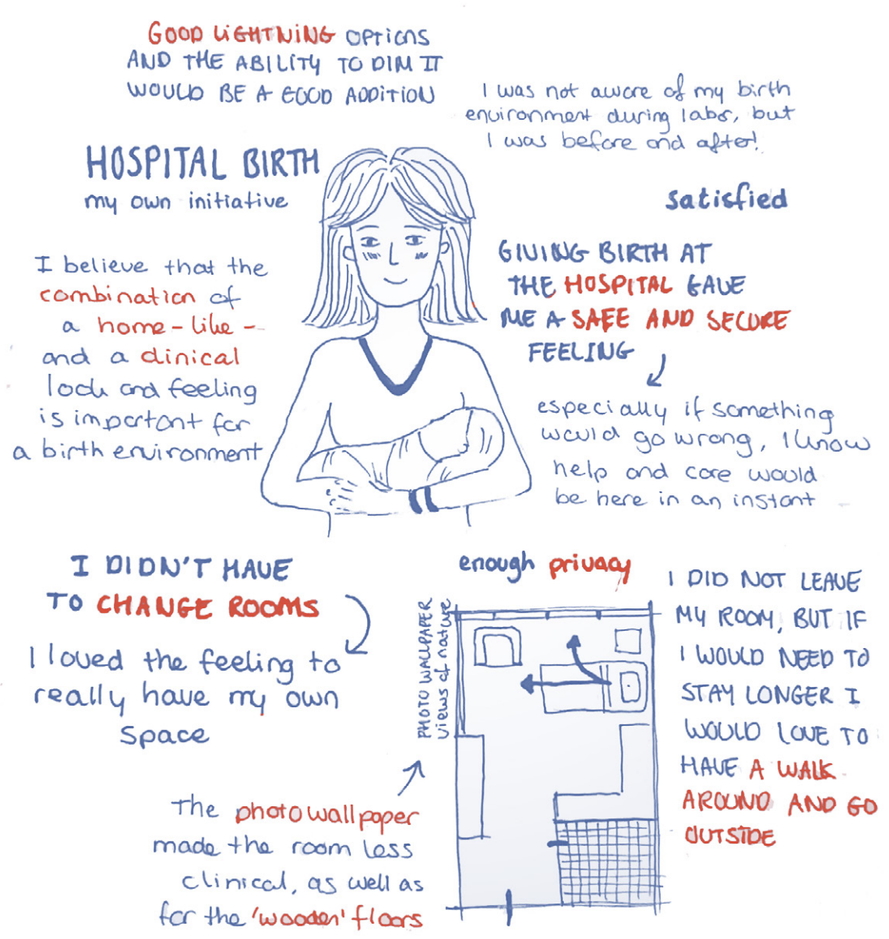


Figure 18. "Illustration of participant number 1"
- Author's own illustration

Figure 19. "Illustration of participant number 2"
- Author's own illustration

Participant 2

The second participant gave birth and received maternity care in the hospital with a medical indication, meaning she did not have the option to give birth at home or in another kind of facility. She gave birth in the same hospital 10 years ago, but disliked the fact that everything still appeared the same; it looked outdated, unhygienic, and the room was too small. Although she did not mind a bit of a clinical appearance, she would have preferred it to be more home-like. Due to the fact that the room was too small, she did not feel that her partner had enough space to stay or sleep in the room, nor to receive multiple visitors or have a place for (her) other children to be at. She liked to have a look outside from her window but missed the view and use of nature. A final addition was that the participant had to change rooms, from a labor room to a maternity care room, which she disliked because it took some time to feel comfortable again in another room. The main keywords of this interview are highlighted in red.

Participant(s) 3

The following group of participants represent obstetrics nurses and facility managers working on or for the maternity ward of the hospital. The overall experience of the staff was good and they strongly believed that women who give birth in the concerning hospital perceived their (architectural) environment as well. This was mostly due to the use of wood-like floors, use of photo-wallpaper, and curtains which made it home-like. Another asset that contributes is that the rooms are not shared with other persons (one-person rooms only) and most medical equipment was behind cabinet doors. Another interesting comment was the noticeable difference in needs, whereby women who stay for a short period of time rather stay in their room or so-called 'bubble', and women who stay for a longer period of time have a preference to leave their room and go to a lobby or have a walk around outside. Finally, the placement of the nurse station was centered in the middle of the ward which created good accessibility for staff and patients, women were clearly hearable in other rooms when making a lot of noise, and it was emphasized that the living situation also often determens why women do not give birth at home. The main keywords of this interview are highlighted in red.

