The Social and Technical Development of Toilet Design

By

Sıdıka Mine AYTAÇ

**A Dissertation Submitted to the
Graduate School in Partial Fulfillment of the
Requirements for the Degree of**

MASTER OF INDUSTRIAL DESIGN

**Department: Industrial Design
Major: Industrial Design**

**İzmir Institute of Technology
İzmir, Turkey**

July, 2004

We approve the thesis of **Sıdıka Mine AYTAÇ**

Date of Signature

..... **28.07.2004**

Assist. Prof. Dr. A. Can ÖZCAN
Supervisor

Izmir University of Economics, Department of Industrial Design

..... **28.07.2004**

Assist. Prof. Yavuz SEÇKİN
Department of Industrial Design

..... **28. 07.2004**

Assist. Prof. Dr. Şölen KİPÖZ

Izmir University of Economics, Department of Fashion Design

..... **28.07.2004**

Assist. Prof. Yavuz SEÇKİN

Head of Department

ACKNOWLEDGEMENTS

I express sincere appreciation to Assist. Prof. Dr. A. Can Özcan for his guidance and insight throughout the research. Thanks go to Mr. U. Kerim Yücel, Mr. Muzaffer Öztürk, and Ege Vitrifiye Sanitarware Company and staff. The support and assistance of them gratefully acknowledged. Special thanks go to Fatma Kadı for her help throughout this study, and especially for her valuable friendship.

I would like to thank Assoc. Prof. Dr. Deniz Şengel for her assistance in detail to constitute my research. Further, thanks go to Assist. Prof. Yavuz Seçkin and Assist. Prof. Dr. Şölen Kipöz for their advice, guidance and support throughout my master study.

Special thanks go to my friend Işıl, Özlem, Nergiz, Deniz, Gözde and Bahar for their valuable support and encouragement. To my all friends at İYTE, I thank for their help and friendship.

Finally, to my parents and my brother, I offer thanks for their support, encouragement, and dedication to this study and my whole education.

ABSTRACT

"Civilization began not with the advent of written language but with the first toilet" (Horan, 1997, p. 3).

'Toilet' is a critical link. The problem of body waste disposal is a subject that has always necessarily been the prime concern for humans living in society. Considering the evolution of the toilet is important for comprehending toilet design today and especially the deficiency of it. The idea of toilet is distinctly connected with the concept of cleanliness. The theory of bacteria and the rise of scientific thought gave rise to the concept of 'hygiene' and its appearance in daily life, which in turn altered the inside view of dwellings. Toilet is a vital part of this home system, distinctly related to human and environmental factors. Basically, the toilet is a machine for mixing faeces, urine, toilet paper, and water. This machine can be equipped with a number of accessories, but whatever its shape, in fact the WC is more than an object based on the idea of disposal of flushing away and hiding or diluting something we do not want. It is obvious that the disposal of waste can only be a part of 'toilet design'.

In the history of the toilet, the main problem has remained the disposal of human waste at city level. This was assumed to be solved when the sewerage system was introduced. In fact, the world has yet to deal with environmental problems. Ecological sanitation offers a solution to toilets' share of pollution. Moreover, the addition to ecological conditions, it is important to design a toilet by thinking in a way regarding human psychological and physiological needs.

For taking toilet design a step further, this research aims to reveal criteria to solve sanitation problems by focusing on the entire mechanism including, the toilet and toilet system, which should be considered and designed to serve all needs of cultures, ages, differences as a part of everyday life, to be adopted in varies occasions adding to global needs and realities–especially to reach 'the ideal toilet'.

ÖZ

"Medeniyet yazılı belgenin bulunmasıyla değil, ilk tuvaletin ortaya çıkışıyla başladı" (Horan, 1997, s. 3).

Tuvalet kritik bir roldedir. Vücut atığının yok edilmesi, her zaman toplum içinde yaşayan bizlerin önemli bir problemi olmuştur. Tuvaletin evriminin incelenip değerlendirilmesi bugünün tuvalet tasarımını ve de özellikle tuvaletin eksikliklerini anlayabilmemiz açısından önemlidir. Fikir olarak tuvalet, 'temizlik' kavramıyla sıkı sıkıya ilişkilidir. Mikrop teorisinin ve de bilisel düşüncenin gelişmesiyle beraber, evin iç görünümünü değiştiren 'hijyen' kavramı da ortaya çıkmıştır. İnsan ve de çevresel fakrörlerle ilişkili olan tuvalet, bu ev sisteminin yaşamsal bir parçasıdır. Genel anlamında tuvalet, dışkı, idrar, tuvalet kağıdı ve de suyu karıştıran basit bir araçtır. Bu araç çeşitli aksesuarla donatılabilir. Fakat şekli ne olursa olsun, gerçekte tuvalet istemediklerimizi gizleyip yok etmekteye yarayan bir objeden fazlasıdır. Şurası kesindir ki, pisliğin yok edilmesi tuvalet tasarımının sadece bir parçasıdır.

Tarih boyunca, insan pisliğinin yok edilmesi yerleşim ölçeğinde bir problem olmuştur. Bu sorunun, kanalizasyon sistemlerinin ortaya çıkmasıyla çözüme kavuştuğu düşünülmüştür. Gerçekte bugün hala bütün dünya çevresel problemlerle uğraşmaktadır. Çevresel sağlık, tuvaletin bu kirlilikteki payına bir çözüm önermektedir. Ama, bununla beraber, tuvalet tasarımının insanın fizyolojik ve psikolojik unsurlarının da göz önüne alınarak düşünülmesi gerekmektedir.

Tuvalet tasarımını bir adım daha ileri götürebilmek için, bu araştırma sağlık problemlerine bir çözüm bulmak amacıyla değişik kültürlerin, yaş gruplarının ihityaçlarını karşılayan ve yaşamın içindeki farklılıklara hizmet verebilen, global ihtiyaçlar ve gerçeklere ek olarak değişik durumlara adapte edilebilen, herşeyden önemlisi ideal tuvalet fikrine ulaşmayı hedefleyen tasarım kriterlerini ortaya koymayı amaçlamaktadır.

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“But, it is more than a Culture…”

CHAPTER 1

INTRODUCTION

1.1. Definition of the Problem

Toilet is a critical link between order and disorder, between good and bad environment. The problem of body waste disposal is a subject that has always necessarily been the prime concern for humans living in society. The processes of elimination have always been surrounded by social and personal rules that have been derived from experience and concerns about personal and group health.

The social rules vary from formal injunctions to informal ideas about the 'correctness' of what one is expected not to do. The history and life experiences have sets up with a social mapping in minds that tells us the appropriate way to behave in social settings and the parameters of acceptability giving the messages of the way; how we should behave. Cultural experiences allow us to develop the constructs by which we make divisions and finite identifications. For this reason, the way in which different cultures perceive toilets and toilet habits is necessarily part of each particular culture. But, it is sure that there can also be differences in perception depending on individual experiences and personal choices within each culture.

Apart from these sociological and psychological facts, there are also physical conditions related to human characteristics and environment realities, distinctly affects 'the idea of toilet'. Early, in the evolution of human, toilets were clearly unnecessary. The outdoors or earth was used to relieve until the permanent settlements. After the set of roots and built dwellings, the need for facilities for the disposal of waste excrement has been exposed as 'vital'. Consequently, primitive toilet facilities were created, first outside of dwellings and then eventually indoor. During the history of toilet, the main problem has stayed as the disposal of human waste at city level. It is obvious that just constructed toilet facilities inside the home or sewer systems has not ever been enough, so various methods and ideas were developed and have still been developing to deal with the situation, 'the problem of toilet'.

All these facts get the concept of toilet design more complicated and confusing under the conditions of globalization realities in every aspects. Today's design and

consumers world is a broad environment with every creative possibility; however, it is restricted with the realities of technical, economical and social facts. Designers have a role to analyze and expose all these aspects and inputs as a part of mass production to get a solution appealing to different groups of consumers, different needs and desires, and also the environmental and sociological realities. In order to reveal a path for 'toilet design', in this research, 'toilet' is observed and criticized under the consideration of universal design principles, ecological sanitation solutions, and also consumers' different psychologies.

Firstly, the idea of universal design principles is important to reach a solution, which can be adapted easily by the majority of the world population in different environments and different needs. Commonly, the approach for toilet or one design is considered for a 'regular adult population' in the age range of about 20 to 50 years, of which are fairly well known about anthropometrics, biomechanics, physiology and psychology, or attitudes and behaviors. But, the reality is completely different from this view; there are other large population groups that are deserved specific concern in society and every individual is unique and the human species is quite diverse as a group. The principles of universal design offer an opportunity to expose a path, which goes to an 'ideal' to everyone in toilet design instead of refuse diversification in population.

Secondly, it is clear that the environmental sustainability is the most important factor for the next generation in the world today. Researches on water conservation, reducing consumption of resources or recycling effort to solve global sanitation crisis about which international statistics (WHO and Unicef 2000), indicates that 2,4 billion people in the world are without any form of 'improved sanitation' and the excreta from the 5,7 billion people are discharged directly into the environment. 'Ecological sanitation' which prevents disease and promotes health, is vital as it conserves water sources eliminating consumption and preventing to contaminate by creating a valuable resource that can be productively recycled back into the environment. As a reason, the idea of ecological sanitation has become more and more important to take into consideration in toilet design because of the environmental realities.

Finally, the idea of 'ecological toilet' or 'universal toilet' is not realistic with any consideration on the consumers' behaviors, requires and especially desires. However, during the history, the disposal of human waste has been a problem in urban areas or at city level, all these are inadequate to explain people's toilet habits using decorative pots, garderobes, close-stools or the whole product variations in the market. A designed space

is more than just a configuration of materials or decorations. As the domain of lived experience, space is a container of social, cultural and political meanings. So, domestic environments and also the designed object related closely to the space have come to be regarded as signs of the occupants' characters, people have gone to great lengths to present a satisfactory account of them. Moreover, they have been driven to catalogues of domestic furnishing to find a persona. In the means of toilet design, the modern evolution of necessity today involves a wider concept and must be seen in relation to desires and needs created by new cultural models, to which a type of luxury involving high-quality and high-performance values corresponds. As a result, the toilet and also the bathroom space as a part of the house is more than a place for relieving or the disposal of human waste, in fact, it is a place to realize fantasies and especially express emotions with its basic function.

In conclusion, the WC is not only a hole on a ground or on a seat. This research aims to reveal criteria to solve sanitation problems by focusing on a whole idea, the toilet and toilet system, which should be considered and designed to serve all needs of cultures, ages, differences as a part of everyday life, to be adopted in varies occasions adding to global needs and realities–especially to reach 'the ideal toilet'.

1.2. Aims of the Study

1. The main purpose of this study is to examine the every aspects of toilet design to reveal a design path for future directions. With this aim, the study focuses on the current methods and concepts related to the 'toilet design'.

2. Understanding design approaches to waste problem, is the starting point of this study to reach a solution. For this reason, observation the concept of cleanliness and toilet design historically and culturally is a way to understand today's toilet.

3. Revealing clearly the condition of the sector is a way to realize the importance of toilet design. In order to this, the firms, the production techniques, general material use and new possibilities, and classification of fixtures are taken as a point to comprehend how future opportunities can be extended for toilet design.

4. Further step is arriving an understanding of how the current design approaches affect the toilet design. One of the main goals in design field and also in toilet concept is 'designing for everyone'. For this reason, universal design principles are observed in the means of toilet design to reach a future solution.

5. The second approach in toilet design is ecological sanitation. It is important to express that the idea of toilet is not a hole to relieve. The problem of toilet design is more complicated than finding a solution that can be adapted inside the home. Another aim of this study is to indicate that toilet is not only related to human, and also related to environment.

6. The last approach is examined to reveal non-intuitive aspects of design in toilet design as in every field of product design. It is obvious that designing a product is a multidisciplinary activity as functional, technological, economical and especially psychological criteria are all involved. In order to show this aspect, this study aims to demonstrate emotional facts, and also consumer preferences and desires in toilet design.

7. Designing toilet is a system solution. Arriving at an ideal for toilet, cluster universal design principles, ecological sanitation solutions and also consumer desires under 'the product' in the reality of production systems and sector by comparing and expressing the today's toilet appearances, is a way to reveal basic criteria of a final goal for future.

1.3. Method of the Study

This study is structured in three parts throughout the considered problem and the aims mentioned above.

Chapter 2 is for constituting a general understanding of 'toilet design', its evolution in different cultures and additionally in history. It starts with the definition of water related distinctly to the concept of cleanliness. The water, which is a tool of cleanliness, is expressed to identify its duality. The concept of cleanliness connected the water's duality, its psychological and physical facts, is explained according to its evolution in history to reach the idea of hygiene. After a simple explanation of hygiene, two basic differences about toilet habits are revealed. The concept of cleanliness and

toilet use in eastern and western cultures are emphasized to comprehend today's toilet idea in industrial design sense. In this chapter, documentation review is the method to get comprehensive and historical information.

In chapter 3, the general appearances of sector and firms are shown to understand the opportunities in design field. After this basic information, ceramics, which is current material used in sanitaryware sector, is defined and classified. After a brief explanation of the evolution of ceramics technology, in addition to the ceramics, new material possibilities are discussed in order to reach new form considerations. The idea of smart materials is mentioned as a part of new materials title. Then the main steps of toilet production are given to reach the design product, 'toilet fixtures'. In this chapter, observation is the basic way to gather accurate information about production system and technology used in toilet design.

The next chapter is a part to reveal main design concepts related to toilet design. The first title is a step to express 'Universal Design Principles' to identify different users' groups. Subtitles are classified to mention the different physical limits of various aged people. The further step under the title of 'Universal Design Principles' is the application of it in toilet space, which is constructed under the consideration of optimum space dimensions, toilet seat height, and the facilities of toilet for using and cleaning. The second main title in this chapter is 'ecological sanitation'. After giving a brief definition and its importance, the main three principles of ecological sanitation are mentioned. Then ecological sanitation is divided into two subtitles related to toilet, which affects distinctly the design concept. For this reason, the 'ecological toilet' and the 'water conservation' are mentioned in a way to identify toilet as an object not only related to human, and also related to environment. The last title of this part is 'designing for emotions', which is a point to introduce the toilet at a psychological side, consumers needs and desires.

Chapter 5 comprises the conclusion of the thesis to find an answer to the question of 'how a toilet design is taken a step further' by criticizing and showing the deficiency of toilet design according to universal design principles, ecological sanitation and psychological facts. Basically, this research is constructed by documentation review and observation.

CHAPTER 2

WATER AND CULTURE

2.1. 'Water', Its Relation to the Concept of 'Cleanliness'

Firstly, the power of water is to clean, which means to detach what sticks to people, to their clothes or to their environments. Furthermore, it can penetrate body and soul to communicate to them its own freshness, clarity, and purity. The dual nature of water shows apparently its ability to purify in addition to its cleaning facility. Water communicates its purity by touching or waking the substance of a thing and cleans by washing dirt from its surface (Illich, 1985, p. 27). Purity refers to a quality of being, when it appears on a being's surface, it is perceived as the manifestation of something deep inside. Its beauty can be lost only through a corruption at the being's core (Illich, 1985, p.28). Purification is by no means a process for which water is always needed. Because the purity that water restores and confers has a special definition of freshness and transparency to transform the innermost being. So, each immersion is a potential attempt at drowning, at transformation and obviously at rebirth in a different form. Our loss of the sense of potential drowning has also been a loss of wealth.

There is a physical memory, which survives longer than individual memory (La Cecle, "At the Mercy of the Waters," Interni Annual–Bagno, 1993–1994, p. 8). This memory is a memory of physical practices elaborated and developed by our ancestors. Our relationship with water is a part of it. The desire to abandon oneself in waters as similar to everyday ablutions restores and relaxes. But, the problem involved in our contact with water is that this contact has been imagined only as a practice related to hygiene. In Franco La Cecle's article, "At the Mercy of the Waters," 'water', however, supplies much more in so far as its capacity to threaten the integrity of our body, negating its confines and invading it is concerned. The bather subjects his or her body to a mixing of substances that prepare it for a metamorphosis; the body ceases to be individual, becoming part of a larger mass. In the water, we dissolve and mingle with the substance as an element of the world (our pores become penetrated by water). As a result, for a short time we can forget that we are separate, discrete, and detached. This is why most animistic cults place great value on water, because there is no other substance

as capable of erasing our detachment from nature (La Cecle, "At the Mercy of the Waters," Interni Annual–Bagno, 1993–1994, p. 11).

Today, our idea of water is connected to the faucet and channeled water. In his *H_2O and the Waters of Forgetfulness*, Ivan Illich explains that this is a part of the reduction of water status to H_2O. Water seen only as an instrument with which to wash as a resource like a purely economic asset enters the cycle of the economy and a cycle of scarcity. Water is considered scarce, but not precious, because we have forgotten almost everything about its substance and we are convinced that it is merely a strange, refreshing liquid. Our knowledge about water is small as well as difficult to define. The idea of water connected to the faucet and channeled water is not enough to express its unfathomable depths rooted in the most obscure myths. Water identifies the primary form of the soul, so it is possible a representation as the form of love (Barberis., "Water and the Place of Bathing," Interni Annual–Bagno, 1991–1992, p. 31).

The distinction between water's spiritual and visual function, and its pragmatic function is difficult to describe in a rational manner. In the present century psychology and the religious sciences have continued this combined tradition of acceptation what water means and the discussion about the power of water to detach and purge filth has resulted in today's hygiene concept and engineering.

2.1.1. The Practice of Cleanliness: 'Hygiene'

> "Hygiene is the practice of keeping yourself and your surroundings clean, especially in order to prevent illness or the spread of diseases" (Collins Cobuild Dictionary, 1993).

'Water' is distinctly related to the practice of 'cleanliness' attached to water in its capacity to clean and to purify. The attitude ward the use of water has shaped the history of bathing and actually toilet habits in different cultures. In the evolution of the conceptious of dirt and in the course of centuries, there is a collective imagination at work regarding the body that determines sensibilities and norms. In addition, as these images evolve, we find new rules and new constraints emerging. 'Cleanliness' is distinctly related to the images of the body, its coverings, and the physical environment. For example, the Roman hot springs can be attributed to the emergence of a new image of the body, which substantially altered behavioral patterns and social norms regarding the practice of bathing. Christianity actually destroyed the idea of bathing to abstain

from ablutions and the frequentation of dissolute pagan places such as public baths (Mibelli, “The Soiled and the Clean,” Interni Annual–Bagno, 1991–1992, p. 19). As mentioned in the article “The Soiled and the Clean”, during the Middle Ages, it is certain that the habit of bathing especially among the aristocracy was not rare, but it was common not just for reasons of hygiene and cleanliness, which meant merely the apparent whiteness of the hands, the face and the visible parts of the body. That time bathing facilities also served as a festive occasion for play and transgression.

During the fifteenth century a new form of regulation for baths went into effect in Europe, which called for distance between bodies, sexes, and places (Mibelli, “The Soiled and the Clean,” Interni Annual–Bagno, 1991–1992, p. 20), because baths were increasingly associated with places of ill repute, condemned by the church and the rules of Christian purity. So, baths were also places of urban revolt, disorder, and social instability. For this reason, in his “The Soiled and the Clean,” as Evi Mibelli mentioned that public baths were definitively closed during the sixteenth century. In addition to all these, because of the fear towards plagues, the idea of reducing occasions for contact, exchange and transmission became imperative. The public baths were a vehicle for infection, contagion and moreover, water was said to weaken the body defenses according to the medical science of the day (Vigarello, 1996, p. 135). The body was seen as absorbent, for this reason, the removal of the protective substances (dirt and oils) of the skin was thought to make it easier for the illness to attack the body. So the bath became a rarity whether public or private until the nineteenth century (Wright, 2000, p. 57).

This attitude resulted in the end of the fifteenth century, in a new form of cleanliness, which no longer concentrated on the body and no longer used water. As a result of this attitude, clothing, underclothes, accessories and perfumes became the symbol of cleanliness. The norms regarding a clean face and hands still applied (as in the Middle Ages), but the hidden parts of the body were not subject to the same sort of care. In France, in the 1600s and 1700s, the use of perfumes and powder, which absorb dirt and oil on the skin, to clean and eliminate bad odors protecting the user from the aggression of maladies accepting all as symbols of status distinguish social classes.

At the end of the eighteenth century, the use of water reappeared by the new social class, ‘burgeoisie’. The trend continued during the years at the turn of the century, when a new concept of cleanliness aimed at re-invigorating bodies as a reaction against the flabbiness and decadence of the ancient regime of the aristocracy. The establishment

was a cross between a health spa and a hygiene center. A new image of the body is in this moment recognized corresponding to this change, which frees itself from the tyranny of appearances, in favor of a concentration on health. With the Industrial Revolution and technical progress, together with progress in the science of medicine, which finally managed to deserve the name of science, the world slowly became aware of the disastrous hygienic conditions of the cities that were true open sewers and the working classes by the nineteenth century.

France, England and Germany begin sanitary reforms with the construction of baths, facilities for the poor, water supplies and sewer systems for all various cities zones between 1800 and 1900. This attention was also dictated by progress in the field of biology, which led to the notion of the microbe, the invisible carrier of disease. Cleanliness and decency did battle against vice associated with dirt and poverty, moreover, guaranteed control of the sullen, rebellious and chaotic masses made into brutes by the needs of the Industrial Revolution.

2.1.2. A Personal Hygiene Tool: 'The Bidet'

Until the 1700s, in Europe, dwellings were built without specific spaces for personal hygiene. Washing and other functions were performed with the aid of objects which could be moved from room to room or even rented; a metal tub and a certain quantity of water transported in special containers, toilet / armchairs with removable bases, for the homes of the nobility. The poor did their business outdoors, in the street. This collection of objects structured without a specific space, along with the absence of a centralized system for distributing water; represent the common panorama of the domestic hygiene at the beginning of the 1800s. During the Victorian era the privatization of personal hygienic practices began; their separation from the social, urban and domestic context, together with the birth of the notion of comfort, the education of the senses. As Raimond Riccini explains:

> Comfort is intertwined with a series of other modern constructs, such as hygiene and order, the interior, intimacy, individuality and sensibility, all belonging to the system of values and practices which began to take hold toward the end of the 1700s. A complex of public initiatives in the era of urban hygiene and in that of public health care services had, initially, ensured the survival of urban populations, improving their living conditions. Nevertheless, for what some scholars have defined as a design of social control to be fully realized, it also had

> to be transferred into the home, taking root as an everyday practice, a mentality, a widespread material culture (Barberis, Interni Annual-Bagno, 1993-1994, p. 16).

Sanitation only became known during the nineteenth century. Throughout the 1840s, the Public Health movement in England started educating the public about hygiene and cleanliness as more knowledge was acquired about dirt and its relation to infectious disease. Similar movements appeared in a number of European countries at that time. Most of them were aimed at improving sanitation and making clean water available. In the 1860s Pasteur began developing the germ theory and in the 1880s he had already identified certain bacteria. This discovery brought about a new approach to cleanliness and the notion of hygiene. It affected human behavior and many aspects of life. In the 1890s the 'Public Health Movement' took a revolutionary approach in order to encourage the public, specifically the labor class, to participate more actively in prevention of disease.

Historically the manner of performing the operations connected to personal hygiene has taken on a series of meanings and symbols, which condition them. The cultural terms of reference for human behavior are necessity and luxury. Bath fixtures and accessories were originally symbols of wealth and social prestige. When the behavior patterns of the aristocracy became socially widespread, moreover, when cultural and social norms dictated hygienic rules, the use of hygiene tools became more widespread and common. Luxury is a result of the connotation, by means of non-essential elements, of a useful object. In the means of furnishings for the bedroom, the hiding place for bath accessories from the seventeenth to the twentieth century, have determined the rules of luxurious ornamentation for tubs, washstands and also bidets. Often bath furniture of the 1700s contained, beneath the basin, a space in which to hide the bidet or the close-stool. The first bidets obviously seemed incomprehensible to all users.

Firstly the bidet appeared in France during the eighteenth century, however, the origin of it remains a mystery. The etymology of the word 'bidet' dates back to 1534, referring to a donkey or horse. In the 1700s, the bidet came to be associated with the device used to clean one's bottom after defecation. It was unknown in the 17th century, being first mentioned in 1710 when the Marquis d'Argenson was charmed to be granted audience by Mme. de Prie whilst she sat. In 1739, in a Parisian advertisement, it was expressed as 'a porcelain violin-case with four legs' (see Figure 2.1). In 1750 'bidets a

seringue' and in 1762 'a portable bidet' with removable metal legs carried in the bowl for the officers on campaign appeared. Madame de Pompadour had two described in historical documents as: "One cased in rosewood, with floral inlay, gilt bronze legs and fittings, and a bowl of tin; the other of walnut, with a cover and back-rest of red morocco with gilt nails, two crystal bottles in the back, and a bowl of porcelain" (Wright, 2000, p. 115).

Figure 2.1. Chamber bidet with structure in brass, cover in wood and porcelain basin (Interni Annual–Bagno, 1996–1997, p. 30)

After 1750, French taste swept through English society, which became more slender and elegant. This affect can be observed on furniture made by Chippendable, Hepplewhite, Shearer, and Sheraton, at least can be claimed according to their pattern books. This elegance age justifies its name focusing on the differentiation from the Bog House to the dressing room, which is the precursor of the bathroom, contained a dressing table, a close-stool, a sink, basins, mirrors, and boxes with makeup or shaving accessories, briefly all the little affairs requisite to dress and the innocent trifles of youth.

Soon the London cabinet-makers equipped dressing stands or shaving tables with additional gadgets, compartments, sliding tops, removable surfaces, raised lids to leave free space to use when changed their positions to closed, which were evaluated into transformable furniture. This furniture showed a complex view with all these gadgets turned into a seemingly simple cabinet when all pieces closed. Shearer's Lady's Dressing Stand of 1788 is described in the catalogue:

> Two drawers and sham drawers in front of a square bidet, supported by two drop feet; a glass-frame hinged to a sliding piece, and four cups; a flap to cover the basin hinged to the back of the drawer; a cistern behind to receive the water from the basin drawer; a sweep a bidet (Wright, 2000, p. 114).

Hepplewhite's Cabinet Maker's and Upholsterer's Guide of the same year shows a similar piece:

> The mirror rises on a ratchet to any desired height. There is a shallow bidet below that slides forward for use: when the bidet is closed its legs, being triangular in section, meet with the main triangular legs to form square-sectioned legs, and so hide the secret (Wright, 2000, p. 115).

Furthermore, at first the bidet kept in the dressing-closet, then it moved the bedroom when secreted in harlequin furniture. In 1783, a night table concealing a bidet appeared in Paris and just antedated Hepplewhite's. An example of the bidet concealed in furniture was pictured as the following Figure 2.2:

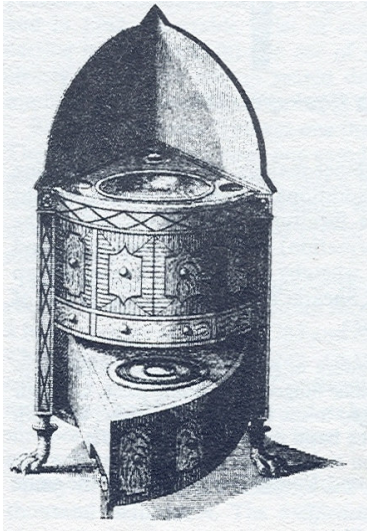


Figure 2.2. Night Bason Stand by Sheraton, 1803
(Wright, 2000, p. 113)

Around 1900, Jennings managed to combine a bidet, a footbath, a Sitz bath and a commode pail in one reversible double receptacle, as a unique example to multi-functionality (see Figure 2.3).

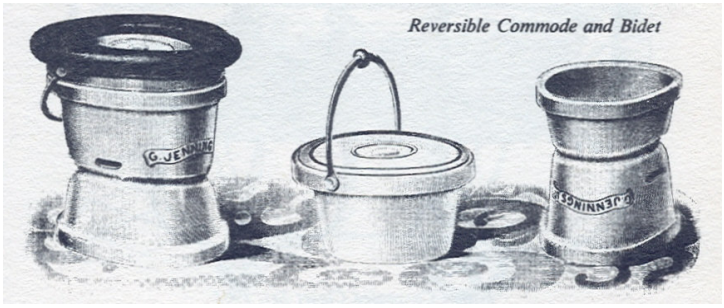


Figure 2.3. Jennings reversible commode and bidet
(Wright, 2000, p. 251)

'The bidet' quickly developed a reputation as extravagant and sexual, in addition to this; it was considered a product of French immorality and used for cleansing genitals after sex. In fact, to the most of the European cultures and especially to the English, the bidet has always carried a certain aura of Continental impropriety and has never quiet been accepted. It is found in bathroom designs of the 1900s, but then commonly in the most palatial places for a sophisticated and well-traveled few. Today, 'the bidet' preserves its use for 'genitals and perineum', in addition to these; it is also used for 'washing the feet', although manufacturers rarely remember this function and feet do not fit in the bidets on the market.

