

**YAŞAR UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

MASTER THESIS

**EVOLUTION AND MAIN CONCERNS: BATHROOM
DESIGN**

Salma A. Mahfouz

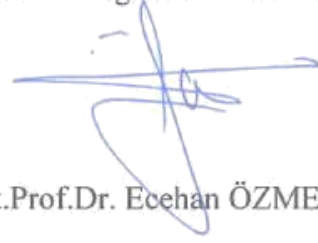
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2016**

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a dissertation for the degree of master of science.



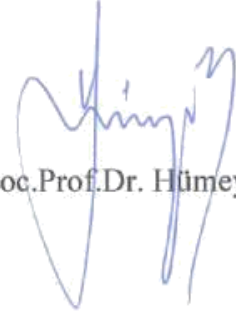
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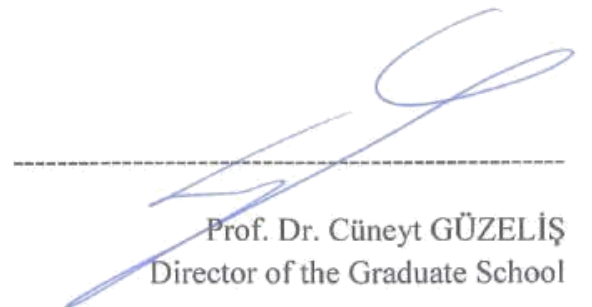
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ABSTRACT

EVOLUTION AND MAIN CONCERNS IN RESIDENCES: BATHROOM DESIGN

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MSc in Interior Architecture

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The development of our contemporary bathroom has also been dependent upon the evolution of history, technology, culture and other socio-economic policies. Good design includes planning spaces that are user friendly, hygienic and healthy. It preferably also reflects sustainable use of resources. The change in the characteristics affects how clients use their bathrooms, the finishing products and materials they demand, as well as the looks and styles they need and favor. The retail markets of today offer the customer and designer an unlimited collection of choices for furnishing bathrooms and allow the designer to create a space to fit every preference and situation, even though certain styles may go in and out of design trends. This research discusses the importance of the location of the bathroom in residence, and investigates the evolution of bathrooms since the 1900's, and analyzes bathrooms spaces.

Keywords: History of Bathrooms, Bathroom Design, Toilet Interior Design, Energy Efficiency, Materials and Resource Efficiency

ÖZET

KONUTLARDAKİ BANYO DİZAYNINI : ZİHİN VE BEDEN ARASINDAKİ İLİŞKİSİ ETKİSİ

TASARIMLARININ OPTİMİZASYONU

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Tez Danışmanı: Assitant Prof. Dr. Ecehan OZMEHMET

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Modern banyo gelişimi de tarih, teknoloji ve diğer sosyo-ekonomik politikaların evrimine bağımlı olmuştur. İyi tasarım kullanıcı için çevre dostu ve sağlıklı alanlar planlamayı içerir ve kaynakların kullanımının sürdürülebilirliğini yansıtır. Müşterilerin banyo kullanımları, talep ettikleri ürünler, görünüm ve stilleri karakterlerindeki değişimi etkiler. Günümüzde perakende pazarları tüketiciye ve tasarımcıya her duruma ve tercihe uygun banyo yaratmak için , bazı stillerde modanın dışına çıkılsa bile banyo malzemelerinde limitsiz seçenekler sunmaktadır. Bu araştırma konularında banyonun yerini ve önemini tartışmakta ve 1900 yılından bu yana banyoların kapladığı alanları analiz etmekte banyoların evrimini incelemektedir.

Anahtar kelimeler: Banyo Tarihi, Tuvalet Tasarımı, Tuvalet İç Tasarım, Enerji Verimliliği, Malzeme ve Kaynak Verimliliği

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Thanks, for everything.

Salma A. Mahfouz

TEXT OF OATH

I declare and honestly confirm that my study, titled “EVOLUTION AND MAIN CONCERNS: BATHROOM DESIGN” and presented as a Master’s Thesis, has been written without applying to any assistance inconsistent with scientific ethics and traditions, that all sources from which I have benefited are listed in the bibliography, and that I have benefited from these sources by means of making references.

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1 INTRODUCTION

1.1 Subject of the Thesis

The bathroom is a very personal and private space of people living in a house. Bathrooms continue to evolve as new products are introduced to the market. Also new standards have an impact on our energy and water consumption. People also change in their abilities, preferences, and desires.

The bathroom is a closed space that we use every day and is matched by an astonishing variety of architectural designs worldwide. People use this space in different ways and have different ideas about function, mood, and ambience. Although the bathroom has changed throughout history, it has always reflected the cultural attitudes of people towards hygiene, cleanliness, privacy, relaxation, socialization, ethics and religion. Nowadays, people think of the contemporary domestic bathroom as a place where function and ritual correspond with the body and mass-produced industrial products. What about the bathroom as a whole?

The bathroom has become a place to perform certain rituals, rather than a room to occupy one's rituals. This chapter will develop on the methods implemented in this research paper to increase the understanding of bathroom usage and inform design solutions to support independence, self-respect and quality of life (Chamberlain 2010). Lately, it has been noticed that with building costs constantly rising and, in turn, forcing a reduction in the size of residential living spaces, have affected the size of the bathroom. It is therefore important to evaluate human space

needs and how new limitations might change behavioral patterns, attitudes, and feelings.

1.2 Aim of the Study

The main research question of this study is: How did bathroom designs evolve throughout history? And what are the environmental consideration and types of material finishes?

This topic is taking into account of “product and furniture design”, “art and design”, “industrial design” and “science and technology”. The aim of this study is to contribute to the field of interior design by discussing and exploring the history up to the point of standardized bathrooms that is scarcely found in documented research. This is because space reflects one’s own body, its rituals, and it’s routines that occur within this space.

Throughout this study an examination was made about the history of bathrooms, factors which have affected bathroom designs, and finally, technological and sustainable issues such as energy efficiency, water quality, waste management, and air quality.

1.3 Significance of the Study and Structure of the Thesis

This research shows a unique spectrum ranging from small to large bathrooms. There are very few studies focusing on bathrooms in literature. Instead, even though there are several studies related with baths and toilets in general, the significance of this thesis is in investigating and discussing the evolution and the main concerns of bathrooms with regards lack of space, bathroom furnishings, and

seeking safety solutions to bathroom problems. Literature related to archeological findings about baths and toilets is reviewed in order to discover how early civilizations developed these in different ways to dispose of human waste and to take a bath. This is because bathroom space location designs, roles and “expressing emotions” in the building is decided by architects and interior designers. Through innovative bathroom spaces, interior architects and designers may provide a more comprehensive, multi-angle combination of bathroom space.

Sustainability is also one of our anticipated future needs. Solutions which are ecologically sound in both using water, energy, durability and longevity of use needs to be considered.

The rest of the thesis is organized as follows. Chapter 2 describes the histories of the development of the bathroom. The thesis is concluded with chapters 3 and 4 by summarizing the results of the literature review and discussing the factors affecting the bathroom design. It also summarizes the evolution, the rule and design methods to enrich our present bathroom design knowledge.

1.4 Literature Review

The evolution in recent years has paid more attention to the concept of health, wellness and sanitary needs. Thus, the contemporary bathroom space is full of inspiration, innovation, comfort, and pureness compared to early history design application of bathrooms. “Home spa”, “Bathrooms that creates top-grade emotional experience”, “Relaxed shower at home”, “Bathing, the art of relaxing and escape”, “Wellness at home” and similar views of books became the main development trends of bathroom design. Comfortable bathroom design makes people want to go home

and dip themselves into their bathtubs. They can place the bathtub near a big enlightening window, on the floor or dug into the floor or surround it by wood and pebbles. Bathrooms can have a touch of green to make people feel like they're in a garden. Some bathtubs can be dipped into water to give the feeling of the pool or sea.

Bathroom design is developing rapidly. Designers pay more attention to “personal spas”, “no boundaries”, “relaxing spaces”, and “comfort areas”. However, this part of research on contemporary bathroom design focuses on its historical development and bathroom spaces. Eco-technologies, trends and human body engineering in bathroom design are a lot to be considered. One of the purposes of this research is to investigate the methods and products used to dispose of human waste and the bathing experience throughout history. This is needed in order to understand the evolution of bathroom designs through history. The literature review began with the investigation of journals, articles, books, and dissertations.

Main databases searched for this study are; Academic Search, Books, Cambridge Journals Online, Science Direct Journals, El Sevier Journals, Dissertations and Theses, Encyclopedia Britannica Online and Google Scholar.

2 HISTORIES OF THE DEVELOPMENT OF THE BATHROOM

2.1 Introduction

Ancient Romans had the highest standard of hygiene. This has only been reached again in our days. Roman thermal baths were important for people's health. This is why the state invested large amounts of money on them. As the Romans used to say: "Orandum est ut si mens sana in corpore sano". This has usually been translated as: "You should pray for a sound mind in a healthy body" (Bruckner, Lischka and Proschwitz 1999). In addition to well-engineered public water supply accomplished through aqueducts, the Roman Empire also established quite sophisticated sewer systems. These did not appear again until the nineteenth century. First developed around 312 B.C., these engineering wonders used gravity to transport water along stone, lead and concrete pipelines into city centers (Palmer 1973).

During the Middle Ages there was a reaction to the high standard of living of imperial Rome. Christianity prohibited sinful extreme personal hygiene and as an alternative turned to spiritual cleanliness. There was a similar fear that water was a carrier of disease and high class society embraced perfumes as replacements. There is indication of flushing toilets from the sixteenth century. But this did not become common until the explosion of innovations and patents in the mid-nineteenth century. These were seen in the Great Exhibition of 1851 in London. Hence, the bathroom has established itself definitely in the domestic environment only since the 1960's. However, there has been no major change to the general format of the toilet, sink and

bath where ceramics was still the favored manufacturers' choice, since themid-nineteenth century (Beamish, et al. 2013) .

2.2 Early Civilizations

Bathing has different functions depending on people cultural background. For thousands of years it had religious meanings in purifying the body and soul. Evidence indicates that ancient Egyptians and the residents of Crete had bathing facilities. The bath was taken to new levels by early the Greek, Minoan, and Roman civilizations (Beamish, et al. 2013). Public bath houses were popular as a focal point of the community among the ancient Greeks and Romans who resourcefully applied sophisticated drainage and heating systems. Most people found the experience so calming that they typically bathed daily in public bath houses. Bathing was a way of life not just for cleaning. In many cultures baths were enjoyed by all social classes of people. The Romans were more thoughtful of their bathing facilities. Early Roman bath houses were often highly decorated with paintings, statues, and elaborated rich architectural details to add to their pleasure (Figure 2.1).



Figure 2.1 The Roman bath Abbey, England (Kratz, James, Flicker, 2008)

In Roman times the term “culture of the closet” is certainly correct. The technical standards were high. Men as well as women met for a chat in the toilet rooms with their expensive marble closets. The seats were only separated from one another by skillfully placed ornaments. Under the seats of cool marble were the water pipes which led away the waste of the noble persons above.

Cloacina was the name of the goddess of the sewage. The Romans built wonderful temples for her celebration and thanked her for the relief she gave by means of the closet (Lambton 2007).

In addition to making bathing an enjoyable experience and a prominent part of their lives, the “*Greeks and Romans understanding and repetition of good sanitation were extraordinary for the time*” (Mazzurco 1986). The Greek and Roman concept of the “bath” and their belief in the power of water has come full circle to the pools, hot tubs, soaking tubs, mineral baths, and spas that we enjoy today.

Public baths were a part of other civilizations such as the “Turkish bath,” a steam bath that is followed by a shower and massage, developed when “*Roman bathing customs were combined with the Byzantines*” (Beamish, et al. 2013).