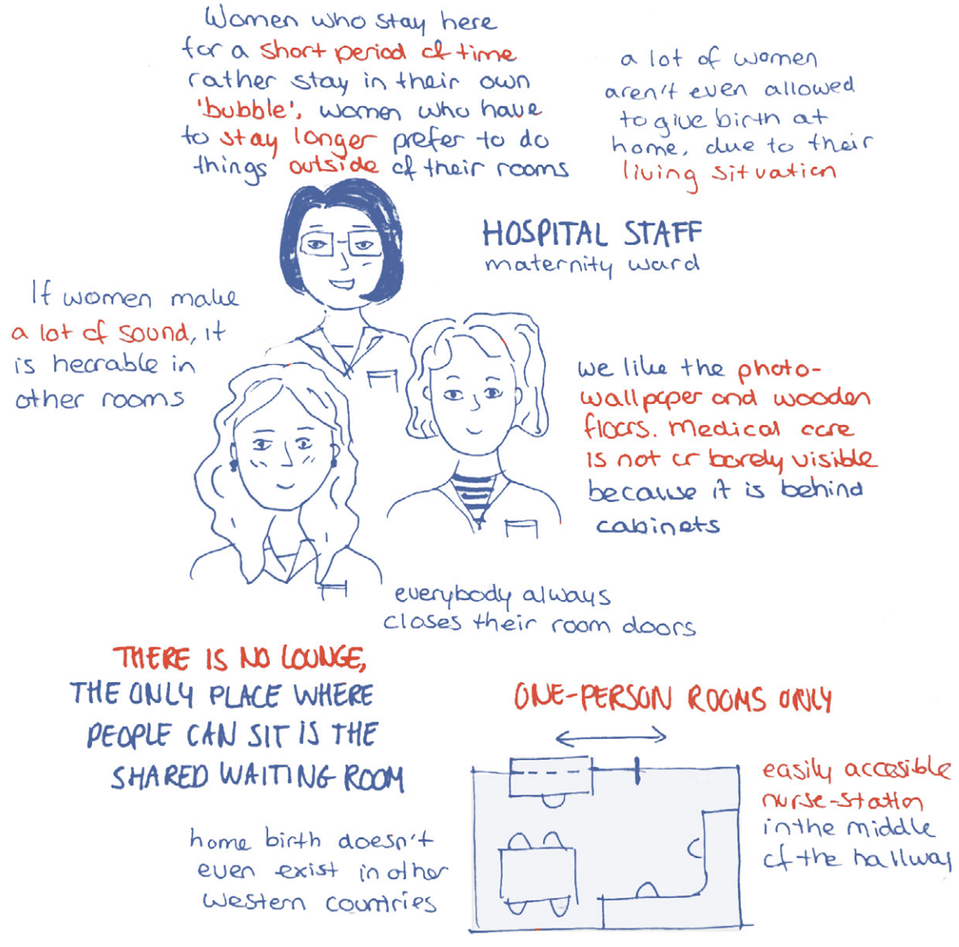


Figure 20. "Illustration of participant(s) number 3"
- Author's own illustration

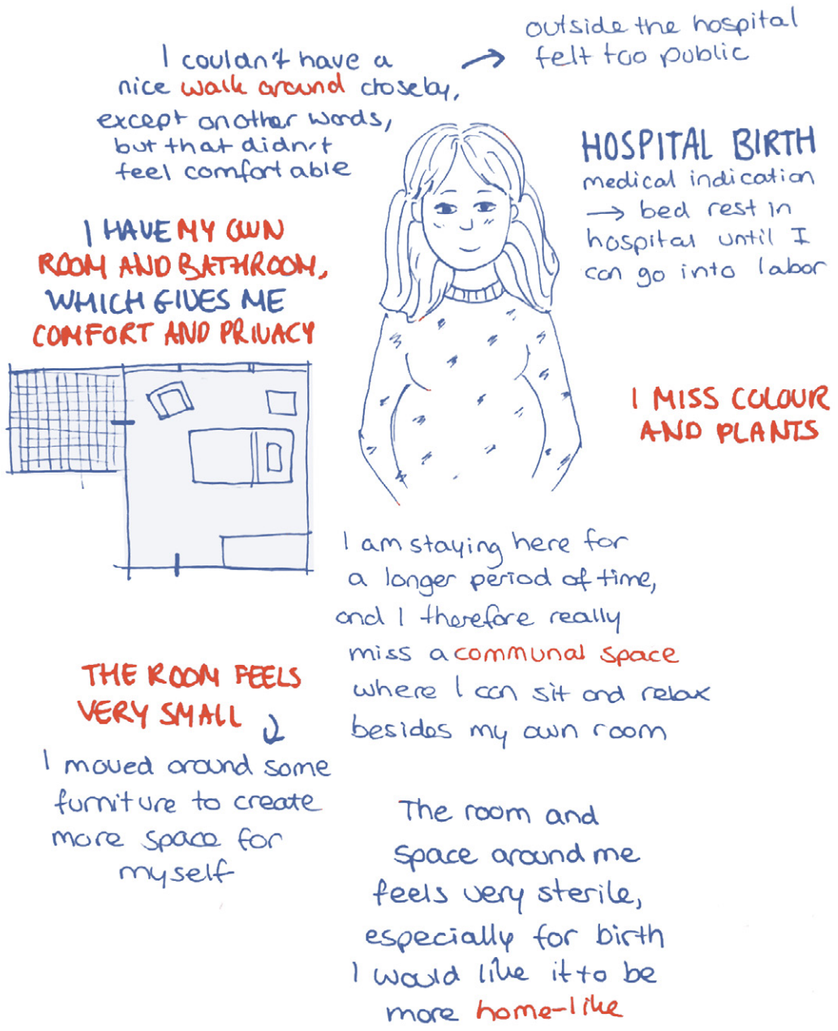


Figure 21. "Illustration of participant number 4"
- Author's own illustration

Participant 4

The final participant who was interviewed in the hospital was a woman who had not given birth yet but was obligated to stay in the hospital to monitor her pregnancy and labor. From all the rooms that were available, was this woman placed in the smallest room. Although she liked the fact that she had a room for herself with a private bathroom (so did the other rooms), did she notice and dislike the size of her room. She hereby mentioned that it did not look home-like enough for a birth environment, that there was not enough space for her personal belongings or to move around, and the fact that she missed color and plants. Unlike the other rooms, this room did not feature a wallpaper of nature. The participant did enjoy having a look outside since she had to stay in the room for a longer period of time, and if she would had been able to, she would have liked to have a secluded walk around. The main keywords of this interview are highlighted in red.

4.2.2
location two: birth center

Participant 5

The following participant decided to give birth and receive maternity care in a birth center due to her living situation. She did not want to give birth in the hospital because this felt 'too medical' for her. She hereby emphasized that a home-like environment is important during childbirth, and warmth and dimmed lights are very important additional aspects during this experience. The participant chuckled and said: "You're in here butt-naked after all!". Although she described the room as outdated, experienced the participant a sense of warmth and comfort due to the wooden floors, wooden furniture, and curtains. Other important findings were the absence of nature and the absence of a little facility or kiosk where she could buy some food and eventually prepare this in the available pantry. This last addition would have given her a sense of control while being in a situation and facility of not having much control or space. Finally, the participant did not mind changing rooms because they were close to each other and she felt safe due to the fact that the hospital was closeby; as long as they did not unsolicitedly mingle with the tasks of the birth center. The main keywords of this interview are highlighted in red.

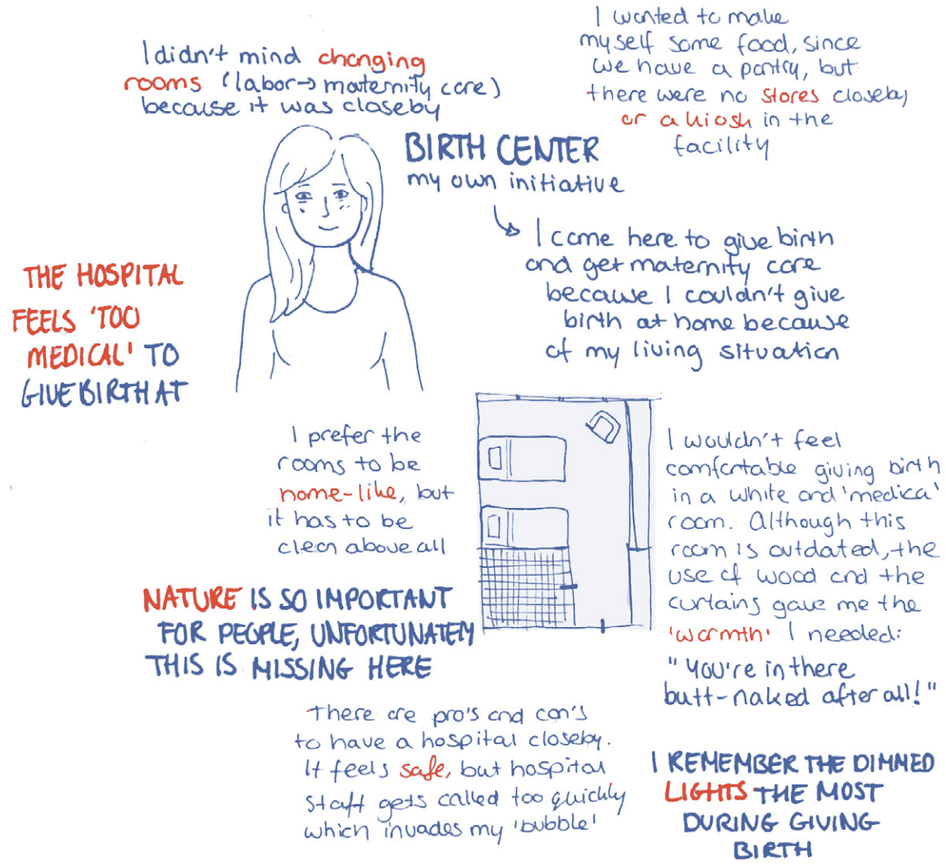


Figure 22. "Illustration of participant number 5"
- Author's own illustration

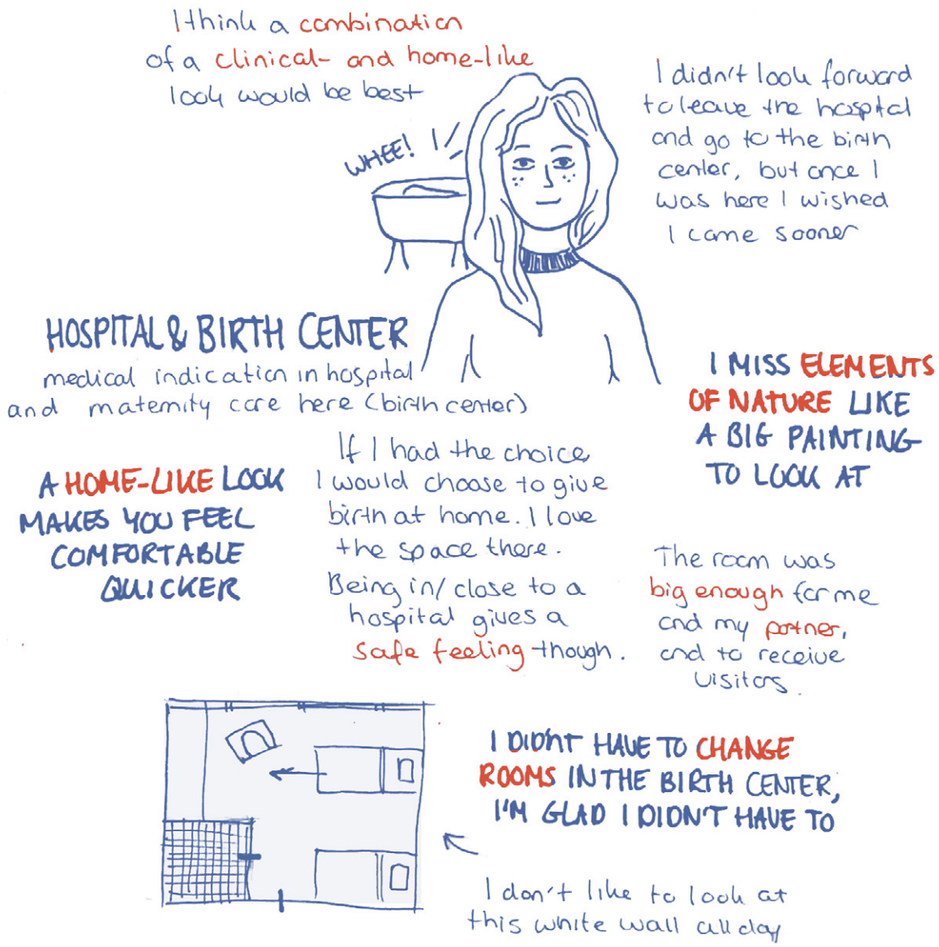


Figure 23. "Illustration of participant number 6"
- Author's own illustration

Participant 6

The sixth participant gave birth in the hospital due to her medical indication and received maternity care in a birth center. She did not look forward to leaving the hospital, but once arrived she wished she had transferred sooner. She hereby enjoyed the fact that it was more home-like which made her feel comfortable quicker, and she enjoyed the space and sleepfacility there was for her partner. Although the participant would have preferred to give birth at home, did she like the fact that the hospital was closeby to this facility in case something went wrong. As a final comment did she mention that she did not like to look at the white wall all day and the fact that she missed elements of nature or a nice painting to look at. The main keywords of this interview are highlighted in red.