2.2. 'Cleanliness' and 'Toilet' in Turkish Culture

Examining the Turkish toilet habits conveys us to focus on the way of life and the beliefs in ancient times when the sources of nature was considered as god. For this reason, water is always vital and has played a sacred role in Turkish daily life. Most of the Turkish tribes refused to contaminate water springs that they worshipped for purifying souls with its Godliness. In addition to this, all attitudes to besmirch the water's holiness, as urinating or defecating, were punished. The Islamic author Cüveyni says; "Anyone is allowed to wash the hands in rivers or to fill the silver or golden cups. The spirit of water should not be stained with dirtiness" (Türkel, 2002, p. 83). At the crown of Cengiz Khan, venerate water accepted as law and this respect had continuously spread through all Turkish communities.

During the ancient times, culture believed 'water' created the idea of 'Ab-ı Hayat' means immortality. It is possible to observe the terms related to 'bathing' or 'toilet place' in the *Divan-ü Lügat-it Türk*, which narrates language, thoughts and the elements

of Turkish culture about 900 years until the eleventh century: “çum, yun: to bath, to plunge, çumuşluk: privy, loo or toilet.” Tribes emigrated from the middle Asia, always settled down close to the water sources: rivers, lakes, etc. The way of nomadic life defined the living space and also exposed the base of attitudes to ‘cleanliness’, which effects nowadays’ habits changing in time. In addition to bathing in stagnant water is contrary to the concept of cleanliness, bathtub or barrel never might be a great invention for bathing because of the transportation problem. For this reason, the ancient nomads used the source of nature for cleaning. The hidden places, constructed with fabric stretched over the pales or thickets, produced enough privacy to bath or to relieve, urinate and defecate.

After the adoption of Islam, the concept of ‘cleanliness’ became more important resulted as the change in the meaning of water. Islam ascribes the most sacred qualities to water as a life giving, sustaining and purifying resource. It is the origin of all life on earth, the substance from which Allah created man and *Kur’an* emphasizes its centrality: “We made from water every living thing” (in *Kur’an*, 21:30). Water is the primary element that existed even before the heavens and the earth did. “Cleanliness is half of faith”, the Prophet Muhammed tells his companions in one of the ‘Hadis’. These well-known and oft-repeated words reveal not only the central importance of purity and cleanliness, but also the essential role water plays in Islamic religion. Purification through ablution is an obligatory component of the Islamic prayer ritual; prayers carried out in an impure state are not valid. This means Muslims are obliged to carry out ritual ablution before each of the five daily prayers. In addition, a more thorough ritual is required on specific occasions.

There are two types of ablution. ‘Abdest’, the minor purification carried out before prayer, consists of washing the hands, the face, the forearms, the head and the feet. The ‘Hadis’ explain that by performing ‘abdest’ the believer washes away sin and that each drop of water that falls in the hand makes the devil flee. ‘Gusül’ is the major purification, which cleanses the whole body from impurities and is required after intercourse, menstruation, childbirth, before adopting Islam, and after death, but also before important celebrations and during the Hajj. For this reason, in Ottoman dwellings, bathing place was placed in a small cupboard called ‘gusülhane’ a solution to ablution obligatory in Islamic culture. The basic element of Turkish house planning is ‘room–oda’, where all daily life facilities like cooking, sleeping, bathing, etc. were sheltered in. The large cupboard for bedding, generally measures 75–90cm to 130-

150cm, served as ‘gusülhane’ in room (see Figure 2.4). The bottom side of the cupboard could be used to bath after the lid was lifted up. ‘Gusülhane’, which has a slopping grid floor to dispose the waste, was used as a kind of shower-tub.

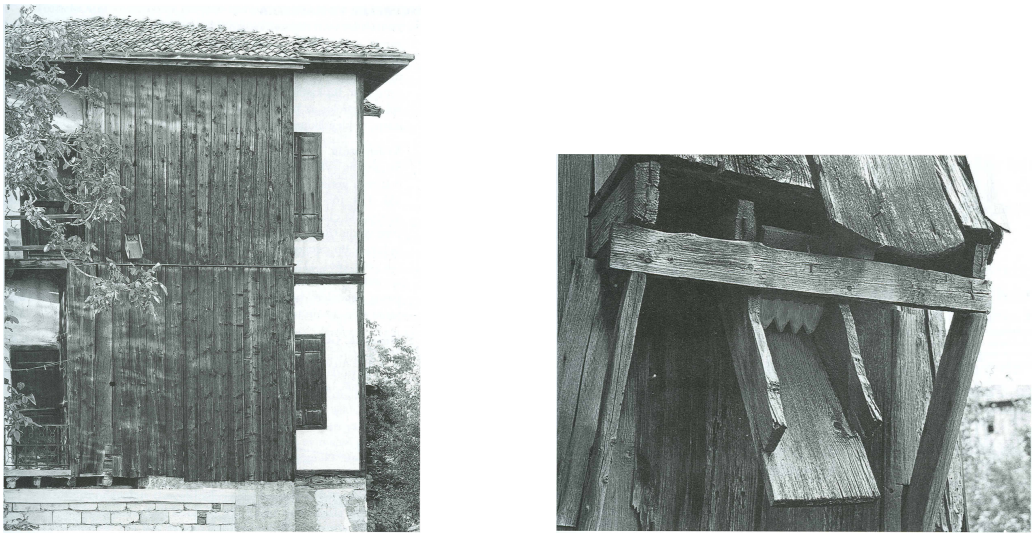
Figure 2.4. Gusülhane
(Günay, 1998, p. 268)

The physical and spiritual components of the purification ritual reflect the Islamic principle of ‘tevhid’ (unity): body and mind should be united in the performance of religious duties. Islam means that the body is the mirror of the soul, and therefore “outer stains suggest inner ones as well.” Over the centuries, water’s importance in Islamic culture has also left its mark on the design of the city. The fountains, cisterns and public baths that can still be found today in cities around the Islamic world survive as a physical testimony to the central role water plays in Muslim society. The ‘hamam’, the public bathhouse, has a long history that goes back to pre-Islamic times. While the visit to the ‘hamam’ was in the first place part of the purification ritual and moreover visited for health reasons, the steam and hot water also served medicinal purposes. Furthermore, visits to the ‘hamam’ have been generally a social event as much as a component of the religious ritual in addition to its health care. ‘Sebil’, the drinking water fountains that existed through the Ottoman Empire, were usually charitable donations from rich and powerful citizens and their water was free for all. They were more than just water sources; soon building were designed around them and they evolved to become architectural features within the urban texture and monuments to water’s holy qualities.

In Islamic culture, the privy refers to desolate space for relieving. The idea of eastern toilet was born in Syria and developed in Anatolia by Turks. In nineteenth century Ottoman Empire, the Turkish toilet was introduced in Europe with a name of 'Alla Turca'. Historically, the toilet called various names different than 'hela'; "abdesthane, ayakyolu, batığlık, kenef, kademhane, keşişhane, kirnaz, markuşhane, memişhane, memşa, mustarah, pişorhane, rahatevi, sayranyolu, taharethane, taşaşürhane, tintin."

Figure 2.5. Sultan's toilet in Topkapı Place
(http://www.theplumber.com/images/toilets-sultan.jpg)

In Ottoman Empire, cities had a sewer system called 'algun', historically the use of it dates back to Hittites' period, to collect and remove the waste from settlements. Some dwellings' channels combined or each one went through as a sole line to move the waste to the nearest stream. This sewer system, 'algun', was built with slab stones joining from side to side. Moreover, in rural areas 'pits–çirkef cukuru' were opened to dispose of waste. Water used for ablution, 'gusülhane' and kitchen was never mixed with the toilet waste. It was poured or ran directly into the garden to be absorbed by the soil preferable to be collected in a separate pit. The first periods of Ottoman Empire, the toilet was usually placed in the garden. By the development of civil architecture, toilet space had added to dwellings' plans. However, toilet in the garden contained just a hole, dwellings' toilet ventilated by a pipe or a hole on the wall opened to outside expressed different characteristics in regions by the use of various materials (wood, marble or stone).



(a) (b)

Figure 2.6. Toilet outside wall in Safranbolu, (a) Wooden wall (damba), (b) Views of wastewater outlet and soap trap (Günay, 1998, p. 269)

Before running water was installed in households, inhabitants of the Ottoman city fetched their water from fountains, cisterns or wells. Until quite recent times the ewer was the last stop in water's journey from its source to houses. Before the advent of a mains water supply, water was brought from public fountains by water carriers and poured into great water jars or raised from garden wells (see Figure 2.7). 'Ewers' were then filled with water for various purposes around the house. Moreover, ewers also placed in toilets and 'gusülhane' for cleaning and ablution (see Figure 2.9).

Figure 2.7. Saka
(Kazgan and Önal, 1999, p.15)

Figure 2.8. İbrikdar or ser-ibriki, cleaning with ewer
(Skylife, December 2000, p.214)

At the court and in wealthy dwellings, ewer bearers, called ‘ibrikdar’ or ‘ser-ibriki’, were employed to bring their masters ewers of water for washing hands and faces, performing ritual ablutions and for drinking. In ordinary homes the younger members of the family performed this task, bringing ewers and pouring water from their elders (see Figure 2.8). Since this task was regarded as almost a sacred duty, it became a ritual whose forms were taught to children from a young age.

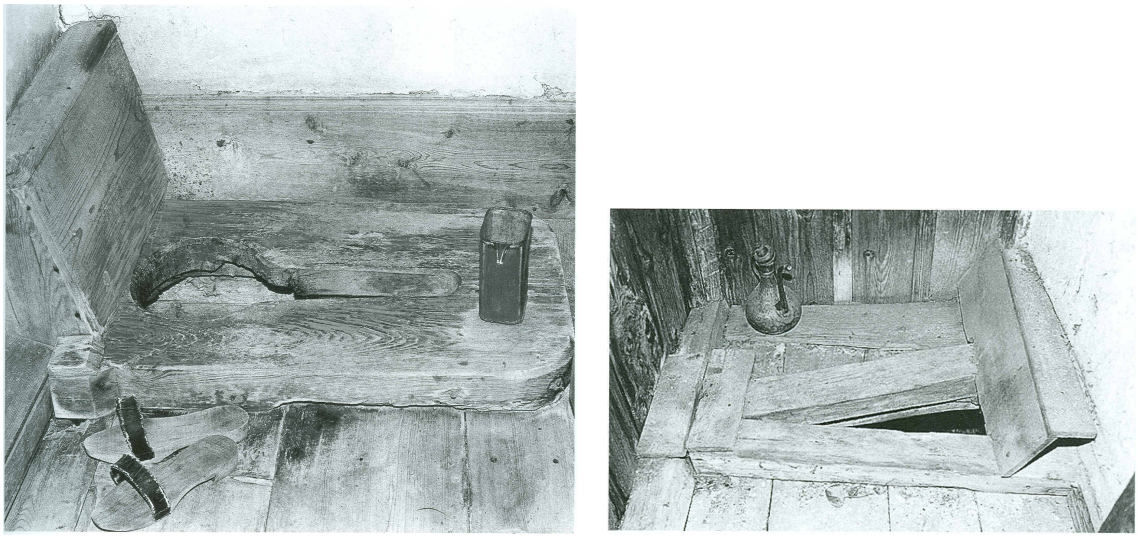
(a) (b)

Figure 2.9. Ewers, (a) A Kayseri ewer details, (b) A faceted ewer, and its basin with soap holder and strainer (Skylife, December 2000, p. 214)

Although the ewer was a vessel that had been widely used in pre-Islamic times, the central importance of ablutions in the Islamic faith lent the ewer almost spiritual significance. Thus, it became one of the most valued household objects, not only in

terms of its function for storing and carrying water, but as a symbol of purity and economy. The Ottoman Turks attached great importance to water and refused the waste of even a single drop of this precious substance.

In Islam, the ablution is required after every use of toilet, before prayer. For this reason, the space of relieving was built adjoining to ablution place to facilitate the daily life routine. ‘Abdestlik–hela’ was generally situated at the middle or upper floor by overhanging. As a very common example, in Safranbolu, ‘hela’ separated from ‘abdesthane’ with a door. The wooden hole was mostly in a triangular shape raised from the floor furnished with slabs (see Figure 2.10). This hole was connected to the pit with a square-section vertical shaft. In addition to this, it is possible that the waste could be dropped directly into the open-pit. For this reason, the middle-floor toilet and upper-floor one was never placed in the same vertical direction because of the waste drop way. The habits observed in the whole Ottoman Empire were similar in spite of the various materials use in toilet design.



(a) (b)

Figure 2.10. Turkish toilets, (a) Craved toilet out of wood, (b) Wooden toilet formed in V (Günay, 1998, pp. 267-268)

The Turkish toilet ancestors are possible to be categorized by observing the differences in forms: ‘basamaklı–raised toilet’ that the feet places were elevated from the base, ‘arkalıklı–toilet with a back’ that a back curved in different shapes were attached to the base and ‘toilets with different shaped holes’ mean that the holes of the

toilet were formed in key-hole, circle, rectangular or V. Different shaped Turkish toilets are shown in the following figure (see Figure 2.11):

(a) (b)

Figure 2.11. Turkish toilets, (a) Ottoman toilets exhibited at the Museum of Underwater Archaeology, in Bodrum (http://www.theplumber.com/images/toilets-ottoman.jpg), (b) Turkish toilet, in Amasra Museum (Arredamento Mimarlık, 05/2000, p. 131)

On the other hand, Ottoman culture had in fact been importing products of western origin since the Tulip Period (1718-1730). One could go back as far as the fifteenth century to talk about a transfer in architecture. But Ottoman upper class crossed the threshold of modernization once it formulated its own cultural change as a goal and opened it to discussion. In the modernization of Ottoman culture, the reign of Sultan Selim III and the works of architect Melling constitute the early phase, but it is early to suggest that the westernization of culture has begun. This attitude begins to change after the second quarter of the nineteenth century. The Westernization policies of the reign Mahmud II (1808-1839) make it possible for certain elements of western interiors to gain new meanings. For the Ottoman Turk, modernity is defined in terms of domestic objects. But the definition, as well as the objects and their relationship to the definition are changing. What is more significant is that a ‘dual-code’ has been established. There are two different but related codes for western and traditional artifacts and they have survived to this day. During the modernization movement of the reign of Mahmud II, western artifacts were of value as signs for public presentation or exhibition. In Ahmet Mithat's Jön Türk, a sumptuous Istanbul mansion is described with the following words:

> The interior is very rich...The error of judgment in this attempt does not elude those who understand these things; the owners of this house have destroyed the precious old architecture for want of an appreciation its worth. This endeavor to renew by destruction can even be seen in the choice of furniture. The old divans and cushions have been removed. They have been replaced by settees, armchairs and chairs. The bedrooms have been filled with bedsteads; commodes and sinks have not been forgotten. Alla turca has been totally replaced by alla franca (Habitat II, 1996, p. 293).

Around the turn of the century, schoolbooks and handbooks go beyond the mere achievement and utilization of western objects and endeavor to introduce their readers to a systematized 'contemporary dwelling and living model'. Ahmet Mithat Efendi's book of etiquette (1894) is a forerunner in this field. Many other books of similar content-introducing and defining an occidental life style-continue to appear until the middle of the twentieth century. The monumental example of this approach is *Rehber-i Umur-u Beytiyye* (A Guide to Domestic Affairs) with only three of its volumes printed between 1903 and 1911. It is a comprehensive encyclopedia of domestic arts. It presents a living standard, which is questionable even among the upper class of Ottoman society. Everything; from western style kitchen equipment to toilets, from paintings to bathrooms, from heating to furniture, from trousseaus to garden design receives mention in the guidebook.

In summary, in Turkish culture and also in Ottoman Empire, basically a toilet is a hole in the ground, isolated in general dwelling planning for privacy, similar to the 'garderobe' in western society in spite of the contrast in form and the usage of water as an element of cleanliness. Muslims pour water from the right hand into the left to clean and wipe themselves with a fabric, which is a personal hygienic tool for each. Briefly, two main characteristics of 'Turkish culture' has in fact retained and been carried today same as in the ancient times using flowing water instead of being stagnant for bathing and squatting toilet. In contrast to the view of modern bathrooms, which was imported to Turkish culture in the nineteenth century Ottoman Empire period, people has kept their toilet and cleaning habits adopted to Western culture. Moreover, it is still possible to observe both closet and squatting toilet in dwellings or a metal pipe attached to the closet for cleaning after defecating as an exception to Western toilets.

2.3. 'The Toilet': History of the Toilet in Western Culture

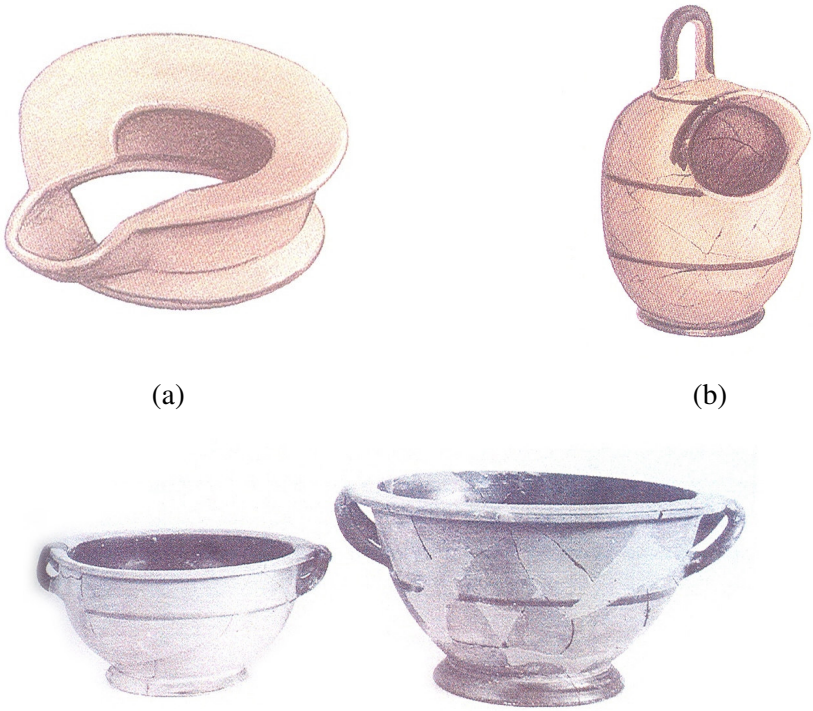
Apart from the Turkish culture, the developments of cleanliness concept and toilet design in Western culture express a different view in history.

2.3.1. Ancient Times

> "Civilization began not with the advent of written language but with the first toilet" (Horan, 1997, p. 3).

Searching for the origin of today's toilet takes us to antiquity when it is possible to observe the first traces. Evolution of the toilet is strictly connected to the settlement of sewer systems and their evolution, in addition to this, the development of social life in different cultures.

The first addresses the human waste problems are Mesopotamia and Indus Valley where the first toilets, cesspits and sewer systems emerged. Mesopotamia is known as the 'seat of sanitation'. In the middle of 3000 B.C., the excavations revealed the ancestral toilet space between the Euphrates and Tigris, which is known the earliest sample of toilet. Its seat resembled a large horseshoe, comfortably fitting around the person's posterior. In Mesopotamia, a sitting space over a cesspit used as privies for nobles, although people defecate widely into earthen pots (see Figure 2.12). The Indus Valley had a history similar to Mesopotamia's. The inhabitants of Indus Valley, Harappans, constructed homes that were hooked up to a street drain submerged in the ground. Many houses had bathrooms and water-flushed latrines. These toilet spaces and baths connected to cesspit network with drains by the way of brick-lined pits. The sewer system was covered to prevent the strong odor of waste. Each house had a bathing platform that served as a type of shower and toilet space was adjacent to the bath outside wall; this entirety presents the first modern bathroom. These spaces had brick walls and a gypsum slab floor, both rendered waterproof with mastic that made of bitumen mixing with sand and fillers. The privy provided a sitting space made of brick or wood and it emptied down to a chute into the street sewers.



(a) (b)

(c)

Figure 2.12. Earthen pots using as toilets, (a) Lasana, (b) Amis, using as urinal, (c) Lekane (Gülbay, 2003)

About 2500 B.C., a unique feature called as the ancestor of flush toilets emerged in the Island of Crete. The water-supply system consisted of a series cone-shaped terracotta pipes ingeniously interconnected (see Figure 2.13). Collected rainwater was used to supply these pipes. The shape of pipes slowed down the velocity of rushing water to prevent overflow. There were handles on pipes used to fasten them together to prevent displacement. Piped water served the bathrooms and latrines in a manner similar to modern toilets. A wooden seat with a circle hole covered an earthenware pan like a modern 'wash-out' closet with a reservoir for flushing water.

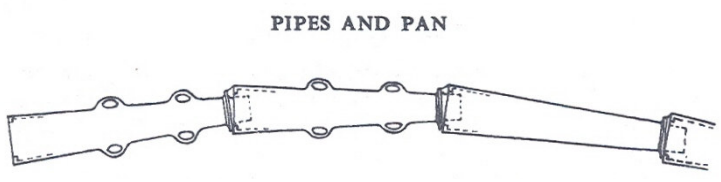


Figure 2.13. Terra-cotta pipes (Wright, 2000, p. 6)

In ancient Egypt, the privy built into the recess of the bathroom wall of a high official house revealed a keyhole shaped seat made of limestone that is similar to Mesopotamian samples. This split seat created a more comfortable fit for the buttocks and anticipated the shape of modern one (see Figure 2.14). The waste fell into a removable vase in a pit below. There was no water flushing and the wastewater went away through a channel in the wall and into a sunken vase probably used to save the precious liquid for the gardener. Another excavation made in the temple of King Suhura showed a portable washbowl shaped toilet on which decorated with metal assembled to the wall. The waste moved out with a copper pipe from the space. The Egyptians manners and customs were in an opposite way to other cultures; "the women make water standing up and the men crouching down" (Horan, 1997, p. 7). They used nature as a way to devour human and animal excrement, carcasses, offal, and other rubbish. The Inhabitants left unwanted things at the edge of desert where the hot sun quickly caused anything left under its rays to disintegrate or dumped them into to the river. All these proved that the ancient Egypt is not the place to improve the conditions of sanitation, the evolution of toilet design and sewer systems.

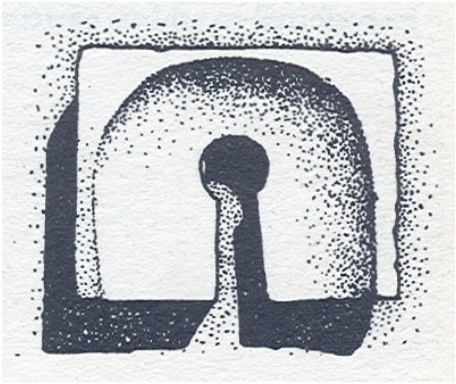


Figure 2.14. Limestone seat, Tel-el-Amara
(Wright, 2000, p. 11)

In a different part of the world, in Holy Land, the Hebrews ruled for cleanliness by the following instructions (in *Deuteronomy* 23:12):

> You shall have a designated area outside the camp to which you shall go. With your utensils you shall have a trowel; when you relieve yourself outside, you shall dig a hole with it and then cover up your excrement. Because the Lord your God travels along with your camp, to save you and to hand over your enemies to you,

> therefore your camp must be holy, so that he may not see anything indecent among you and turn away from you (Horan, 1997, p. 9).

Rabbinical Jews believed the privy was a house of unclean spirits, such as a dung-eating god. So a perfect attention had to be shown not to inhale in privy to prevent these spirits that caused diseases when they enter the bodies.

In ancient Greece, the community had a close relationship with other Mediterranean nations because of trade. They undoubtedly assimilated elements from other cultures as well as spreading many of their own ideas. However the city sanitation was not a priority, the Greeks used a system similar to Egyptian. Upper-class citizens of the Greek city latrines equipped like the Egyptian high officials. In contradiction, the Athenians emphasized on beauty set them apart from their contemporaries. The main rule managed the society was visible beauty. As a result of this, the Greeks formed the idea of beauty in the chamber pots. Because of the idleness, leaving the room to relieve oneself was too much of an effort. So they took their pots to parties or on their travels as portable toilets.

Figure 2.15. Earthen toilet for infant
(Gülbay, 2003)

During the seventh century B.C. the Etruscans, the great followers of the Greeks, left Rome the greatest sewer system, 'Cloaca Maxima', was precious in the world of sanitation. In sixth century B.C., the Etruscans built sewer trenches drained into the Tiber River that developed later into the largest sewer of the ancient times. The 'Cloaca Maxima' measured over 16 feet (488cm) wide and then was expanded by the Romans. The 7 branches, which connected to the main channel by going under the city streets,

revealed the sewer system cleaned by the pounding force of rainwater. The 'Cloaca Maxima' used 25 hundred years in modern Rome after it was built.

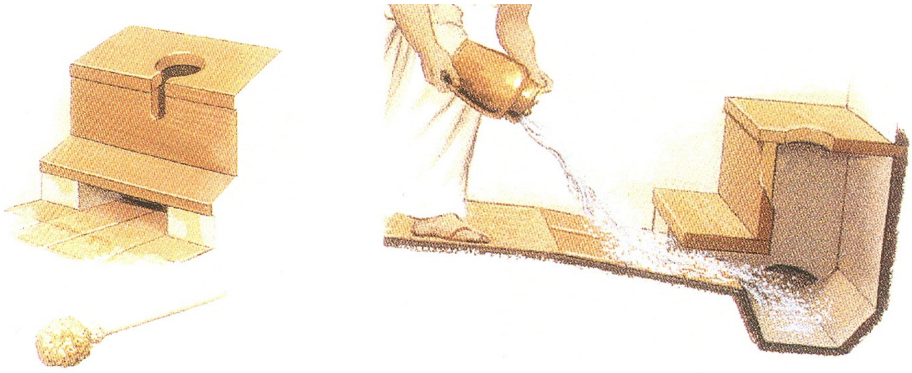


Figure 2.16. Toilet and a stick with sponge for cleansing, in Rome
(Gülbay, 2003)

In Rome, all citizens could not benefit from the sanitation system. A few privileged homes connected to city sewers by paying for permits sold by Roman officials, so which were limited to rich homeowners. The sewer system affected the life directly, people used the trenches to abolish things as unwanted babies, executed prisoners, etc. Romans rigged up the empire with chamber pots, cesspits, and latrines to control the accumulation of human excrement. Moreover, vases called 'gastra' were placed along the sides of roads and streets for travelers to relieve themselves. In addition to this, Rome also pioneered the men's public urinal, which was referred to the 'pissoir' or 'vespasienne', was placed to collect the urine for the use as dye sold by Emperor Vespasian.

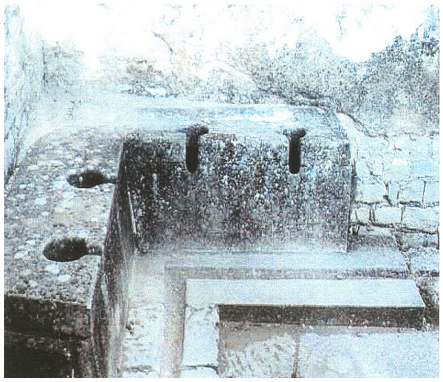


Figure 2.17. Public toilet, Latrine
(Gülbay, 2003)

Roman culture was well known because of its social spaces instead of the sanitary invention, 'the toilet'. The citizens who could not afford for the sewer relieved themselves in latrines that arranged from the simple to the luxurious similar to Roman baths. By 315 A.D. there were said to be more than 140 public latrines in the city. These public places possessed wooden or marble seats with beautifully carved dolphins separating the seats from each other to provide some privacy. However the elegance of Roman public latrines, they did not have enough sanitary facilities. Water used for cleaning was traveling in the trough that was set in front of the seats, although the waste emptied into another channel below. Clean water was recycling and the canals were being cleaned permanently. In addition to water, sticks with sponges on the end were used to wipe and the people dipped them into the trough in front. There were buckets placed in latrines to put sticks in. There is a view of latrine visualized as in the following figure (see Figure 2.18):

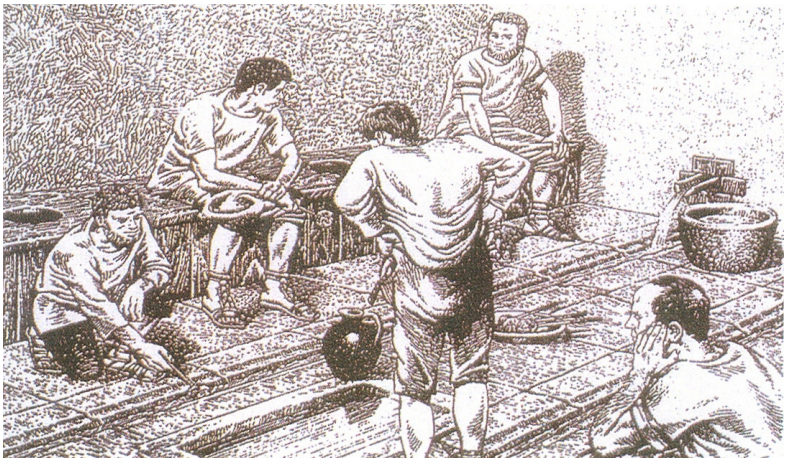


Figure 2.18. View of latrine animated toilet behaviors in Rome
(Gülbay, 2003)

Chamber pots, or simple clay jars served as the primary sanitation device. Jars would be emptied into a public cesspit or directly from the window into the streets. The city-paid sanitary workers collected the contents of cesspits and carted them away in wagons. The Roman practice of throwing the contents of urine jars out of the window was to continue for centuries. Many people fell victim to intentional or unintentional deluges from above. The Romans were practical engineers; they built houses around a courtyard with service rooms such as kitchens and latrines placed in the corners of the house. A Roman wall in Northumberland could accommodate twenty men using the

latrines at once. Even Hadrians' Wall, built in 120 A.D., had an elaborate system of stone water tanks, drains, a bathhouse and latrines. Surplus water from a tank flushed the latrines and a tap allowed an occasional more thorough flush. The main latrine measured 31ft. (945cm) by 16ft. (488cm) internally. A continuous trough went along the two sides with wooden seats above. Earthen pipes (tubuli) were common excluding wooden pipes that had tapers and socket joints were more rare.