Just as baths were public facilities in early Roman and Greek civilizations, so were the latrines. Although, some early evidence of the house chamber pot was also recorded, Roman latrines were actually flushed by water (Figure 2.2).



Figure 2.2 Latrines Ephesus, Turkey (Mahfouz, Salma, 2013)

While the Romans did not invent the aqueduct, primitive canals for irrigation and water transport existed earlier in Egypt, Assyria and Babylon (Beamish, et al. 2013). Romans were not concerned with privacy in the latrines and they sat next to each other. Roman technology was astonishingly ahead of its time, but these latrines disappeared along with the civilizations they came from. Human waste was used for the fertilization of the fields. *“The god Stercutius, considered to be the brother of Cloacina, was also worshipped”* (Eveleigh 2003).

Romans used sponge sticks for cleaning themselves after using the closet. Such sticks were simply a natural sponge on a stick and were kept in containers of salt water so they would be sterilized ready for the next user. They would often be washed before being replaced in a creative sewer of flowing rainwater in which they could be further washed (Lambton 2007).

The Romans were masters at constructing sewerage systems. They used closely fitting cut stones to carry fresh water and sewage. To be sure that rainwater would not damage the walls below; they would use floating floors completely separate from the ceiling immediately below. This was the room used for relieving and adorning the

body. Sewage channels were connected very skillfully. Water pipes led from fountains powered by gravity into the houses, ending in holes under the floor where they were used as water reservoirs. Sewage ended its journey in a huge basin built of very thick and strong oak boards anchored firmly in the ground. The pipes rested on a bed of pebbles. This ingenious technology was not continued beyond the Roman period and in medieval times Roman pipes rotted, while former water reservoirs were used for garbage and human waste. Only in Rome itself was the famous “Cloaca maxima” still used today. But it was also considered to be perfect for water disposal under the ground (Illi and Steiner 1992).

Italian “*Terme di Caracalla*” is a good example of which scale a bathhouse the Romans enjoyed. At the baths of Caracalla, ancient (Latin) *Thermae Antoninianae* “Antonine Baths”, public baths in ancient Rome begun by the emperor Septimius Severus in 206 A.D. and completed by his son emperor Caracalla in 216 A.D. Similar to all bathhouses in ancient Rome, the Baths of Caracalla, included three fundamental bathing rooms. These rooms consisted of the cold pool or “*frigidarium*”, the warm pool or “*tepidarium*” and the hot pool or “*calidarium*”. Between Rome’s most beautiful and luxurious baths, designed to accommodate about 1,600 bathers, the Baths of Caracalla continued to be in use until the sixth century. The bath complex stands on a vast rectangular platform, measuring 328 by 400 meters, that was partially quarried out of the side of the Aventine hill (About Rome.info n.d.). The underground level carries the water system. The rectangular plan is typical of the great royal baths. The central thermal building itself was oriented in North-East/South-West, for the exploitation of sunlight. Following the traditional plan of Roman baths, the principal rooms were lined up on the short

central axis of the bath block in the ritual order in which the Romans would use them. They used the technique of raised floors and created spaces between the walls to let hot air from the heater to circulate through. The heater was close to the Tepidarium and Calidarium. In the middle of the building the frigidarium was situated and edged by two massive areas called Palaestra. These were outdoor gymnastic areas. Palaestra was an area to run and workout or competitions and games took place. Both areas were 328 by 400 meters in size (Murray and Murray 1998). The Natatio, an Olympic size pool 80 meters long and reserved for recreational swimming activities was found at the back of the building. The decorations and works of art: The baths of Caracalla were adorned with columns, precious marble slabs on the vaults, stucco paintings and hundreds of statues and colossal sculptures. Two basic functions for the baths for the ancient Romans were a necessity in sanitation or sanitary facilities and they provided an opportunity for socialization (Smith 1990).

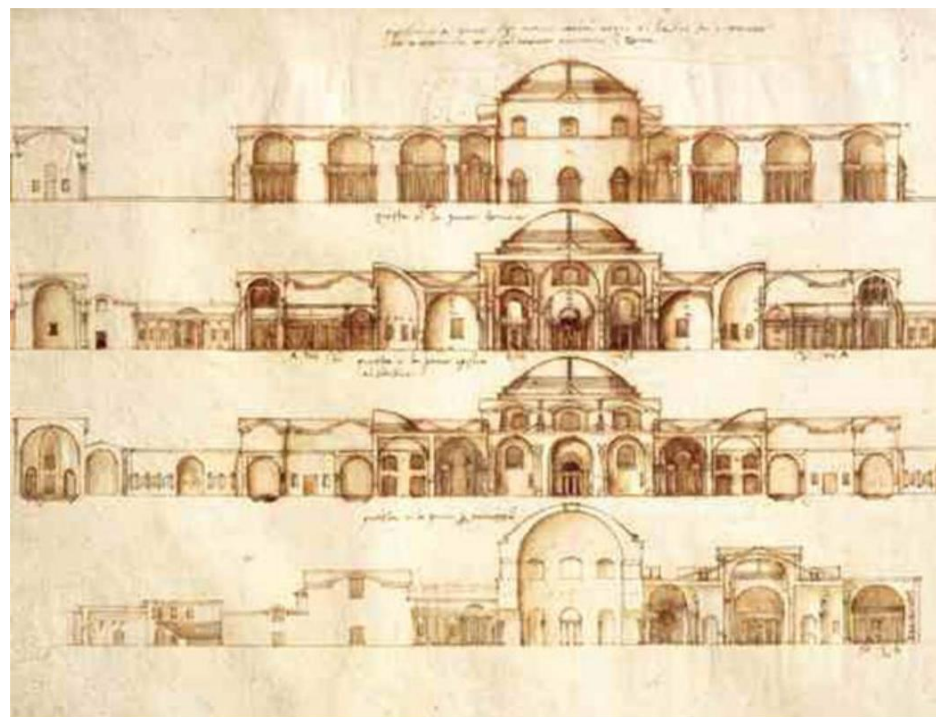


Figure 2.3 Section of the baths of Caracalla (Pinterest, 2015)



Figure 2.4 Current situations of the baths of Caracalla, Italy (Manalin, Jagem, 2015)

The Caracalla bath complex of buildings was more a leisure center than just a series of baths. It was massive, covering about fifty acres that included swimming pools, exercise yards, a stadium, steam rooms, libraries, meeting rooms, fountains, and other amenities. All were enclosed in formal gardens.

With the fall of the Roman Empire, the bath was no longer an important part of daily life and disappeared for centuries. But people were not dirty in medieval times, only their attitudes changed. Private and public baths were used for meetings, eating, drinking and sometimes gambling. People washed, had their hair dressed and generally enjoyed their time in the sauna. This inevitably encouraged the brothel culture, which was at the time much criticized by the church.

2.3 Middle Ages

Through the Middle Ages, from fifth to fifteenth centuries, bathing was not a common activity and little attention was given to personal hygiene. There was a similar fear that water was a carrier of disease and high class society embraced perfumes as replacements. The spread of diseases and the tightening of church policy eventually closed down communal baths in Europe. Sanitation in general suffered during the Middle Ages (Beamish, et al. 2013). Few, if any, advances were made in devices to collect waste. Without a sewer system or other disposal methods, chamber pots were usually emptied out the windows. Sometimes that meant pouring waste onto the streets below and often onto people using the streets. Water for domestic use was drawn from the closest water supply, which could easily be contaminated by free-flowing waste. During the Middle Ages, there was an awareness of the link between sanitation and disease. But no real effort was made to improve the circumstances (Newman 2001). There is indication of flushing toilets as early as the sixteenth century. Sir John Harington designed and invented the first flushing toilet with a reservoir. Harington worked from drawings by the Italian architect, Barozzi da Vignola. He also was the godson of Queen Elizabeth I and when she visited shortly after he had fitted it and saw his closet, she was so impressed that she asked him to make an exact copy for Richmond Palace (Palmer 1973). The toilet was fitted in his house in 1592, but this did not turn out to be common until the explosion of innovations and patents in the mid-nineteenth century that corresponded with the Great exhibition of 1851 in London (Palmer 1973). The large quantity of ceramic

industries, which had developed through the industrial revolution, began to turn their fabrication to bathroom products which had earlier been produced in wood and metal. The origin of Islam can be traced back to seventh century Saudi Arabia ("Who is God?" All About GOD Ministries n.d.). Under Islamic rule, Islamic bath or Ḥammam in Arabic was established, public bathing developed in countries that reflects the fusion of an original Eastern bath tradition and the elaborate Roman bathing process. In Islamic culture, bathing was part of a purification ritual attached to religious beliefs, along with a source of meditation, relaxation, and entertainment (Benrens-Abouseif 1999).

2.4 Seventeenth, Eighteenth and Nineteenth Centuries

In the mid-eighteenth century, the benefits of washing the body with water were not believed in. Taking a bath was considered to be unhealthy. People who studied medicine at this time considered water to be poisonous for the body. They thought that dirt protected the skin against diseases and bathing would remove this protection (Bonneville 2002). This point of view changed at the end of the eighteenth century with the French philosopher Jean Jacques Rousseau. With the emphasis on getting “back to nature” bathing became a habit again. Doctors re-discovered the value of water for health and for cleaning the body as prevention of disease. From about 1850 onwards the bath was not concealed, only the closet and bidet being hidden or disguised. Women started to decorate their bathrooms attractively (Bonneville 2002). European immigrants brought similar beliefs about the unpleasantness and the harmful effects of bathing to America. During the seventeenth and much of the eighteenth centuries little attention was given to body care. Pioneers

who desired to bathe did so infrequently because it was so difficult. At the beginning they needed to find a container big enough to bathe in, and then carry in water and heat it. The bathroom did not become common in the average house until there was a reliable supply of running water and the accessibility of economical metal pipe and ceramic fixtures which were made possible through mass production during the Industrial Revolution. The introduction of running water made it both economical and practical to bring personal hygiene activities all into the same space. It made sense to locate a house's bathroom on the second floor because of the location of the water supply in the roof space, even though many were also on the first floor next to the kitchen. The second floor location in houses helped in providing the privacy that many people desired. The next generation of water closets (WC) was a "washout" or "wash down" design that used a remarkable amount of water to flush waste away completely because of the availability of running water (Palmer 1973). The first application of indoor plumbing for the middle class people was incorporated because of the availability of running water (Figure 2.9).

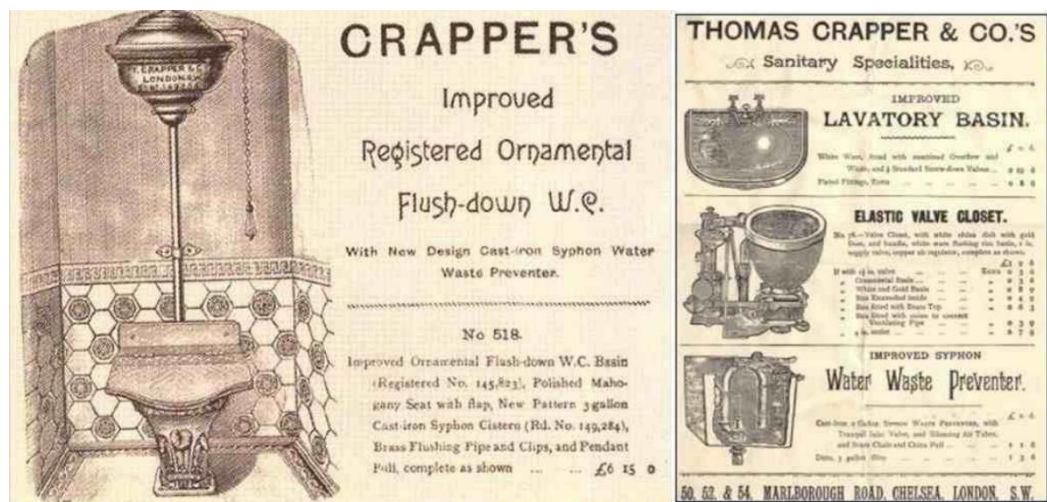


Figure 2.9 Advertisement of the early flush toilets used overhead tank to hold the water that should be used (Errol on 3oclockballcock, 2015)

The first patent for water closets (WC) was taken in 1775 by Alexander Cummings, a Scottish watchmaker. The S-shaped trap was invented by him to prevent sewer gases from entering buildings. This was considerably improved three years later by Joseph Bramah, a joiner from Yorkshire, who was granted a patent in 1778 for a double valve closet which sealed off smells (Lambton 2007).