Participant(s) 7

The final participants were staff working in or for the birth center and additional midwives from women who gave birth in the birth center. The participants were satisfied with the layout of the birth center and acquired a centralized 'nurse station' in the middle of the facility. An interesting observation was shared whereby a difference was noticed between women who transferred from a hospital to the birth center and women who transferred from home. Women who transferred from the hospital experienced the facility as home-like, whereas women who transferred from home were disappointed with the home-like appearance. The staff further emphasized that warmth and comfort are important features to have in this kind of facilities, as well as having enough room for their partners and having a hospital close by in case something goes wrong. Lastly are the state of living, cultural background, and the level of education factors that influence the choice of giving birth at home or in a facility like a birth center. The main keywords of this interview are highlighted in red.

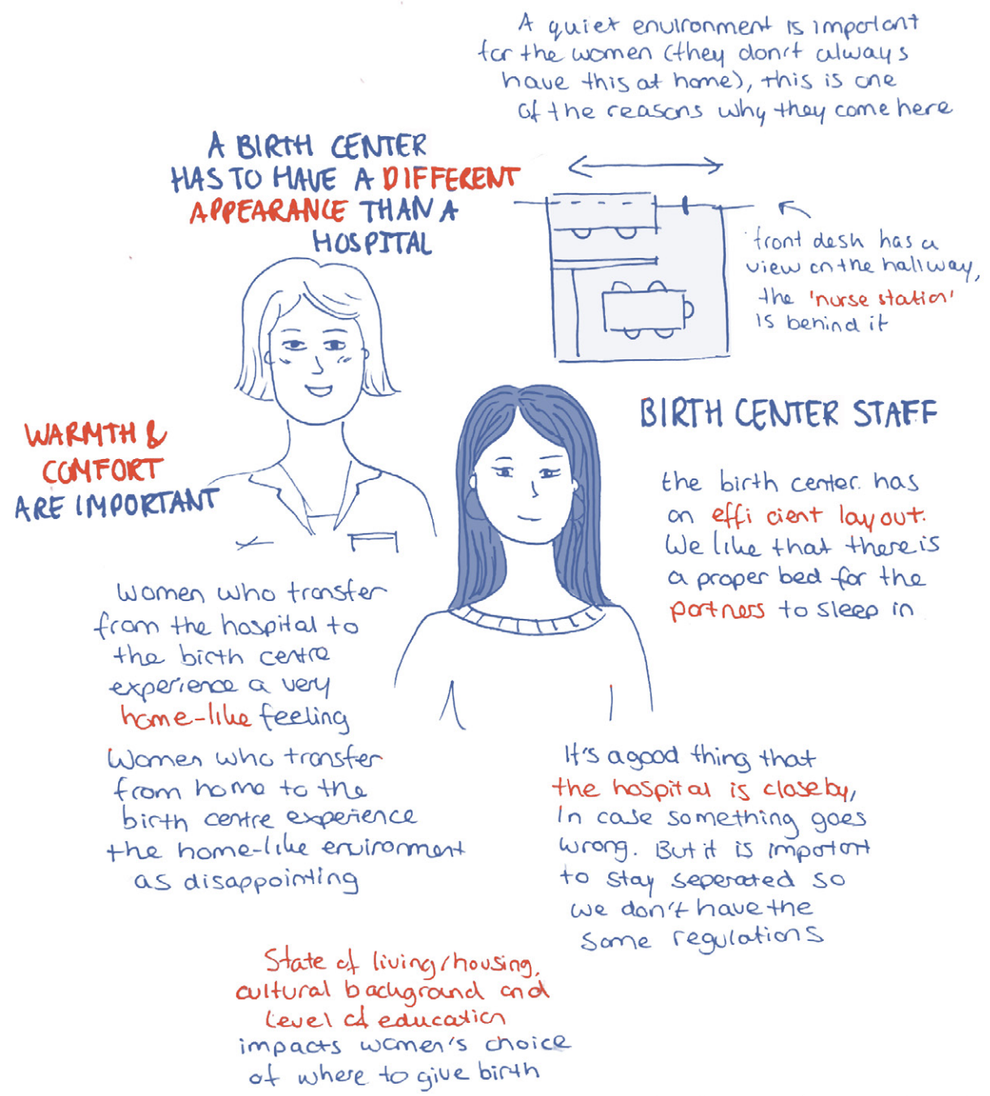


Figure 24. "Illustration of participant(s) number 7"
- Author's own illustration

4.3
conclusion and design principles

The fieldwork and interviews with women who were pregnant and/or have given birth in a maternal healthcare facility and employees of the hospital or birth center in question gave insight into several topics regarding the (architectural) birth environment. The experience and answers of the participants have led to a variety of topics, which will be added or merged within the six design principles that have been formed, based on the research of Nielsen and Overgaard, and Browning, Ryan, and Clancy. Remarks that were described or emphasized by several participants, often seen in the red highlighted words in the illustrations, have been described underneath the six design principles. This summary hereby describes the perception of the (architectural) environment and needs of women during the stage of LDRP in a contemporary maternal healthcare facility. It hereby adds evidence to the research and confirms or adds elements to the design principles (fig. 25).

1. Guiding focus of the physical birth environment

A home-like atmosphere is a topic that often repeats itself in the conversations which therefore seems to be one of the most important elements of the birth environment. The interviewed women strongly believed that the birth environment, whether it is in the hospital or as an independent facility, should have a different appearance than hospitals or other related facilities. They hereby mentioned that the combination of a clinical- and a home-like atmosphere would be best, although this preference often came with contradictions or perhaps misperceptions. A clinical environment was often associated with the presence of medical care, which gave a positive feeling of safety as well as the idea of having a hygienic birth environment. However, the idea of a solely clinical environment was not preferred because it was associated with white and sterile-looking rooms or facilities, which makes the preference for a clinical environment a contradiction. A solely home-like environment made women associate with an environment with more un-hygenic elements, such as carpets, uncleanable furniture, and the lack of medical care. It is therefore important to understand the actual needs of the women during the stage of LDPR, and taking into account that creating a home-like environment seems to be a big preference, as long as it does not neglect elements that give women a sense of safety and hygiene.

The rooms where women during the stage of LDRP stay have to have enough square meters of space. The amount of space is clearly not endless, since these kinds of facilities often do not have the luxury to have or facilitate large rooms. Nevertheless, the rooms should have enough space to offer freedom of movement. The interviews have shown that the ability to walk around in the room and being able to move freely during the stage of LDRP is an important element for these women.

Another important element that determines the size of the room is the amount of space there is for a partner. The involvement of the partner during the stage of LDRP is very important for women, as well as for the partner himself, and it should therefore facilitate enough space for both to be comfortable. A good example was in the birth center, where every room always had a permanent bed for the partner to sleep in. This was experienced as much better compared to the hospital where there were solely foldable chairs available that could be turned into beds.

The windows gave the women the ability to look outside and visually ‘step out of their bubble’ when needed.

In addition to the present design elements, it has to be taken into account that changing to a different room was not experienced as well by the women in the maternal healthcare facilities. The rooms for labor and the rooms for maternal care have different functions and are therefore separated for a reason, but the change between rooms forced the women to make themselves feel ‘at home’ and comfortable in another room all over again. Although changing rooms was experienced as less unpleasant when the room was closeby, will this element of not changing rooms, or perhaps having multi-purpose rooms, be added within the design principle, and should be considered when designing such facilities.

In both maternal healthcare facilities, women were missing facilities to gain a sense of freedom and empowerment. Facilities like a little kiosk or shop to buy (and to prepare) their own food, or a place to have a (secluded) walk around were missing. Furthermore was there no place to relax or receive visitors or children outside of their rooms. Especially when having a bigger family or already having (multiple) children, a place for them to be outside of their rooms would have been preferred.

Lastly, it is a two-way street in terms of the location of the maternal healthcare facility. On the one hand, a maternal healthcare facility that is connected or integrated into the hospital gives feelings of safety, in case something goes wrong. The downside to this is, according to the women, that the hospital staff interferes too quickly (and unnecessarily medicalized), which causes turmoil in women’s experiences. Nevertheless, it is preferred to have a maternal healthcare facility close to the hospital.

2. Visual and auditory stimuli

There were no visual or auditory stimuli present in the researched facilities, nor were women able to envision the positive effect of these stimuli.

3. Interior, furniture, and equipment

Another important element is the little to non-visible medical equipment, for example behind cabinets. The awareness that there is medical equipment for care or interventions closeby could bring a sense of safety and should therefore be stimulated. However, it should not interfere with the home-like atmosphere that is desired, nor appear as a clinical environment.

4. Privacy

Within hospitals and other types of healthcare facilities, one-person rooms seem to become the norm. This is also an element that is important for the women to gain a feeling of privacy and comfort. It is hereby important that the rooms feature a private bathroom that is easily accessible during the stage of LDRP.