Civilization began with strict attention to the disposal of human waste and the development of 'the toilet'. Building on the plumbing knowledge of the Etruscans before them, the Romans reached the height of their empire at the same time they reached the pinnacle of toilet evolution. The Roman occupation was not a single episode, but covered a period about equal to that between Queens Elizabeth I and II.

Besides all these examples in history, in Western Anatolia, it is possible to observe the traces of ancestral toilet. The excavation in Afyon-Ayazini Valley identified a stable toilet with a tap built about seventh century B.C., designed as a double stepped bowl and spaces carved in stones reached by steps that provide a privacy for people defecating and urinating.

In summary, the concept of 'the toilet' appeared in ancient times and has continued its evolution in times according to the technology and changes in social life. In its basic meaning, it is a sitting place with a hole to keep the waste and odor that have to be removed from the living area for hygiene.

2.3.2. Medieval Times

Examining the Medieval Times conveys us to focus on the sanitation systems in castles, monasteries, and town homes. Studying on waste disposal can answer the reason of why disease nearly wiped out an entire continent. During this period, which had been expressed as dirty days for a thousand years, Europe went unwashed because of the religion's power. The monasteries were the guardians of culture and also sanitation. They were the post-Roman pioneers of water supply and drainage.

> The early church condemned bathing, quoting St. Benedict's command that to those that are well, and especially to the young, bathing shall seldom be permitted. St. Agnes died unwashed at the age of thirteen, and a fourth century Christian pilgrim to Jerusalem boasted that she had not washed her face for

eighteen years for fear of removing the holy chrism of baptism (Wright, 2000, p. 24).

Living conditions for medieval times monasteries were rather convenient to those of the townspeople's. Their isolated life protected them from epidemics especially the Black Death plague. Although the strict rules about bathing, the monks allowed having it except in times of illness and additionally they valued efficient latrines and lavatories. Most of the monasteries were settled down next to a river to solve the waste problem by drifting it down to stream. The stream was split up if necessary, so as to flow under the 'rere-dorter', infirmary and the kitchen, and might later be covered in for secret passages, which seem to link monastery and nunnery, but are in fact old sewers of this kind. In many monasteries the 'rere-dorter' or 'sanitary wing', on an upper floor, was linked to the 'dorter' or 'dormitory' by a bridge, probably serving as the equivalent of the ventilated lobby of modern toilets. These wings were often very long-145ft. (44m) at Canterbury, and 158ft. (48m) at Lewes. Since every act of the day was subject to a strict timetable, large numbers had to be expected. At 'Furness' the seats were ranged back to back in a double row, but usually they were set against the wall in one long single row, divided by partitions and each with its window. Below was a walled-in drain that was either artificial or a natural stream perhaps diverted.

Besides elaborate water supply systems were constructed at early dates. The Canterbury Christ Church was installed underground pipes, cisterns, baths and privies. A conduit-house, a round tower, built close to the source to distribute the water by a pipe which passed through five oblong settling tanks to purify water. Each tank was controlled by a 'suspirail' or 'vent'. Passing under the city wall water ran to a laver in the monastery, which fed a tank raised on a central pillar to give a head of water. Water split into two pipes from to tank; one to the fraters' place, scullery and kitchen, the other to the bake house, brew house, guest hall and a laver near the infirmary. The bathhouse and a tank for the use of the townsfolk obtained water from further branches. The waste collected into a fishpond goes to a tank where joined by desecrate from the bathhouse and the rainwater from the roofs. There was an emergency supply in the infirmary laid in a hollow column standing on the main pipe, into which well water could be poured to keep up the supply in times of drought. Short branches called 'purgatoria' served for flushing the pipes. Adding to this great attention to efficiency of the water system, it is

possible to observe the importance of privacy in privy construction, the seats were separated by a paneled wall for the sight of a naked body.

According to an account of the monastery at Durham, there was a large, and decent place, adjoining to the west side of the said ‘dorter’, towards the water, for the monks and novices to resort to, called the ‘privies’, two great pillars of stone bearing up the whole floor. Every seat and partition was of wainscot, close on either side, so that they could not see one another when they were in that place. There were as many seats on either side as lighting with little windows in the wall. Consequently, all these evidences have proved the monks had all the facilities of modern sanitation system as saving hot water or latrines in contrast the appearance of era.

Figure 2.19. Garderobe at Count’s Castle in Ghent, Belgium
(Horan, 1997, p. 26)

Although the strict toilet routine in monasteries, the habits were more moderate in castles and manor houses. ‘Garderobe’ is generally used to describe the castle’s privy (see Figure 2.19); the small room was identified by various names in the middle ages. During the sixteenth century, the vault was known as the ‘priest’s hole’ because it was used to hide Roman Catholic priests from persecution in England. The majority of names were euphemistic terms designed to hide the purpose of the room; they included “the place of easement, the oratory, the chape, necessarium or necessary house”. The term ‘privy’ that takes its name from the Latin word for privacy became popular when the ‘garderobe’ was recognized as a place of solitude. ‘Garderobe’ was built within the

sufficient thickness of the walls; each had its own vertical shaft below a stone or wooden seat. But it was possible to form sole ‘garderobe’ within a buttress or to use an outlet to carry out the waste instead of a shaft. For each floor level a block of several might be repeated with multiple shafts grouped like chimney flues.

> At Langley Castle in Northumberland, four seats on each of three floors were so arranged, and were thought worthy of the principal tower. At Bodiam Castle there were at least twenty seats to choose from. At Southwell Palace they radiated round a central shaft, facing outward on to a circular passage: neighbors were sociably within hearing but decently out of sight (Wright, 2000, p. 47).

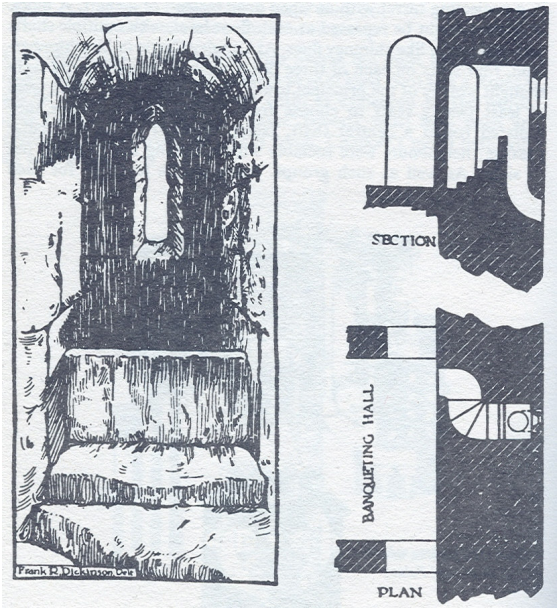


Figure 2.20. Garderobe in the Tower of London
(Wright, 2000, p. 48)

In many castles, one ‘garderobe’ was placed for each important room as one conveniently near the banqueting table in the Tower of London (see Figure 2.20). A small room, about 3ft. (91cm) wide with a narrow window, has a stone riser probably to carry a wooden seat and an open that discharged down the face of the wall into the moat, but a ruler of England, King Henry III worried about the appearance of the walls stained with the waste and ordered to built a hollow column or a flue to hide the offense. If there were no stream or moat to drift the waste away, a removable barrel or a pit placed to collect waste. It was a solution for cold to built ‘garderobes’ into chimney’s breast and this placing made possible to collect toilet waste and also the kitchen rubbish.

> We can only guess how these garderobes were furnished, but a well-appointed one, wainscoted, matted, and perhaps with 'paper wallys' and a bookshelf, could have been almost cozy. In 'The Life of St. Gregory' this is the retreat recommended for uninterrupted reading (Wright, 2000, p. 48).

In common life, the lower orders used some private latrines requiring garderobe pits, if not walled, must be at least 5-½ ft. (168cm) from the party line; if walled, 2-½ ft. (76cm) in housing ordinances of 1189. A common privy in London Wall within Cripplegate Ward at the head of Philips Lane, a 'four-holler' at Temple Pier south of Fleet Street built over the Thames and roofed in, one at Queenhithe over an open sewer and another serving the occupants of 138 houses on London Bridge were latrines of London as recorded.

In fact, during the Medieval Times waste problem solved by dumping into rivers, burying in pits, or shipping out of town to use as fertilizer in countryside. Although the convenient use of rivers as sewers, London's watercourses, the Fleet River and the Walbrook were filled the depths with faeces and blocked, so the Sherborne Lane had become known as Shiteburn Lane and Fleet River turned to Fleet Street by the effects of overhanging latrines. When the Black Death reached its climax and carried off a third of England's population about the mid-century, some attention was given to its causes. Fleet was listed among the sanitary ordinances of Edward III; no more privies were to be built over it. The 'gongfermors' or 'rakers', a deservedly well-paid trade cleaned the cities cesspits, sources of epidemics. The name 'gongfermor' comes from the Saxon word 'gang' meaning to go off, and 'fermor' from 'fey', to cleanse.

Despite 'latrines' or 'garderobes', it was common to use a pot. Early in the period the earthenware or tin chamber pots were in basic designed with a wide base, a narrow neck and an opening. Medieval residents referred to their chamber pots as 'originals' or 'jerrys'. By the sixteenth century, the discovery of Chinese porcelain changed camber pots into decorative objects. But conversely this appearance change, the pots displayed openly before were began to hide in furniture. Toward the end of the middle ages, close-stools that were consisted of a chamber pot placed inside a wood box became popular among the rich. By the end of the era, innovative devices appeared as an alternative to the Middle Ages toilet habits. In 1449 Thomas Brigthfield of the parish of St. Martin built a kind of water closet flushing by rainwater through a pipe from a cistern, but this time before invention did not include the important feature, a valve to prevent backflow and unbearable odor. In addition to this, Leonardo da Vinci's invention of folding closet

seat mentioned in his proposal for *Ten New Towns* was unique. The seat must turn round like the little window in monasteries, being brought back to its original position by a counterweight.

In summary, during the Medieval Times many European major cities were in similar situation. All evidences express an image of unbearable squalor and stench that is why this period is remembered by perfumes alleviating the smell of era.

2.3.3. Premodern Europe: 1500–1700

By the 1500s, the renaissance spread northward from Italy to whole Europe. Martin Luther's criticism of the Catholic Church resulted in the creation of rival protestant churches and the reformation of the Catholic Church. Religion lost power and royalty gained. In terms of toilets, the former hygiene practices belong to monastery changed into the flamboyantly decorated apparatuses of the privilegeds. The 'medieval type garderobe' was no longer built. In common life, chamber pots and privies continued to rule the day during the early modern European times. Chamber pots changed their crude tin or earthenware appearances were reflected by the status of users. The cardinal's chamber pot was glass with velour, a gold band with silk and tassels. Louis XIV had a gold chamber pot decorated with his royal coat of arms to use for both traveling and warfare. Additionally the appearance of the privy also indicated a change in attitude toward privacy in high society. The nobles valued the privacy offered by closed doors. The aristocracy of Europe gradually incorporated the small room into their homes.

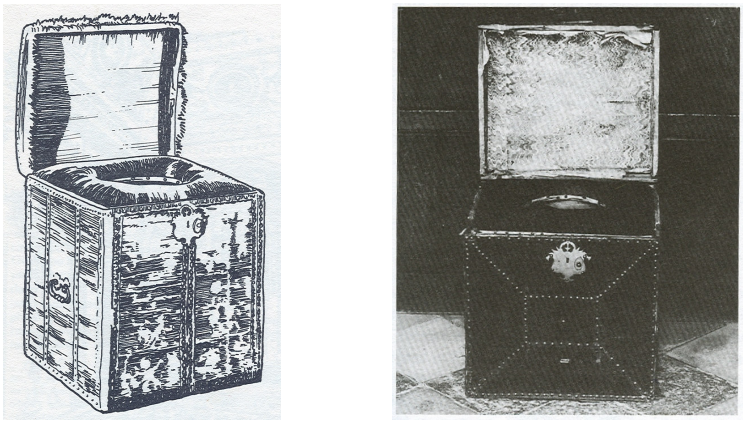


Figure 2.21. Close-stool, (a) Royal close stool at Hampton Court (Wright, 2000, p. 70), (b) Close-stool used by James II of England (Horan, 1997, p. 53)

In addition to royal chamber pots, ‘close-stools’ marked the period toilet habits (see Figure 2.21). The ‘close-stool’, was a chamber pot inside a wooden box with a lid, cozier for the user but hard on the servants. The user simply lifted the lid and sat on top of the pot in the box. Many close stools were made by the Royal Coffer Makers in London, the family of Green or Greene, prominent members of the Leather-sellers’ Company, whose names appear often in the Royal Household Accounts. The close-stool offered varies imaginative decors to hide the offending tool–pot under furnishings of various kinds. There were different use of gold and silver with engravings of birds, landscapes and Chinese motifs for close-stool makers. Moreover, velvet, crimson damask or leather cushioned the privileged rear of the stools. Louis XI of France had a ‘retraict’ in his room, an iron framework covered with curtains to screen the stool sweetening its air with ‘coq mente’ (tansy) and some herbs. A stool made in 1547 for the king’s use was covered with black velvet, garnished with ribbons, fringes and 2000 gilt nails. White ‘fuschan’ filled with down used to cover the seats and arms of the stool that was supplied with two leather cases lined with black cotton and fitted with straps, one case for the stool and one for the bowl-‘sesstornes’ or ‘cisterns’. For this reason, it seemed to use as a portable water closet for travels. A stool for Elizabeth I or James I, was covered in crimson velvet bounding with lace to secure by gilt nails, likewise has carrying handles. There was a pot under the velvet-padded seat with a lit that might be locked against illicit use.

In 1596, Sir John Harrington, a godson of Queen Elizabeth, wrote his *Metamorphosis of Ajax: A Cloacinean Satire*, describing a valve water closet of his invention, erected at Kelston near Bath. The closet had a seat with a pan, a cistern above shown with fishes in it to indicate water, an overflow pipe, and a valve or a stopple. He illustrated it with *Plan Plots of a Privy in Perfection* and completely detailed its construction, cost and maintenance:

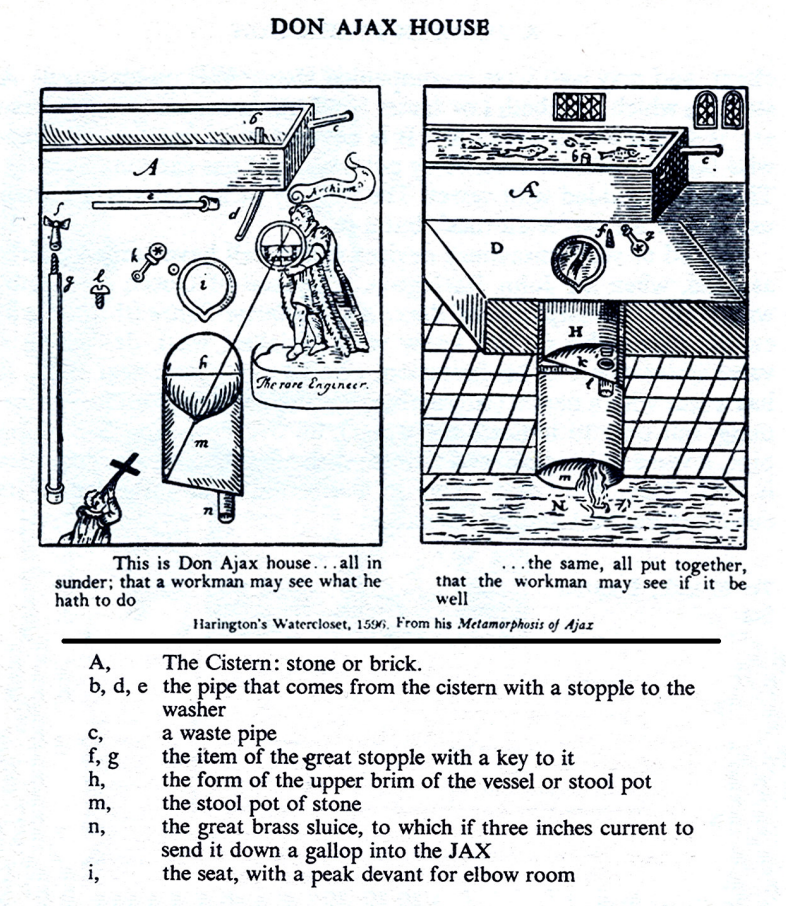


Figure 2.22. Sir John Harington's Metamorphosis of Ajax (Wright, 2000, p. 72)

The general use of valve-closet was delayed for nearly 200 years, despite Sir John Harrington's invention embodies all the features of it. The majority found it to be a vulgar device and refused its usage in daily life. But the practical reason for the failure during this period was the scarcity of water systems to support the operations of the device. Despite of these changes in toilets, the pre-modern European city dwellers continued to discharge the contents from their windows into the streets following a custom retained from Roman days for disposing of human waste. The passers-by were politely warned of the impending contents to keep themselves away from the waste. In *English Social History* G. M. Trevelyan describes a vivid picture of early morning in Edinburgh in Queen Anne's time:

> Far overhead the windows opened, five, six or ten storeys in the air, and the close-stools of Edinburgh discharged the collected filth of the last twenty-four hours into the street. It was good manners for those above to cry 'Gardy-loo!'(Gardez l'eau) before throwing. The returning roysterer cried back 'Haud yer han', and ran

> with humped shoulders, lucky if his vast and expensive full-bottomed wig was not put out of action by a cataract of filth. The ordure thus sent down lay in the broad High Street and in the deep, well-like closes and winds around it making the night air horrible, until early in the morning it was perfunctorily cleared away by the City Guard. Only on a Sabbath morn it might not be touched, but lay there all day long, filling Scotland's capital with the savor of a mistaken piety (Wright, 2000, p. 76).

In addition to this custom, some people accepted the chamber pot itself as waste. Instead of dumping the contents of the pot, they dropped it into the street. In most of the European cities, throwing human waste out the window forbade by governments. The mess accumulated in the streets cleaned by sanitary engineers or scavengers as in medieval times in England.

The plague of 1666 and the Great Fire of 1667 marked the seventeenth century England. The Great Fire destroyed many of the filthy neighborhoods harboring disease-carrying pests. The demolished portion of the city was rebuilt according to sanitary codes. The Parliament passed a regulation restricting the height of houses, width of streets and called for the construction of sewers. But in practice these regulations about the disposal of human waste has retained as a problem in Western civilization. In reality, the government regulations concerning sanitation did not take into consideration until the Victorian period.

2.3.4. The Age of Enlightenment: 1700–1800

The seventeenth century was a period of filth, epidemics including Plague and disorder, as the following of conditions in mediaeval times. By the eighteenth century improvement had begun, although the period was a mark to produce more excrement with no place to go. The 1700s was a transition before the Victorian era began. Chamber pots, close-stools and privies continued to be the disposal apparatus with changes in the idea of 'privacy'; it gained a permanent place in the expectations of eighteenth century western society.

At the end of the eighteenth century, the stool gradually lost its place of honor by an occurrence of a new attitude toward bodily functions and it was considered to be hidden inside another piece of furniture or to be ignored. The famous furniture manufactures, Hepplewhite and Sheraton, designed pieces to use as hiding places of the pots. Night tables consisted of a cabinet space were able to hold one or two chamber

pots, additionally varied in shape to place a basin and an ewer for morning wash. Made from fine wood and carved in the fashionable style of the period, the tables served as furniture for someone's excrement, but unfortunately the sickening smell could not be masked despite of good-looking appearance. A model popular in France at the time of the Dutch war was known as *Voyage au Pays Bas*, the pile of large dummy volumes that hid the secret, but the work was important to be recognizable for what it was. The shape of the furniture would have been a trick for the guest in his remote bedchamber, to find at the last moment that the books were real (see Figure 2.23).

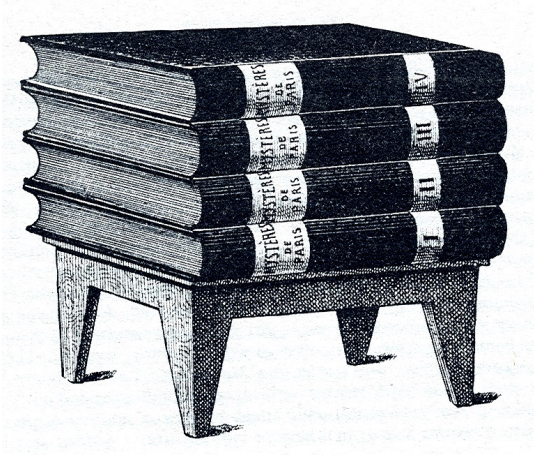


Figure 2.23. Voyage au Pays Bas, the title of the pile volumes that hid the secret (Wright, 2000, p. 102)

From the view of aristocracy, the court was well equipped with close-stools represented an individual's throne for nobles, referred to alternately as (chaise persées), 'chair of affairs' (chaises d'affaires), 'holed chair' (chaires pertuissées), 'retirement chair' (chayéres de retrait), 'necessary chair' (chaises necessaries) or simply 'privy' (selles). In addition to these, in *Dictionnaire de l'Ameublement*, a new term was invented to use instead of all, 'furniture of odor' (ce meuble odorant). This piece of furniture designed ostentatiously and decorated to suit the extravagant tastes of its owner as a symbol of status. These magnificent requests of users became available by the improvements in the process of making china porcelain. This technical development turned the dull chamber pot industry into one turning out works of art. The use of silica in production durable white porcelain made pots could be painted and printed upon.

An inventory of Louis XIV lists a total of 264 stools at Versailles. 208 of these were covered with red, dark red or blue damask (damas rouge,cramoisy ou bleu), red

morocco leather (de maroquin du Levant rouge), red velvet (de moquette rouge), red or green velour (de velours rouge ou vert). 66 had concealing drawers and covers for the 'pot'. The XV Louis's close-stool was in black lacquer with Japanese landscapes and birds in gold or colored relief, inlaid borders of mother-of-pearl, additionally Chinese bronze fittings, red lacquer interior and padded seat in green velour. Another example to close-stools; Madame de Pompadour, XV Louis's mistress, owned one decorated with blue motifs, red stars and black lines inlaid on a white background, gold-embroidered blue velvet to trim the stool. The arms and feet of the chair were in gold with a covered Moroccan leather seat, a silver pot under it.

These exaggerations for personal usage: stools, cosmetics, outrageous wigs and heavy perfume worn by aristocrats were thought to be indicative of their lazy, indulgent nature. The reduction differences between social classes caused standardization in objects and changed the attitude toward the sanitary tools, close-stool moved into the 'closet' for 'privacy' and the first mention in the history unisex device developed into another agent for separating the sexes. In 1739, in the Great Ball of Paris, close-stools were placed in small cabinets containing the inscriptions over the doors; 'garderobes pour les homes', with chambermaids in the former and valets in the latter.

In eighteenth century Europe the water closet is admittedly something of a novelty, even in the great houses they are rare and rude, without running water and ventilation of the space posed an important problem for house owners. For this reason, in Europe and America during the eighteenth century and even in the nineteenth century, most privies continued to find at outside, usually near the garden, some of which were decorated similarly to a house reflecting their owners' wealth by ranging in appearance. During the period privies generally accommodated several people at a time, even some included a child-sized hole. The primitive examples of water closet were little more than indoor privies placed into a corner niche or small cabinet. Mainly the working schedule of it was to pull a handle opened a trap for flushing; consequently water escaped from the cistern above and washed the contents down. Desperately a small number of wealthy houses benefited from this sanitary devices because of sewer and water supply problems.

Queen Anne of England (1665–1714) ordered to build a water closet into her dressing room in Windsor Castle. Sluices of water used to wash the waste down, however there was not a trap and valve meant the privy was not cleaned adequately and escaped odors from the sewer below filled the space. In 1718, at Beddington, a

machine, which may have been a self-operating intermittent flushing device, was to clean the house by a small stream of water no bigger than one's finger. The water ran into an engine made like a bit fire-shovel, which hung upon its center of gravity, so that when it was full a considerable quantity of water fell down with some force. In 1748, at Woburn, a drainage system was installed for Duke of Bedford ended with four water closets. At Kedleston, at Osterley House architect James Paine placed a water closet in a niche in one of the rooms, with a door so close to the seat as to hide it only when not in use, the drain was brought into the house to connect with its unventilated soil-pipe.

The water closet of the eighteenth century might be made of lead or hewn from solid marble with a metal pan or plunger mechanism, but towards the end of the century the upper bowl might be changed to glazed pottery. As an example, in the pan closet, a hinged metal pan kept a few inches of water at the bottom of an upper bowl. When a handle was pulled the pan swung down and the contents were supposed to be tipped into a cast iron or lead receiver and to pass into a trap below. Similar to the pan closet, in the plunger or plug closet, a plug from above was supposed to close the outlet until a handle was lifted. A pan closet is visualized as in the following figure (see Figure 2.24):

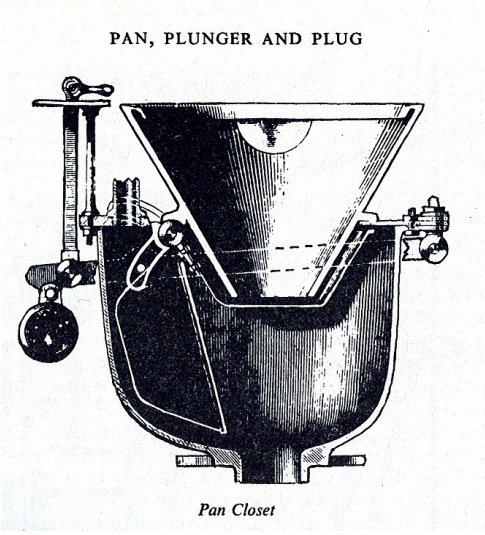


Figure 2.24. Pan Closet
(Wright, 2000, p. 106)

The late 1700s offered a beginning to next generation modern toilet led by the improvements in the simple water closet. The invention of Alexander Cummings culminated in adjustments by Joseph Bramah to expose criteria of designing a water closet without odor. In 1775, Alexander Cummings, a London watchmaker, received the

first patent for a water closet, 179 years after Ajax, Sir John Harington's invention (see Figure 2.25). Cummings water closet had the overhead supply cistern, the valve interconnected with the flush, the pull-up handle and the siphon-trap. The water was brought into the basin very low down and kept in the basin by what Cummings called the slider. His design was based on the principle of Harington's use of gravity to aid the flow of water, but adding to this a valve trap placed to secure the area between bowl and the outtake pipes meant less smell by a closed system.

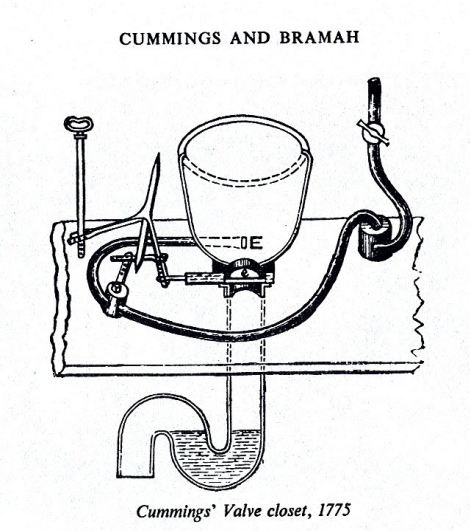


Figure 2.25. Cumming's valve closet, 1775
(Wright, 2000, p. 107)

> The advantages of the said water closet depend upon the shape of the pan or bason, the manner of admitting water into it, and on having the sink-trap so constructed that its contents shall, or may, be emptied every time the closet is used (Wright, 2000, p. 107).

Joseph Bramah constitutes an important historical figure for his contributions to Cumming's valve resulted that the new design was to serve for over a century. The problem of Cumming's water closet was the flap, which slid open when the mechanical arm was pulled. Bramah improved a flap system helps to clean out the contents by swirling action of water in the bowl (see Figure 2.26). He was a cabinet-maker and also one of his jobs was to fit up water closets. As a result of the experiences, Bramah's patent dated 1778, scheduled a cranking motion with a valve instead of Cumming's sliding flap that damaged by cold weather.