Dealing with human waste became a cause that was embraced by social reformers, physicians, technicians and researchers in the nineteenth century. There were several systems for solving the waste problem. But it generally depended on the wealth of the community: which system was chosen. Nonetheless, in the middle of the nineteenth century, the more wealthy areas occasionally selected to have no system at all. The rich were powerful enough to prevent the implementation of sewerage systems, and sometimes did so because they feared a rise in property taxes. It was argued that the damage caused by sewage, and the cost of necessary treatment plants, were a worse evil than the systems or non-systems of earlier times (Beamish, et al. 2013).

In many towns sewerage systems were voted down. It was argued that a private problem would become a public concern, as far as the dispersal of excrement was concerned. Until mid/to late nineteenth century, cesspools, Underground hole or container for holding liquid waste from a building, were mostly used to deal with sewage. But these often leaked into the nearest stretch of water or, when not regularly emptied by “rakers” also known as “scavengers”, the people whose job it was to empty cesspools, caused soil saturation and consequent damage (Landau 2006).

Inventors worked very hard to find solutions to these problems. Reverend Moule, the inventor of the earth closet, said that W.C.s were more of an evil than a benefit because of the polluted water associated with them. Some municipalities such as

Manchester attempted to reduce this problem by discouraging the use of W.C.s. Many northern towns and cities in England continued to use dry privies due to the lack of necessary infrastructure (Palmer 1973).

Drainage was the main problem with the W.C., not only because of the waste, but also because of water pollution. Water source was also very costly and created unpopular increases to property rates. The city of Liverpool, however, set a very positive example, which many subsequently followed: the Council developed and built a water supply and sewerage system second to none in Britain, and installed it between 1847 and 1867 (Eveleigh 2003).

In 1883 the English firm T. W. Twyford created the “Unitas”, which later became known as the “Queen of Closets”. It was the first W.C., which encased the trap in one piece of ceramic and therefore was a special W.C. It became extremely successful and later became the model which set several standards on which many closets were based, (for example the height of the W.C. still used today at 420mm), including future Twyford models (Lambton 2007).

At this time Liverpool had approximately 250 miles of sewers. Water did not come cheap. Between 3% and 5% of a council tenant’s annual rent was allocated to the cost of supply. Many cities followed Liverpool’s example when the benefits became clear. Until this time, sewage from cities was mostly plumbed straight into tidal rivers.

London’s sewerage system construction began in 1859 and had an amazing 1300 miles of sewers which connected to 82 miles of main tunnels (Eveleigh 2003).

In 1895, a siphon action water closet or flushing toilets was developed that used vacuum or sucking action to more efficiently flush away the waste or excess with a

smaller amount of water. This siphonic action or flushing is used by most modern toilets (Palmer 1973).

Bathing methods also improved with the accessibility of running water. A concern about hygiene encouraged people to question how someone could become hygienic while sitting in a tub of water that developed gradually dirty as one bathed. Such concerns led to an attention in the vapor or steam bath and the shower as better options to the bath tub. The shower became promising when a method was created to pump warm water up a pipe for the overhead spray. The first shower was a simple device that used a hand pump to transfer water up a pipe over a manageable or outdoor tub. In the long run, public water supplies included enough pressure to force the water to the showerhead. Most likely the last fixture to be followed was the lavatory (Beamish, et al. 2013). The new fixture was designed much like the previous wash basin and stand, emerging as a bowl-shaped basin on a stand base with a drain in the middle (Figure 2.10).

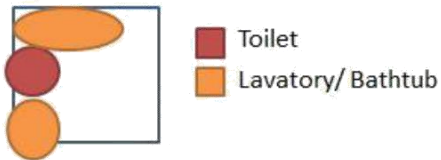
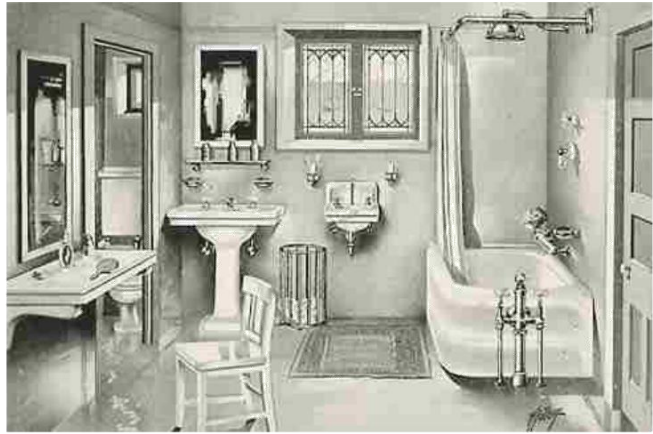
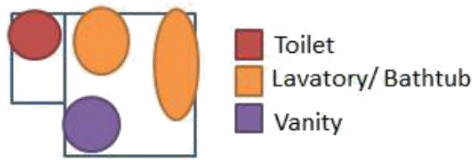


Figure 2.10 The photos are taken from magazines, books and online sources covering the early 1900's to the 1920's (1912bungalow, 2004)

The first tap used a hand pump to draw water, and later a tap with hot and cold water controls was attached. Soon the stand lavatories disappeared as cabinetry entered the bathroom, and sinks were installed into vanities that contained the much desired and needed built-in storage. This design became common by the 1950s (Eveleigh 2003).

2.5 Globalization and development of bathroom design in today's world starting the 20th century

Globalization is the ongoing process that is linking people, neighborhoods, cities, regions and countries much more closely together than they have ever been before. This has resulted in our lives being tangled with people in all parts of the world via the food we eat, the clothing we wear, the music we listen to, the information we get and the ideas we hold. Development of the Internet makes information collaborative communication faster around the world. Global cultural combination enriches the design type of bathroom products, with the closer economic integration and the impact of globalization has entered into a deeper level of human life. As one of the most dynamic groups of companies operating in the sanitary industry, Duravit AG develops and manufactures sanitary ceramics, bathroom furniture, shower trays and bathtubs, whirl and wellness systems, shower-toilets, kitchen sinks and accessories for the international market. Overall, Duravit operates with more than 30 affiliated companies and is present in almost 120 countries. Manufacture takes place in Germany and at several international locations: Egypt, China, France, India, Tunisia and Turkey (IF world design guid n.d.). Other international companies like kohler, Grohe, HansGrohe, Crestial, Toto and many more provide international products that were not available because at that time there was not much scope for the bathroom design. But now the story has taken a new turn. Every variety of national and international products has become available which is helping in boosting the bathroom design. Globalization in design is also responsible for the growing market.

Bathroom design was moving away from the lavish toward the convenient layout as it shows in figures 2.11, 2.12, and 2.13. A concern for sanitation and hygiene was dominant in bathroom design, emphasizing on maintenance and safety emerged. A foot tub, pedestal lavatory, and water closet made up the standard three-piece bathroom. The cage shower was introduced as a single shower fixture (Figure 2.14) (Beamish, et al. 2013).



Figure 2.11 Standard Bath Lavatory Bathroom, 1905 (vintageadbrowser, 2015)



Figure 2.12 Kohler of Kohler (tumblr, 2015)



Figure 2.13 Standard Sanitary Manufacturing Co Bathroom & Plumbing Fixtures (pinterest, 2015)



Figure 2.14 Bathroom Fixtures Mother Baby Standard Sanitary, 1906 (pinterest, 2015)

According to the decade of 1920's, the closed-in rectangular porcelain tub was produced. Faucets and shower controls lined up vertically under the showerhead. Pedestal lavatories were popular, as well as console lavatories supported by metal legs (Figure 2.15 and 2.16). Lavatories were often made of Monel, a corrosive resistant, light-weight, white metal containing a mix of copper and nickel. Nickel was used for bright work on faucets. White was still popular, but porcelain made it possible to add color. The color matching of vitreous china glazes and cast iron enamels was perfected. Colors included blue, green, ivory, yellow (Figure 2.24), brown, lavender, and gray. The bathroom continued to be viewed as a functional space, not for relaxation. Lighting consisted of a center ceiling lamp surrounded by milk-glass diffusers of various shapes. The first copper plumbing systems were installed late in the decade (Beamish, et al. 2013).



Figure 2.15 Standard Plumbing Fixtures (etsy, 2015)



A FOUR-FIXTURE BATHROOM BUILT AROUND THE NEW *Cosmopolitan* BATH

One of the most interesting details of this colorful room is the new Kohler *Cosmopolitan*... the bath with flatter bottom, wider rim, lower sides, K-3514-CV. Other matched fixtures which make up the foursome are the Claridge vitreous china lavatory, K-4946-F; Walcot vitreous china dental lavatory, K-3360-BA; quiet-performing siphon jet Integra closet, K-3580-A. The Kohler color is Tuscan.

The bathroom above measures 12'11" x 6". Floor and walls are 6"x12" glazed tile. Upper walls are sand blasted plate glass. Glass linen cabinet doors. Indirect lighting above the tub and in lavatory recess. Plaster ceiling is painted.

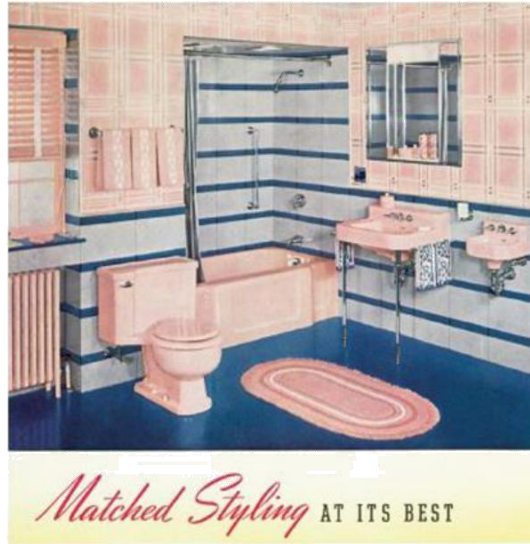


The dental lavatory should be in every home, especially one with children, as it encourages regular brushing of teeth. Relieves bathroom congestion. Shelf at back. Hot-and-cold water. www.kohler.com



Figure 2.16 Kohler of Kohler (tumblr, 2015)

In the 1940s, new colors has been introduced such as rouge (burgundy), Tuscan (gold), and spring green (light green), as well as pink (see Figure 2.17) and bright blue, emerged. By the mid-1940s, the dental lavatory disappeared from ads. The single, mixing lever for showers was available. The bench bath allowed parents to sit on the edge to watch children as they bathed (Figure 2.18). Laminates, mirrored walls, glass counters, and cork floors were trendy. Stainless steel became popular for lavatories and countertops (Beamish, et al. 2013).



Plumbing: Contemporary KOHLER
 Bench Bath, lavatory K-1000,
 BA vitrolite, brass knobs, K-1000
 brass sink, metal legs and wall
 panel base, K-1000-BL vitrolite
 chair, dental lavatory, K-1000-
 K-1000-FH overtop chair.

The problem of the two-door bathroom is here solved by grouping the fixtures closely, with all hot water outlets on the same inside wall to save on piping and protect from freezing. A Kohler Compact radiator, recessed under the window to meet cold as it enters, keeps the bathroom comfortably warm.