In addition to the preference for windows, to let women visually ‘step out of their bubble’ when needed, curtains or screens are an important addition to give women the ability to gain more privacy and accentuate their feeling of being in a bubble.

5. Light

Diverse lighting options and the ability to control and dim the lights were elements that were missing or not optimal in the current researched facilities. The ability to have smaller- and dimmed lights were elements that were emphasized that could strengthen a home-like atmosphere that is preferred during the stage of LDRP.

6. Nature-(inspired) elements

The use of photo-wallpaper with a view of nature seemed to have a positive effect on women, compared to the participants who had the view of a white wall. The wood-like floors were also an element that was preferred over white- or sterile-looking floors, which gave a sense of warmth and a home-like atmosphere. Other (visual) connections to nature-(like) elements were missing. It is therefore important to integrate similar or additional kind of elements that relate to nature.

(GUIDING FOCUS OF THE) PHYSICAL BIRTH ENVIRONMENT 1

- Home-like environment
- Amply spaced and flexible room
- Space for partner
- Windows
- Restrict changing between rooms and/or have multi-purpose rooms
- Facilities that provide a place to lounge, receive visitors and/or children, and buy & prepare food
- Space to have a (secluded) walk around in- or outside
- Nearby or integrated in the hospital

VISUAL AND AUDITORY STIMULI 2

- Snoezelen/ inspired audial and visual scenery on walls providing positive distractions

INTERIOR, FURNITURE, AND EQUIPMENT 3

- Nordic contemporary style furniture resembling private home environment
- Television
- Traditional hospital labor bed covered or placed less visibly
- Necessary- and medical equipment covered or placed less visibly
- Relaxation area with sofa bed, chairs, and coffee table
- (Sofa) bed for partner
- Bathtub

PRIVACY 4

- Single occupancy rooms, including a private bathroom
- Curtains or screens to cover the windows

LIGHT 5

- Overhead light off unless needed for assessment purposes
- Dimly lit scenario projections controlled by woman and her partner
- Dimmed light in relaxation area her partner

NATURE-(INSPIRED) ELEMENTS 6

- Visual connection with nature
- Non-visual connection with nature
- Thermal & airflow variability
- Presence of water
- Material connection with nature

Figure 25. "Diagram with design principles and guidelines"
- Authors own illustration

CHAPTER 5

ANALYZING THE PRESENCE AND USE OF THE TARGET GROUP'S NEEDS IN CURRENT (MATERNAL) HEALTHCARE FACILITIES

How are the (architectural) environmental needs of women during the stage of LDRP currently visible in the maternal healthcare facilities?

5.1 introduction

This chapter will illustrate how and if women's (environmental) needs are currently visible in contemporary maternal healthcare facilities.
To find out what design strategies have proven to be efficient, or based on the literature study, interviews, or fieldwork have proven to be inefficient, case studies of maternal care facilities or other healthcare facilities that relate or add value to the research will be researched. The case studies will be researched through analysis of floor plans, the program and pictures. Furthermore, design guidelines derived from the first three subquestions will hereby be used as a base to research the case studies' qualities to analyze what guidelines have been implemented in existing (maternal) healthcare facilities.

The following case studies will be researched:

1. Ikazia Hospital (Mother and Child center); a hospital in Rotterdam, The Netherlands, with a recently renovated Mother and Child center. The focus will be on maternity wards and other maternity-related spaces
2. Birth Center Sophia (within Erasmus MC Hospital); a hospital in Rotterdam, The Netherlands. The focus will mainly be on the birth center itself, whereby the joint maternity wards of Erasmus MC will be researched briefly
3. EKH Children Hospital, a children's hospital in Samut Sakhon, Thailand, designed by Intergrated Field

5.2
Ikazia Hospital

Ikazia Hospital is located in Rotterdam, the Netherlands, and is also known to be a training hospital. It is located close to the highway and provides easy access to the city center. Ikazia Hospital offers all kinds of care, including care for mother and child. Their 'Mother and Child' center, which was renovated in 2021, features several types of wards, including a birth center, an obstetrics ward, neonatology, a children's department, and a gynecology ward. The birth center is integrated within the obstetrics ward and does not function as an independent center. The obstetrics wards are located on the 7th and 8th floor, and are spread out over building blocks A and B, as seen in Figure 27.

Location: Rotterdam, the Netherlands

Architect: Renovated by EGM Architecten

Area: 11.000 m²

Year: 1968, renovated between 2017-2021

Figure 26. "Photograph of Ikazia Hospital, Rotterdam"
- (EGM Architecten, n.d.)

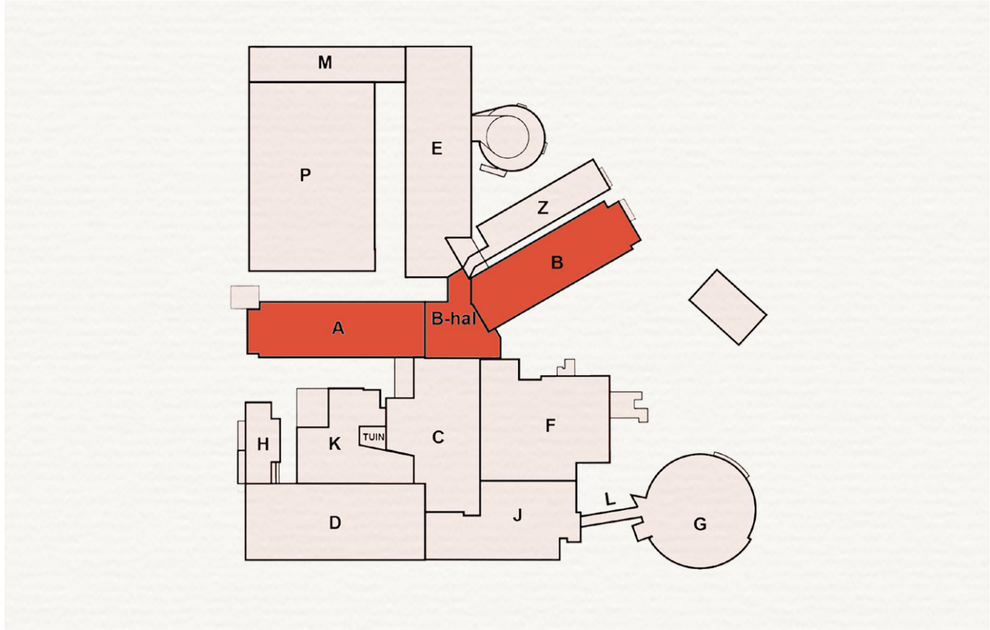


Figure 27. "Illustration of Ikazia Hospital's building structure"
- Authors own illustration, based on Ikazia Hospital's information