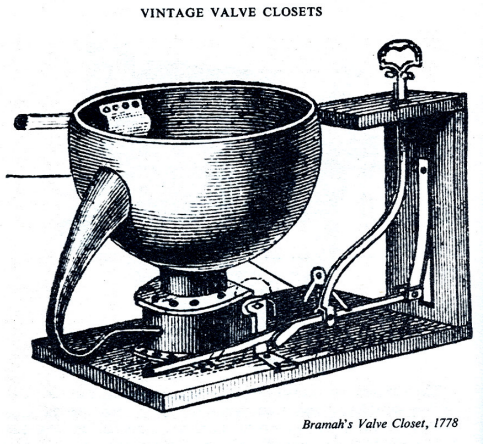


Figure 2.26. Bramah's valve closet, 1778
(Wright, 2000, p. 108)

By 1797 Bramah had produced about 6000 closets and the firm went on making them until about 1890. The production amount was not a large number comparing with about eight million England population at the time because of the distribution by the fact that there was not a standardization in sewer system caused installation problems. He went on to invent the hydraulic press and the lock. His design continued to surpass challengers for the next ninety-eight years, the accepted pattern improved by Hellyer and others, valve closets essentially Bramah are still found in use;

> The Royal Institute of British Architects had one in their former premises in Conduit Street, that incidentally had the flap of the valve whimsically made of mirror glass (Wright, 2000, p. 108).

During the 1700s,on a city scale, the most exciting of all, more houses were being connected to the main sewer system. This resulted in healthier sanitation facilities in settlements than the mediaeval times.

> In the first half of the century England's population increased by one-fifth (by one million) but the rise in the death rate was due more to cheap gin than to bad sanitation. From 1750 to 1800 London's population increased by one half, but the death rate fell. Fewer persons died in the large London of 1791 than in the small London of 1697. Though the towns were growing, their conditions were becoming more healthy (Wright, 2000, p. 91).

Furthermore, the new attitude in urban planning, architecture and even evolution in technology, accepted the facts to shape cities carrying them towards a modern appearances.

> Streets were being widened and paved, drains covered in, houses rebuilt in brick and at much lower densities. Steam pumps (1743) and iron pipes (1746) came in, to improve the water supply. Cheap cotton cloth appeared; cotton can be boiled without spoiling it; boiling kills lice. Cheap crockery and iron utensils also encouraged cleanliness (Wright, 2000, pp. 91-92).

In summary, at the period of 1700 and 1800, in contrary to the improvements about toilet, sewer systems and sanitation facilities, bathing might be rare depend upon the mediaeval habits, but the concept of hygiene increasingly has continued to spread up its importance. Medicine ceased to be a blend of alchemy and magic, became a science. Finally, the scientific age began.

2.3.5. The Victorian Age: 1800–1920

The Victorian age bearing Queen Victoria's name was a period displaying moral propriety despite the absolution of sins. City streets were dumped with filth and human waste from overcrowded urban dwellings that were homes to millions of people who worked in factories for pennies a day, as before the time. The remarkable influx of people to city centers during the Industrial Revolution of the nineteenth century, first in Britain and then in the United States, moved citizens, charities and politicians to call for a healthy environment, in reality cleanliness was not priority of the government. The laws concerning disposal of excrement generally appeared only after a major epidemic of disease. During the mid–1800s, a series of smallpox, cholera and typhoid epidemics in Europe and America, were considered people on sanitation regulations, even improvements realized by isolating the germ for cholera under the microscope in 1883 as the discovery of a connection between sanitary conditions and diseases. Without this verification, British lawmakers refused to infringe on citizens' property by passing a law to build sewers and in addition to this the government could represent only minor changes in rebuilding and construction.

The general appearance of European cities were commonly similar, the network of drains was slowly spreading because of the bad maintenance and unqualified workmanship. In the first thirty years of the century the London's population almost doubled, increased to 1 ½ millions and additionally in the next twenty years another million joined to this amount. At this time the death rate per 1000 under five years old was 240 in the country and 480 in the town. Today five times as many children survive

their infancy as did in 1848. Over half a million were dying from preventable causes mainly as a reason of living conditions.

> 568 streets were taken for examination: 68 were paved. 96 were not paved, drained nor cleaned; one of them, with 176 families, had not been touched for 15 years. Whole streets were floating with sewage; 200 were crossed with clotheslines. Over 500 cellars were in occupation. 156 rudimentary schools provided for 7000 children; the Sunday-schools took in 11000; 15000 went altogether untaught. Finally we learn there were 451 public houses, 98 brothels, 2 churches and 39 meetinghouses. The death rate in the clean streets was 1 in 36, in the dirty streets 1 in 23 (Wright, 2000, p. 144).

Sewers and privies were increasingly common in neighborhoods serving the rich and middle class, in contrary the poor who were generally the last to benefit from sanitary reforms used common privy pits found in tenement buildings or their backyards, in example 2300 night-soil carts were used to empty privy pits in Paris. 'Night Men', successors to the mediaeval 'gongfermors' performed this office, carted away the waste. Similar to in Paris, in the most settlements of England the 'pail-system' continued to be in use until the turn of the century. The chamber pots commonly ended in a petroleum cask placed in front of the houses to collect the human waste, the cask was colored especially to indicate an illness. Furthermore, advance a vision to planning; the new jerry was built in working-class houses, which had no cellars to house rats. The scheme of houses was in double rows back-to-back, without ventilation or drainage, reduced window numbers to minimum to avoid the Window Tax. This scheme resulted in squalid courts; with a pump at one end and a privy at the other serve assumingly twenty dwellings. A solution to disposal of the waste, at first the value of the end product to farmers made it worth while to remove it from the town, but as the town had broadened the transportation became uneconomical. So the waste then carried (or the new invented Machine Carts were driven) to larger communal cesspits or to the nearest river, from which the drinking water was obtained. In 1848 the control of London's drainage divided among eight different bodies, was vested in a Board of Commissioners. They had almost got rid of cesspits for two years in London, to attack the old sewers called an appalling task described as below:

> The deposit has been found to comprise all the ingredients from the breweries, the gas-works and the several chemical and mineral manufactories; dead dogs, cats, kittens and rats; offal from slaughter-houses, sometimes even including the

> entrails of the animals; street-pavement dirt of every variety; vegetable refuse; stable-dung; the refuse of pig-styles; night-soil; ashes; tin kettles and pans (panshreds); broken stoneware, as jars, pitchers, flower-pots & c.; bricks; pieces of wood; rotten mortar and rubbish of different kinds; and even rags. A sewer from the Westminster Workhouse, which was of all shapes and sizes, was in so wretched a condition that the leveler could scarcely work for the thick scum that covered the glasses of the spirit-level in a few minutes after being wiped…a chamber is reached about 30 feet in length, from the roof of which hangings of putrid matter like stalactites descend three feet in length. At the end of this chamber, the sewer passes under the public privies, the ceilings of which can be seen from it. Beyond this it is not possible to go (Wright, 2000, p. 154).

In Paris, during the reign of Emperor Napoleon III (1808–1873), modernization of the city became more important by also the population increase. The small mediaeval streets were widened to enable the passage of a large army and laid sewer tunnels beneath most of them by 1870. The tunnels opened to the Seine River to transport the waste to community downstream. In contrary to this modern sewer system, early one resembled little more than a network of street gutters, which were open and relatively shallow, as a reason of overflowing during heavy rains. A brief account of early sewers, they were inadequate in number and often private, additionally were rarely maintained. By the revolution, the Parisian sewer system was expanded throughout the city and constructed large enough to allow men to walk upright, boats or carts to travel its length. Prior to the French Revolution in 1789, Paris had sixteen miles of underground sewers. In 1840, the sewage system measured sixty miles. In 1853, its length reached to eighty-nine miles. In the years that followed, the system expanded to 480 miles of sewer line. A cholera epidemic and progressive attitudes toward sanitation reform accounted for the rapid building of sewers. But, in contrast, the engineers followed the way to improve the old design of the sewers by increasing their size and concentrating on effective methods for cleaning the underground passages.

During the period, Victorians believed extreme emotions as characteristics of faintness, so relieving accepted the action to hide. In the nineteenth century, furniture continued to design as places to hide the activity of defecate and actually chamber pots:

> Gadgets and secret doors were hidden in every corner of a seemingly innocuous cupboard. In 1833 John Loudon described the ‘wash-hand stand’ as enclosed in a bureau with the washstand opening to accommodate a basin, soap dish, and a comb box. The underside of the cover could be raised via a rack and horse. Below was a space capable of holding an ewer, a basin, and a chamber pot. George Jennings designed a combination bidet, footbath, sitz bath, and commode pail.

> The ambitious invention was reversible and fit in one piece, taking up little space. (Horan, 1997, p. 81)

By the Industrial Revolution, the changes in social life occurred consciousness in middle-class citizens. Reform movements reasoned in calling for qualifying the environment and sanitation facilities. The intensity behind the nineteenth century social-reform movements matched the growing intolerance of filth. The end of 1800s brought the golden age of toilets into life. Toilets placed in the scheme of the settlements, a part of the planning and construction. Inventors and entrepreneurs scrambled to corner the new market by the creativity in dealing with the body's personal needs. They were the giants of their time. Rather than designing an original system or an evolution, 'Bramah toilet' had taken into account until each functioning and installation problem was solved. The inventors of eighteenth century, who transformed the concept of human waste disposal into a viable industry, deserve to be known as the ancestors of the toilet. Closet of the century constructed on the siphonic system of flushing, was the action allowed for a fast flush followed by a slow flush emptying the bowl more efficiently.

G. Jennings' design was principally based on this action. The flushing movement produced by increasing the pressure of water resulted in rush of water to clean the bowl better than previous models had. He intensified his success with an innovation in public hygiene. Jennings believed that " the civilization of people can be measured by the domestic and sanitary appliances"(Wright, 2000, p. 200). In 1851 he had installed public lavatories in the crystal palace for the Great Exhibition, which were used to pay by 14 percent of the visitors, in fact more specially by females. In 1858, Jennings idea of public hygiene approved to be a new vision for an advanced stage of civilization:

> I know the subject is a peculiar one and very difficult to handle, but no false delicacy ought to prevent immediate attention being given to matters affecting the health and comfort to thousands who daily throng the thoroughfares of your City...the civilization of a people can be measured by their Domestic and Sanitary appliances and although my proposition may be startling I am convinced the day will come when Halting Stations replete with every convenience will be constructed in all localities where numbers assemble. Fancy one of these complete, having a respectable attendant, who on pain of dismissal should be obliged to give each seat a rub over with a damp leather after use, the same attendant to hand a clean towel, comb and brush to those who may require to use them. A shoe black might do a shining trade, as many go with Dirty Boots rather than stand exposed to the public gaze (Wright, 2000, p. 200).

At the turn of the century, in Europe, it was possible to see ‘public urinals’, commonly called ‘pissoirs’, placed at the intersection of main streets, in parks or in stations. Rather similar to today with no luxuries, the ‘pissiors’ enabled only men to quickly attend to business and be on their way, with no doors and just a drain in the floor. By the way, the idea of public hygiene almost became to life with ‘pissior’ at various locations in the cities.

‘Bramah toilet’ had served well enough until a rival; hopper closet emerged in 1870. The hopper closet was consisted of a conical pan, which had long and short types, flushed by a thin spiral of water (see Figure 2.27). A criticism to design by its own creator, Hellyer was, “with such a twirling motion, that by the time it has twirled itself down to the trap it has no energy left to carry anything with it” (Wright, 2000, p. 201). ‘Hopper closet’ made in two pieces of fireclay that supported easy and also cheap way in manufacturing.

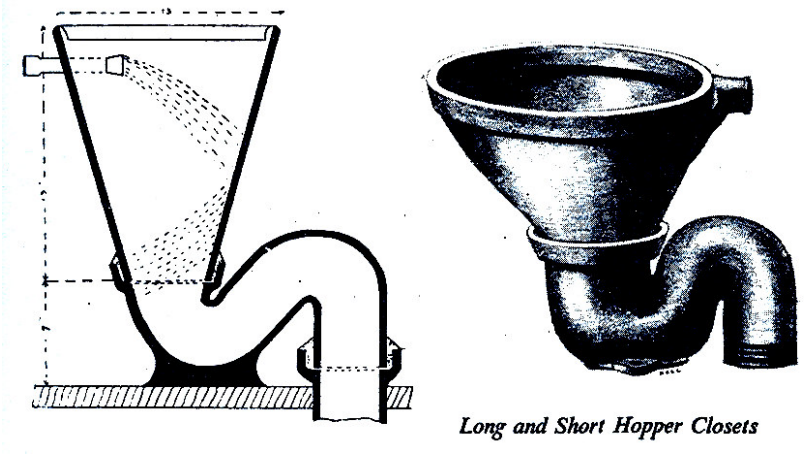


Figure 2.27. Long and short hopper closets
(Wright, 2000, p. 201)

In about 1870, Thomas W. Twyford contributed to the appearance of closet to transform all earthenware types into washout form (see Figure 2.28), in which a very shallow bowl held about an inch of water and additionally the flush might empty the bowl that lost most of its force in doing so, gravitated through the trap in a most unselfish kind of way. Despite of Hellyer’s words, “the flush taking little or nothing with it”, Twyford’s sales reached 10000 a year and washout closets were lately to be found still in use (Wright, 2000, p. 202).

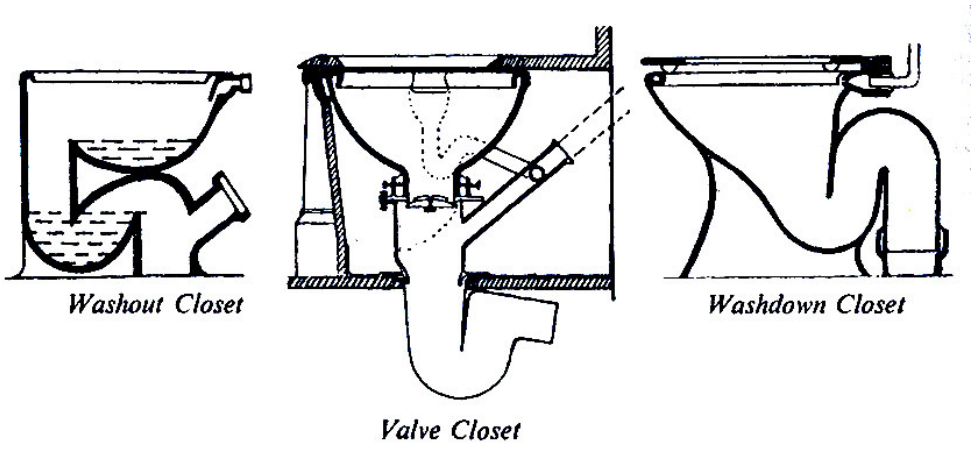


Figure 2.28. Washout, valve and washdown closets
(Wright, 2000, p. 202)

There were three defects about the Bramah's old closet; the flushing operation failed if the handle was not pulled up all the way, a seldom-used closet could lose its water-seal by evaporation, and the flush was noisy. Hellyer's 'Optimus' was a solution to overcome these defects. Basically, this complex machine was known as a valve closet, concealed in a special mahogany case or a cabinet standing like a throne on a dais raised to make room for the trap or in an elegant choir with wickerwork panels (see Figure 2.29). 'Optimus' was the favorite toilet of royalty in the nineteenth century.

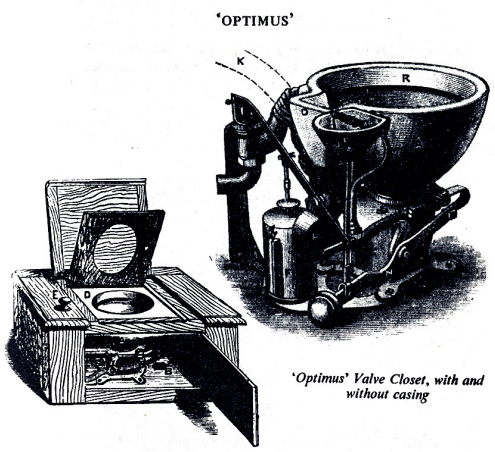


Figure 2.29. Optimus valve closet, with and without casing
(Wright, 2000, p. 203)

1870 also the time of the 'syphonic closet' improved by J.R.Mann (see Figure 2.30). The bowl held some water before the action of pulling a handle, which supplied a fast flush following by a slower one, while 'syphonic' action kept things moving. The

'syphonic closet' exposed a way to solve the noise, the announcement to the entire neighborhood that some one had used the toilet.

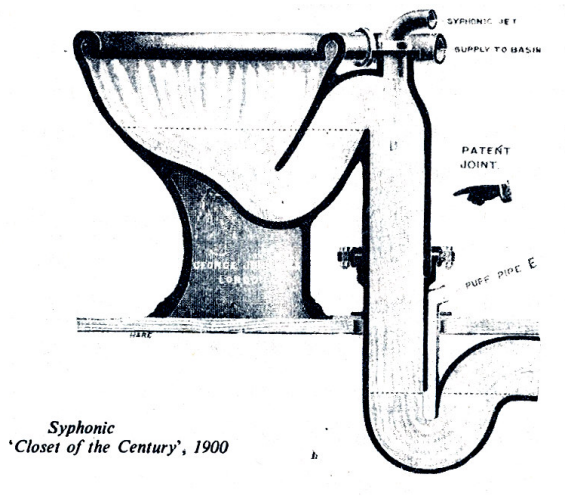
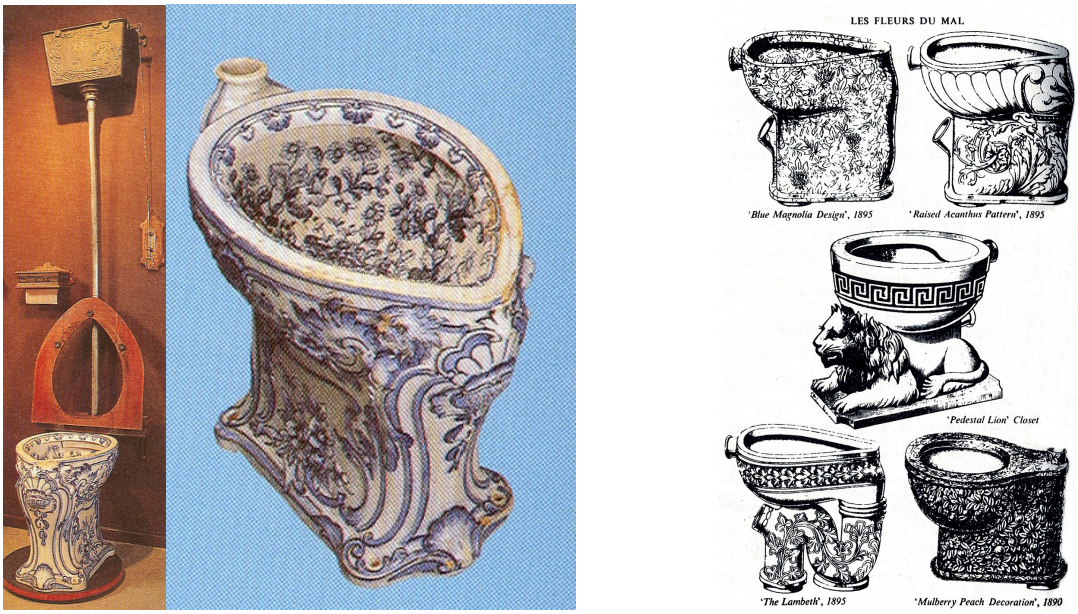


Figure 2.30. Syphonic closet of the century, 1900
(Wright, 2000, p. 204)

At the Health Exhibition of 1884, the name of the Jennings appeared in design history of toilet by 'pedestal vase' being judged as perfect a sanitary closet as can be made, brought a Gold Medal Award to its inventor:

> In a test, it completely cleared with a 2-gallon flush;
> 10 apples averaging 1 ¼ ins. diameter
> 1 flat sponge about 4 ½ ins. diameter
> Plumber's 'smudge' coated over the pan
> 4 pieces of paper adhering closely to the soiled surface (Wright, 2000, p. 204)

In 1885, Twyford came out with the 'washout unitas', claimed as the pioneer of pedestal closets and certainly close in date to Jennings Pedestal Vase. He encapsulated the mechanism in porcelain to provide an aesthetic and functional addition to the toilet. The practice of fixing closets, could be made in one piece, changed the appearance to open and exposed, without woodwork, whereby joints, corners and dirt traps abolished. New material promoted the toilet design to the work of art, by which closets were possible to mold into different kinds of shapes; dolphins, lions or flower motifs, etc (see Figure 2.31).



(a) (b)

Figure 2.31. Toilets, examples of '1800-1920' period, (a) Toilet zone of a bath from the turn of the century, with toilet in porcelain decorated with floral motifs, made in Europe in 1895 (Interni Annual–Bagno, 1996–1997, p. 33), (b) Porcelain toilets decorated with different motifs (Wright, 2000, p. 206)

The valve system of Thomas Crapper dates from 1884. In this system, loose-fitting valves was placed to prevent the loss of water from cisterns. The novelty of Crapper's design was in the way the water could automatically refill without a slide valve. There was a pull-chain attached to a circular chamber above the cistern to unleash water when engaged. The water traveled up a pipe, displacing the pipe's air. The movement of water created a force to empty the cistern tank into the flushing bowl. The design of T. Crapper became known as the "Pull and Let Go", because there was no need to hold the chain until the contents of the tank emptied.

> The valve type of flush needs no interval for filling between each use, but has came up against objections as to possible waste of water, or even demands by the water authorities that it be fed through a meter. A device which automatically closes the valve, after a pre-determined quantity of water has been discharged, has overcome these objections. (Wright, 2000, p. 205)

Henry Moule is commonly forgotten in the development of toilet design, but his name lives in the adjacent annals of cleanliness by his invention, the 'Earth Closet' (see Figure 2.32). In its simplest form there was a bucket placed under a wooden seat and additionally a hopper, above at the back, filled with dry earth, charcoal or ashes. A

handle when it was pulled operated the fall of earth into the bucket to cover the excrement lying in.

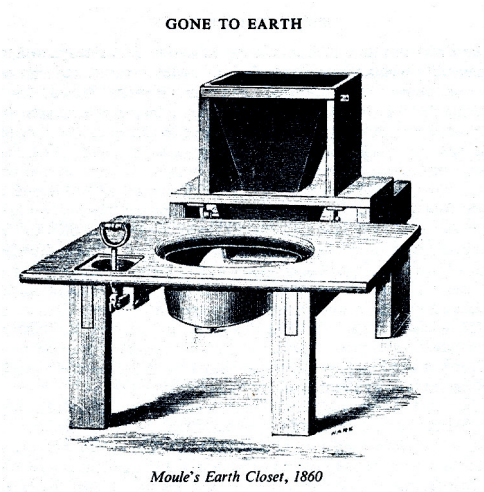


Figure 2.32. Moule's earth closet, 1860
(Wright, 2000, p. 209)

Chemists assures the end-product quickly transforms into sterile and inoffensive substance, but despite of the assurance, an advertisement of a famous firm, in 1990, shows us;

> Commodes or portable closets, are serviceable in bedrooms and nurseries; whilst in sick rooms, in hospitals and in infirmaries they are invaluable. Each commode is fitted with an earth reservoir, with apparatus suitable for delivering the earth, and with a pail. The reservoir must be filled and the pail must be emptied, as often as may be requisite. (Wright, 2000, p. 208)

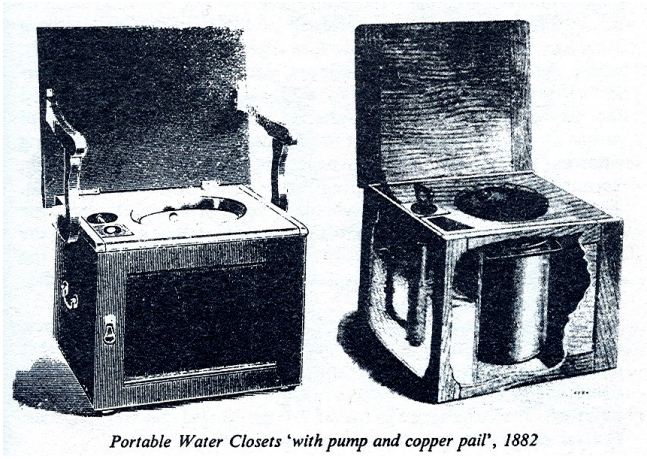


Figure 2.33. Portable water closets, 1882
(Wright, 2000, p. 209)

In addition to Earth Closet, Dr Vivian Poore introduced an 'ecological closet' described in his book *The Dwelling House*. Earth was used to cover the waste as similar to the earth closet. Furthermore, a box was attached to the toilet for composting the human waste to fertilizer. Therefore, it is significant that many patent gadgets were being offered to disinfect water closets, usually on the principle (still accepted today) of 'a smell to hide a stink' recognizing the fault but curing only its symptoms. Steven Hellyer summarizes briefly the problems about functioning of the system included all elements of waste disposal;

> Drains too large to be self cleansing, drain running uphill or through right angled joints, waste-pipes acting as flues for sewer-gas, unventilated soil-pipes, untrapped fittings, inefficient traps, pan closets, washout closets, drains vents near windows; all with current examples as gruesome as anything that had been uncovered by the reformers of a generation before. Hellyer objects to many of the new water-closets that are springing up like mushrooms - a vivid picture this – and complains with some reason of having to wait eight minutes before a second flush can be given. (Wright, 2000, p. 211)

In summary, the examples prove that all, these evolutions in toilet designing, the new sewers, the public baths and the general awakening to the effects of bad plumbing did not bring quick results in daily life. The last cholera wave in 1886 was just a simple evidence of trouble, enteric fever and typhoid still went on worse before.

2.4. The Twentieth Century Toilet: The Idea of 'Industrial Design'

In the means of natural selection, it was evitable that the bathroom would gain prominence in the modern household. In fact, the bathroom tends to be a necessity that cannot easily disappear or be replaced. New attitudes in house design also reflected the design of bathroom basically by enlarging its size to three times the previous one. By changing mean of bathroom, many accessories and fittings as jacuzzis, bathtub, bidet or etc. have been added to space. Although these modern and luxurious developments have placed in bathroom design, there has been little innovation or upgrading of the toilet bowl. Toilets today are designed especially for water efficiency and ease, basically not for beauty. The evolution of the modern toilet during the twentieth century presented some creative ideas. After the initial water closet was invented and perfected, inventors

worked on new patterns claiming to be the discovery of the century. Many of these inventions never produced and mostly called bizarre.

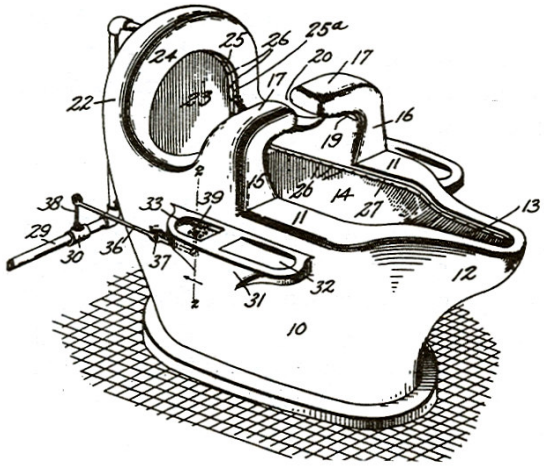


Figure 2.34. An example of toilet inventions, patented in 1917
(Horan, 1997, p. 114)

The twentieth century toilet, especially the bathroom space, has been shaped by changes in design process after the Industrial Revolution, which has also affected the community as sociological and cultural by changing living attitudes and behaviors.

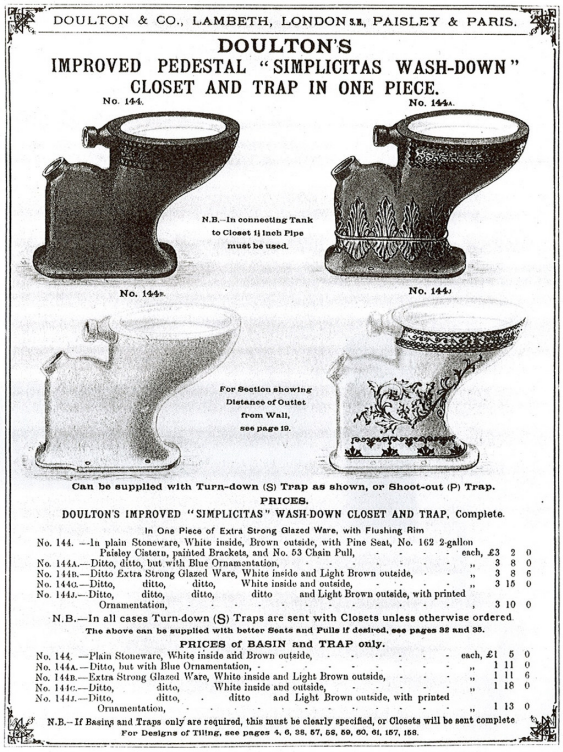
> The Industrial Revolution not only transformed traditional crafts, but, as the pace of technical innovations increased, established many new industries which applied mechanized processes to the production of a host of new forms. (Heskett, 1995, p. 27)

The continuing expansion of trade and commercial opportunities and the growth in size of production units, created competitive pressures that in turn led to demand for innovations and for some characteristic feature or aspect of skill to distinguish a product and attract the interest of customers. By the attitudes to create characteristic features for products, the idea of 'industrial design', has been revealed. It is specifically linked to the development of industrialization and mechanization that began with the Industrial Revolution around 1770.