A true recess with dropped ceiling, lighted from above and faced with Vitrolite to ceiling height, focuses importance on the tub. Vitrolite continues around the room as a wainscot, drawing the other fixtures into the picture. Above the wainscot the walls are wallpaper, in which is repeated the Peaseblow of the fixtures.

Figure 2.17 Kohler of Kohler, 1940 (retrorenovation, 2015)



"Now all our friends want a bathroom like ours"

YOUR children will find Kohler fixtures inviting to use. Your friends will admire the matching harmony of Kohler designs. And through the years you will enjoy the durability and reliability that Kohler plumbing fixtures demonstrate in daily use—at no extra cost.

The background of Kohler knowledge, experience and a careful eye in manufacturing, brings you such advantages as the lustrous, glass-hard, easy-to-clean surfaces the non-fading, non-base of the Contemporary Bench Bath, cast for rugged strength and rigidity—along with the convenient Triton shower fitting and

Nickelken safety fire workmanship that transforms selected clays into the lovely Gramercy vitrolite chair lavatory, with its recessed shelf.

When you buy Kohler fixtures, ask to have them equipped with the Kohler chrome-plated brass fittings especially designed for them. An all-Kohler installation will assure maximum efficiency of all working parts. Consult your Kohler dealer for advice in selecting fixtures and fittings, in matched sets or individual pieces, for bathroom, washroom, kitchen or laundry. Send for a free copy of booklet A-23.

Kohler Co., Kohler, Wisconsin, Established 1873.

KOHLER OF KOHLER

PLUMBING FIXTURES • HEATING EQUIPMENT • ELECTRIC PLANS

Figure 2.18 Kohler of Kohler, 1949 (retrorenovation, 2015)

In the 1950's, small lavatories called dental lavatories were marketed as a means to help children practice dental hygiene (Figure 2.19). A foot tub, pedestal lavatory, and water closet made up the standard three-piece bathroom. The leak-proof, one-piece shower was developed. Bathrooms were lit by a single, flush-mounted ceiling fixture in the center of the room, which remained the norm until the 1970s (Beamish, et al. 2013).

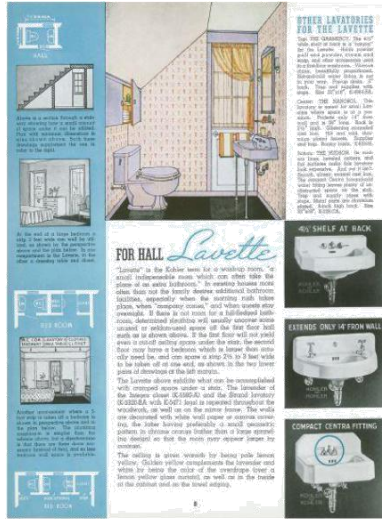


Figure 2.19 The “lavette,” later called the powder room, was marketed by Kohler as a way to incorporate an extra bathroom by converting small spaces, such as bedroom closets and spaces under stairs, into a small bathroom (tumblr, 2015)



Figure 2.20 Standard Plumbing Fixtures (ebay, 2015)

New bathrooms in the 1960’s were more luxurious and second bathrooms were promoted. The idea of relaxation was finally coming back to the bathroom. Ads portrayed hometown girls and happy moms relaxing in the bathroom (Figure 2.21 and 2.22). Bold colors emerged, including orange, bright yellow, deep red, dark brown, dark green, avocado green and harvest gold (Figure 2.23) (Beamish, et al. 2013).



Figure 2.21 Kohler of Kohler (pintrest, 2015)



Figure 2.22 Kohler of Kohler (gogd.tjs-labs, 2015)



Figure 2.23 Kohler of Kohler (pintrest, 2015)

The bathroom started to gain its status as a place of relaxation. In 1975 Villeroy & Boch was created bathroom design almost revolutionary when they gave the public a design based on ergonomic principles and imaginative soft shapes and tailored to the body (Villeroy & Boch 2012). The double lavatory was an important selling point in new houses. The nostalgic look reappeared in a vintage toilet with elevated tank and chain pull, the ball-and claw-foot tub, and pedestal lavatory. Homeowners switched to fluorescent lamps to save energy, and to track lighting to increase the amount of light. Hydromassage tubs, such as the whirlpool tub, were available. Colored fixtures were an important part of the bathroom design. Theme designs were shown for the bathroom, including the patriotic, desert southwest and Caribbean motifs. Solid surface countertops with integral lavatory were developed in 1968, but were not introduced to the builder market until 1971. Later in the decade; bathrooms were becoming a place of leisure with larger tubs for relaxation (Beamish, et al. 2013).

2.6 Historical development of bathroom design in residential buildings in the world.

Bathrooms have transformed the world we live in. Two hundred years ago, bathrooms did not exist. The bathroom's development has not been a straightforward matter, the idea of a room in a home dedicated to personal hygiene and grooming is a recent one. Houses that are built much before the turn of the century did not have bathrooms. So, in the span of about one hundred years, the modern bathroom has evolved from an innovation into a universal residential feature. On the other hand, disposing of human waste has always been a need, as well as a need for providing facilities for grooming and bathing. Those human needs evolved into the modern bathroom in both technology and culture (Buckley 2005). The first indoor bathrooms that were made possible by the modification of the toilet were communal affairs shared by many people. More rich residences might require a dedicated dressing room that contained a water closet, a portable bath, and a washstand, but this type of centralized bathroom didn't become widespread until indoor plumbing and permanent water closets gained acceptance toward the end of the nineteenth century (Landau 2006). The followings examples has been chosen to allow expanding and generalizing theories by combining the existing theoretical knowledge with new realistic insights. These examples are useful in capturing new layers of reality, and developing new valid theoretical and practical point of view.

2.6.1 House Takumi (Pictures taken by Takumi in 2014) (Takumi 2014)

This house is located Toshima, Tokyo, Japan. It was built in 2009.

Site pictures

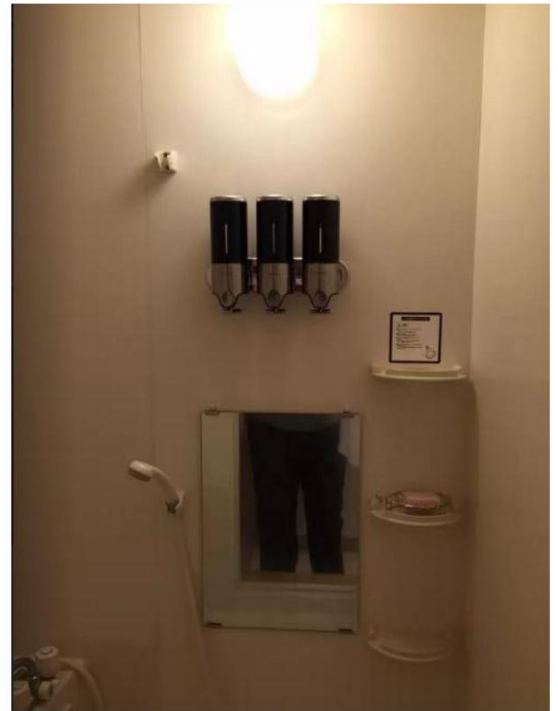


Figure 2.28 Site Pictures of the sink, toilet and bathing areas (Takumi Japan, 2014)

Lighting design

No source for natural lighting as a result it has ceiling light fixture and light fixtures over the mirror.

Evaluation

The sink, toilet, and bath are in separate rooms. Japanese bathrooms are usually wet-rooms made out of acrylic. Hooked on the top of the toilet tank, a small sink may be built. There is a tap with the top of the tank forming the sink, and the water draining into the tank which runs during the flush cycle. This is common mainly in mid-twentieth century buildings. A clothes changing room is the room with the sink, usually includes a space for a clothes-washing machine. The room which contains the bathtub is waterproof with a space for washing, and often for showering, adjacent to the tub. As a result, bathwater is neither soapy nor dirty, and can be reused.

2.6.2 House Adam (Pictures taken by Adam in 2015) (Adam 2015)

This house is located London, United Kingdom. It was built in 2009

Site pictures



Figure 2.29 Site Pictures, (Adam U.K., 2015)

Lighting design

No windows available it depends on artificial lights. It has spot lights in the ceiling and over the mirror.

Evaluation

The area of the bathroom is approximately 6 m². It includes a sink, a toilet and a bathtub, all the basic fixtures. Hard surface materials are used as a counter top and on the floor for better maintenance. As for ventilation, air conditioning system is used.

2.6.3 House Venkatesh (Pictures taken by Venkatesh in 2012) (Venkatesh 2012)

This house is located North Parramatta, NSW, Australia. It was built in 2005.

Site pictures



Figure 2.30 Site Pictures, (Venkatesh, Australia, 2012)

Lighting design

A small window is available for natural day light as well as ceiling light.

Evaluation

The area of the bathroom is approximately 7.2 m². It includes a sink, a toilet, a shower and a bathtub. Hard surface materials are used from floor to walls for better maintenance. The existence of the window allows natural ventilation.

2.6.4 House Tamara (Pictures taken by Tamara in 2014) (Tamara 2014)

This house is located New York, United States. It was built in 2005.

Site pictures

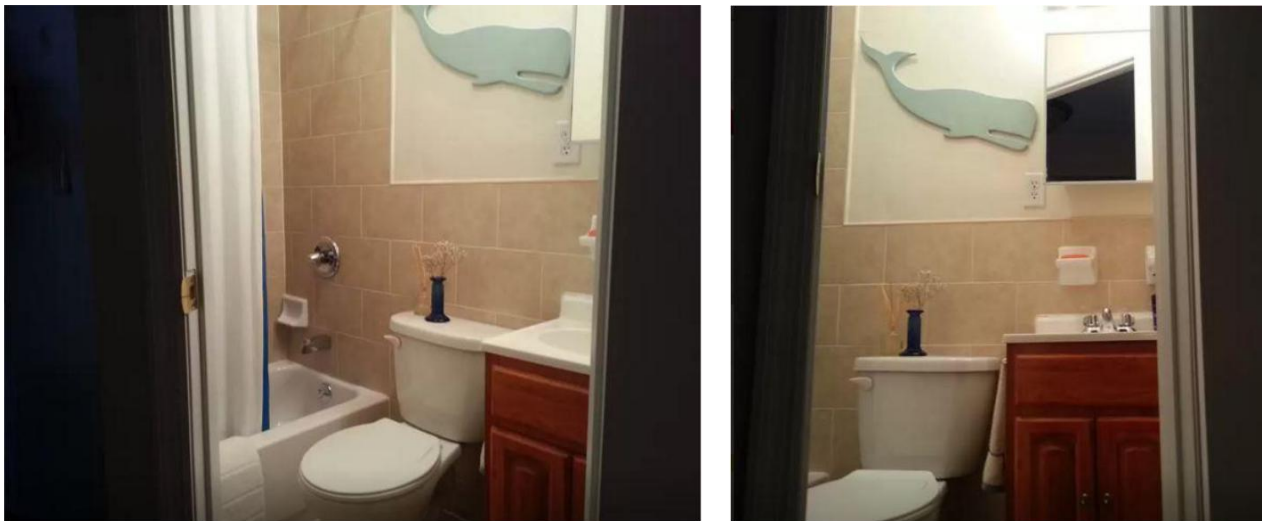


Figure 2.31 Site Pictures, (Tamara U.S.A., 2014)

Lighting design

Windows are absent in this bathroom as a result it has a ceiling light fixture.

Evaluation

The area of the bathroom is approximately 4.5 m². It includes a sink, a toilet and a bathtub, all the basic fixtures. Hard surface materials are used from floor to walls for better maintenance.

2.6.5 House Sahar (Pictures taken by Salma Mahfouz in 2014)

This house is located Cairo, Egypt. It was built in 2010.

Site pictures



Figure 2.32 Casa Apartments, (Salma Mahfouz Cairo, Egypt, 2015)



Lighting design

A small window is used for natural lighting as well as a ceiling light fixture and light fixtures over the mirror.