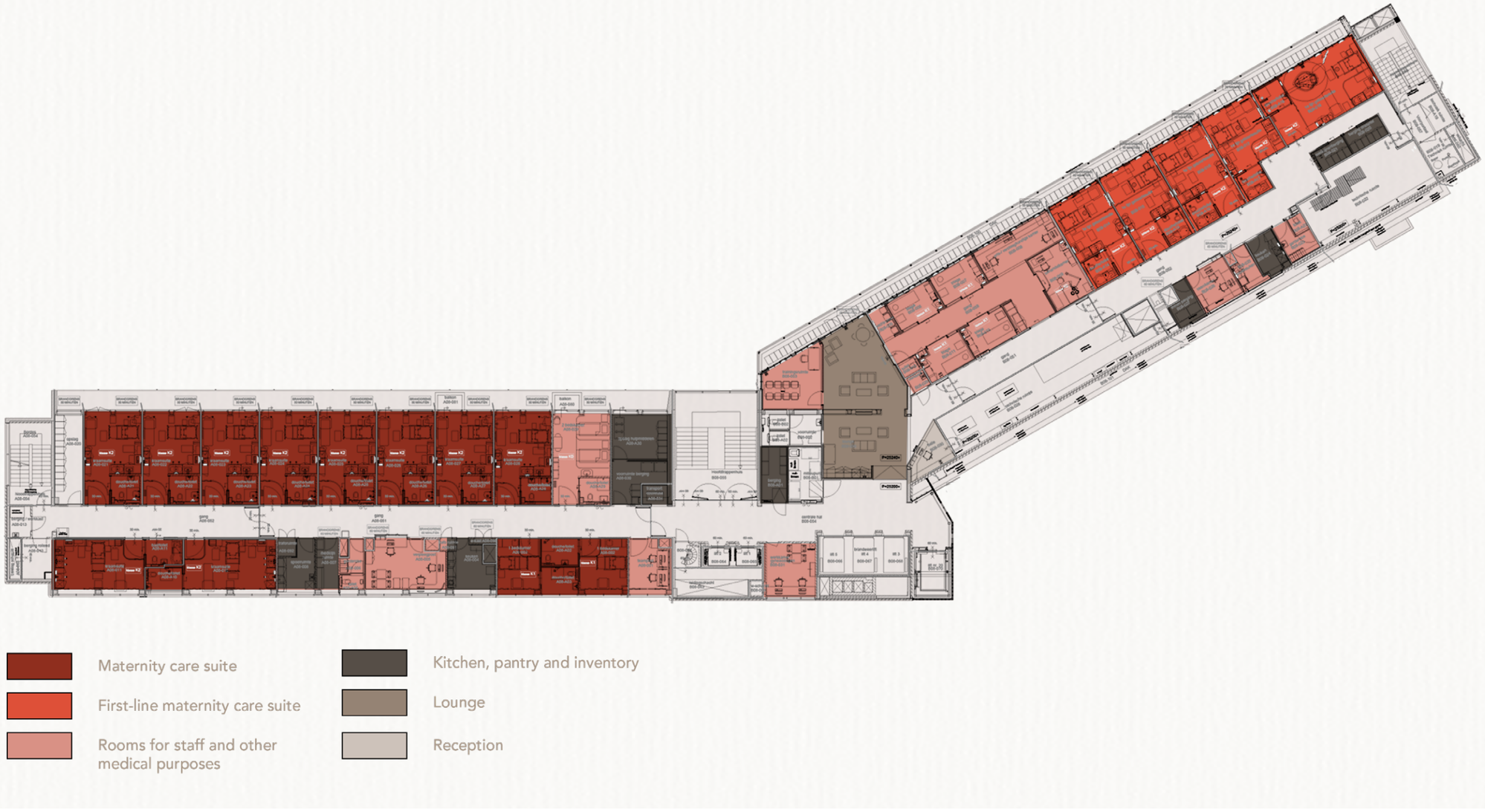


Figure 28. "Illustration of Ikazia Hospital's floor plan"
- Authors own illustration, based on Ikazia Hospital's information

Ikazia Hospital's obstetrics ward, including the birth center also referred to as the first-line maternity care, has a quite structured layout. The obstetrics wards on the 7th and 8th floors can be accessed by elevators and stairs, centrally located in between building blocks A and B. All regular maternity care suites are located on the left wing, in block A, and are meant for women with a medical indication. First-line maternity care suites are located on the right wing, in block B, and are meant for women who self-initiate their birth to be at a hospital. Overall, the obstetrics ward on both floors contains approximately 20 maternity care suites and five first-line maternity care suites. Furthermore, the obstetrics ward contains rooms for staff, such as a nursing station and a wardrobe, as well as rooms for inventory, a kitchen, and bathrooms. In the center of the building blocks is a lounge, which is mainly used as a waiting room. Patients and their corresponding visitors can be received by the receptionist in the main hall.

Figure 29. "Photographs of maternity care suites in Ikazia Hospital"
- Author's own photographs

Through the lens of the six design principles, based on the research of Nielsen and Overgaard, and Browning, Ryan, and Clancy, Ikazia Hospital's maternity care suites will be analyzed. With the help of the diagram (fig. 25), the suites will be analyzed on the topics of ***1. Guiding focus of the physical birth environment, 2. Visual and auditory stimuli, 3. Interior, furniture and equipment, 4. Privacy, 5. Light, and 6. Nature-(inspired) elements,*** including their accumulating design elements. This analysis will show what design elements have been implemented in this case study and/or what elements could be further added to the formed design principles.

1. Guiding focus of the physical birth environment

Overall, it seems that the recent renovation of Ikazia Hospital made the rooms more home-like, by placing medical equipment behind cabinets and using nature-inspired elements such as photo-wallpaper and wood-like floors. Especially the first-line maternity suites offer amply spaced suites, however, most regular suites offer little additional space for the partner or to receive visitors. The suites also contain operatable windows.

Elements that seem to be missing are a proper lounge where women can feel comfortable to stay and 'escape' from their bubble when needed. The facility only contains a lounge that is used as a waiting room. Lastly, there is no space for the women to have a secluded walk around. Women have access to walk through the hospital wards, there is however no secluded garden or other place to walk in or outside the hospital.

2. Visual and auditory stimuli

There are no visual or auditory stimuli present in the maternity suites.

3. Interior, furniture, and equipment

The maternity suites of Ikazia Hospital offer a few design elements within this design principle. As can be seen in the photographs of Figure 29, the suites offer a television, a foldable chair/bed for their partner, and most medical equipment is placed behind cabinets. Unfortunately, the suites do not offer enough space to have a permanent bed for their partner, and once the chairs are unfolded into beds, the remaining space in the suites is scarce. This is not optimal for women's need for freedom of movement, nor does it support the involvement and needed space for their partner. In addition, the suites do not contain furniture resembling a private home environment, nor do the suites contain a relaxation area or a bathtub. An exception is a single first-line maternity suite, which contains a bathtub that can be used during labor.

4. Privacy

The regular maternity care suites as well as the first-line maternity care suites are single-occupancy rooms and all include private bathrooms. The rooms furthermore have curtains to obtain women's privacy. There are no elements missing within this design principle.

5. Light

The lighting options within the suites are scarce. Apart from one wall fixture, all other lamps seem to be overhead lights. It is not clear if the lightning options can be adjusted to dimmed lights.

6. Nature-(inspired) elements

As mentioned before, the suites contain nature-inspired and home-like elements like photo wallpaper and wood-like floors. Other nature-inspired elements are not found within the suites, like a non-visual connection to nature or the presence of water. The view from the window also fails to offer a view of nature.

Conclusion

The regular- and first-line maternity suites offer several elements within the six design principles. It seems that the hospital tries to minimize the medical appearance by placing medical equipment behind cabinets and offering a more home-like environment by providing nature-inspired wallpaper and wood-like floors. The suites could be optimized by creating more space for women and their partners, and by including more nature-inspired elements.

5.3
Birth Center Sophia

Birth Center Sophia is located within Erasmus MC's 'Sophia Children's Hospital' (fig. 31). The birth center is located in Rotterdam, the Netherlands, and is located close to the city center. the highway and provides easy access to the city center. Within Erasmus MC, the hospital offers all kinds of care, including care for mother and child. Their 'Mother and Child' center features several types of wards, including a birth center, an obstetrics ward, neonatology, a children's department, and a gynecology ward. The birth center is integrated within the overall obstetrics wards and can be entered through the main hall of Sophia Children's Hospital, however, it does function as an independent center. The birth center is adjacent to the obstetrics wards.

Location: Rotterdam, the Netherlands

Architect: Willem Nicolaas Rose, renovated by EGM Architecten

Area: 210.000 m²

Year: 1840, renovated in 2017

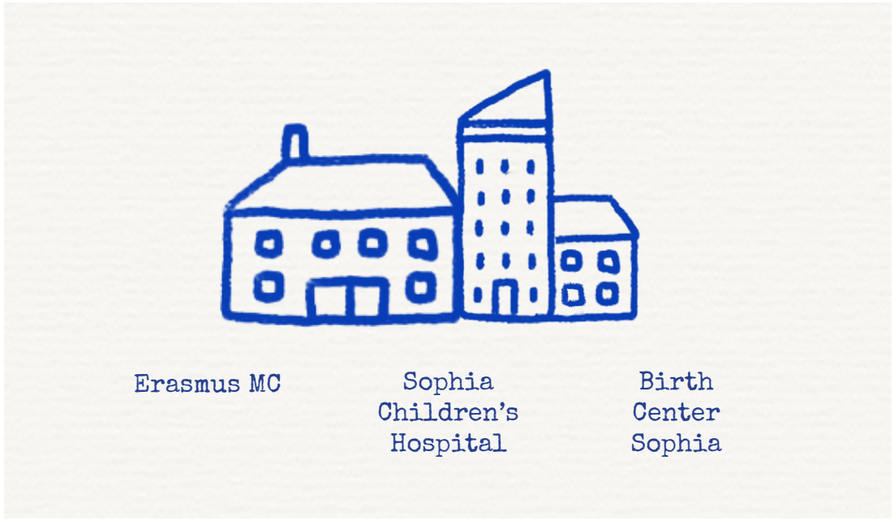


Figure 31. "Illustration of the building structure of Erasmus MC"
- Authors own illustration

Figure 30. "Photograph of Erasmus MC, Rotterdam"
- (EGM Architecten, n.d.)