'Industrial design' is a process of creation, invention and definition separated from the means of production, involving an eventual synthesis of contributory and often conflicting factors into a concept of three-dimensional form, moreover its material

reality, capable of multiple reproduction by mechanical means. In nineteenth century Britain, the discussion of design was dominated by the tension created between a continuing and expanding demand for articles with a tradition of craft production, such as a furniture, ceramics, metalwares and the development of a commercialized production which appropriated and modified the forms and values of the past, making them accessible to a greater proportion of the population.

New processes and techniques enabled a prodigious variety of designs to be manufactured, the products of some companies ranging from stark utilitarian forms to the most flamboyantly ornate. In the pottery industry the molding techniques evolved in North Staffordshire in the eighteenth century were further developed and applied to a great diversity of new forms.


DOULTON & CO., LAMBETH, LONDON S.E., PAISLEY & PARIS.

DOULTON'S
IMPROVED PEDESTAL "SIMPLICITAS WASH-DOWN"
CLOSET AND TRAP IN ONE PIECE.

No. 144. No. 144A.

N.B.—In connecting Tank to Closet 1¼ Inch Pipe must be used.

No. 144B. No. 144J.

For Section showing Distance of Outlet from Wall, see page 19.

Can be supplied with Turn-down (S) Trap as shown, or Shoot-out (P) Trap.

PRICES.

DOULTON'S IMPROVED "SIMPLICITAS" WASH-DOWN CLOSET AND TRAP. Complete.

In One Piece of Extra Strong Glazed Ware, with Flushing Rim

No. 144. —In plain Stoneware, White inside, Brown outside, with Pine Seat, No. 162 2-gallon Paisley Cistern, painted Brackets, and No. 53 Chain Pull,	each,	£3	2	0
No. 144A.—Ditto, ditto, but with Blue Ornamentation,	,,	3	8	0
No. 144B.—Ditto Extra Strong Glazed Ware, White inside and Light Brown outside,	,,	3	8	6
No. 144C.—Ditto, ditto, ditto, White inside and outside,	,,	3	15	0
No. 144J.—Ditto, ditto, ditto, ditto and Light Brown outside, with printed Ornamentation,	,	3	10	0

N.B.—In all cases Turn-down (S) Traps are sent with Closets unless otherwise ordered.

The above can be supplied with better Seats and Pulls if desired, see pages 32 and 35.

PRICES of BASIN and TRAP only.

No. 144. —Plain Stoneware, White inside and Brown outside,	each,	£1	5	0
No. 144A.—Ditto, but with Blue Ornamentation,	,,	1	11	0
No. 144B.—Extra Strong Glazed Ware, White inside and Light Brown outside,	,,	1	11	6
No. 144C.—Ditto, ditto, White inside and outside,	,,	1	18	0
No. 144J.—Ditto, ditto, ditto and Light Brown outside, with printed Ornamentation,	,,	1	13	0

N.B.—*If* Basins and Traps only are required, this must be clearly specified, or Closets will be sent complete.

For Designs of Tiling, see pages 4, 6, 38, 57, 58, 59, 60, 61, 157, 158.

Figure 2.35. A page from Doulton's 1898 catalogue, illustrating the range of water closets (Heskett, 1995, p. 45)

The artistic achievement of Henry Doulton's Lambeth Studio was subsequent to the firm's rapid growth and the establishment of its reputation on the basis of producing wares for more utilitarian purposes. The squalor and disease of rapidly growing cities had required urgent measures and Doulton persuaded to begin large-scale production of

stoneware pipes for sewers and water conduits. It was a highly successful venture, followed by the production of a large range of domestic sanitaryware. By this development, Doulton became a major manufacturer and also the forerunner of bathroom furnishing industry. The range and variety of designs for sanitaryware products were enormous, catering for large institutions such as barracks and prisons as well as for domestic use across the social scale. Sinks, baths, lavatory pedestals, and toilets were produced in serious moldings of which some ornate or some simply utilitarian (see Figure 2.35).

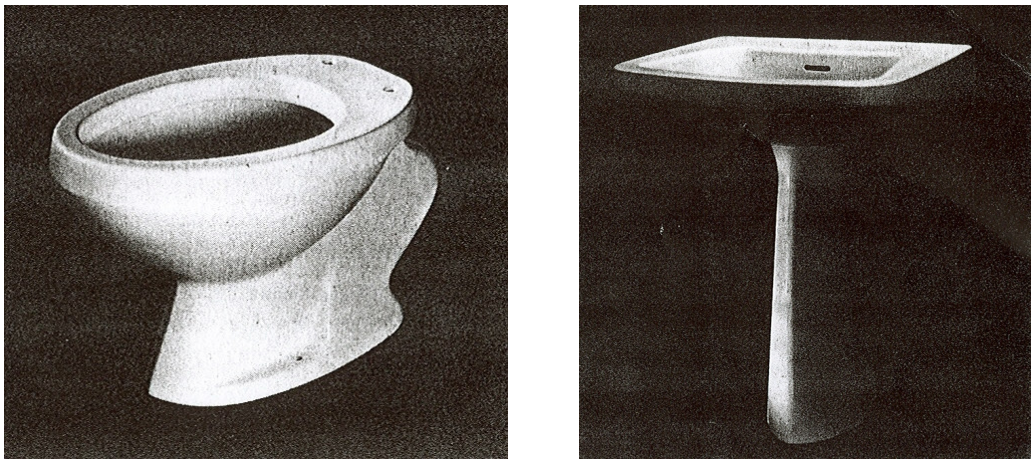
In contrary to ostentatious products, the evolution of American system demonstrated the idea that a product had to be standardized because of the mass production system. With the growth in scale of industrial production and commercial organization in the twentieth century, the concept of standardization became extended and focused on the product varied in dimensions. In the early stages of industrialization, each firm established its own specification for the manufacture of parts and fittings, resulting in different dimensions and types of connections, which occurred problems about sanitary products installation. The adoption of technical standards was essential to rationalize the large-scale production, moreover, to be effective on a national scale.

In 1921 the German Government founded the *Reichskuratorium für Wirtschaftlichkeit* (State Efficieny Board) to investigate and publicize more efficient means of production and procedure. This institution also devoted many studies to domestic rationalization, producing specifications for household furniture and implements to facilitate easier housework. Each object consideration was analyzed under the heading of material, form, function, utilization and price. As a result of the First World War and the post-war economic depression, enormous social problems faced the city such as huge slam-areas, deprivation and disease. Cost limitations and the urgency of the situation led to a concept of the ‘minimum-existence dwelling’, in an attempt to provide rapid improvements in basic living conditions for the maximum number of people (see Figure 2.36). A careful study was made of household work and dimensions, and since the furniture designed to fit the more spacious pre-war houses was too large to be utilized, a set of Frankfurt Standards was devised to match the new concept. A team of architects and designers including May, Adolf Meyer, Fredinand Kramer, Mart Stam and Franz Schuster designed new forms of every kind of fitting and furnishing.

Figure 2.36. A bathroom set by Fredinand Kramer, designed for the ‘minimum existence dwellings’ built to rehouse slum-dwellers in Frankfurt in the 1920s (Heskett, 1995, p. 82)

Briefly, Frankfurt was an exception, however, in the 1920s standardization and rationalization came to be regarded as concepts relating solely to industrial and commercial efficiency. But apart from their contribution, the austere aesthetic in this concept were felt to be inadequate to satisfy human needs. Finally, ‘optimum’ instead of ‘maximum’ efficiency became the goal resulting in more flexible interpretations. Moreover, the basic principle remained unaffected and standardization remains a fundamental concept in modern industrial production and also in bathroom design.

At the same time as ideas on standardization and rationalization were evolving, a series of European art movements such as Futurism, Purism and Constructivism attempted to redefine aesthetic form and its function in relation to industrial civilization. In many European countries, architects found opportunities to work in industry and made major contributions to design by these new art movements. They have also affected the bathroom, which has been shaping for today, as one of the main parts of living space. One example of these architects was Gio Ponti, who worked active and versatile in the field of design, developed a concept of true form to be attained by discarding all conventions and remolding a form in accordance with its function. He designed a set of sanitaryware included a slim washbasin stand and a lavatory bowl set high on plinth to emphasize the forceful sweep of its lines, for the Ideal-Standard Company.



(a) (b)

Figure 2.37. Gio Ponti, toilet and lavatory designed for Ideal-Standard, 1954 (Heskett, 1995, p. 90)

The other important approach of the twentieth century, which has affected the design and especially the bathroom design, is an unprecedented degree of diversity and specialization not only in economic structure and occupational categories, but also in attitudes towards the different phases of individual life. There are distinct phases such as childhood, adulthood and old age when we consider on one's life. So it cannot be accepted as a continuum, with a corresponding opportunity in design to focus on the specific needs of these differentiated groups and activities.

In the course of all these historical development, the role of industrial design has focused on making technology usable in forms that are accessible and comprehensible to the greatest possible number of people. In design rank, there can be found a high proportion of socially aware and responsible men and women, sensitive to the needs not only of those who employ them, but also of those who use and are affected by the forms they design. Design work has in large measure contributed to the improved health, comfort and convenience that are accepted as part of the normal life of an increasing proportion of the human race and represent a standard of aspiration for those to whom they are not available. It is obvious that industrial design is one of a number of activities combined under the general title of research and development which takes a part to realize the object from the sketching phase to product-3D phase, as so in toilet design.

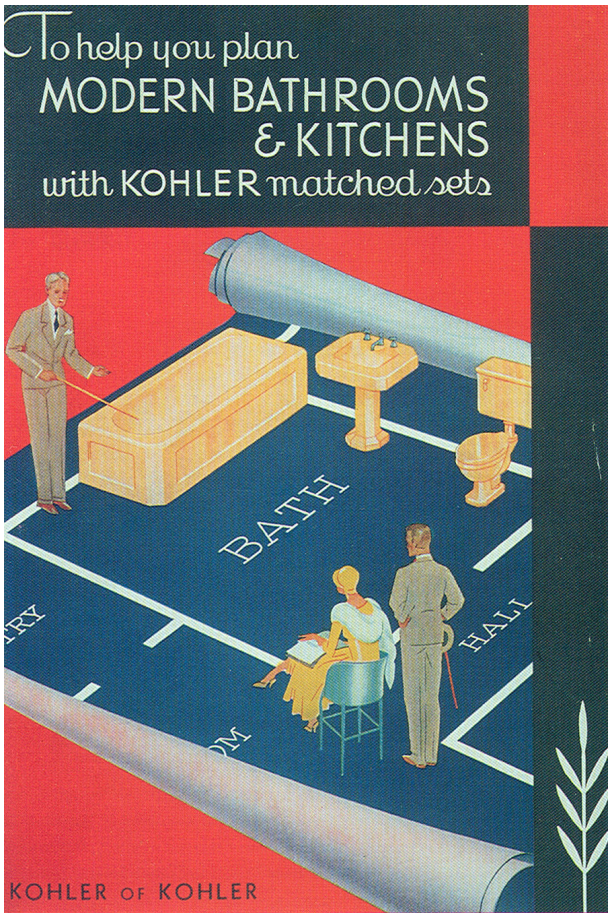


Figure 2.38. Brochure, Kohler Company, 1932
(Blaszczyk, 2000, p. 160)

CHAPTER 3

TOILET DESIGN AND PRODUCTION

3.1. The Firms and General Appearance of the Sanitaryware Sector

The industries of the ceramics sector are usually divided into two broad categories: the 'traditional ceramics' and the so-called 'advanced ceramics'. Traditional Ceramics are wall and floor tiles, tableware, sanitaryware, and brick and heavy clay. Advanced Ceramics are technical ceramics, bioceramics, ceramic coatings, and electrical and electronic ceramics. Traditional ceramics make up the bulk of the overall production of the ceramic sector. In 1994, the relevant traditional European ceramics sector had a 20,400 MECUs (Municipal Employees Credit Union) turnover and employed more than 300,000 workers.

In the following, the sub-sectors of the ceramic industry are briefly described:

1. Tiles: The tiles industry is the most significant ceramics industry sector. In 1992, it accounted for about 60% of the total annual sales of 14,000 MECUs; the remainder was equally shared between tableware and sanitaryware.

2. Tableware: The average distribution for the production costs indicates that labor is the largest cost item since, with little automation and emphasis on decoration. This industry is highly labor intensive. In tableware production, energy costs have the least significance in term of total production costs for any of the sub-sectors. Because especially true for high quality products requiring skilled craftsmen whose labor rates exceed the energy costs.

3. Sanitaryware: With an output for 1995 of 53,382,000 articles out of an estimated world total of 150 million articles/year. Europe is without doubt the area of greatest production and consumption. Energy costs constitute a larger part of the total production costs. However, the sector is still labor intensive because of the product handling, glazing and inspection steps.

4. Brick and heavy clay: EU brick production level is reported at about 70 million t/year. The brick industry is a local one since the weight of the product makes long-distance transportation unprofitable, whereas the raw materials are abundant in many locations.

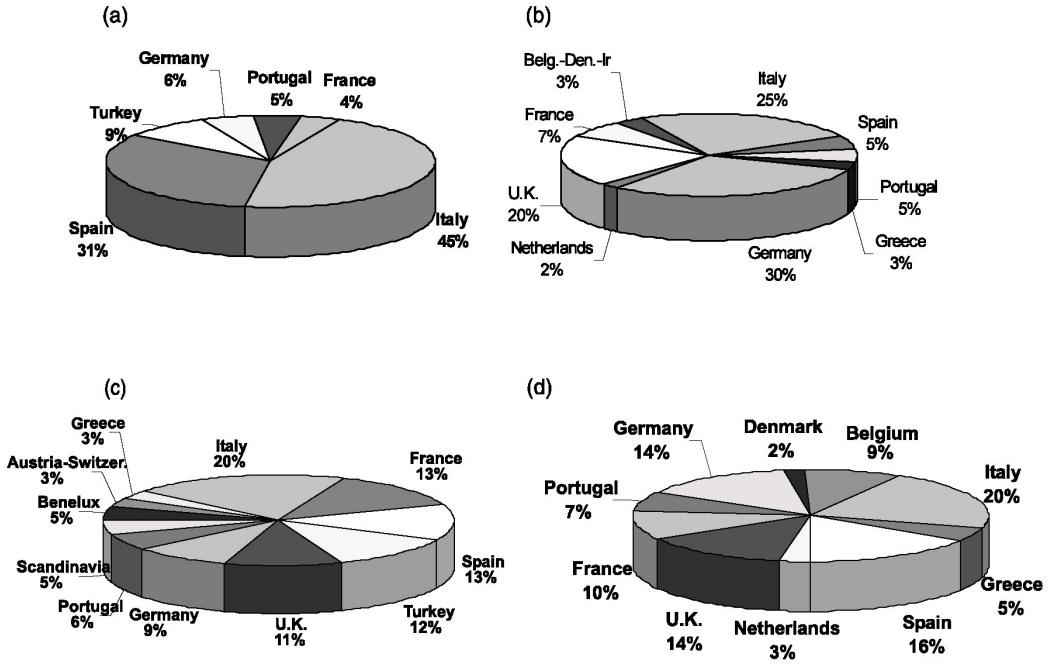


Figure 3.1. Geographical distribution of the European Traditional Ceramics Industry (a) tiles, (b) tableware, (c) sanitaryware, (d) bricks and heavy clay. (Agrafiotis and Tsoutsos, Energy Saving Technologies in the European Ceramic Sector: A Systematic Review, 2000)

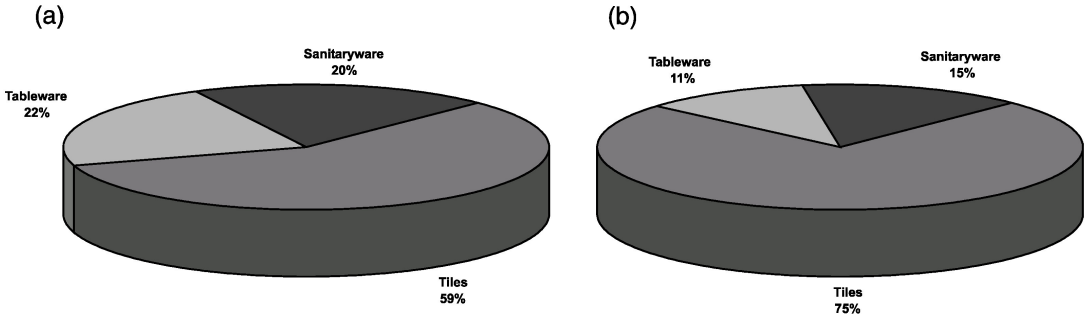


Figure 3.2. European Ceramics Industry in 1992, (a) sales turnover, (b) energy Consumption (Agrafiotis and Tsoutsos, Energy Saving Technologies in the European Ceramic Sector: A Systematic Review, 2000)

Turkey has started the production of ceramics in an industrial sense in 1950s. Today, it is one of the leading sanitaryware producers in the world with its 9 large and

about 35 small-scale operational firms in the sector. The production capacity of Turkish sanitaryware sector, which was 200,000 pieces/year in 1960, has reached 12 million pieces/year. By the increase in the capacity, Turkey has become the second largest sanitaryware producer in Europe in 2000, with an 18% achieve of the total European production. In addition, Turkey is the sixth major market and the 99% market domestic demand of about 4.5 million units annually is satisfied by local production.

Table 3.1. Turkish sanitaryware production capacity and export charts in 2002 (http://www.turkishceramics.com/san_tilesector.asp)

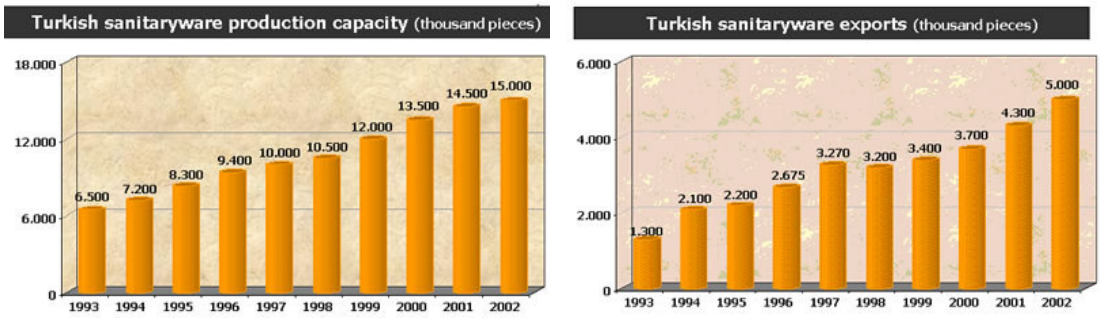


Table 3.2. Countries production capacities and dispersion in years (http://www.turkishceramics.com/san_tilesector.asp)

1999		2000		2001	
Countries	**Quantity**	**Countries**	**Quantity**	**Countries**	**Quantity**
Germany	21.383	England	10.159	England	12.048
England	8.171	Germany	16.543	Germany	10.603
Italy	1.229	Bulgaria	44	Bulgaria	6.151
Ireland	2.763	Spain	2.062	Spain	5.834
Israel	2.131	Israel	2.923	Israel	3.218
USA	1.040	USA	1.938	USA	2.812
Spain	170	France	1.564	France	1.721
France	1.181	Italy	5.385	Italy	2.272
Macedonia	495	Ireland	3.036	Ireland	1.446
Austria	915	Greece	403	Greece	1.056
Holland	1.578	Canada	465	Canada	667
Canada	493	Austria	1.034	Austria	778
Australia	195	Holland	679	Holland	645
Azerbaijan	362	Denmark	424	Denmark	431
Denmark	165	Russian Fed.	693	Russian Fed.	740
Others	6.476	Others	6.222	Others	10.375
Total	48.747	Total	53.576	Total	60.796

Moreover, Turkish sanitaryware sector has become the third of all in European countries with the progress during the last decade by exporting 3.5 million pieces in 2001 (see Table 3.1). The largest export customers are England, Germany, Bulgaria, Spain, the USA and Israel (see Table 3.2).

The main producers in Turkish sanitaryware sector are VitrA–Eczacıbaşı, Serel, Toprak, Ege Seramik, Kalevit–Roca, Prima–Duravit, Sevit–Erbe, Eskişehir Seramik, Heriş, Çanakçılar Seramik, Çelvit and Ece Seramik. VitrA–Eczacıbaşı is the first producer in the mean of industry as well as the largest plant in the world with its today 4 million capacity. In the first half of the 1940s, Nejat Eczacıbaşı and Pestallas established a ceramic firm to manufacture 'coffee cups' with his 8 workers and a small furnace in Kartal, İstanbul. Furthermore the coffee cup production scale expanded to fabricate kitchenware. In 1951, Pastellas immigrated to France and Eczacıbaşı became the sole director of the ceramic firm. In the second half of the 1950s, this kitchenware producer has strongly focused on sanitaryware manufacture and expanded its capacity from 3000 ton to today scale.

(a) (b)

Figure 3.3. VitrA-Eczacıbaşı, (a) Eczacıbaşı in 1959 (Arredamento Mimarlık, 05/2000, p.133), (b) VitrA, a brand of Eczacıbaşı in 2004 (http:// www.eczacibasi.com.tr/channels/1.asp?id=389)

In summary, the development of Turkish sanitaryware sector, which was started with a small enterprise and then accelerated by Eczacıbaşı, has continued increasingly due to being a country rich in raw materials used in manufacturing of ceramics, highly qualified work force and the geographical proximity to major sanitaryware market.

3.2. Materials Used in the Sector

3.2.1. Design with Ceramics: Definition and General Characteristics

The term ‘ceramic’, which is derived from the Greek word ‘keramikos’ meaning clay, is used to designate every ceramic product such as baked soil, polished tiles and porcelain (soft, hard or twice-fired ceramic). It has been adopted for this purpose both in the French ‘céramique’ and in the German ‘keramik’. Because of having a thousand years history, the production of ceramic objects is one of the oldest crafts. Ceramics is a material that is not specific to any country or region and also industries are built around quarries where the clay and coal are readily available.

With so many varieties and applications, ceramics is difficult to define. It encompasses a multitude of product areas that range from building materials to teacups, bulletproof vests to kitchen knives. Ceramics are hard; they have excellent compression strength, high melting points and a good resistance to chemicals. The cost, manufacturing potential and versatility give ceramics an unrivalled advantage in so many industries in the means of more traditional cases. Ceramic has a high quality to be immediate and simple to form. It can be pushed and pulled, squeeze and molded, or poured and ground. But in contrary, at the same time it can be highly precise and shockingly hard, with the most enduring of physical properties. It can be polished to an extraordinarily smooth surface but it is also appreciated for its surface texture. It is this diversity and versatility which makes ceramic difficult to characterize.

In an industrial way and also in art, ceramic products differ from each other both in terms of the mud mixture and the baking method. Ceramics are defined as inorganic and non-metallic materials consolidated and acquire their desired properties under the application of heat. The heat application, in practice, takes place inside high-temperature kilns, usually for long periods of time. For this reason, the ceramics industry is by definition energy intensive one, which is characterized by the lengthy operation of high-temperature kilns and furnaces. In ceramic industry, the energy cost is a significant percentage of the total production costs. The ceramic sector energy requirements are covered largely by fossil fuels that are environmentally harmful and therefore frequently coupled with the requirements for reduced emissions.

It is also hard to classify ceramics, because, in addition to the applications are so varied, there is a vast range of ceramic materials and grades used over the mass of

industries. Apart from the more traditional materials, such as porcelain, clay and terracotta, there are advanced ceramics that consists of various types of oxides, nitrides, borides, carbides and silicates.

The types of ceramics can be expressed and summarized as above:

'Aluminum nitride'; is specifically of interest for its very high thermal conductivity in combination with its effective electrical insulation. It can be produced by dry press and sinter or by hot pressing with sintering aids. The material suffers surface oxidation above 700°C. Applications are in the electrical area where heat removal is important. Another character is good corrosion-resistance.

'Alumina' (aluminum oxide); is one the most widely used advanced ceramic, because of its balance of cost, availability and good mechanical properties. It can be produced in a range of purities with additives designed to enhance properties. It can be formed using many ceramic-processing methods and machined or net shaped to produce a wide range of sizes and shapes of component. In addition it can be readily joined to metals or other ceramics using metalizing and brazing techniques. Typical characteristics include good strength and stiffness, good hardness and wear-resistance, good corrosion and good thermal stability.

'Bone china'; developed in England in the 19th century as a result of trying to produce porcelain. Bone china consists of 50% bone ash (hydroxy-apatite), which gives it its translucent and hard characteristics, 25% kaolin and 25% quartz, feldspar and mica.

'Cement'; is a powdered mixture of limestone, clay and shale. By adding water, the powder is set and can be used for molding. Adding too much water reduces the hardness of the cement. If it is not enough, the chemical reaction does not fully take place and the cement does not harden. The most common form of construction is Portland cement.

'China clay' (kaolin); is a pure form of hydrated aluminum silicate used to make porcelain for a range of electrical and standard porcelain bodies. China clay is made of kaolinite mica and quartz. Visually it does not have the translucency or hardness of bone china.

‘Clay’; is found in a variety of forms all over the world, each with distinctive characteristics. Formed by rocks, which have been broken down and decomposed by natural weathering. Its moldable properties make it a basic ingredient for many products.

‘Concrete’; forms a stone-like material with its biggest application in the construction industry. Concrete is a mixture of cement, sand and an inert aggregate, which can be any number of materials but it is usually small stones.

‘Cornish stone’ (china stone); is less decomposed than china clay containing a large amount of feldspar. Generally used as a flux and porcelain bodies.

‘Earthenware’; is a porous and non-waterproof clay. Fired at a relatively low temperature of 1150°C, it must be glazed in order to hold liquids. Easier to work with than bone china or porcelain, earthenware is the workhorse of traditional ceramics.

‘Glass ceramic’; has an advantage that it can be readily machined into complex shapes and precision parts using ordinary metalworking tools, quickly and economically. No post firing is required after machining, ensuring fast turnaround. Glass ceramic typically withstands high temperature up to 1000°C. It is non-wetting, exhibits zero porosity and does not deform. It is also an excellent insulator at high voltages, various frequencies and high temperatures. Moreover, it offers excellent sealing, joining and metalizing performance.

‘Graphite’; it is a type of carbon and available in several forms as pyrolytic graphite, recrystallized graphite, fibers, colloidal and piezoelectric graphite. Characterized by relatively low strength at room temperature but unlike most materials, its strength increases with temperature up to a maximum of 4530°F. It also has an excellent strength to weight ratio.

‘Granite’; is made up of mica, feldspar and quartz. It comes in many forms and is distinguished by its hardness, durability and good weatherbility. Granite can be used as a building material and moreover, its decorative effects can be enhanced by polishing to emphasize its crystals.

‘Jasper’; is a stoneware developed by Josiah Wedgewood, which is a kind of fine pottery, the most remarkable being what is called jasper, either white or colored throughout the body. It is capable of being molded into the most delicate forms, so that fine and minute bas-reliefs like cameos were made of it, fit even for being set as jewels.

‘Magnesia’ (magnesium oxide); is not normally used in the form of dense magnesia as an engineering ceramic. However, lower density magnesia, for example with 30% porosity, is used in a variety of applications due to its electrical and refractory properties. Typical characteristics include high temperature capability, low electrical and high thermal conductivity, good corrosion-resistance and infrared transparency.

‘Oxides’; a family of ceramics made up of single and double oxides. Single oxides include aluminum, magnesium and zirconium oxide. In the double oxide family there is steatite, cordierite, forsterite and zircon. Each material has its own distinct properties but can be characterized by relative low cost compared to other advanced ceramics, high density and ability to produce high tolerances.

‘Plaster of Paris’; is composed of gypsum, which is hydrated calcium sulfate. In ceramics production it is generally used for making molds. Becomes solid when mixed with water.

‘Porcelain’; is hard, vitrified, white and translucent ceramic, normally fired at over 1300°C. It is used in a vast range of industries, which include electrical insulators, formers in production and teacups. Depending on the final application, it generally contains clay, quartz, feldspar and kaolin. There are different grades of porcelain depending on the final application; these include electrical, chemical and vita porcelains that are used in dentistry. Key features include good hardness, excellent chemical resistance and low thermal shock resistance.

‘Pyrolytic boron nitride’ (PBN); is a white solid material that is non-porous and non-toxic. While boron nitride can be formed by pressing/sintering methods, a vapor deposition process forms this high purity pyrolytic material. PBN is also a very good electrical insulator and has very high thermal conductivity. The material is stable and inert. It is reducing atmospheres up to 2800°C and in oxidizing atmosphere to 850°C. Typical characteristics include high thermal conductivity, low thermal expansion, good thermal shock resistance, high electrical resistance, good chemical resistance and low density.

‘Quartz’; is composed of hexagonal crystals. Quartz, which is the most common form of silica, in its natural, pure state is colorless and pure. It is mainly found as granules and one of the key ingredients in porcelain and china clay.