Evaluation

The area of the bathroom is approximately 4 m². It includes a sink, a toilet and a bathtub, all the basic fixtures. Hard surface materials are used as a counter top, on walls and on the floor for better maintenance. The existence of the window allows natural ventilation.

Evaluation of 2.6

Larger houses of this period brought additional bathrooms. Energy and water conservation features are incorporated into more eco-friendly bathrooms. Furniture pieces are taking the place of cabinetry, and contemporary styling is emerging with its clean lines and floating cabinetry. More color is coming into the bathroom, including colored bathroom fixtures and the use of more ornamental design elements. The master bath suite becomes multipurpose, incorporating space for two users and activities such as dressing, laundry, and relaxation. Feng Shui and the Asian culture are influencing bathroom designs. Jetted tubs became popular. Vessel lavatories are appearing in many styles, materials, and mounting configurations. A keen awareness of universal design is influencing bathroom design, materials, and styling. Showers are more popular than ever and are emerging as the preferred bathing method for most adults. Technology is an important part of the modern bathroom and is used for entertainment, relaxation, and grooming.

2.7 Conclusion

This chapter looked at bathroom space, its relationship and development over centuries and people's bathing cultures from a historical perspective. Since ancient time's baths introduced people how to enjoy nature in entertainment bathing process. Bathroom was intended as a place for relaxation. Thousands of years of civil engineering and social change are the result of the privacy, comfort, luxury and extreme sanitary conditions that people associate with the bathrooms today. People have always had the need to use toilet facilities and have used bathing as a way to cleanse themselves. It took centuries to bring these two important utilities together into one convenient space. A clear understanding of space and how this space will be used in order to fulfill the needs, desires and personal tastes of people, leads to a successful bathroom planning. While globalization is not a new process, it has accelerated rapidly since the late 1930's till the 1940's, and is having many effects on people, the environment, cultures, national governments, economic development and human well-being in countries around the world. Throughout the duration of the bathroom hauntings, the research has aided me in making knowledgeable decisions about the relationship between space, body, and products. In a world dominated by standardized, industrial products, the bathroom explores what an interior space designed specifically for an individual could be. Through the study of the case studies, an observation has been made about that there is great value in not standardizing a bathroom or filling it with collections of mass-produced accessories and products. Each individual bathroom could be unique on its own to suit its inhabitants, mimicking their movements, daily rituals and routines to form a space

that fits its user in comparison to the rigid geometries, aesthetics and mass-production of common domestic bathrooms and the fixtures they contain. Designing for one's individual rituals and routines allows the shape, structure, and aesthetics of one's bathroom to take on the form of the movements required to perform in that area. Because the design has taken on the form of these activities of such daily rituals and routines, the bathroom space transforms into a room that fits one's own body and accommodates activities which occur within the bathroom. Ergonomics is a new interdisciplinary field of studying the anatomy, physiology and psychology of various factors for instance, its content, method and means as scientific and technological progress, improved living standards constantly change and improve (Baixiang and Xianghua 2008). As a result, the introduction of the principles of ergonomics to the interior space design's objective is to optimize the relationships between users and fixtures. The improvement of fixtures to achieve the highest levels of effective interaction (Jun 2008), and strive to make people - machine - environment system to achieve the best combination.

3 Ergonomics, Environmental Consideration and Material Finishes in Bathroom Design

3.1 Introduction

The bathroom design environment is mainly related to the interface space shapes, sizes, toilet sound, light, electricity and thermal comfort factors. Older houses did not have an extra space, area or room that could be devoted to a complete bathroom. It was somewhat easy to add a small lavatory or toilet. But including a bathtub required a major amount of space (Eveleigh 2003). Bathrooms can be built-into a bedroom or dressing room, it was considered a waste to dedicate too much room to them, because they were supposed to be as a practical or functional space.

Sustainability is a way of life, and so is sustainability in the bathroom. A person don't need to compromise on style, quality or individuality to care for the environment. "*Act so that the effects of your action are compatible with the permanence of genuine human life*", philosopher Hans Jonas actually defined a personal understanding of sustainable building which is about fulfilling s the needs of the present and, at the same time, keeping a livable environment and healthy for future generations.

Water is the lifeblood of any bathroom. It's also a precious resource. Using it wisely is not just about how much of it we use in the bathroom. It is also about how we heat it and what products we select to deliver it. The right solution to ventilation will make an enormous difference to the feeling of the bathroom, as well as helping to use the energy more efficiently. Ventilation is especially important in bathrooms in order to remove unwanted moisture, and prevent the growth of mold and mildew.

Too much moisture in a house can result in mold, mildew, and other organic growths. This in turn can lead to a variety of negative health effects ranging from allergic reactions, asthma attacks and to more serious illnesses. In addition to health problems, severe moisture problems can result in rotting, structural damages or premature paint failure.

Since bathrooms are often the center of activity, durability is as important as design. After exploring various bathroom designs and layouts, the client should have a clear vision of what the new bathroom will look like. Most materials used in the bathroom will require an exterior finish to protect it from the environment and to improve the look of the material. Finishes are usually applied to protect the material from moisture, wear, abrasion, fungus, mold or insect attack, to change the materials appearance, its color or texture, and to enhance the materials durability, surface hardness or other properties. Bring bathrooms to life with finishes for instance: ceramic tiles, granite countertops and vanities, Corian vanities, travertine sinks, porcelain sinks, stainless steel sinks and more.

3.2 Application of Ergonomics in Bathroom Design

The first complete bathrooms belonged to the wealthy, who usually converted an extra bedroom into a bathroom (Beamish, et al. 2013). Better-quality houses were built, by the mid-nineteenth century, with a separate bathroom. Even though it was possible to obtain hot and cold running water by the late 1800s and early 1900s, it was still considered a luxury and it was combined only into the houses of the wealthy. The finest luxury bathrooms of the time often included a sit bath, foot bath, bidet, pedestal lavatory, siphonaction toilet, enameled tub, and shower bath with receptor

(Palmer 1973). Servants were no longer around to transfer water and perform other duties, when smaller and more functional bathrooms were introduced because they had fixtures crowded together for efficiency. It was hard during the late nineteenth and early twentieth centuries for people who did convert a room to a bathroom, because they were not sure how it should appear. So the first bathrooms were unique in layout and design. Many styles emerged during this era, including wood floorings bathrooms, with a wooden toilet container, seat, and a wooden bathtub that were massive and imposing. Some luxury rooms were heavily draped, elaborately wallpapered, and carpeted (Palmer 1973). They included marble, glass, and glazed tiles. For the middle class, however, hardwood floors in the plain, simple, hygienic bathroom with plaster walls became eventually the standard. Early in the twentieth century, the compact sanitary bathroom with its white walls and fixtures became the model of the modern bathroom. Color was the innovation that manufacturers hanged attractively to homeowners after 1925. Colors from the late twenty's forward were available at a small additional cost (Figure 3.1).

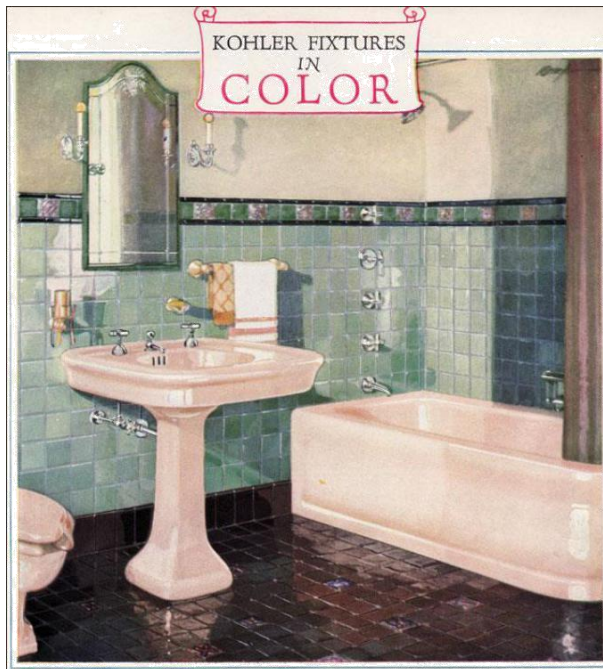


Figure 3.1 Kohler Bathroom, (antiquehomestyle, 1928)

“Pipes were left exposed, partly to show the shiny, sanitary fixtures. The early bathroom was minimal in size; a toilet, a lavatory, and a bathtub/shower were the three standard fixtures. The popularity of the bathroom increased, and more households found ways to convert a space to accommodate a bathroom” (Beamish, et al. 2013).

Today’s bathroom contains countless numbers of the basic elements of earlier bathrooms. But new technologies, materials, and lifestyles have made the bathroom into a more inviting, relaxing, and comfortable space to enjoy. Since the end of World War II, lots of awareness to the need for universal and accessible design has been growing, especially with the requirements of disabled patients, and the aging population becoming more important (Beamish, et al. 2013).

3.3 Environmental Considerations

3.3.1 Air Quality

Good indoor air quality makes a space enjoyable and healthy to be in. Part of the design process is to secure that space is pollution free. Providing good indoor air quality needs source control by minimizing or preventing the sources of indoor air pollution in a room or building. Ventilation is needed by providing adequate air exchange, through mechanical or natural ventilation, the need to dilute the absorption of indoor air pollutants and ensure that the space has a supply of fresh air; and air cleaning by when necessary. *“Filters or other devices can be used to remove potentially harmful indoor air pollutants. There are a number of sources of potential air pollution, in the bathroom”*. (European Communities 2014).

3.3.2 Water

A bathroom is a wet place. Water is used for many purposes, both functional and luxurious. In the process of using a bathroom, swallowing, inhaling and absorbing water may occur. For these reasons, the water used in a bathroom should be safe and healthy, in addition to its taste, and purity. Much of the water used in a bathroom is heated. The energy used to heat the water is also contributing in wasting water. Conserving and reducing energy to heat water are part of a sustainable house (Beamish, et al. 2013). Water used in the bathtub is largely related to the size of the tub. A tub for soaking needs to have enough water to cover most of a person’s body. Sometimes smaller, but deeper, tubs may use less water. In jetted tubs or Jacuzzis, the jets are placed lower in the tub to provide an effective massage with less water. When

designing shower systems with multiple showerheads, put individual controls on each fitting. By Adjusting showerheads, the user can then provide only the desired amount of water and it will result in reducing waste, especially of hot water. Aerators on taps are important to water conservation. With an aerator, the air added to the water flow increases the force and makes the running water seems greater. Water use is reduced. Often water is wasted in a bathroom’s lavatory tab during teeth brushing because it is inconvenient to turn the water on and off. “A method to control water is by using a tap with an electronic and motion-activator that only turns on when a hand, toothbrush, or a razor is under the tap”. In most houses, the single greatest use of water is for flushing the toilet. Older toilets may use three to five or more gallons per flush (Figure 3.2).