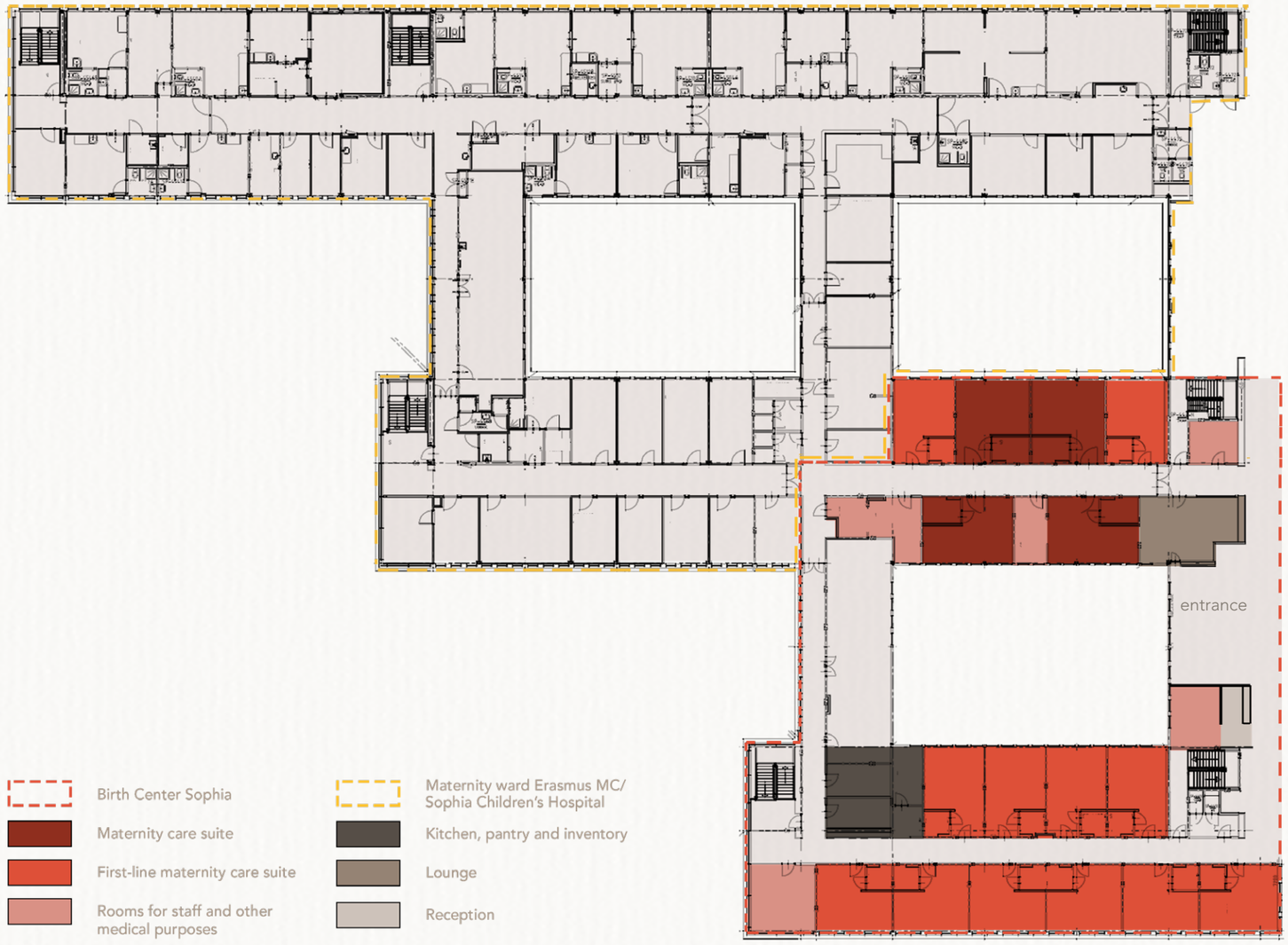


Figure 32. "Illustration of Erasmus MC's floor plan"
- Authors own illustration, based on Erasmus MC's information

Although a significant part of Erasmus MC has been renovated over the past years, Birth Center Sophia remained as it is. Birth Center Sophia, as seen within the red dashed line, contains a main entrance at the reception and can be accessed through the main hall of Sophia Children's Hospital. Overall, the birth center has a structured 'circular' layout. Within this layout, the center contains four delivery rooms and twelve maternity care rooms. Birth Center Sophia solely offers delivery rooms and maternity care for women who choose to give birth there themselves. Women with a medical indication only have the option to receive maternity care after their birth in a hospital. Furthermore, Birth Center Sophia contains rooms for staff, such as a space to work and a little conference room, as well as rooms for inventory, a pantry, and bathrooms. Close to the entrance is a small lounge, often used as a waiting room, that includes a small pantry as well. Patients and their corresponding visitors can be received by the receptionist at the entrance of the birth center.

Figure 33. "Photographs of maternity care rooms in Birth Center Sophia"
- Author's own photographs

Through the lens of the six design principles, Birth Center Sophia's maternity care rooms will be analyzed. With the help of the diagram (fig. 25), the rooms will be analyzed on the topics of ***1. Guiding focus of the physical birth environment, 2. Visual and auditory stimuli, 3. Interior, furniture and equipment, 4. Privacy, 5. Light, and 6. Nature-(inspired) elements,*** including their accumulating design elements. This analysis will show what design elements have been implemented in this case study and/or what elements could be further added to the formed design principles.

1. Guiding focus of the physical birth environment

Overall, the birth center comes across as quite outdated. Although a significant part of Erasmus MC has been renovated over the past years, Birth Center Sophia does not contain of these newly made improvements. The birth center advertises itself as an 'atmospheric' and 'hotel-like' birth environment for women, but unlike the advertisement, the birth center contains little of the elements that provide a home-like environment. Design elements that are present within this design principle, are the amply spaced rooms, space for their partner, medical equipment that is placed behind cabinets, and windows.
Elements that furthermore seem to be missing are a proper lounge where women can feel comfortable to stay and 'escape' from their bubble when needed. The facility only contains a lounge that is used as a waiting room. The birth center contains of a small pantry to prepare food but does not facilitate a small shop for food. Lastly, there is no space for the women to have a secluded walk around. Women have access to walk through the birth center or adjacent obstetrics wards, there is however no secluded garden or other place to walk in or outside the hospital.

2. Visual and auditory stimuli

There are no visual or auditory stimuli present in the maternity suites.

3. Interior, furniture, and equipment

The maternity care rooms of Birth Center Sophia offer a few design elements within this design principle. The rooms offer a television, a permanent bed for their partner, and most medical equipment is placed behind cabinets. Although the rooms seem to offer enough space for freedom of movement and space for their partner, are there no additional interior elements that could improve women's emotional and physical comfort, such as a relaxation area or a coffee table. In addition, the suites do not contain furniture resembling a private home environment. The current furniture comes across as quite outdated and does not provide a warm, home-like feeling. Lastly, all four delivery rooms have access to an inflatable bathtub. Although an inflatable bathtub is preferred over the absence of a bathtub, the presence of a permanent bathtub would be more desireable.

4. Privacy

The maternity care room as well as the delivery rooms are single-occupancy rooms and all include private bathrooms. The rooms furthermore have curtains to obtain women's privacy. There are no elements missing within this design principle.

5. Light

The lighting options within the suites are scarce. Apart from a few wall fixtures, all other lamps seem to be overhead lights. It is not clear if the lightning options can be adjusted to dimmed lights.

6. Nature-(inspired) elements

The use of nature-inspired elements is scarce, apart from the use of wood-like floors and wooden furniture. Other nature-inspired elements are not found within the rooms, like a non-visual connection to nature or the presence of water. The view from the window also fails to offer a view of nature.

Conclusion

The maternity care rooms and delivery rooms contain a few of the elements within the six design principles. Overall, the birth center is outdated and lacks health- and birth experience-improving elements. The rooms provide enough space and a permanent bed for the partner but could be improved by modernizing their interior, making it more home-like and including more nature-inspired design elements.

5.4
EKH Children Hospital

EKH Children Hospital is located in Samut Sakhon, Thailand, and was recently created through the design philosophy 'Playing is Healing' and the key concept of 'Children Dimension'. The architects have tried to create a more pleasant and friendlier environment, whereby the architecture and interior decoration are almost equivalent to a shopping mall or high-end hotels. The interior furthermore provides many child-friendly elements, such as a giant slider and a waiting room that serves as a playground (ArchDaily, 2020). The hospital provides all children-related care and contains five floors.