‘Refractory materials’; they can withstand extremely high temperatures. They are used in the construction of furnaces and kiln furniture.

‘Silicon dioxide’; is one of the most common materials on the planet. Sand, rock and clays all largely made up of silica. It is one of the main elements in glass. Fused silica is a form used in making glass with extremely high temperature requirements. It withstands thermal shock quietly well.

‘Silicon carbide’ (SiC); it is highly wear-resistant and also has good mechanical properties, including high temperature strength and thermal shock resistance. SiC, as a technical ceramic, produced in two main ways. Reaction-bonded SiC is made by infiltrating compacts made of mixtures of SiC and carbon with liquid silicon. The silicon reacts with the carbon, forming SiC. The reaction product bonds the SiC particles. Sintered SiC is produced from pure SiC powder with non-oxide sintering aids. Conventional ceramic forming processes are used and the material is sintered in an inert atmosphere at temperatures up to 2000°C or higher. Other characteristics include low density, high strength, oxidation resistance (reaction-bonded), excellent chemical resistance and high conductivity.

‘Silicon nitride’; is produced in three main types. They are reaction-bonded silicon nitride (RBSN), hot-pressed silicon nitride (HPSN) and sintered silicon nitride (SSN). RBSN is made by direct reacting compacted silicon powder with nitrogen. It produces a relatively low-density product compared with HPSN and SSN, however the process has only a small volume change allowing net shape forming. HPSN and SSN materials are made with sintering aids and offer better physical properties suitable for more demanding applications. Key features include good thermal shock resistance, good high temperature strength, low density, good hardness, wear resistance, high fracture toughness, good oxidation, chemical and good creep resistance.

‘Steatite’; is a magnesium silicate material. It is formed using standard ceramic processing methods and can readily be machined or net shape sintered into a variety of forms. The material is lower in cost than alumina but has reduced mechanical properties. However, steatite has very good electrical resistance properties, which are retained at high temperatures, along with moderate mechanical strength and temperature resistance. It has been used in electrical insulation for many years in both large-scale electrical systems, electronic and domestic appliances.

‘Stoneware’; is a vitreous and non-porous ceramic. Key features include water resistance, good hardness, excellent chemical resistance, low thermal shock resistance and low tensile strength.

‘Talc’; is a hydrated magnesium silicate used for a variety of applications. In its pure white state it is used as a cosmetic. In powdered form it is used as filler for plastics and for paper coatings. Steatite is a type used in solid block form for electrical insulation.

‘Terracotta’; it is low-fired and unglazed clay with a distinctive red and orange color. In addition, although other shades are available and white terracotta is also obtained. It is generally used as a material for exterior applications such as tiles, plant containers and hollow building bricks due to its ability to withstand frost.

‘Titanium dioxide’ (titania, titanium oxide); white titania is used in large quantities in powder form, bulk-sintered material has limited mechanical applications, due to its relatively low fracture toughness compared to alumina. This material is tan in color and has been used to produce thread guides where there is relatively soft wear on the yard. In addition, the material can be produced in a reduced form, black in color, which is electrically conductive for thread guide applications where static electricity is a problem. Typical characteristics include low-friction, high thermal conductivity, corrosion-resistance, strength, high dielectric properties in pure form and electric conductivity in reduced form.

‘Zirconia’ (zirconium oxide); offers chemical and corrosion resistance to temperatures well above the melting point of alumina. In its pure form crystal structure changes limit mechanical applications, however stabilized zirconias produced by the addition of calcium, magnesium or yttrium oxides can produce very high strength, hardness and particularly toughness. In addition the material has low thermal conductivity and is an ionic conductor above 600°C. This has lead to applications in oxygen sensors and high temperature fuel cells.

‘Zirconia-toughened alumina’ (ZTA); is used in mechanical applications. It is considerably higher in strength and toughness than alumina. This is as a result of the stress-induced transformation toughening achieved by incorporating fine zirconia particles uniformly throughout the alumina. Typical zirconia content is between 10 and 20%. As a result, ZTA is more expensive than alumina but offers increased component life and performance. Other typical characteristics include excellent wear-resistance, high temperature stability and good corrosion-resistance.

3.2.2. A Brief History of Ceramics and Ceramic Technology

The history of ceramic processing technology is very interesting in that both simple processes developed in ancient times for natural materials and recently developed relatively sophisticated processes dependent on synthetic materials are used extensively near the end of the twentieth century. Ceramics history is as old as mankind and ceramic material use appeared through history in many different forms. When we look at the past civilizations, ceramics can be found in various areas, from religious idols to architectural elements, from kitchen and decorative goods to communication tablets. By the Neolithic revolution after 10000-8000 BC, mankind has started the first production. At this stage, the first step towards making ceramics by mixing materials in nature has been taken place. Hand mixing, hand building, scratch and slip decorating of earthenware date back to before 5000 BC. The first forming machine was probably the potter's wheel, which was used earlier than 3500 BC for throwing a plastic earthenware body and later for turning a somewhat dried, leather, hard body. Shaping by pressing material in fired molds and firing in a closed kiln were subsequent developments.

The first ceramic artwork in history originated in Anatolia. While the first ceramics was created in Çatalhöyük around 6000 BC, the Yang-Shao culture, one of the Chinese civilization's forefathers, was to wait for another 2000 years before making its first earthenware pots. After Turks stepped on Anatolian land, first Seljuks, then Ottomans took the historical legacy of human civilization to new horizons. The Seljuks were influenced by the cultural heritage they encountered in Anatolia, adapting them to the techniques that they had brought with from the Iranian plateau. This resulted in a distinctively Anatolian style of Seljuk architecture that accelerated by the 13th century. The most frequent type of architectural decoration during the Anatolian Seljuk period involved the use of glazed bricks, which were arranged to expose a variety of patterns, mostly on the facades of buildings. Except their use in conjunction with glazed brick, hexagonal, triangular, square and rectangular monochrome tiles were suitable for geometrical arrangements. In addition to variety in shape, diverse color use and gilding determined different composition. Moreover, mosaic tile was the third technique in which the Seljuks were skilled. Tile mosaic is formed by pieces of tile cut into shapes to fit the pattern intended. This compositions are generally geometrical, but floral motifs, Kufic or Thuluth calligraphy are also found.

Emirate-period tiles were generally a continuation of Seljuk techniques, except the introduction of the cuerda seca technique, which was subsequently developed by the Ottomans. In this technique, a red paste is given a coating of white-slip. The design is stamped or carved into the surface after which colored glazes are applied. The contours of the designs are picked out with a mixture of beeswax or vegetable fat, and manganese oxide. During the firing, the wax or fat burns away producing red or black contours that prevent the mix of differently colored glazes. This technique makes possible to create extremely complex and detailed motifs on ceramic surfaces. The late fifteenth and early sixteenth century marks the beginning of a new period in Ottoman tile and ceramic making. The most important center active at this time was İznik. Designs prepared by artists who were employed in the studios of the Ottoman court were sent to İznik to be executed in wares ordered for use at the palace.

The earliest example of the new style emerged in the Ottoman period are the 'blue and white' İznik ceramics. The techniques observed in this period are extremely advanced with quite hard pastes, fine pure white and other colored-glazes quality as compared with anything previously done. These techniques used in ceramics production were to last through various changes in style until the middle of the seventeenth century. During the late fifteenth and early sixteenth centuries, İznik was the production center of blue and white wares more than wall tiles for which it was later to become famous. In addition to these products, İznik is also a place where Damascus, a misnamed group of ceramics dated around the middle of the sixteenth century, was manufactured. By the end of the sixteenth century, the Ottoman ceramic industry had been producing more utensils than architectural tiles. Around the middle of the seventeenth century, the İznik ceramic industry fell into the economic distress by the political upheavals that the Ottoman Empire had begun to suffer. Designs became crude and were haphazardly executed, moreover, pastes turned into coarse finish and glazes became to suffer from cracking. During this period the İznik manufactories apparently directed their attentions to the demands of customers who were less finicky than the İstanbul court and its circles. The following figure shows an example of İznik work (see Figure 3.4).

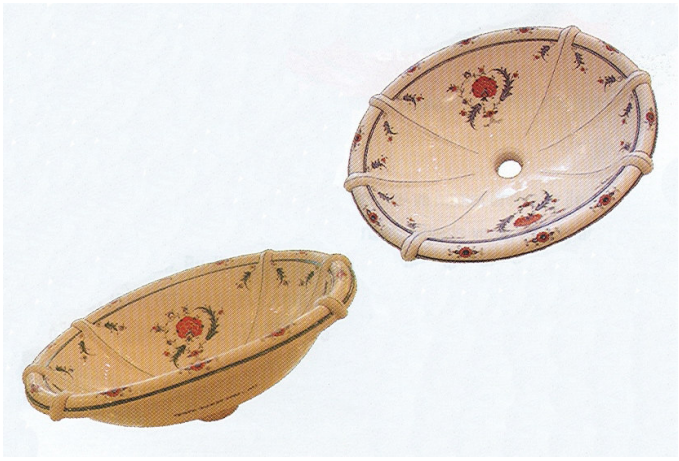


Figure 3.4. An example of İznik works
(Banyo+Mutfak, 02/2003, p. 73)

By the eighteenth century, the ceramic industry in İznik had died out completely and Kütahya replaced it as the leading center in western Anatolia. In fact, Kütahya had been in operation as a secondary center along with İznik since the fourteenth century. During the first half of the nineteenth century, Kütahya ceramic industry suffered a downturn from which it slowly recovered during the second half and into the early part of twentieth century. The art of Turkish tile and ceramic making developed over the centuries incorporating many different styles. Enriched by the arrival of the Seljuks, the ceramic industry in Anatolia achieved a deservedly worldwide reputation with the support of the Ottoman court. By the political and economical crisis in Ottoman Empire, the developments in ceramics had become slow and Turks had almost lost to be the leader in ceramic production and techniques.

On the other hand, the Christian era had become the center of ceramic production evolutions in the means of industrial way. The most notable early achievement was the development in China of pure white porcelain and its high translucency. A young German alchemist, Fredrich Bottger, under the direction of the celebrated physicist Count von Tschirnhaus, discovered that fine porcelain could be produced on firing a body containing fire-resistant clay with fusible materials. Other inventions in the eighteenth century included the use of a template for forming, slip casting in porous molds, auger extrusion, transfer decoration and firing in a tunnel kiln.

The introduction of steam power in the nineteenth century led to the mechanization of mixing, filter pressing, dry pressing and pebble mill grinding. Near the end of that century, separate phases of silica were distinguished using optical

microscopy and silicon carbide was synthesized in an electric furnace. Pyrometric cones were developed by Seager to control firing. The first half of the twentieth century saw the rapid development of x-ray techniques for the analysis of the atomic structure of crystals and later electron microscopy for examining microstructure beyond the limit of the optical microscope. Material systems became more refined. Special compounds were developed, synthesized and fabricated into products for refractory and electronic applications. Refined organic additives were purposefully introduced to improve the processing behavior. Industrial production became mechanized and several stages of manufacturing were automated. Thermocouples were used routinely to monitor temperatures during firing.

The second half of the twentieth century has witnessed major advances in the synthesis, characterization and fabrication of ceramic products. Scanning electron microscopy is now used for routine microstructural analysis for quality control in manufacturing. Several different instrumented techniques have been developed for bulk chemical analysis at a concentration of less than a fraction of one part in a million and surface concentrations a few atomic layers in thickness. The particle size distribution of a material can be determined to below 0.1μm in a few minutes. The flow behavior during forming is developed and controlled using a multicomponent system of additives. Testing apparatus and processing machinery are much more advanced. Computers are now used throughout the industry to monitor or control raw-material handling, preparation, fabrication and firing.

3.2.3. New Material Possibilities in Toilet Design

Apart from the traditional application and uses of ceramic materials, they have been used in advance in the most futuristic industries. The aerospace industry is one that ceramics are used in the protective facing of the space shuttle, because they are resistant than any other traditional or synthetic materials. Advanced ceramics are also preferred for their high performance and heat resistance. These results have been achieved by simply utilizing the intrinsic properties of this ancient material adding special powders and components by applying radical processing techniques. Wood, which is another traditional material, has also been the object of technological development in material applying. The features of wood are joined in one advanced substance, which are exceptional resistance, ease of workmanship, and very pleasing touch and appearance.

Hypertechnical ceramics and wood panels provide a higher level of environmental eco-compatibility than other materials especially since European norms have imposed limits for the use of toxic formaldehyde. This requirement of eco-compatibility will provide ideas for enterprises, designers, dealers and manufacturers, because in the future it will become increasingly important for the definition of costs and the strategic choices of corporations. The costs of recycling and production wastes are already taken into account in the calculation of the production cost and definitively in the price of the finished product. Ceramics are recyclable, reutilisable and do not lead to the production of harmful chemical powders.

Sintering is one of the processes for accentuating the properties of ceramics. This sintered ceramic not only resists wide, rapid temperature changes, but it is also incredibly resistant to wear, corrosion or chemical agents. Furthermore, the hygienic ability of ceramic material is one of the most positive and important traits. The typical limitations (fragility and workmanship constraints) of ceramics are being overcome by improving blends and manufacturing techniques. The new ductility of bath porcelains has made it possible to obtain splendid sink-tops, which have continuous surfaces eliminate anti-hygiene infiltrations and leaks. These contributions make the washstand an important piece of furniture easy to clean. In addition to this, the same flexibility also broadens the range of fixtures forms.

Figure 3.5. Chrome-nickel steel use in sanitaryware, from Franke catalogue (Banyo+Mutfak, 03/2003, p. 93)

(a) (b)

Figure 3.6. Franke chrome-nickel steel toilets, (a) WC pan with horizontal outlet (http://www.franke-wss.com/prod_104_209_en.html), (b) Squatting toilet (http://www.franke-wss.com/prod_103_201_en.html)

Aside from ceramics, porcelain, wood and marble, there is also an advance in the bath sector of new and semi-new materials, designed to replace traditional ones in an advantageous way (see Figure 3.5 and 3.6). One group of these is the compounds, highly compresses mixtures of mineral substances and plastic fragments held together by synthetic substances. These have been efficient solutions for spaces such as the kitchen or public places, in which it is necessary to overcome the functional limitations of ceramic or enamelled surfaces, the extreme porousness of marble and the workability problems of wood. They are useful in situations where it is important to be able to rapidly repair surfaces without special techniques or substances, and without the need to replace fixtures. The compounds, which should not be confused with composites (high-performance synthetic) materials utilized in advanced industrial sectors, have been used for products for the kitchen and bath at convenient prices. The use of the compounds has been spread by their impact-resistance, easy workability and great versatility, available in a unique variety of textures, designs and colors including perfect simulations of marble, tile, inlay work, woods and mosaics. A new thermoplastic material belongs to the category of the polymers; which is suitable for the production of sink and washstand counters because of its excellent level hygiene opportunity (see Figure 3.7). It has the classical virtues of the technopolymers with the quality of resistance, workability and corrosion resistance. In addition, it is also very ductile, easy to repair if damaged and capable of assuming any three-dimensional objects in excellent aesthetic forms with competitive prices.

Figure 3.7. Polyurethane material use in sanitaryware
(http://www.jongeriuslab.com/index2.htm)

On the other hand, it is important to mention about a new attitude in material engineering, which can be an inspiration in design fields, in fact in toilet design. Smart materials and structures are the popular concepts offering a great potential. In fact, an important observation is that no intelligent material has yet been realized from a single compound or a single structure, however instinctive and inert materials are often pure compounds.

It is useful to classify smart materials briefly as following to expose a scheme that shows how materials can be broaden our imagination in such fields.

1. Living materials need to continuously dissipate energy and require suitable energy sources. They are capable of reacting to their surroundings, and these reactions may be classified into the instinctive and the intelligent. The latter implies a decision-making process based upon past experience. The former implies a reaction that requires no such analysis. The living material should also have the capacity to reproduce.

2. The instinctive or reactive material is simply a transducer material that responds to a particular stimulus by changing its properties in a physical, chemical, electromagnetic, or similar domain. All materials are reactive especially to temperature.

3. Inert materials are usually structural or decorative and are specifically designed to give minimal response to external stimuli (Culshaw, 1996, p. 185).

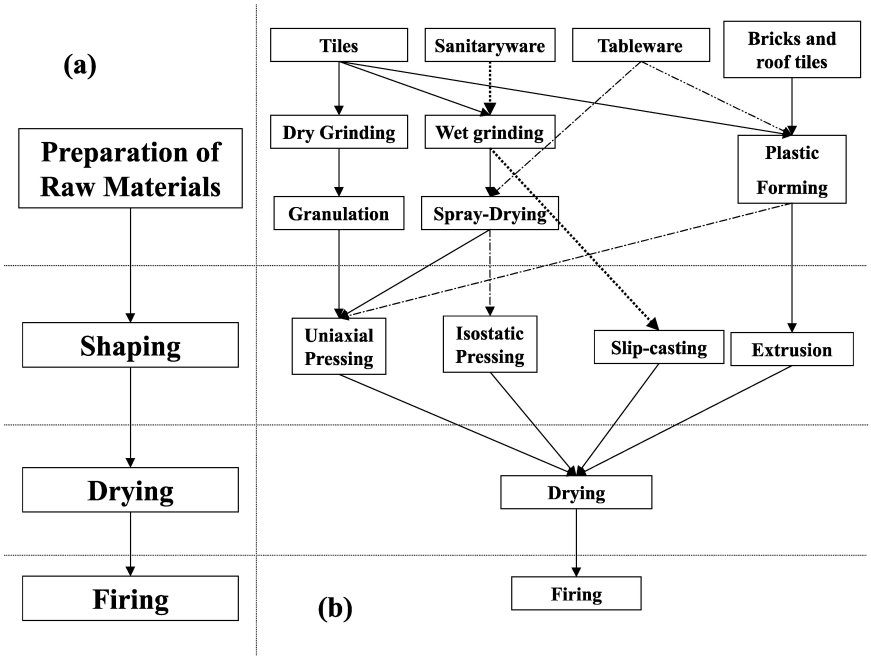
In summary, all developments in materials and material engineering promise new possibilities to shape in various forms, colors, textures and sensations. The difficulties about the relationship between users and these materials have led to chemical

corporations to develop research in the area of special finishes or product qualities appeal to human needs, in order to communicate sensations.

3.3. Production Techniques Used in the Sector

Ceramics processing technology is used to produce commercial products that are very diverse in size, detail, complexity, material composition, structure and cost. The functions of ceramic products are very dependent on their chemical composition, their atomic and microscale structure, which determines their properties. Compositions of ceramic products vary widely, both oxide and monoxide materials are used. Today the composition and structure of grains, grain boundary phases, the distribution and structure of pores is more carefully controlled to achieve greater product performance and reliability. The process of forming ceramics consists of three main steps. First step is the preparation of the ceramic ingredients. The next stage is the forming of the part. Finally, the last one is, in most cases, drying and firing, or sintering. As with most materials, ceramics can be formed in a number of methods to account for low, medium and high volume production.

Table 3.3. The flow chart of the ceramic production process, (a) general scheme, (b) particular course for each sub-sector.(Agrafiotis and Tsoutsos, Energy Saving Technologies in the European Ceramic Sector: A Systematic Review, 2000)



3.3.1. Preparation of Raw Materials

This stage involves the preparation of the ceramic mixes together with the required additives for the following stages of the process and the reduction of their particle size, which is usually achieved by dry or wet grinding. In this first stage of process, if the mixture is used wet, then the right degree of plasticity is obtained by mixing plastic clays with non-plastic ingredients. In dry grinding, first the raw materials are almost completely dried by hot air stream and then are dry ground. In order to achieve granulation, the dry ground powder is mixed with a very fine spray of water to provide moisture content of up to roughly 10%. Then, the material is agglomerated with the aid of the granulator's rational movement. On the other hand, wet grinding is a process, which consists of grinding the raw materials in water and successive spray drying the slip to obtain the required water content for dust pressing. Wet grinding allows finer particle sizes to be obtained and it is important in order to develop a dense homogenous structure during firing. The water permits optimum homogenization of the various raw materials forming the mix.

Figure 3.8. Preparation of raw materials
(Eczacıbaşı 40. Yıl, 1982, p. 39)

3.2.2. Shaping

Shaping gives to the finely ground material its required shape before firing. The coherent but unfired object formed at this stage is known by the term 'green body'. Shaping can be accomplished by a variety of methods, depending on the shape of the final product. Tiles can be shaped by dry pressing of the powder into pressing dies or by extrusion, i.e. flow of a wetted, plastic mass through a die under pressure. Extrusion is

also the shaping process for bricks and roof tiles. For the dry-pressing process the powder has to have excellent flow ability and this is usually achieved by spray drying the slip to form granules. All sanitaryware pieces are formed by slip casting, for example preparation of a slurry of the raw powders, which is then cast into plaster moulds, through which the water is slowly absorbed leaving the green object as a crust inside the mould.

Figure 3.9. Inside view of a sanitaryware factory
(http://www.vitra.com.tr/tmp/template.asp?templateID=77)

3.2.2.1. Slip-Casting

Slip-casting is based on slip, a creamy suspension of clay in water. This is occurs first on the side closest to the mould, forming a thick skin. If it is left longer, the skin gets thicker depending on the time. The process is used for making forms that need to have cavities or are hollow. The slip-cast is a section, ceramic particles held in water, which known as the creamy suspension, are poured into a porous mould. In many cases, the mould is made of plaster, which draws out the water from the wet slip and leaves a ceramic slip on the inner surface of the mould. The mould is inverted and the excess ceramic is poured out leaving the final product to be dried and fired. Slip-casting is ideal for large and intricate shapes. There are various forms of slip-casting which are dependent on the type and scale of product.

3.2.2.2. Vacuum Pressing

Pressing casting is a method of sanitaryware shaping consists in supplying the casting benches with slip under pressure. The conventional plaster moulds are replaced by porous resin ones. Rather than waiting for the mould to absorb water the mould is used as a filter where the water is eliminated through the porosity of the mould. This technology has made it possible to reduce the casting time down to as low as 10 min for example water closets with a pressure at around 20atm. Complex moulds are continuously been developed to fully automate a sanitaryware factory. Articles are currently pressure cast in two, four or five part moulds (wash basins, WCs, water tanks). All the moulds are used simultaneously and robotics demount the green ware automatically and place them on motorized transport belts. Porous resin materials and hard plasters have solved many problems of withstanding the higher stresses and lasting for an acceptable number of cycles. It is possible to use one mould for about 50,000.

3.2.3. Drying

Drying is the slow and gentle expulsion of water from the green products before the final firing, so that no damage is caused within the body. Temperatures encountered at this stage can vary from 60ºC to 120ºC. Drying times depend on the initial moisture content and on the dimensions of the ware. Sanitaryware requires the most time and tiles the least. After forming, the green product contains moisture that must be removed prior to firing. Slip-cast ware contains the most water: ~20%, plastic formed ware follows with 15% and then pressed granulate at least than 5%. In the traditional tunnel dryers the pieces to be dried are placed on wheeled carts, which move slowly from one end to the other. Hot air from the cooling area of the kiln moves in the opposite direction absorbing the water evaporating in the drying process. When leaving the dryer the pieces usually have water content below 1%. These dryers have a high percentage of recycled moist air expelled at ~80ºC which is reintroduced into the dryer together with hot, dry gases from the burner. The passage from natural to artificial ventilation led to enormous increases in the overall efficiency of the heavy clay products' factories by releasing them from seasonal operation. Apart from the ceramic product, the moulds used for slip casting need themselves to be dried before re-use.

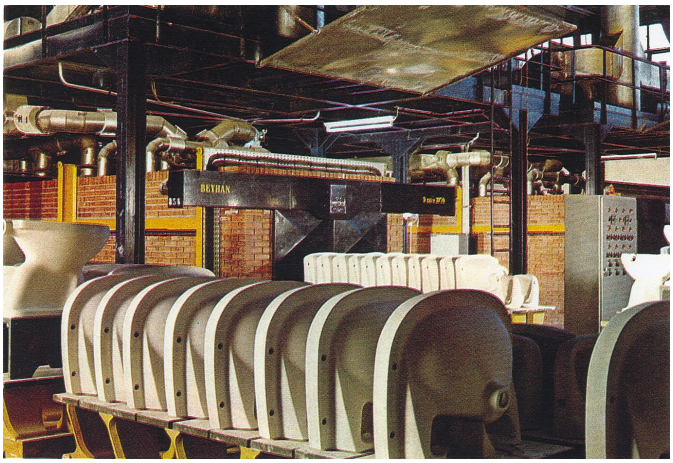


Figure 3.10. Inside view of a sanitaryware factory
(Eczacıbaşı 40. Yıl, 1982, p. 39)

3.3.4. Glazing and Vitrification

Before the shaped product is placed in the furnace, it needs to be fully dried. Drying should be progressed slowly according to the products details; otherwise the product may crack during the drying process or when it is left in the furnace to be baked. The dried surface product is finally applied by sandpaper or foam rubber in order to form a smooth surface and placed in the furnace. Glaze is applied with an appropriate technique, which is plunging, spraying, pouring, dusting, etc., to make the baked product durable (see Figure 3.11). Glaze is a hard coating of glass applied to the ceramics surfaces as decoration and to seal porous bodies. The glazed product is baked for the second time at a high temperature. Temperature of the furnace differs according to the type of the glaze. Glazing adds a nice visual effect and a hygienic quality to products. Having opaque and shiny types, glazes can be varied by adding color. By the reason of technical advances in dressing technology, it is possible to give various effects on sanitaryware products from porous and opaque surfaces to vitriform, smooth and hygienic ones. There are various ranges of finishes, textures and colors to determine a highly valuable base for decoration and variation.

Figure 3.11. Robotic glazing
(http://www.turkishceramics.com/sanitary.asp)

3.3.5. Firing Systems

Firing is the core of the ceramics production process and gives to the product its coherence and properties through a series of physical and structural transformation that take place. The process called firing proceeds in three stages: 1) reactions preliminary to sintering, which include organic burnout and the elimination of gaseous products of decomposition and oxidation, 2) sintering and 3) cooling, which may include thermal and chemical annealing. 'Sintering' is the term used to describe the consolidation of the product during firing. Consolidation implies that within the product, particles have joined together into an aggregate that has strength. Highly porous, refractory insulation products may actually be less dense after they have been sintered. In principle, the firing of tiles, sanitaryware and the cheapest tableware can take place in one stage. However, for other products a series of firings might be required. All firings are carried out at either continuous or intermittent (batch) kilns.

Intermittent kilns for industrial firing, commonly called periodic kilns, are usually of the shuttle or elevator type. When loading a shuttle kiln, product items placed on refractory setters and kiln furniture, in addition to this, or product contained in refractory saggers are set on refractory shelves that are supported on a thermally insulated kiln car (see Figure 3.12). The car mounted on a rail is pushed into the kiln for firing and withdrawn for unloading. Continuous tunnel kilns of the car, sled, roller hearth and continuous belt type are commonly used for firing high-volume production items. When firing in a car or sled kiln, the product is set in a manner similar to shuttle kilns, but the cars or sleds move through the thermal gradient in the kiln.

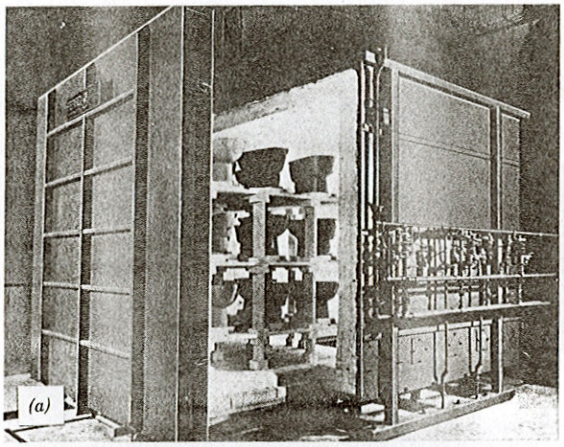
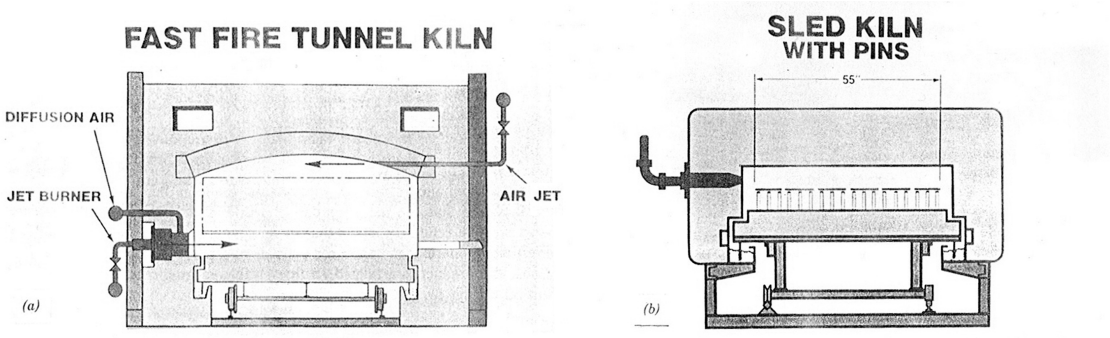


Figure 3.12. Shuttle kiln
(Reed, 1995, p. 584)

When firing products with a large mass or setting surface, the product is supported on mobile refractory supports, a granular bed or partially fired ‘shrink plate’ that can accommodate the differential shrinkage between the product and the setter. Products that have a tendency to deform during firing are supported on contoured refractory setters. In some setting configurations, the product is arranged so that shrinkage gradients and dimensional distortion during firing can compensate for density gradients or oversize dimensions in the green product.