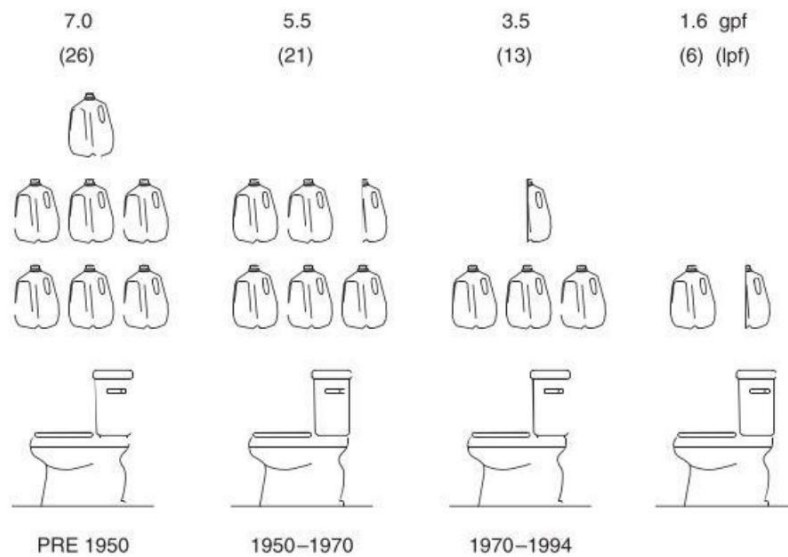


Figure 3.2 The number of gallons (liters) per flush has decreased as toilets became more efficient. *Sustainable Design Methods for Architecture* (New York: John Wiley & Sons, 2012)

“Some toilet products on the market today use even a reduced amount of water per flush. An effective flushing system reduces the likelihood that a second flush will be

used to remove all the waste. In addition to saving water, efficient and effective flushing systems reduce costs of maintenance. Some toilets have dual-flush systems that let the user choose the amount of water per flush” (U.S. Environmental Protection Agency 2014). An important factor in efficient use of water is to avoid water leaks. Toilets or taps that drip can waste great amounts of water. Selecting good quality fixtures, fittings and water-using appliances will be ways to maintain and less likely to develop leaks. This is important as water conservation measure, but will also save money and reduce maintenance for the client.

3.3.3 Moisture, Molds and Health in Bathrooms

Excess moisture is at the top of the list Moisture gets created while showering, soaking in the bathtub, using running water in the lavatory, water evaporating from the toilet bowl, and towels drying. In a new bathroom, water is available in many building products such as grout, joint compounds, plaster and latex paints. As these products dry and cure, and water vapor released. A lot of moisture can create a humid space for the bathroom user and can also lead to structural damage (Figure 3.3).

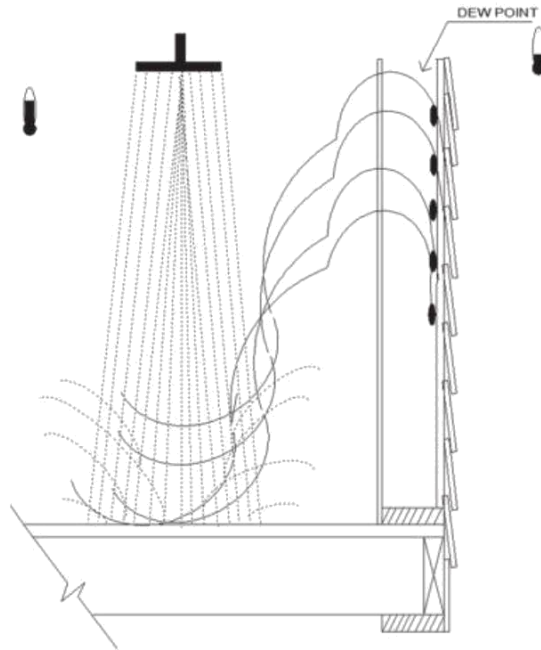


Figure 3.3 As warm, moist air moves through a wall, condensation will occur when the air is cooled to the dew point temperature. Rendered in 20-20 (Brgoch, Michael, CKD, 2015)

When the level of moisture is high in an enclosed space like a bathroom creates and fosters the growth of biological pollutants such as molds, viruses, and bacteria. As a result of Excess moisture in building materials, structural problems can occur, such as peeling paint, rusting metal and deterioration of joints and framing. Building materials that are damp tend to draw dirt and as a result it requires more maintenance and cleaning. Many organic pollutants have better chances of growth because Damp spaces make good environments. *“Viruses and bacteria grow well as dust mites to cockroaches. Further structural damage can be led by Wet building materials which also can be a factor in harboring mold. Mold can be a threat to the health. In addition, mold growing on interior finish materials smells bad and is ugly”* (U.S. Department of Health and Human Services & Housing and Urban Development 2011). Molds are fungi. There are thousands of varieties of molds, which reproduce by bacteria that are blown out into the air. The bacteria can be dormant for years. Then, given the right conditions of food and moisture, they can begin to grow. Molds

can affect people in different ways. Some people are allergic to specific species, that can cause problems such as headaches, breathing difficulties, and skin irritation, as well as aggravating other health conditions such as asthma can be caused by Molds producing chemicals. Molds can sensitize the body so that someone becomes more susceptible to health effects from future exposures. Some molds produce toxins. The likelihood of health effects increases with the amount of exposure to mold, and also depends on the sensitivity of the individual. Moisture problems can be prevented by selecting the right finish materials. The more absorbent the materials, after exposure to water and humidity the longer they will stay damp. Requiring hard surface or nonabsorbent materials such as solid surfacing, glazed tiles, engineered stone, or vitreous china reduces the likelihood problems cause by moisture (Figure 3.4).

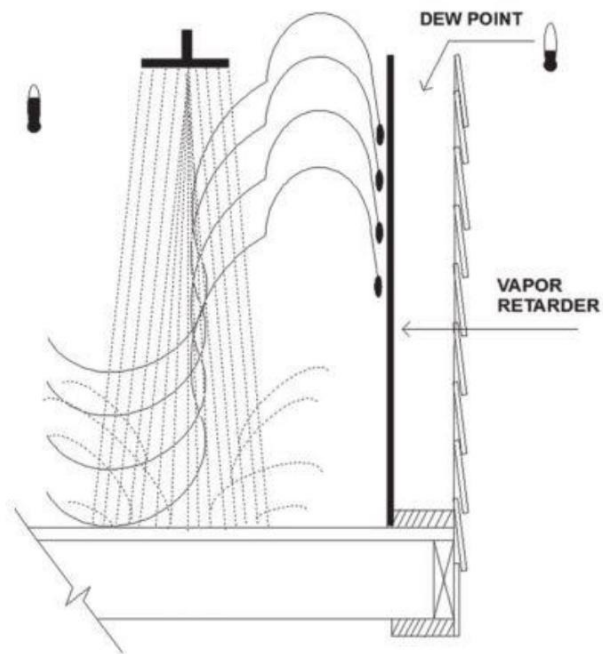


Figure 3.4 Place a vapor retarder material on the warm or interior side of the wall, to help prevent moisture condensation inside the wall, in climates with cold winters. In hot, humid climates, where air conditioning is used most of the year, the placement of the vapor retarder may be different. Rendered in 20-20 (Brgoch, Michael, CKD, 2015)

Good ventilation is absolutely necessary to prevent moisture problems and mold growth. *“Air cleaner is a system that is often incorporated into the ventilating, heating, or air conditioning system of the residence”*. Through a filtering medium, a typical air cleaner will use a fan to take air and then blow the air back into the room, or through ductwork. The importance of exhaust ventilation in a bathroom is to remove moist and possibly polluted air to the outside. Furthermore, objectionable noise in the small space of a bathroom may be created by the fan of the air cleaner (Beamish, et al. 2013).

3.4 Material Finishes

3.4.1 Floors

Bathroom floors should be of a type that can be cleaned easily, particularly in the area of bathtubs, showers, and toilets.

Ceramic tile has been used for thousands of years in a variety of house applications, but it should not be highly glazed because glazed tiles, when used on a floor; can be slippery when wet. Its advantages paired with limitless options from size, color, shape, pattern and even texture. This makes it a great choice for any style bathroom. Durability and longevity coupled with a slim price tag make this material a homeowner favorite. Foot traffic, splashes and more could not destroy these floors if they tried. Cleanup is simple by a mop, vacuum or sweep as the situation calls for it. The variety available through ceramic tiles is limitless. Tiles sizes range and nearly as diverse in shapes such as square, round, rectangle, hexagonal, oval, and even unique shapes such as fish. The range in colors and finishes are never lacking, from shiny

ebony to transparent sea-glass looking tiles. *“Constant special cleaning and sealing will help the grout lines to stay sanitary as they are often hard to keep clean. Waterproof and easy to install, but requires little maintenance over the years”* (Riggs 2008).

Porcelain tile is a durable ceramic tile; it is dense in type that does not easily absorb water or other liquids. Baked clay is the main material for both tiles and they are manufactured similarly. Therefore the strength and density of the tiles is primarily that separates the two. Porcelain tiles are much less absorbent than ceramic tiles. Porcelain tiles tend to be more expensive than ceramic tiles (Diffen n.d.).

For centuries, natural stones have been used as flooring. Marble, slate, limestone and travertine are popular, but other options are available when it comes to stone. Though the beauty is extraordinary, so is the price tag. In stone, the rich option from piece to piece is because no two cuts of stone are matching resulting this material offers the bathroom an elegant foundation. This is a beautiful feature that other materials can't imitate well. The advantages of natural stone are a timeless, classic choice is stunning floors that will last a lifetime. Cleanup is simple more like that of ceramic tile. The layers in slate sometimes peel with age, soft stones can scratch or chip and porous stones will need occasional protection with a sealer. Depending on the installation, the grout lines might not exist. Colors, styles and installation patterns are extremely diverse. It's important to choose for an improved or at least textured surface to keep it from becoming too slippery when wet. Hard rock is tough to stand long on natural stone without a rug in place (Rona Home & Garden 2015).

Cork is natural merchandise that is sustainably harvested. Fact, it comes from barque of the Sir Herbert Beerbohm Tree that is simply clipping rachis from the tree in the material used for flooring, which leaves the trees undamaged. Eco-friendly consumers prefer to purchase this product. It wasn't until recent years that cork became available in different shades and varieties patterns (Figure 3.5).



Figure 3.5 Allegro Natural cork flooring (houzz, 2015)

Cork floors are shock absorbing, easier to stand and they offer a comfort underfoot. Cork softens sounds, and brings a cozy mood to the space. *“This flooring embraces well the temperature by getting neither hot nor cold. It is as well hypoallergenic and will not absorb or attract dust”*. Suberin is the natural substance name it can resist water, mildew, mold, rot and pests. Occasionally to keep it protected, cork may need resealing with wax or polyurethane. Regular cleaning is a must because floors should stay free of dirt to keep it from damaging and scarring the surface. Small tears are

fine and will heal, but major tears may prove difficult to repair. Heavy bathroom fixtures such as a claw foot bathtub could mark the surface beyond repair (Riggs 2008).

Wood is a classical and timeless material that will never go out of fashion. Once it is properly maintained, solid wood floors can last for generations. *“Several styles for wood furnishes with the diverse types available for flooring as well as installation patterns. There are a wide variety of choices and patterns for every taste. A sense of warmth and charm is usually brought by wood floors to a space while feeling beautiful underfoot”* (Riggs 2008). It is hard to replace solid wood floors because it is a classic. It is better to avoid wood in moist areas especially it can do damage if not quickly taken care of. Knowing the type of the wood first will definitely help in avoiding certain types that can hollow or scratch easily, and needing for refinishing. Wood floors are the best shock-absorbing and it falls between cork and concrete, as different woods have different densities. It is hard to clean wooden floors because it seems to attract dust (Riggs 2008).

Laminate floors are man-made fabricated of layers of engineered material glued together. *“The upper and final layer is often a thin veneer of wood. Veneers are available in different thicknesses, the thicker the veneer, the pricier the material. Installing, maintenance and cleanup are easy. Laminate does not scratch making it a great addition to houses with extreme use or destructive children and pets”* (Riggs 2008). The general feel of the floors will not feel real but though the look closely resembles the real-deal.

Several clients said that these floors feel hollow, and noise levels on them are often high. To resist water damage, laminate floors need to be extremely sealed well in the

bathroom. If chosen a thin veneer on top, most likely it won't have enough wood to sand down and refinish, when the floors show signs of wear and tear, they will need to be completely replaced (Riggs 2008).