Location: Samut Sakhon, Thailand

Architect: IF (Integrated Field)

Area: 6000 m²

Year: 2019

Figure 34. "Photograph of EKH Children Hospital, Thailand"
- (ArchDaily, 2020)

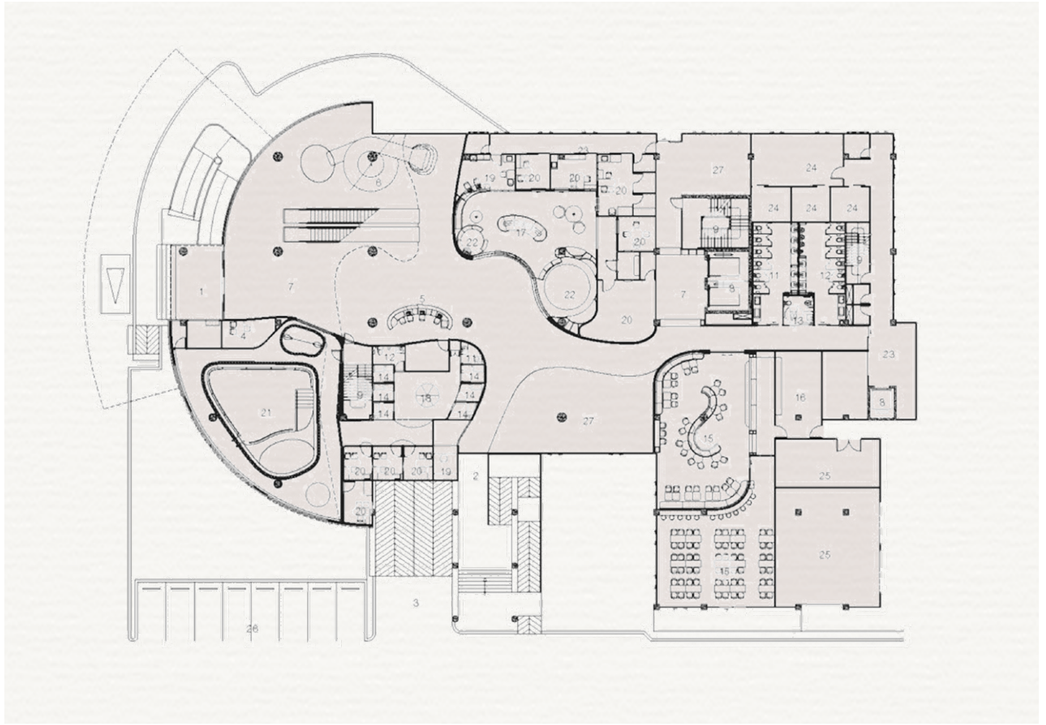


Figure 35. "Floor plan of EKH Children Hospital"
- (ArchDaily, 2020)

Figure 36. "Photographs of EKH Children Hospital"
- (ArchDaily, 2020)

The EKH Children Hospital will not be analyzed the same way as the previous two case studies since it is not a maternal healthcare facility. Nevertheless, the hospital will be analyzed for its remarkable design choices.

As can be seen in Figure 35, the hospital has an overall curvy layout that echoes through all floors. The curves are also visible in the interior as well as the furniture, as seen in the photographs in Figure 36. Getting back to maternal healthcare facilities, Bellini, Macchi, Setola, and Lindahl write in their research about sensory design in birth environments, that curved shapes can provide a positive visual stimulus in the labor and delivery room, producing beneficial psychological and physiological changes in women's behaviors and in clinical outcomes (Bellini, Macchi, Setola, & Lindahl, 2023). It could thus be an inspiration and a valuable addition to the six design principles.

The hospital furthermore facilitates all kinds of rooms, including amply spaced patient rooms with enough space for children's parents, which are all designed from a child-friendly environment where the element of 'fun' is key. In the main hall, on the top left of the floor plan (fig. 35), the giant slide is visible. Moreover, the hospital contains a swimming pool and playgrounds in waiting rooms. Overall, the hospital and its rooms are designed with pastel-colored tones that encourage the children's use of imagination. The use of indirect light in all the hallways ensures that the children will not be disturbed by excessively bright lightning.

The architects furthermore articulate the focus on a design for children by mentioning the following:

> *"The children dimension is created using various physical shapes, colors and symbols materialized from the design language that is made up of delicately curved lines and deliberately avoids the perfect geometric forms. The arches constructed above the doorways and seating areas are calculated to correspond with children's body proportion, creating a built environment that truly accommodates children's behaviors and preferences. " (Integrated Field, ArchDaily, 2020)*

Conclusion

The EKH Children Hospital is difficult to compare to a maternal healthcare facility since it does not offer the same kind of rooms and facilities. The hospital can however offer great inspiration for healthcare facilities, amongst maternal healthcare facilities. The use of soft colors, wooden interiors, and curved shapes of interior and furniture create a very subtle and friendly appearance and environment. This element will therefore be added to 3. Interior, furniture and equipment (fig. 37). The hospital further provides evidence of how a healthcare environment adjusts to the needs of its users.

(GUIDING FOCUS OF THE) PHYSICAL BIRTH ENVIRONMENT **1**

- Home-like environment
- Amply spaced and flexible room
- Space for partner
- Windows
- Restrict changing between rooms and/or have multi-purpose rooms
- Facilities that provide a place to lounge, receive visitors and/or children, and buy & prepare food
- Space to have a (secluded) walk around in- or outside
- Nearby or integrated in the hospital

VISUAL AND AUDITORY STIMULI **2**

- Snoezelen/ inspired audial and visual scenery on walls providing positive distractions

INTERIOR, FURNITURE, AND EQUIPMENT **3**

- Nordic contemporary style furniture resembling private home environment
- Television
- Traditional hospital labor bed covered or placed less visibly
- Necessary- and medical equipment covered or placed less visibly
- Relaxation area with sofa bed, chairs, and coffee table
- (Sofa) bed for partner
- Bathtub
- Soft colors and curved interior & furniture

PRIVACY **4**

- Single occupancy rooms, including a private bathroom
- Curtains or screens to cover the windows

LIGHT **5**

- Overhead light off unless needed for assessment purposes
- Dimly lit scenario projections controlled by woman and her partner
- Dimmed light in relaxation area her partner

NATURE-(INSPIRED) ELEMENTS **6**

- Visual connection with nature
- Non-visual connection with nature
- Thermal & airflow variability
- Presence of water
- Material connection with nature

Figure 37. "Final diagram with design principles and guidelines"
- Authors own illustration

Figure 38. "Illustrated final diagram"
- Authors own illustration

CHAPTER 6

CONCLUSION

06.
conclusion

Under the influence of negative experiences, childbirth can be harmful and have negative effects on the women's (mental) health, such as stress and anxiety which can lead to prolonged labor, impaired mother-child attachment, and even postpartum depression which is the most common condition among new mothers. One of the factors that profoundly affects women's experience of childbirth is the physical environment. Unfortunately, a problem that often occurs in contemporary maternal healthcare facilities is that these facilities are designed from a highly-regulated and medicalized maternity care perspective, instead of a woman-centered and nature-inspired design approach. The research therefore aimed to answer the following main question:

> **"What kind of architectural environment could contribute to a positive experience, improving health & well-being, for women during the stage of LDRP* in a maternal healthcare facility?"**
> *labor, delivery, recovery, and postpartum

Four sub-questions were formulated to answer the main question. The first sub-question *"What are the (environmental) needs of women during the stage of LDRP in a maternal healthcare facility?"* has been answered as a result of a literature study, based on Nielsen and Overgaard's research, amongst additional literature. It can be stated that overall, women's environmental needs derive from their needs for emotional support, the involvement of their partner, and the need for physical comfort. These needs are connected to physical design elements that have been added within the five design principles, based on Nielsen and Overgaard's five design principles.
In order to answer the second sub-question *"What kind of nature-inspired design principles could improve women's health & well-being in a maternal healthcare facility?"*, a further literate study has been executed to gain more knowledge on healing architecture, specifically biophilic design. Based on the book *'14 patterns of biophilic design; Improving health & well-being in the built environment'* and additional literature, it can be stated that patterns of biophilic design can contribute to people's health and well-being. Specifically, the research shows that negative effects that derive from negative experiences within childbirth, such as stress and anxiety, as well as the previously mentioned need for emotional support and physical comfort, can be reduced and supported with biophilic design. It can hereby be said that these nature-inspired design principles could improve women's health and well-being in a maternal healthcare facility. The literature study for both sub-questions has together formed six design principles that form the base of this research's design guidelines. The design principles cover the topics of *1. Guiding focus of the physical birth environment, 2. Visual and auditory stimuli,*

3. Interior, furniture and equipment, 4. Privacy, 5. Light, and 6. Nature-(inspired) elements.

The third sub-question *"How do women during the stage of LDRP perceive their (architectural) environment in contemporary maternal healthcare facilities?"* has been answered by carrying out fieldwork, including conducting semi-structured interviews. The fieldwork and interviews with women who were pregnant and/or have given birth in a maternal healthcare facility and employees of the hospital or birth center in question confirmed and added elements to the six design principles.

The fourth and final sub-question *"How are the (architectural) environmental needs of women during the stage of LDRP currently visible in the maternal healthcare facilities?"* was answered by researching three case studies of (maternal) healthcare facilities. The first two case studies confirmed that maternal healthcare facilities are not optimized for women's needs. It moreover confirmed the lack of nature-inspired elements, which have proven to improve health and well-being. Although the third case study was not related to maternal healthcare, this case study is evidence of how a healthcare environment can adjust to the needs of its users.