(a) (b)

Figure 3.13. Cross-section of kilns, (a) Car-type kiln, (b) Sled-type kiln
(Reed, 1995, p. 586)

Periodic kilns are used when a wide variety in product firing schedules or a relatively small or intermittent production volume requires flexibility in firing. Products from a continuous kiln that have had a minor body or glaze defect repaired are also often refired in a periodic kiln. The car-type tunnel kiln, introduced in 1916, is used widely for firing large products and heavy loads when the firing cycle exceeds about 6h.

Sled, roller hearth and small periodic kilns are commonly used when the firing cycle is as short as 0.5h. Different types of energy are used for heating purposes. They are fuel oil, diesel fuel, LPG (liquid petroleum gas), methane or natural gas, coal (coke) and electricity.

3.4. Toilet Fixtures

The toilet fixtures produced in sanitaryware sector can be categorized mainly as above:

3.4.1. Floor-Mounted Toilet

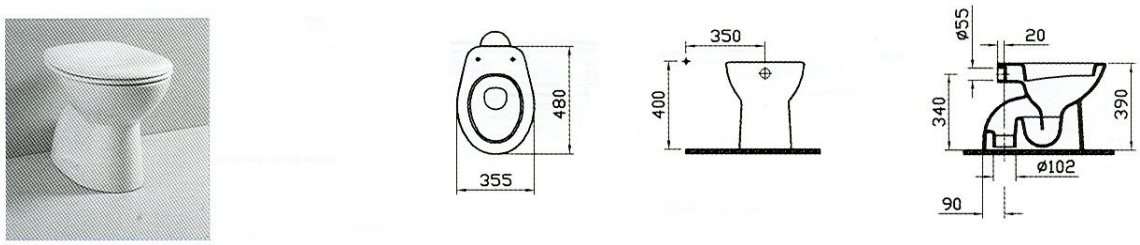
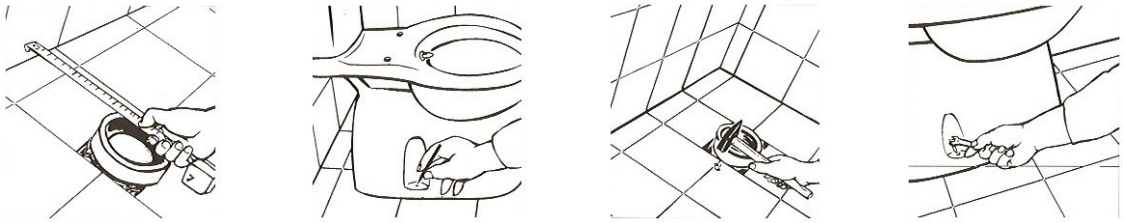


Figure 3.14. WC pan with vertical outlet
(Vitra Ceramic Sanitaryware Catalogue, 2003)



(a) (b) (c) (d)

Figure 3.15**.** Assembly of WC pan with vertical outlet**,** (a) Fix the distance according to closet between the center of waste outlet and the wall, (b) Closet and cistern place temporarily to sign the assembly holes on the ground, (c) Plastic dowels fastened to the holes on the floor, (d) Closet placed and fixed to the floor
(Vitra Ceramic Sanitaryware Technical Catalogue, 2003)

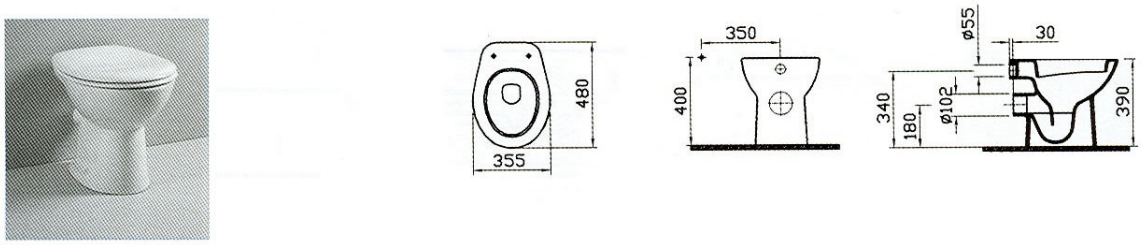
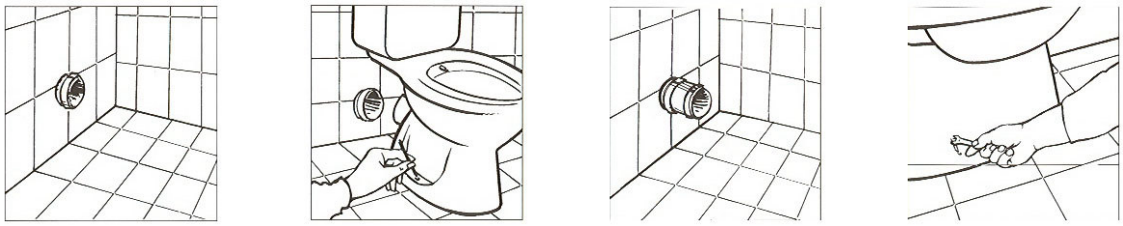


Figure 3.16**.** WC pan with horizontal outlet
(Vitra Ceramic Sanitaryware Catalogue, 2003)



(a) (b) (c) (d)

Figure 3.17. Assembly of WC pan with horizontal outlet**,** (a) Waste outlet prepared according to closet height, (b) Closet and cistern place temporarily to sign the assembly holes on the ground, (c) Adjust the waste pipe height and fasten it to the outlet, (d) Closet fixed to the floor and covers placed on the tops of assembly screws (Vitra Ceramic Sanitaryware Technical Catalogue, 2003)

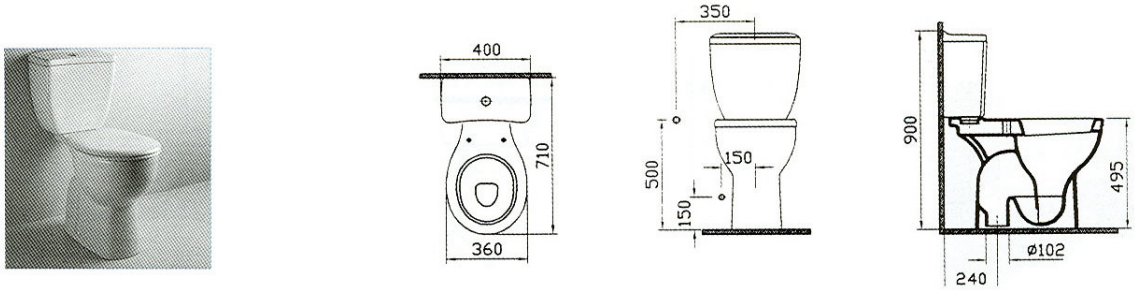
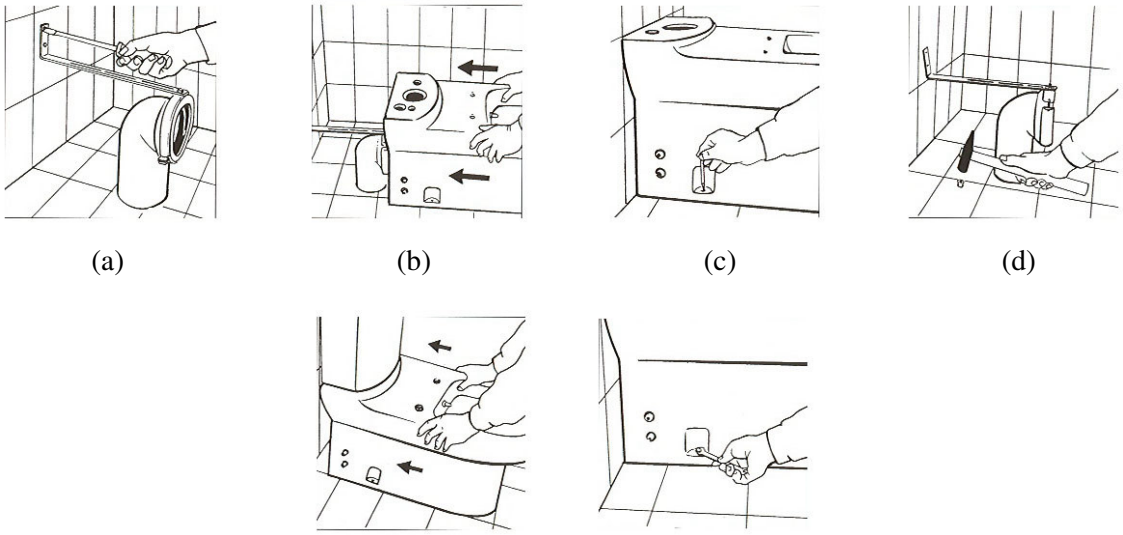


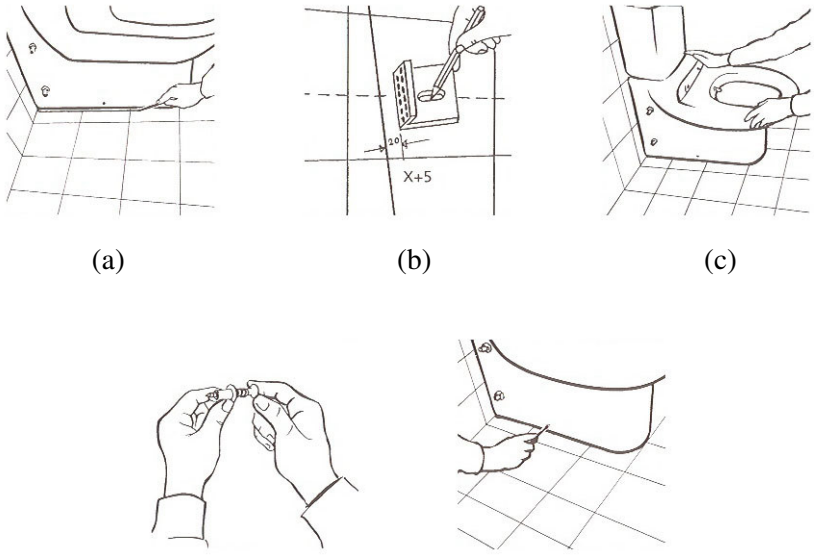
Figure 3.18. WC pan-vertical and horizontal outlets with cistern for physically disabled people (Vitra Ceramic Sanitaryware Catalogue, 2003)



(a) (b) (c) (d)

(e) (f)

Figure 3.19. Assembly of WC pan back to wall with cistern, (a) Fix the 90° plastic elbow pipe, (b) Closet placed temporarily, (c) Assembly holes signed on the ground**,** (d) Plastic dowels fixed to the floor, (e) Closet placed by pushing to the wall, (f) Closet fastened to the floor with the assembly screws
(Vitra Ceramic Sanitaryware Technical Catalogue, 2003)



(a) (b) (c)

(d) (e)

Figure 3.20. Assembly of WC pan back to wall with cistern, if the assembly kit is fastened from sides, (a) Closet placed temporarily, the bottom edge and the assembly holes signed on the floor, (b) Assembly apparatus placed to x (bottom edge thickness)+5 mm from end and front sides and the holes signed, (c) Closet placed with the cistern taking attention to the edge line signed on the floor, (d) Plastic joint fasten to the screw, (e) Screws with joints placed in the holes to fix the closet to the floor (Vitra Ceramic Sanitaryware Technical Catalogue, 2003)

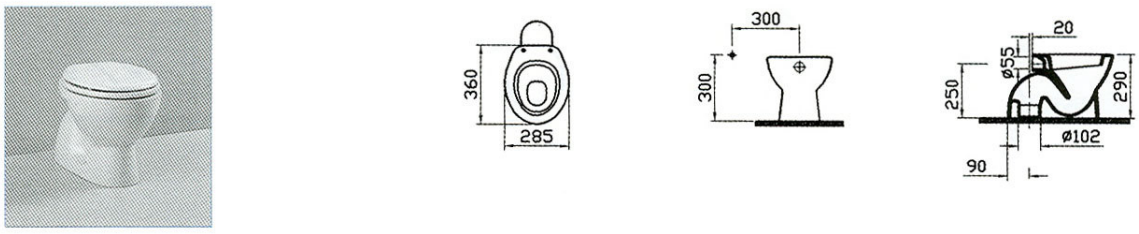


Figure 3.21. WC pan for children
(Vitra Ceramic Sanitaryware Catalogue, 2003)

3.4.2. Wall-Mounted Toilet

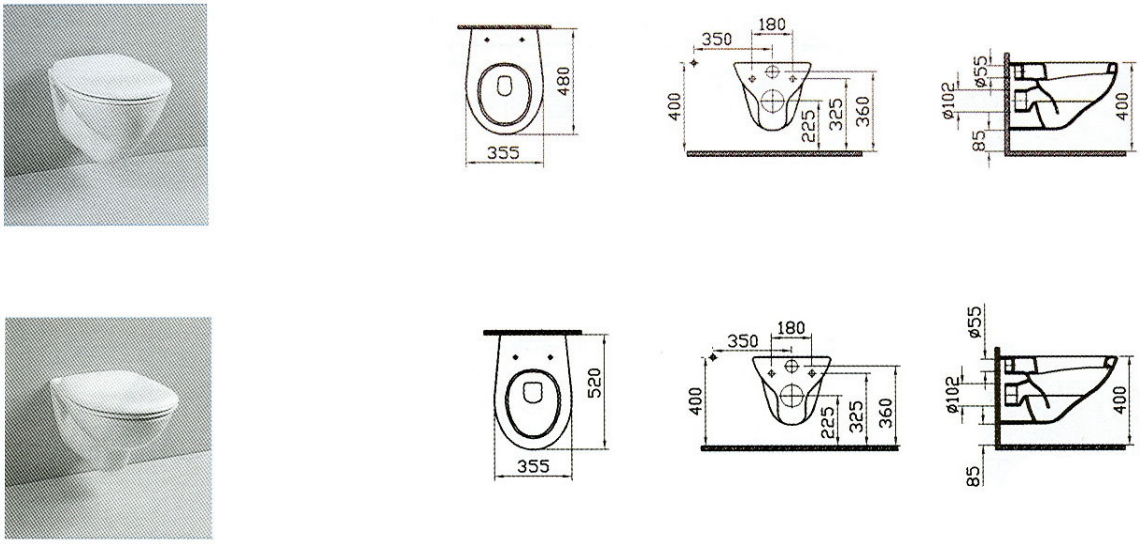


Figure 3.22. Wall-hang pan differentiated in length (short and long)
(Vitra Ceramic Sanitaryware Catalogue, 2003)

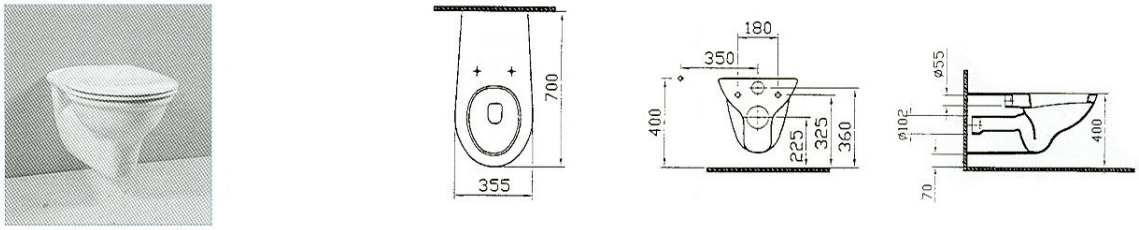


Figure 3.23. Wall-hang pan for physically disabled people
(Vitra Ceramic Sanitaryware Catalogue, 2003)

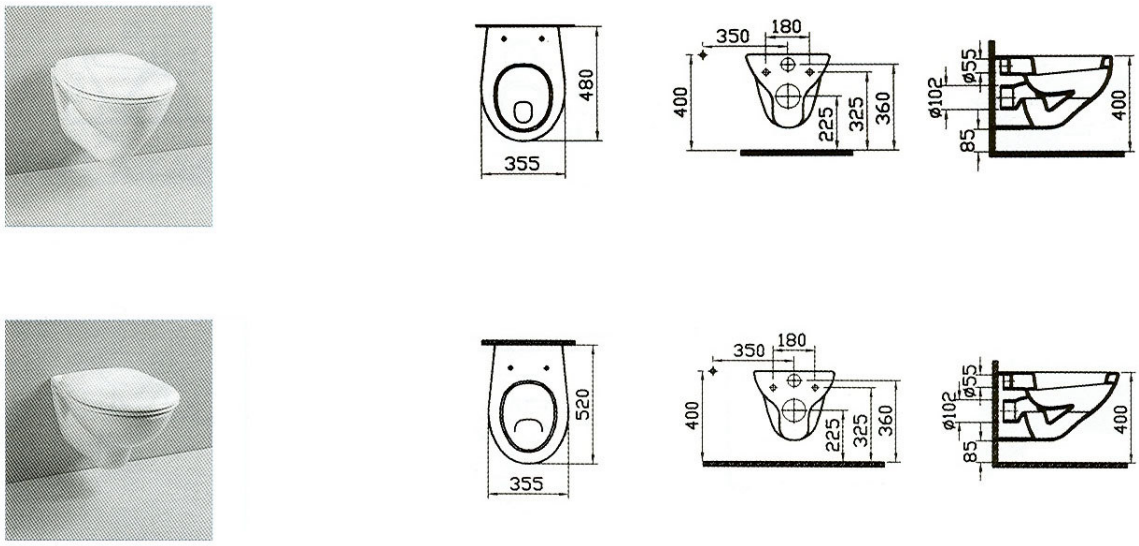
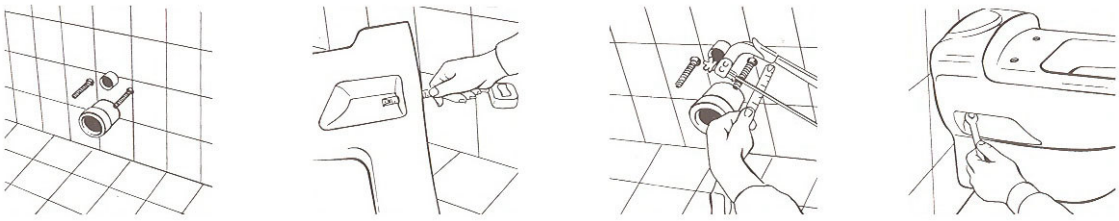


Figure 3.24. Wall-hang pan for hospitals differentiated in length (short and long)
(Vitra Ceramic Sanitaryware Catalogue, 2003)



(a) (b) (c) (d)

Figure 3.25. Assembly of wall-hang pan, (a) Installation prepared before assembly, (b) Efficient fastener size decided for assembly of wall-hang pan, (c) The excess part of the fasteners cut out, (d) Wall-hang pan fixed to the wall
(Vitra Ceramic Sanitaryware Technical Catalogue, 2003)

3.4.3. Squatting Pan / Alla Turca

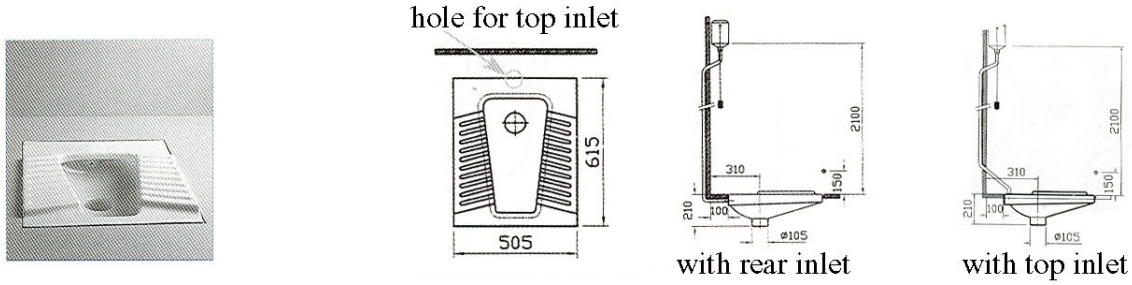


Figure 3.26. Squatting pan with top and rear inlets
(Vitra Ceramic Sanitaryware Catalogue, 2003)

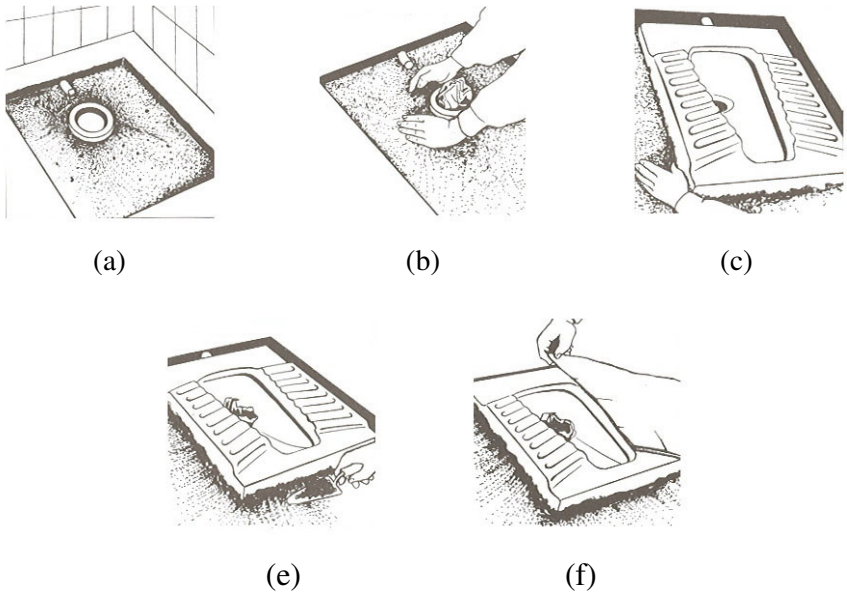


Figure 3.27. Assembly of squatting pan / Alla Turca, (a) Siphon placed on the floor filling with mortar, (b) Siphon outlet closed and sand filled**,** (c) Squatting toilet placed and the holes filled with sand after the installation of water, (d) After control the squatting toilet with water scales-balance, fill the hole on the ground with mortar to the 2-3 cm rest from the floor level, (e) Squatting toilet covered to protect and the floor finish completed (Vitra Ceramic Sanitaryware Technical Catalogue, 2003)

3.4.4. Urinal

Figure 3.28. Urinal top inlet
(Vitra Ceramic Sanitaryware Catalogue, 2003)

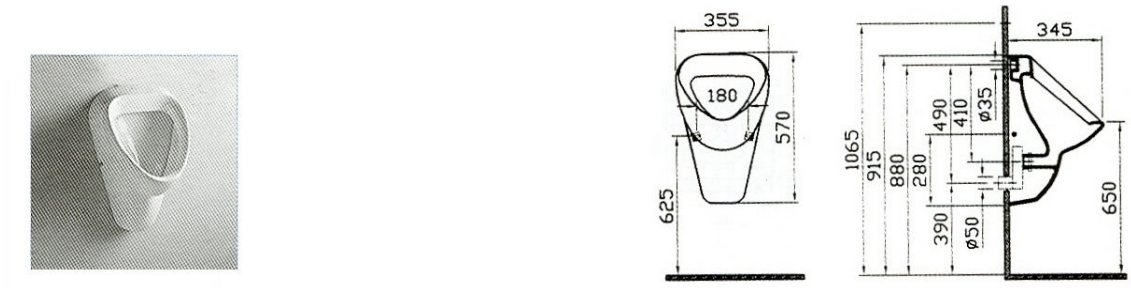
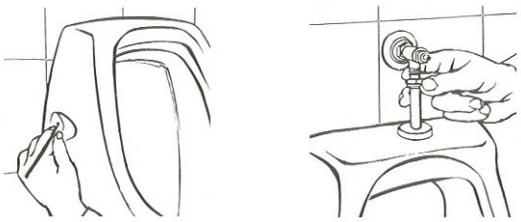
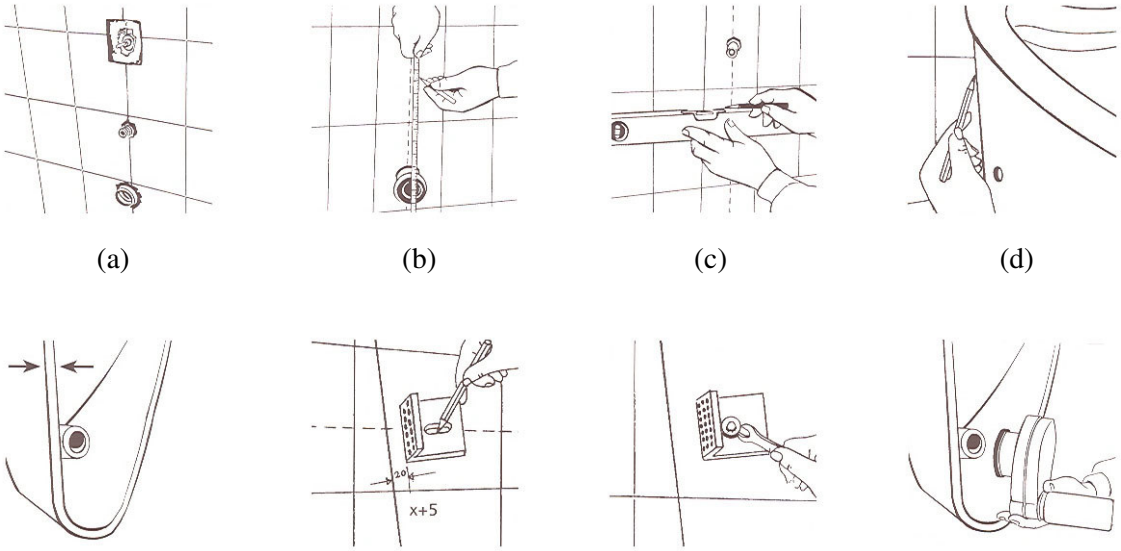


Figure 3.29. Urinal rear inlet
(Vitra Ceramic Sanitaryware Catalogue, 2003)



(a) (b)

Figure 3.30. Assembly of urinal, (a) After urinal placed with the siphon and the holes signed, it fastened to the wall, (b) Faucet installed to the urinal and water-flow regulated (Vitra Ceramic Sanitaryware Technical Catalogue, 2003)



(a) (b) (c) (d)

(e) (f) (g) (h)

(j) (k)

Figure 3.31. Assembly of urinal, if the assembly kit is fastened from sides, (a) Installation prepared before assembly according to the measures of the urinal, (b) The height of assembly apparatus from the floor signed on the wall, (c) The axis of assembly holes signed by a water scales, (d) Urinal placed temporarily to draw the side contour on the wall, (e) The edge thickness (x) measured, (f) The place of hole signed parallel to the apparatus and x+5 mm on the axis, (g) The assembly apparatus fixed on the wall, (h) Siphon placed on the urinal adjusting the size to the waste outlet, (j) Plastic joint placed, (k) Urinal placed and fixed to the wall (Vitra Ceramic Sanitaryware Technical Catalogue, 2003)

3.4.5. Special Use

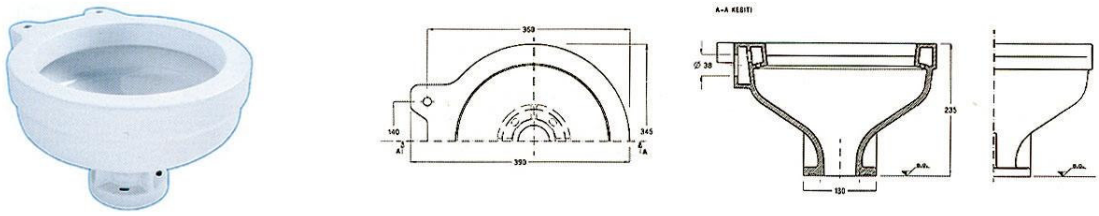


Figure 3.32. Yacht closet
(Serel Ceramic Sanitaryware Catalogue, 1999)

In summary, today, firms in sanitaryware sector produce solutions either by forecasting consumer demands and expectations, or by analyzing them in advance. Analysis of parameters comprising the design input and realizing a concept in this orientation, allows creation of contemporary designs. In addition to these useful parameters, the application of CAD-CAM technologies in product design have improved the quality of product, especially in sanitaryware sector and also have shortened the design process. Product groups are created and produced to present different solutions for various needs by combining the concepts of ergonomics and maximum functionality with aesthetic needs and also technological approach.