Vinyl used to be the cheap, tacky flooring material but not anymore. With the option of using wide sheets or individual tiles, elegant designs and finishes became available. Vinyl often copies quite well other materials like tile, stone, wood. Price is its main lead in money value, the similar look of other materials at a significantly reduced price. Installation is easy, cleanup is quick and simple, but some dirt will dock if the vinyl is textured. It is actually quite comfortable to stand on unlike other dense flooring materials. *“Vinyl needs to be waxed and/or polished from time to time because it is porous. Tiny scratches in the surfaces can be made by dirt and other contaminants, dulling its finish over time”* (Riggs 2008). Other factor that can affect vinyl is the sunlight as a result in fade and even curl, dent and bubble as it ages. Generally, durability is not its strong suit (Riggs 2008).

Linoleum is very different with vinyl; their construction and materials are distinctly different. Linoleum used to be available in the past but it is now considered as eco-friendly material and consumers are realizing its benefits. *“Vinyl flooring main substance is all natural: linseed oil, wood flour, resins and other natural materials comprise it. Linoleum is famous for its versatility”* (Riggs 2008). From any shades, tones and hues under the sun to unique installation patterns, any look can accomplished nearly with linoleum. Price wise it is affordable as well the material is durable and the maintenance is simple but color can fade and show signs of wear over the years. At the manufacturing facility, a protective coating is often applied to the surface (Riggs 2008) (Rona Home & Garden 2015).

With the explosion of the industrial-chic style came the transformation of concrete floors. the garage, basement and under other flooring materials concrete was the main material used but suddenly the focus came on it. Designers became creative in texturing, staining, imprinting, and more turn the gray cement that used to be known for into an attractive, durable flooring material. No other material can be more durable than solid concrete which is basically eternal. Easy to cleanup. Unlimited Styles can mimic other materials through the use of faux finishes (figure 3.6).



Figure 3.6 Bathroom concrete floor (bathroomflooringtileideas, 2015)

Also, concrete is the perfect subfloor, for installing tile, carpet or wood overtop. Concrete is downright cold come wintertime. It is hard on the feet; it is hard to stand long on concrete without a rug in place. *“Concrete is a porous material, which needs to be sealed to protect it from water and to keep stains away”* (Rona Home & Garden 2015).

3.4.2 Walls

Wall coverings are often used in bathrooms. Vinyl or vinyl-coated wall coverings are recommended because they are easy to wipe dry and maintain. It is important to use moisture-resistant adhesive not ordinary wallpaper paste. Only semi-gloss paint or enamels that can withstand moisture should be used on bathroom walls. Paint is the most economical choice, and specifies gloss or semi-gloss for easy cleaning and extra moisture resistance. There is a wide variety of types of paints but the best one is the acrylic paints because it's good light and weather resistance, washable, and anti-fungus/anti-bacterial. Walls should be treated to prevent possible mildew. In the shower area possibly marble, ceramic, granite tiles as solid surface or laminate materials. For a space-expanding look, these materials can extend to the rest of the bath or add interest with different wall treatments. Glass block can be used for interior walls to obtain rather modern but definitely beautiful to build half walls and to create partitions without blocking light. Wood paneling is a choice by some clients, select the kind that has been treated with a waterproof plastic finish, and choose cedar or redwood, which resist moisture better than other woods. Most of the manufactured materials used for counters can be used to cover vertical surfaces, either on the wall or as a shower enclosure. If an acrylic shower and tub surround is not used, ceramic tile is installed because of its clear quality (Riggs 2008).

3.4.3 Facilities

Bathtubs

“The typical tract-home bathroom is 1.524 meters long, 0.762 meters wide, and, in less expensive styles, only 0.3556 meters deep. Tubs that are 1.8288 meters long are available, however, for those who like to soak. Tub heights, measured from floor, may vary (0.381, 0.4064, or even 0.5588 meters). Tub heights of 4.2672 meters are convenient for bathing children. The depth figures represent the outside tub measurements, however, and allowing for the overflow pipe, a 0.3556 meters tub height does not permit the drawing of a very deep bath” (Neufert and Neufert 2012).

Many semicustom houses feature oval tubs in master baths. There are so many sizes and shapes of tubs, however, that there is no longer an “*average size*”. Many tubs come with a handle on one or both sides, which is extremely useful for the elderly or infirm. The straight end of the bathtub contains the drain and the plumbing, such as faucets or fittings, and the overflow pipe, therefore, the location of the bathtub must be decided before the order is placed. Bathtubs may be ordered with a left or right drain, all four sides enclosed the front and two sides enclosed, or the front and one side enclosed. For a completely built in look, a drop-in model may be specified. The drop-in model is sometimes installed as a sunken tub. Although a sunken tub may present a luxurious appearance, it can be difficult to get in and out of such tubs. In addition, sunken tubs can be difficult to clean. Cleaning a sunken tub means lying flat on the floor to reach the interior. Sunken or recessed tubs can present a safety hazard in that small children may crawl into the bathtub and hurt themselves or at worst drown (Beamish, et al. 2013).

Bathtubs are manufactured of several materials. The old standby is the porcelain coated cast-iron tub, which was originally a high sided bathtub raised from the floor on ball and claw feet with the underside exposed. This style is still available today in a modernized version from Kohler. Cast-iron tubs are prepared by pouring molten iron into a mold of the chosen shape, later smoothing and coating it with a thick layer of coating. It is certainly the most durable tub ever produced, and the finish is resistant to chipping, scratching and bumping, as well as most types of chemicals. Various numbers of different colors are available, and there's richness to cast-iron that's hard to match. The heavy material also tends to maintain the water's heat. The disadvantage is the weight. These tubs are extremely heavy and require extra labor and sometimes extra floor reinforcement to install. On the market, they're typically going to be among the most expensive tubs (Riggs 2008).

Porcelain on steel or coated steel is another inexpensive and very popular bathtub material. The tub is engraved from a thin sheet of steel, and then finished with a layer of porcelain coating. These tubs are durable and easy to clean. The finish is resistant to most common chemicals, and retains its gloss for a long time. It is very limited in the number of shapes and sizes that are available (Bianchina 2012).

If a cast-iron or steel bathtub is badly stained or chipped, it can be "replaced" without treating out the walls to get access to the old tub. The product that makes this possible is called "Re-Bath", a bathtub liner made of nonporous ABS (acrylonic butadiene styrene) acrylic, custom modeled to fit into any bathtub without disturbing flooring, walls, or plumbing. Re-Bath wall systems, which are designed to go over existing tile walls, and shower base liners are also available. A new overflow and drain are provided with Re-Bath tub liners (Riggs 2008).

Heavy-duty polyester reinforced with fiberglass and surfaced with gel coat can be used for bathtubs. *“In specifying this type of tub, it is important to select a brand; there are currently many poor-quality investments. Therefore, the tubs can crack easily and lose their cleansers are recommend using a coat of marine wax or a good automotive wax to restore the shine to dulled surfaces of gel-coat tubs”* (Bianchina 2012).

Another type of lightweight bathtub is acrylic reinforced with fiberglass. This type of bathtub does not have such as a high gloss as the gel-coated ones, but maintenance is easier. For reinforcement underneath, acrylic tubs use fiberglass sheets, vacuum-formed sheets of colored acrylic. Acrylic and fiberglass share the same advantages, even though acrylic tubs are more expensive. Disadvantages are that the finish can discolor or scratch with time, although this problem has been reduced to a minimum when it comes to better grades of tub finishes. Clients usually have choices of shapes, sizes and colors. Acrylic is a good all-around choice, although it may lack a certain high-end appeal for some people (Bianchina 2012).

“Fiberglass or fiberglass-reinforced plastic or FRP is typically going to be the cheapest bathtub material. A fiberglass bathtub is made by creating layers of fiberglass into the desired shape, then coating it with gel-coat resin” (Bianchina 2012). Low cost, light weight, easy installation, and a repaired finish are advantages. The problem is in the durability of fiberglass because bathtubs are thin; they bend and do not have a stable feel. Cracking, scratching and color fading are disadvantages of the final finish (Riggs 2008) (Bianchina 2012).

Soaking tubs are also made from reinforced fiberglass. Instead of sitting or resting in the tub, one sits on a molded, built-in seat, and the tub is filled to the required depth.

Some soaking tubs are recessed into the floor and the bather steps over the edge and down into the tub; others are placed at floor level and require several steps to reach to the top. Soaking tubs should not be installed in every bathroom in the house, because it is impossible to bathe small children in such tubs and the elderly or infirm will find it too dangerous to enter and leave a soaking tub. A regular bathtub should be installed in at least one bathroom in the house (Riggs 2008) (Bianchina 2012).

“Jacuzzi was the inventor of the whirlpool bath, and the name has become equal with whirlpool baths. Whirlpool baths are generally bathroom fixtures; it is a device that whirls and often heats the water, they must be drained after each use. The Jacuzzi uses continuous cast acrylic, reinforced with fiberglass for added strength. Quiet jets are placed low in the bath for the best results in hydrotherapy” (Eveleigh 2003).

These whirlpool jets create a circular pattern of bubbles as the air/water mixture flows into the tub, providing a deeply penetrating massage. Most companies manufacture a corner bath, which can be either a plain bath or more often a whirlpool. The corner location gives a feeling of openness. Tub surrounds and shower enclosures may also be reinforced fiberglass, or they may be decorative laminate, ceramic tiles, solid ABS, or solid acrylic. Many of these surrounds and enclosures have integrated tubs with built-in whirlpool systems. The all-in-one type eliminates the need to waterproof the tub surround properly is the major cause of leaks in the tub area. When designing a bathroom, the bathtub should be placed where an access panel can be installed to simplify future plumbing repairs (Eveleigh 2003) (Riggs 2008).

Cultured marble tubs are made from crushed limestone mixed with resin, then finished with gel-coat. The client has a lot of options for size, color, and style. It is

more durable when the gel-coat finish used with cultured marble than used with fiberglass. The price tag typically falls somewhere between acrylic and cast iron. Ceramic tile tubs provide more design options with this material than any other and it can be custom made on site to whatever size and shape the client desire. The grout can cause a problem if not paid attention to the application, because it is the grout that makes ceramic tile a waterproof material and it requires regular maintenance. The substrate must be exterior-grade plywood or a special water-resistant grade of gypsum board. When a cast-iron tub is used, the extra weight may cause a slight sagging of the floor. Any space caused by this settling should be sealed immediately. Solid-surface materials are relatively new arrival to the bathtub market. They are durable, retain heat well, variety of subtle, natural-looking colors, and the finish can be restored if required. Also they can be made in a variety of sizes and shapes. The disadvantage is that they are to some extent heavy and quite expensive, and may require a long lead time to get (Riggs 2008).

Technology made custom design easy, so a variety of natural stone materials were used in creating bathtubs such as marbles, granites, onyxes, travertine, basalts, sandstones and other materials. These tubs are really heavy, and require different structural framing to support their weight. Some clients prefer to custom design a wooden bathtub that can be made from teak and certain other woods. In the case of wood and some of the stones, it's going to require a lot of maintenance in order to retain the tub's original beauty (Kennon and Harmon 2011).

Showers

Showers may be installed for use in a bathtub or they may be in a separate shower stand. There should always be at least one bathtub in a house, but stand showers may be used in the remaining bathrooms. When used with a bathtub, the tub jet contains a diverter that closes off the jet and diverts the water to the shower head. A bathroom with a shower instead of a tub is designated as a three-quarter bath.

“Stand showers are 0.8636 square meters; a slightly larger 0.9144 square meters is recommended if space is available. These are minimum requirements; deluxe showers may be 1.2192 square meters or even 1.524 x 0.9144 meters wide. The larger ones usually include a seat” (Neufert and Neufert 2012).

Stand showers may be constructed entirely of ceramic tile; in other words, the sloping base and walls are all made of tile. When installing a ceramic tile shower area, particular attention should be paid to the waterproof base and to the installation procedures supplied by the manufacture. *“Other stall showers have a preformed base, shower pan or base of terrazzo or acrylic, with the surround touching the of 0.127 to 0.1524 meters deep base. This preformed base is less slippery than a base of a tile but not quite as aesthetically pleasing”* (Neufert and Neufert 2012) (Beamish, et al. 2013).