Combining the results of these sub-questions has created six substantiated design principles and accumulating guidelines, that could help and inspire designing a maternal healthcare facility. Building on Browning, Ryan, and Clancy's quote, it should be taken into account that these design principles and guidelines are not formulas;

> **"they are meant to inform, guide and assist in the design process and should be thought of as another tool in the designer's toolkit."** (Browning, Ryan, & Clancy, 2014)

At last, this research provides answers regarding women's (environmental) needs, architecture, the birth environment, women-centered care, and biophilic design. The sub-questions hereby answer the main research question:

> **"Women's (environmental) needs derive from their need for emotional support, the involvement of their partner, and the need for physical comfort. These needs are connected to physical design elements that have translated into six design principles, 1. Guiding focus of the physical birth environment, 2. Visual and auditory stimuli, 3. Interior, furniture and equipment, 4. Privacy, 5. Light, and 6. Nature-(inspired) elements. These design principles provide design guidelines proving to contribute to a positive experience, improving health & well-being, for women during the stage of LDRP* in a maternal healthcare facility."**
> *labor, delivery, recovery, and postpartum

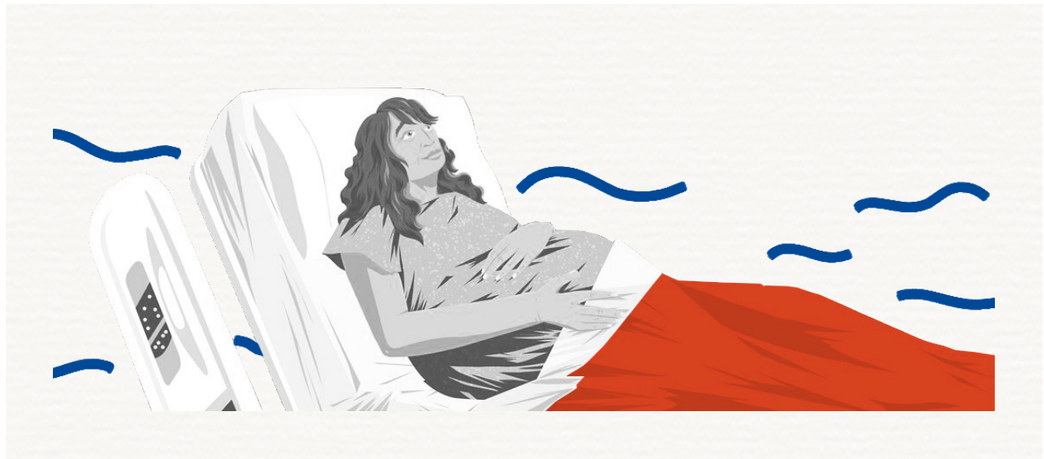


Figure 39. "Illustration of a pregnant woman"
- Authors own illustration

CHAPTER 7

BIBLIOGRAPHY &
LIST OF FIGURES

07.
bibliography & list of figures

Bibliography

ArchDaily. (2020, January 2020). EKH Children Hospital / IF (Integrated Field). Retrieved from ArchDaily: https://www.archdaily.com/932317/ekh-children-hospital-s-csb

Bellini, E., Macchi, A., Setola, N., & Lindahl, G. (2023, February 24). Sensory Design in the Birth Environment: Learning from Existing Case Studies. Buildings 2023, 13(3), 604, pp. 1-28.

BNR Webredactie. (2019, January 31). Steeds meer Nederlanders blijven kinderloos. Retrieved from BNR: https://www.bnr.nl/nieuws/binnenland/10368308/steeds-meer-nederlanders-blijven-kinderloos

Browning, W. D., Ryan, C. O., & Clancy, J. O. (2014). 14 Patterns of Biophilic Design. New York: Terrapin Bright Green llc.

Centraal Bureau voor de Statistiek. (n.d.). Kinder krijgen. Retrieved from Centraal Bureau voor de Statistiek: https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/levensloop/kinderen-krijgen

Centraal Bureau voor de Statistiek. (n.d.). Mannen en vrouwen. Retrieved from Centraal Bureau voor de Statistiek: https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/mannen-en-vrouwen#:~:text=Op%201%20januari%202022%20telde,meerderheid%2C%20op%20hogere%20leeftijden%20vrouwen.

Ecker, J. (2016, January 14). Where is best for birth: Hospital or home? Retrieved from Harvard Health Publishing; Harvard Medical School: https://www.health.harvard.edu/blog/where-is-best-for-birth-hospital-or-home-201601149001

EGM Architecten. (n.d.). Erasmus MC Ziekenhuis. Retrieved from EGM Architecten: https://www.egm.nl/architecten/projecten/erasmus-mc-hospital/347

EGM Architecten. (n.d.). Ikazia ziekenhuis. Retrieved from EGM Architecten: https://egm.nl/architecten/projecten/ikazia-ziekenhuis/54

Esfeh, B. K., Kazemi, A., & Shamsaie, A. (2020, December 10). Designing architecture of soothing labor–delivery–recovery–postpartum unit: a study protocol. Reproductive Health 17, Article number: 196, pp. 1-4.

Joyce, S. (2021, November). Wait and transfer, curate and prosume: Women's social experiences of birth spaces architecture. Woman and Birth, Volume 34, Issue 6, pp. 540-553.

Kenniscentrum Immaterieel Erfgoed Nederland. (2021, April). De Nederlandse thuisbevalcultuur. Retrieved from Kenniscentrum Immaterieel Erfgoed Nederland: https://www.immaterieelerfgoed.nl/en/page/3821/de-nederlandse-thuisbevalcultuur

Lee, K. (2022, March 9). The Interior Experience of Architecture: An Emotional Connection between Space and the Body. Buildings 2022, 12(3), 326, pp. 1-16.

Lorentzen, I., Andersen, C. S., Jensen, H. S., Fogsgaard, A., Foureur, M., Lauszus, F. F., & Nohr, E. A. (2019, June). Study protocol for a randomised trial evaluating the effect of a "birth environment room" versus a standard labour room on birth outcomes and the birth experience. Contemporary Clinical Trials Communications.

Lubbe, R. (2021). Zorg en pijnbestrijding bij de bevalling. Eenvandaag; Opiniepanel.

Maasstad Ziekenhuis. (n.d.). Verloskunde. Retrieved from Maasstad Ziekenhuis: https://www.maasstadziekenhuis.nl/specialismen-afdelingen/verloskunde/

McKelvin, G., Thomson, G., & Downe, S. (2021, September). The childbirth experience: A systematic review of predictors and outcomes. Women and Birth, Volume 34, Issue 5, pp. 407-416.

Nederlands Jeugdinstituut. (2023, November 7). Cijfers over geboorte. Retrieved from Nederlands Jeugdinstituut: https://www.nji.nl/cijfers/geboorte

Newburn, M., & Singh, D. (n.d.). Creating a Better Birth Environment; Women's views about the design and facilities in maternity units: a national survey. The National Childbirth Trust.

Nielsen, J. H., & Overgaard, C. (2020, May 11). Healing architecture and Snoezelen in delivery room design: a qualitative study of women's birth experiences and patient-centeredness of care. BMC Pregnancy and Childbirth 20, Article number: 283, pp. 1-11.

Projectgroep Geboortecentrum Onderzoek. (2016). Het Geboortecentrum; Een prima plek voor vrouwen die kiezen om niet thuis te bevallen.

Radboudumc. (n.d.). Verpleegafdeling Verloskunde. Retrieved from Radboudumc: https://www.radboudumc.nl/patientenzorg/verpleegafdelingen/verpleegafdeling-verloskunde

Sosa, A. V. (2020). Healing Architecture and Evidence-based Design.

The Guardian. (2010, May 6). Maggie's Centres: Healing architecture? Retrieved from The Guardian: https://www.theguardian.com/artanddesign/gallery/2010/may/06/maggies-centres-design-architects

Trimbos Instituut. (n.d.). Zwangerschap en depressie. Retrieved from Trimbos: https://www.trimbos.nl/kennis/mentale-gezondheid-preventie/expertisecentrum-mentale-gezondheid/mentale-gezondheid-en-zwangerschap/zwangerschap-en-depressie/

Valentijn, P. (2023, February 22). Wat is 1e, 2e en 3e lijns zorg? Retrieved from Essenburgh: https://www.essenburgh.com/wat-is-1e-2e-en-3e-lijns-zorg/

Verloskundige Centrum Breda. (n.d.). Thuis of poliklinisch bevallen. Retrieved from Verloskundig Centrum: https://verloskundigcentrum.nl/de-bevalling/thuis-of-poliklinisch-bevallen/#:~:text=Het%20bed%20moet%20verhoogd%20zijn,verstandig%20om%20thuis%20te%20bevallen.

Verloskundigen Veenendaal. (n.d.). Plaats. Retrieved from Verloskundigen Veenendaal: https://www.verloskundigenveenendaal.nl/bevalling/plaats-van-de-bevalling/#:~:text=In%20flats%20zonder%20lift%20boven,naar%20buiten%20gebracht%20kunt%20worden.

List of figures

ARCHITECTURE & CHILDBIRTH

THE POSITIVE INFLUENCE OF ARCHITECTURE ON WOMEN DURING LABOR, DELIVERY, RECOVERY AND POSTPARTUM

RACHELLE DE GEUS

AR3AD110 DWELLING GRADUATION STUDIO:
DESIGNING FOR HEALTH AND CARE