Lavatories

Lavatories are often referred to as basins, come in many sizes, shapes, and materials according to personal and space requirements. Many types of materials are used, but most lavatories are made of vitreous china. All of the following materials may be used, however: glass, cast iron, stainless steel, sculpted marble, china or ceramic, enameled steel, polished brass, or solid-surface materials. *“Lavatories are*

usually round or oval, but they may also be rectangular, or even triangular for corner installations. Sizes range from 0.2794 x 0.2794 meters for powder rooms to 0.9652 x 0.7112 meters”.

- Pedestal lavatories

Glass lavatories are available in clear glass, cobalt, and aquamarine. For a unique lavatory, a self-rimming painted ceramic washbasin may be used (Neufert and Neufert 2012) (Beamish, et al. 2013).

Taps

Many types of taps are currently available. The single handle tap was the invention of Alfred M. Moen. Center-fit tap fittings have been used ever since the 1980's. Placement of the taps depends on the design of the sink. Some sinks have predrilled holes for the taps, others require a deck-mounted style, and still others are wall mounted. Taps must be ordered after the sink has been selected. To conserve water, bathroom taps are now set to a flow of two gallons per minute. Most manufactures are using a ceramic disc cartridge inside the tap; ceramic disc cartridges are considered the most durable, especially with problem water. The cartridge helps prevent dripping, which can waste gallons of water each year. Several companies are now manufacturing taps designed as barrier free products with water conservation in mind. When the tap's electronic sensor beam is broken by the hands, water flows at the preset temperature. Savings of up to 85% over normal water usage are typical. Additional energy savings are realized because hot water is conserved.

Taps may be polished chrome, black chrome, polished brass, or even gold plated. A current trend is to use two different finishes on the same tap, such as black chrome with polished chrome and/or polished brass, or wood and brass. Brushed nickel with

brass is often used. Two finishes are often used on what is known as the ring handle. Usually chrome is the most durable finish, followed by colors and then brass. With the introduction of the PVD process, brass is now a viable choice. Translucent and metal handles have slight indentations to provide a nonslip surface. The handles may also be of a lever type. The traditional shape for jets is being replaced by a more delicately curved shape. Pull-out jets, which have previously been a feature of kitchen taps, are now used for lavatories. Wrist-control handles do not require turning or pulling but are activated by a push or a pull with the wrist rather than the fingers (Beamish, et al. 2013) (Kennon and Harmon 2011).

Toilets

There are two basic shapes to a toilet: regular or round bowl and the elongated bowl. Toilets may be wall hung, which leaves the floor unobstructed for easy cleaning, or floor mounted. *“Wall hung toilets have a wall outlet; in other words, they flush through a drain in the wall. To support the weight of a wall hung toilet, 0.1524 meters studs must be used and an L-shaped unit called chair carrier must be installed.*

Floor mounted toilets flush through the floor or the wall. For concrete floor construction, wall outlets are suggested to eliminate the extra cost of slab piercing. Another choice in the design of toilets is whether tank and bowl should be a low-profile, one-piece integral unit, or whether the tank and bowl should be in two pieces”. An old fashioned ambience can be created by using an overhead wall hung tank with a traditional pull chain. All toilets are required to have a visible water turn off near the bowl on the back wall in case of a faulty valve in the tank (Palmer 1973).

Toilet bowls and tanks are constructed of vitreous china. Only vitreous china can withstand the acids to which a toilet is subjected. Most toilets are designed with water-saving devices that are important both economically and environmentally (Buckley 2005).

Bidets

“A bidet is generally installed as a companion and adjacent to the toilet and is used for cleansing the privet area”. Bidet bowls are constructed of vitreous china; usually it comes with same model as the toilet (Beamish, et al. 2013).

Countertops

Most custom-designed bathrooms have specially designed cabinets containing the lavatory with a storage area beneath. A bathroom countertop may be made of the same materials as a kitchen counter, although marble is more frequently used in bathrooms than in kitchens (Beamish, et al. 2013). Decorative laminate for countertop use, two thicknesses are available; a choice of one or the other depends on the type of counter construction. For square-edged counters, the general-purpose grade is used. If it is necessary to roll the laminate on a simple radius over the edges of the substrate, a post-forming type is specified. The post-forming method eliminates the joint or brown line at the edge of the counter. Decorative laminate may be cleaned with warm water and mild dish soaps. Use of abrasives or special cleansers should be avoided because they may contain abrasives, acids or alkaline (Buckley 2005). Wood counters are usually made of a hard wood, such as birch or maple, and are constructed of glued strips of wood that are then sealed and coated with a varnish. Unsealed wood will permanently absorb stains. Any water accumulating around the sink should be mopped up immediately, as a wood surface can become damaged from prolonged

contact with moisture (Beamish, et al. 2013). The beauty of quartz is reminiscent of granite, but is available in a color range that expands the design options. It is twice as strong as granite, and resists staining and abrasion. It has the same certification as stainless steel (Kennon and Harmon 2011). A concrete counter may be poured on-site or at the factory. It is poured with reinforcements added and the allowed to cure. It is sally ground with diamond cutters and the sealed with several coats of epoxy. Maintenance is to apply a high-quality water based liquid wax every nine months to a year. When travertine is used as a counter material, it must be filled. Granite has become a very popular material in upscale houses. However; granite will absorb stains, and therefore should be sealed. Construction of the cabinets must be strong enough to support the extra wright of stone. Slate may be used as a counter material but it also needs to be sealed. Solid surface materials for countertops, vanities, lavatory bowls, showers, and bathtubs are becoming increasingly popular because they are multipurpose and attractive (Beamish, et al. 2013). Corian is an advanced blend of natural materials and pure acrylic polymer, and combines the smoothness of marble with the solid feel of granite and the workability of wood. Corian is manufactured as continuous cast-sheet product. *“Corian is nonporous and highly resistant to abuse; even cigarette burns, stains, and scratches can be removed with a household cleanser pad. Corian is acrylic and it can be formed to a very tight radius before the inside of the curve becomes too compresses and the outside too stretched”*. Other brands of solid-surface materials are made of polyester, which resists tight ranges. Dark colors may perform differently from light colors. Solid surface materials may have thicker, built-up edges, made by using joint adhesive, and can be

routed into a variety of decorative treatments, including bullnose edge and sandwich inserts (Kennon and Harmon 2011) (Beamish, et al. 2013).

3.5 Conclusion

The bathroom is an important part of any home. Often it is located in both private and social areas. All bathrooms are composed of a combination of insides where the major activities of the bathroom take place like: grooming, bathing/showering, and toileting.

Sustainable design benefits the client as well as the community as a whole, because allowing all human's wellbeing, now and in the future without reducing its capacity will demand a lot from the environment. Sustainability also means providing a healthy place for living, which can be practiced in many different ways. The designer who makes sustainability a priority uses various codes, standards, certifications, and guidelines to be informed and knowledgeable on products, policies, and practices. To avoid the issue of humidity in bathrooms is addressed. Bacteria and Mold growth due to extended levels of high humid areas is a major cause of allergic reactions. Good ventilation of potentially affected spaces is the main strategy to reduce this problem. The goal is always to use resources efficiently, to have a futuristic vision, and to be concerned for the health and safety of the client.

Larger houses of 2000's period brought additional bathrooms. Energy and water conservation features are incorporated into more eco-friendly bathrooms. Contemporary furniture pieces are taking place of cabinetry, and the styling is developing with its clean lines and floating cabinetry. More colors are coming into

the bathroom, including colored bathroom fixtures and the use of more ornamental design elements.

The master bathroom suite becomes multipurpose, space fit in for two users and activities such as relaxation, laundry, and dressing. Feng Shui and the Asian culture are influencing bathroom designs. Jetted tubs became popular. Vessel lavatories are appearing in many styles, materials, and mounting configurations. Bathroom design, materials, and styling are influenced by the awareness of universal design. Showers became more popular than ever and most adults prefer this bathing method. Technology became an important part of the current bathroom and is used for entertainment, grooming, and relaxation. The bathroom is one area of the house that is extremely vulnerable to water damage. Tubs, showers, toilets, and vanities deliver hundreds of water gallons on demand each day. In addition, steam and evaporating water from showers and baths significantly increase the indoor humidity. Well-designed bathrooms should include substrate materials beneath the surface finishes, which effectively manage water and moisture to prevent structural problems and resist mold growth.

4 Conclusion

The primary question of this study was about observing, evaluating and analyzing the evolution of bathrooms throughout history until it reaches its current state.

As we know it today, the bathroom space has evolved through time beginning with the early Greek and Roman bathing concepts. But it took its current shape during the seventeenth, eighteenth and nineteenth centuries. The current bathroom design is the result of the concerns for health and sanitation, the development of new materials and technologies that led to changes in lifestyles, and the installation of a dependable infrastructure for water and waste management. Lifestyle changes and technological developments continue to impact the design of our bathrooms, not only including function and accessibility, but as well the element of relaxation fostered by the early Greek and Roman civilizations. Also the religion plays an important factor in the rituals performed in a bathroom; attitudes associated with these education effects individuals and their rituals. In order to design bathrooms that meet the needs and desires of their clients, designers need to stay informed about trends as well as cultural and lifestyle changes. More than any other space in the house, a bathroom represents the intersection of form and function. Safety, efficiency, and comfort must be taken into consideration when designing a room. Practicality is not the main issue; legal and code restrictions increasingly affect the design elements that can or must be included in a contemporary or updated bathroom, which represents a huge design challenge. A great bathroom provides a comfortable, attractive, and convenient environment. It is a private retreat, where a person can tend to their needs in a relaxed and pleasant fashion. When designing a new bathroom or renovating an existing one,

style can be as significant as considering its functionality. From the choice of materials to the layout of the fixtures, the space should reflect your individuality in style from the user's perspective in choosing particular colors, textures, and patterns, without losing or forgetting that it should fulfill foremost its functionality purpose. There is at least one bathroom in the house that can be reached through a corridor. Most bathrooms have a vanity that is either semi-recessed, wall-hung, or a pedestal type, and that has a step-free shower with an adjustable shower head height. A toilet can be used by people of all abilities requirements. The growth of mold and bacteria is inhibited by good ventilation. There is at least one opening window in each bathroom, or an extraction fan in each bathroom and toilet.

The ergonomics of the bathroom is mainly studying the man/machine relationships between the environment, to design and optimization tasks, jobs, products, environment and systems to satisfy needs, capabilities and limitations. Modern interior design considers the issue of starting point and ultimate goal is for human to meet their day to day lives. For people to create the ideal interior space of the physical health and quality of the environment, it provides a beautiful, comfortable, safe, healthy and harmonious human environment. As a result, the introduction of the principles of ergonomics to the interior space design's objective is to optimize the relationships between users and fixtures. Psychologist Professor Samuel Gosling from the University of Texas studied the connection between people and their possessions. He explained that an apartment has to fill other psychological needs, such as relaxation and self-expression that might not be as easily met in a highly small space (Urist 2013).

As the literature review study of this study shows that a bathroom can be used by a diverse range of people. While doing the research, it was hard to find documented bathrooms in a chronological order as well as for new projects, the interior of the living room, the kitchen, the bedroom and even the terrace are the focus of the presentation but it's rarely to find a complete package including the bathroom. In a world dominated by standardized, industrial products, the bathroom explores what an interior space designed specifically for an individual could be. Through the study of the example studies, an observation has been made about that there is great value in not standardizing a bathroom or filling it with collections of mass-produced accessories and products.

This is only the beginning for future researches. A survey could be done to determine the rituals and time spent in a bathroom for each culture and how this could affect the bathroom design. As well further research is also required when most residential buildings will have the new trend of sustainable-technological bathroom; is technology going to make individuals custom design their rituals for their own needs.

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