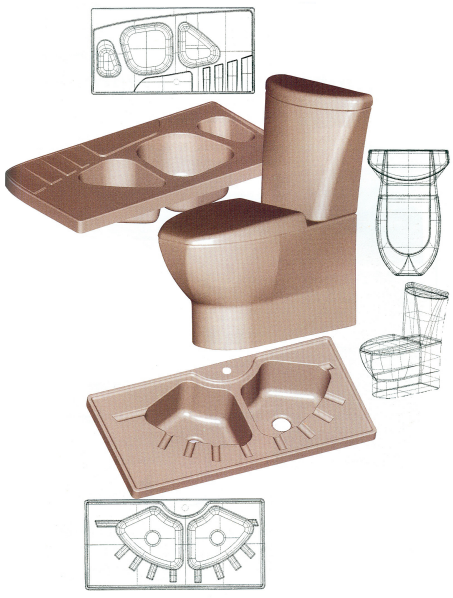


Figure 3.33. Computer-aided design (CAD) in sanitaryware
(Banyo+Mutfak, 11/1999, p. 67)

CHAPTER 4

CRITERIA IN TOILET DESIGN: COMPARING AND DEFINING FOR THE FUTURE

Focusing on design approaches, technical solutions or limitations, and also historical evolution of toilet, leads us to the idea of 'toilet design', which is based on three main headlines. Basically, the principles of universal design, ecological sanitation rules and the design criteria restricted by consumers' psychological needs and especially desires have shaped and directed the design attitude of 'today's toilet'. Moreover, these headlines will be in consideration with greater attention, to expose a solution about waste problem, human beings physiological and psychological limitations for 'future toilet'.

4.1. Designing for Everyone: 'Universal Design Principles'

Basically, the toilet design problem is exposed dividing into two parts; the toilet refers solely the object to relieve and the disposal of the waste. Commonly, the approach for toilet or one design is considered for a 'regular adult population' in the age range of about 20 to 50 years, of which are fairly well known about anthropometrics, biomechanics, physiology and psychology, or attitudes and behaviors. This is the group of most interest to industry and to society as 'movers' and contributors to the gross national product. But, yet there are other large population groups that are deserved specific concern in society. These are pregnant women, children, the aging and the disabled. Every individual is unique and the human species is quite diverse as a group.

It is possible to design a product or an environment to suit a broad range of users, including children, older adults, people with disabilities, people of atypical size or shape, people who are ill or injured, and people inconvenienced by circumstance. This approach is known as universal design, which can be defined as "the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities." Universal design respects human diversity and promotes inclusion of all people in all activities of life. The concept is also called inclusive design, design-for-all, lifespan design or human-centered design.

Concern for usability is one of the most important frontiers in design. Longer life spans and higher survival rates for people with severe injuries and illnesses mean more people are living with disabilities, moreover, the number is increasing. Universal design is getting more important as these trends persist and the average age of the world's population continues to climb. Fortunately, the practice of universal design is becoming more sophisticated each year as understanding, guidelines, examples, teaching strategies, design experience, and marketing skills evolve. By these attitudes to design problems, the challenge inherent in the universal design approach should be taken as an inspiration for good design and not an obstacle.

4.1.1. Universal Design and Body Functions, Understanding the Spectrum of Human Abilities

For the first time, in the 1970s, an American architect, Michael Bednar, introduced the idea that everyone's functional capacity is enhanced when environmental barriers are removed. He suggested that a new concept beyond accessibility, which has been used as design term in legal standards beginning with *Section 504 of the Rehabilitation Act of 1973*, was needed that would be broader and more universal. A number of trends converged in the 1980s. People with disabilities noted the unintended consequence that laws governing accessible design had reduced design to a set of minimum requirements too often resulting in designs that were accessible but felt separate and unequal. The laws offered invaluable protections but had the unintended consequence of diminishing attention to the creative potential of design to enhance everyone's experience through design that anticipated human diversity and integrated solutions seamlessly.

In 1987, a group of Irish designers succeeded in getting a resolution passed at the World Design Congress that designers everywhere should factor disability and aging into their work. In the U.S., Ron Mace, who started using the term universal design and figuring out how to define it in relation to accessible design, made the case that universal design is not a new science, a style or unique in any way. It requires only an awareness of need that means market and a commonsense approach to making everything we design or produce usable by everyone to the greatest extent possible. The term universal was realized not to be ideal to express the idea. It could be interpreted to promise an impossible standard. It is clear that there is always be a small number of people for whom an individual design does not work. More accurately, universal design

is an orientation to design in which designers strive to incorporate features that make each design more universally usable.

Interest in the concepts of universal design grew in the 1990s. Clearly, the most enthusiastic initial discipline within design was industrial design-a field of design almost completely excluded from legal requirements for accessible design. The Industrial designer appeal to the end user, who is more attuned to market opportunity than other designer, assumes the validity of focusing on the needs and preferences of users. Because, the changed demographic of ever-increasing user diversity established a clear, commonsense case for universal design. Each person is unique in age, size, abilities, talents and preferences. Any human characteristic that can be measured spans a broad range in any population. An understanding of human diversity is critical to designing effectively. Successful application of universal design principles requires an understanding of how abilities vary with age, disability, the environment or the circumstances.

4.1.1.1. Designing for Men and Women

These are systematic differences between adult and women, especially in body sizes and in physical capabilities. In general, any workstation, any piece of equipment or tool can be designed to use by either women or men. In some cases, adjustability is needed or one may have to provide objects in different dimension ranges. These adjustments and ranges, however, often are not gender-specific but are simply needed to fit different people. Healthy adults in theirs 20s, 30s and 40s are commonly considered ‘the norm’. About them most ergonomic information is available and for them most ergonomic efforts are made. In contrary to the idea of ‘norm’, the sociologic, psychological or physiological differences that cannot be refused exist between men and women. However, one group among adults identified as ‘pregnant females’ needs specific attention.

Pregnancy is one of the most common life events, surprisingly little systematic and scientific information is available in the literature for ergonomic purposes. One set of information concerns the changes in body dimensions during pregnancy. These become apparent after two or three months and most increase throughout the course of pregnancy. The most obvious changes are in body weight, abdominal protrusion and circumference. The increasing abdominal protrusion makes daily affairs increasingly

difficult for women throughout their pregnancy. The working area of the hands becomes smaller during pregnancy, in addition to this, manipulating objects that are now further ahead of the spinal column generates an increased compression and bending strain on the spine, on ligaments and muscles in the back. This loading is clearly also due to the increasing mass of the abdomen. The variations in abdominal shape also change the body posture that assumes a backward pelvic rotation accompanied by forward movement of the trochanterion and brings about a flattening of the lumbar lordosis. Physical performance capabilities also change during pregnancy. Although there are great variations among individuals, many everyday tasks that require exertion of large energies, much mobility or far reaches become more difficult with pregnancy. All these indicate clearly certain ergonomic measures accepted as a frontier in design to accommodate pregnant women, either at the workplace, in transportation or at home.

Table 4.1. Anthropometric data relevant to WC design
(Pheasant, 1988, p. 222)

	Men				Women			
Posture	5th %ile	50th %ile	95th %ile	SD	5th %ile	50th %ile	95th %ile	SD
Sitting								
Seat height[a]	345	410	475	40	290	370	450	50
Perineal length[b]	200	250	300	30	140	190	240	30
Squatting								
Seat height[a]	45	160	275	70	100	180	260	50
Perineal length[b]	240	290	340	30	170	220	270	30
Preferred seat height[c]	380	430	480	30	345	400	455	33

[a]Vertical distance from floor to buttocks.
[b]Horizontal distance from buttock-cleft to genitalia.
[c]As determined in fitting trial.
Data from McClelland and Ward (1976, 1982).

On the other hand, by the anthropometric means of men or women, different ergonomic data is expressed that resulted in various approaches to toilet design (see Table 4.1). Furthermore, there is a controversy for water closet that exists as to whether the seat of the WC should be at its conventional height (400mm) or lower. A squatting position, in which the things are pressed against the abdomen, is an aid to the efficient emptying of the bowel. For this reason, this position is possible to help prevent a variety of unpleasant and potentially life-threatening diseases to which civilized people are prone, largely as a consequence of diet and lifestyle. A subsequent fitting quality

showed quite clearly that subjects were most comfortable at a conventional range of heights. Moreover, lowering the WC seat to 200mm or less would cause considerable problems for males and females who have difficulties in standing up and sitting down, even with conventional appliances.

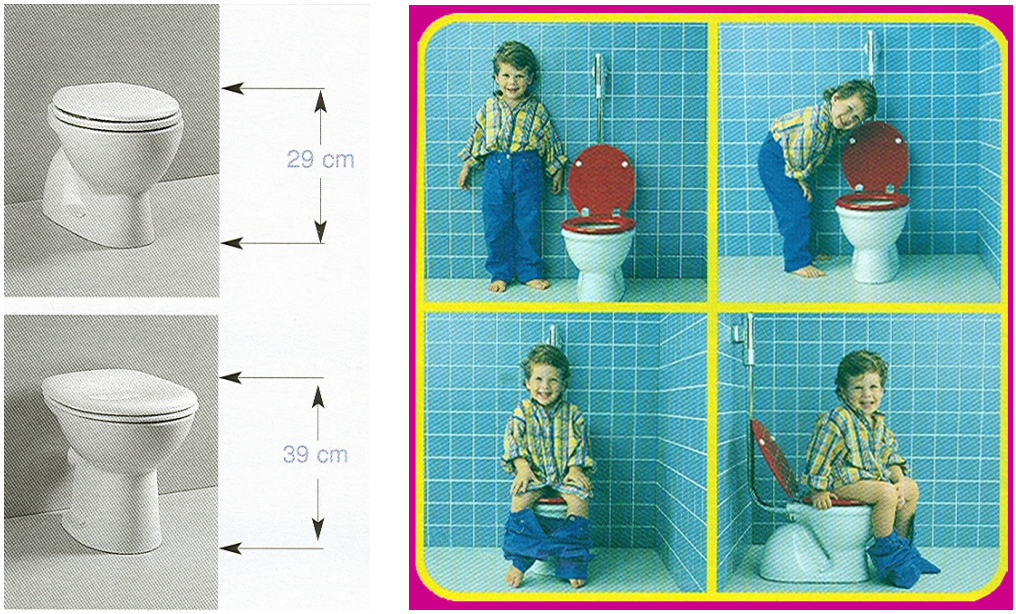
4.1.1.2. Designing for Children

There is another group that draw everyone's attention: infants and children. Specific ergonomic information is available for small children, but little is systematically known about teenagers. The time span between birth and early adulthood (at about 18 years) is characterized by very large changes in body dimensions, body strength, skill and other physical or psychological variables. But, these changes over time are individually quite different and appear to be related not only to genetic factors, also to environmental variables. As a result, there is no 'typical' boy or girl.

Measurements on children are difficult to take, particularly if these are very young. They do not understand or follow instructions and their attention span is very short. For example, the body length (stature) of babies and infants, up to the age of two years, is customarily measured with the child lying on its back; later, stature is taken when standing up. Today's children may have different dimensions; in addition, children from other areas and countries are likely to have different sizes. Body dimensions of children are important for the design of furniture and fixtures, particularly as used in schools. This poses problems, because children of different body sizes may be combined in the same rooms from kindergarten on up.

Figure 4.1. Baby seats, a solution for different dimensions of infant (http://www.boots.com/shop/product_enlarge.jsp?productid=1012757&classificationid=1013468&slmRefer=000&imageid=1)

Today's children may have different dimensions; in addition, children from other areas and countries are likely to have different sizes. Body dimensions of children are important for the design of furniture and fixtures, particularly as used in schools. This poses problems, because children of different body sizes may be combined in the same rooms from kindergarten on up. Furthermore, designing for children is not based solely on dimensions. In general, the group of children is also different in abilities, talents and preferences.



(a) (b)

Figure 4.2. Toilets for infants
(Vitra Ceramic Sanitaryware Catalogue, 2003)

4.1.1.3. Designing for the Aging

"Old age is not necessarily a condition of disability, but rather an increase in the probability of a number of small changes in performance parameters" as Rabbitt says (Kroemers, Ergonomics, 1994, p. 620). Aging people are another large group who need special ergonomic attention. Body size and posture, physical capabilities and psychological traits change, for some over a short time, for some over decades. Life expectancy of humans has changed dramatically. The average life span was less than 20 years in "prehistory" until about 1000 BC. It increased into the low 20s in Ancient Greece up to around the year 0. In the Middle Ages, which is about 1000 AC, life expectancies increased in Western Europe to the thirties and reached the low forties in

the nineteenth century. Finally, it reached to about 50 years by 1900 and to about 75 around 1990 in the United States. Life expectancies depend on genetic heritage, gender, climate, hygiene, nutrition, diseases, wars and accidents.

It is obvious that many or almost all physical, perceptual, cognitive, and decision-making capabilities decline with age. Some of these losses are slow and not easily observed. Other capabilities and facilities decline fast, on the other hand, they may deteriorate slowly at first and then quickly at some point in time at which stabilizing for a while. Some of these changes are independent of each other, but many are linked directly or indirectly. Failing physical health may have effects on attitude and intentness. *The U.S. Age Discrimination Acts* have defined the 'older' person as either age 40 or 45 and above. Definitely, certain work tasks become more difficult as getting older. This includes strenuous physical exertions, such as moving heavy loads; tasks that require high mobility, particularly of the body and back, work that requires high visual acuity and close focusing.

In summary, a 50 year old, who purchases a home or durable product, will be a rather different individual still using it ten, twenty or thirty years later. A person's ability to live alone, to live in the home with some outside help, to be cared for at home and to live in a care environment is a complex function of various abilities or disabilities. The bathroom is one of the major areas in the house concerns an ergonomic approach. Basic equipment includes a bathtub and/or shower, toilet and lavatory. Furthermore, there are usually storage facilities, towels, etc. One part of the bathroom, the toilet is obviously deserved great importance in allowing one to expel body wastes, to keep the body openings and adjacent anatomical areas clean. The use of proper ergonomic measures, carefully selected and applied, is just 'good human engineering', which would help 'all age groups' but is of particular importance for older people.

4.1.1.4. Designing for the Disabled

Another group of people, most but not all of them adults, also need special ergonomic consideration: the impaired and disabled. They may differ from their peers in size, posture capacity, and abilities. In many cases, proper ergonomic design of their environment and their equipment can help them overcome their handicaps and live a satisfactory life. Many of the design considerations, which can be applied to aging people, are also relevant to disabled persons. This is particularly true for those design

recommendations that help to alleviate, overcome or sidestep impairments, so as to attain the largest possible independence and everyday functioning capability.

We are all only temporarily able-bodied: as children, we lack the strength and skill that we hope to acquire during adulthood; and while aging, we lose some of the facilities that we previously enjoyed. Many suffer from injuries or illnesses that deprive us of certain capabilities, often only for some period of time, but possibly forever. The *Americans with Disabilities Act* (ADA), signed into law in the United States in 1990, defines disability as "a physical or mental impairment which substantially limits one or more of an individual's major activities of daily living such as walking, hearing, speaking, learning, and performing manual tasks" (Kroemers, Ergonomics, 1994, p. 636). The Committee on National Statistics of the U.S. National Research Council, like the World Health Organization, defined disability as "any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner, or in the range, considered norma" (Kroemers, Ergonomics, 1994, p. 636). As a result, human activities are various; there are many different kinds of disabilities.

'Impairment' is a chronic physiologic, psychological or anatomical abnormality of bodily structure function caused by disease or injury. 'Handicap' is the social and economic disadvantage that results from impairment or disability. It may cause loss of income, social status or social contacts. Accordingly, there is a large variety of disabilities. The disabilities and impairments may result from very dissimilar conditions. For most impaired persons, a specific disability, or a combination of disabilities, can be compensated by ergonomic means. Helping impaired people to overcome their handicaps through assistive devices is one of the major concerns of ergonomics and rehabilitation engineering. Systematic procedures are at hand to determine the kind and extent of disabilities for specific activities, and often help can be provided either with mechanical devices or computers, which can be particularly beneficial for a person with disabilities for most physical tasks. There are now many software programs available that have been specifically developed for disabled individuals, such as to control the environmental conditions of a home or office.

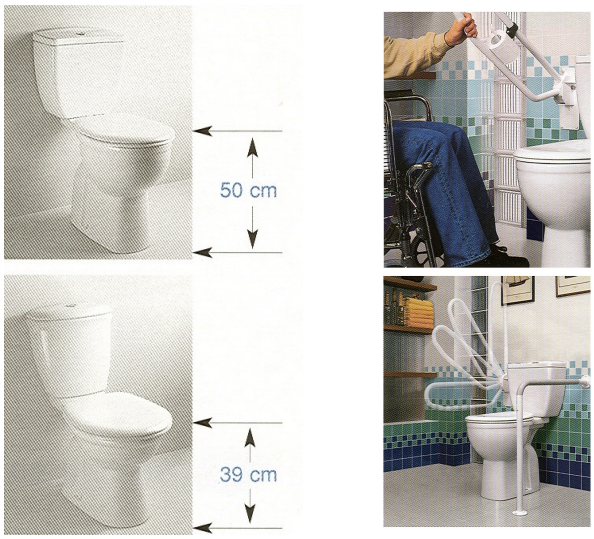


Figure 4.3. Solutions for disabled and old people
(Vitra Ceramic Sanitaryware Catalogue, 2003)

4.1.2. The Application of Universal Design Principles for Toilet Space

Universal design is simple in theory but more complicated in practice, also defining the term is not sufficient. Proponents of universal design have traditionally employed two strategies to communicate the approach. The first method has been through citation of good examples of aspects of the concept, such as lever door handles that require no grasping, remote controls to adjust devices from afar and motion detecting room lights. The second strategy has been to offer time proven tests for universal use, such as determining whether a device "can be used with a closed fist," or "can be used in the dark," or "requires 5 lbs. or less of force." There were no definitive criteria covering all aspects of any design.

The purpose of the evaluations was to determine optimal performance characteristics and use features that make products and environments usable by the greatest diversity of people. Universal design principles are convenient to apply to all design disciplines and all people for evaluate existing designs, guide the design process or educate designers and consumers about the characteristics of more usable products and environments. 'Universal design' will be accepted, by having an opportunity of a high aesthetics standard. In fact the most successful universal designs often express the usability features of the product or environment as strong aesthetics qualities and are successful precisely because they are beautiful as well as useful. Four principles can help to assure that this goal will be achieved: Insuring a wide range of anthropometric

fit, reducing energy expenditure, clarifying the environment and using the systems approach.

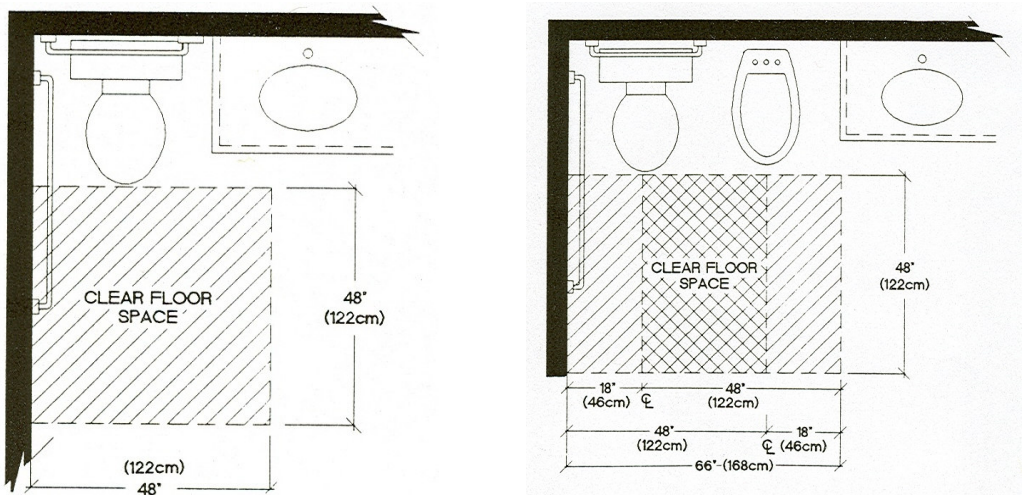


Figure 4.4. Clear floor spaces for water closet, with and without bidet (Peterson, 1998, pp. 208-209)

In general sense, a toilet space formed with universal design principles has increased lighting for more visibility. The materials used in furnishing are safe, not slippery and have facilities to clean easily. These are overall elements of an accessible toilet make it comfortable and convenient: Non-slip flooring, ample natural and glare-free lighting, motion-sensing light, easy-to-reach open storage shelves and hooks, telephone and intercom system by the toilet and lever door handles. Apart from the general features, firstly, the space consideration is the most important criteria for toilet design. Clear floor space deserved a great attention for mobility; especially maneuver (see Figure 4.4 and 4.5).

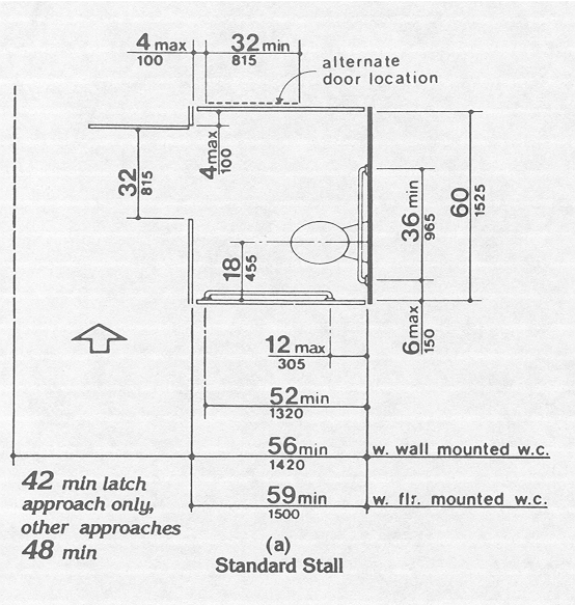


Figure 4.5. Toilet standard stall, (The location of the door is illustrated to be in front of the clear space (next to the water closet), with a maximum stile width of 4 inches (100 mm). An alternate door location is illustrated to be on the side of the toilet stall with a maximum stile width of 4 inches (100 mm). The minimum width of the standard stall shall be 60 inches (1525 mm). The centerline of the water closet shall be 18 inches (455 mm) from the sidewall.) (http://www.access-board.gov/ufas/ufas-html/fig30a.html)

The second basic element specifically related to toilet is the height of a toilet seat. It is key to comfort and convenient use. Furthermore, elevated toilet or adjustable toilet seat convenient for anyone who is physically challenged and has difficulty sitting down or rising. Low seats are not convenient for anyone except small children. The wrong height of seat makes difficult to use of toilet for people with mobility impairments. People using wheelchairs can transfer on easily, but definitely have problems to back from toilet seat to higher wheelchair seat. Finally, the wrong height cause a standing difficulty from a low position for anyone with back strain like pregnant women and reduced strength or joint conditions like arthritis. The range of heights specified for toilet seats in residential spaces is 15″-19″ (38cm–48cm). The compromise recommended by most experts is 18″ (46cm), which is the same height as many wheelchairs. The majority of toilet seat height is the traditional 15″ (38cm).

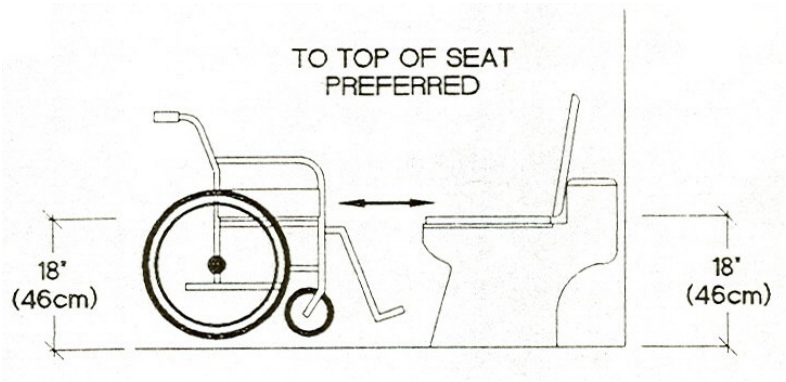


Figure 4.6. Optimum toilet seat height
(Peterson, 1998, pp. 208-209)

Special toilet seats or spacers that fit between the toilet seat and the rim of the toilet bowl offer an adjustable height up from the standard 15″ (38cm). These apparatus have the advantage of flexibility which means modifies as needs changes. In addition, a toilet module is a solution that adjusts easily and instantly to accommodate the height of a standing or seated user (see Figure 4.7). The entire system folds up against the wall when not in use for easy cleaning and flexible maneuvering. By these features, the module is a quite universal solution for toilet use. Electric powered toilet seat is another choice for disabled people with its mechanism that tilts, raises or lowers the seat to assist a person in moving from a standing position to a seated position, and again to a standing position (see Figure 4.8).

Figure 4.7. Modular toilet system adjusts in height
(http://www.ap.buffalo.edu/idea/ubdweb: Universal Design Exhibition/page8.htm)

Figure 4.8. Powered toilet seat elevator
(Peterson, 1998, p. 214)

There is also a more low-tech assistive device for moving are seat mounted grab bars, but they are absolutely barriers for people in chairs who slide to transfer. Grab bars or railings placed in toilet space are capable of supporting 136kg and 1/2″ (4cm) from the wall (see Fig. 4.9 and 4.10). The diameter of grab bars, which have a slip-resistant surface, is 1 1/4″-1 1/2″ (3cm–4cm) or less than 2″ (5cm) at the largest point if the shape is different than round. The recommended height for grab bars is generally 33″-36″ (84cm–91cm) off the floor on both walls. One is to be on the sidewall not more than 12″ (30cm) off the back wall and a minimum 42″ (107cm) long. The second one is to be a maximum 6″ (15cm) off the sidewall and a minimum 24″ (61cm) long. The grab bar on the back wall is placed at 12″ (30cm) on either side of the toilet centerline. Horizontal grab bars are the basic and most useful choice. It is possible to find them in all shapes, sizes, materials and colors.

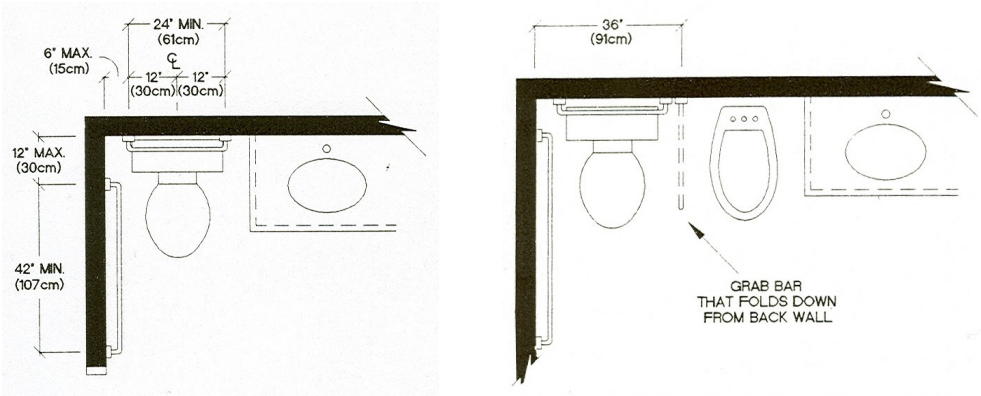


Figure 4.9. Grab bars location for water closets
. (Peterson, 1998, pp. 209-210)

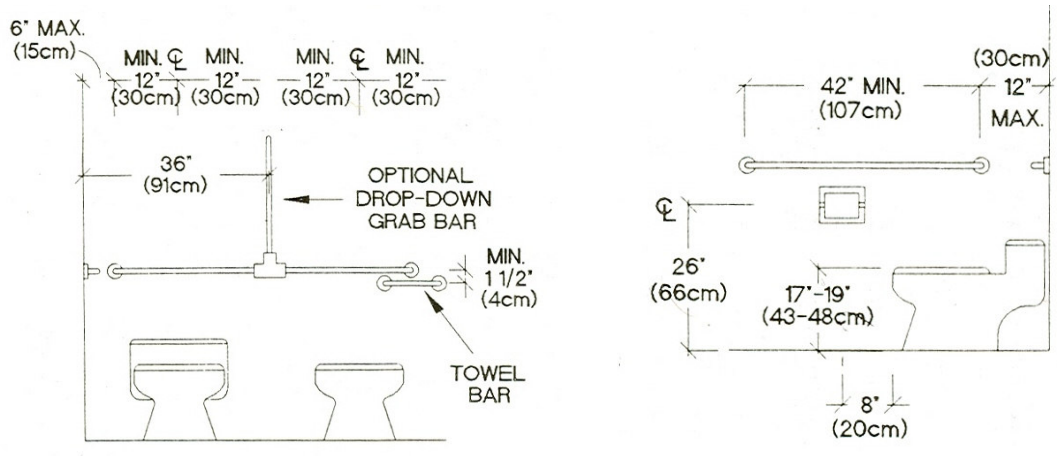


Figure 4.10. Grab bars for water closets
. (Peterson, 1998, pp. 209-210)

A toilet paper holder with an open-end design featuring a single post that's easy to change with one hand, or a new design toilet paper holder with a pivot bar that you lift to reload provides an opportunity for an efficient use of toilet. The toilet tissue holder and the towel storage fro the bidet is placed within the universal reach range of 15″-48″ (38cm–122cm). The preferred location for the toilet tissue holder is ideal 8″ (20cm) in front of the seat and 26″ (66cm) off the floor. Placement of minimum of 1 1/2″ (4cm) below the bar is important to locate towel holder not to obstruct the use of the grab bar.

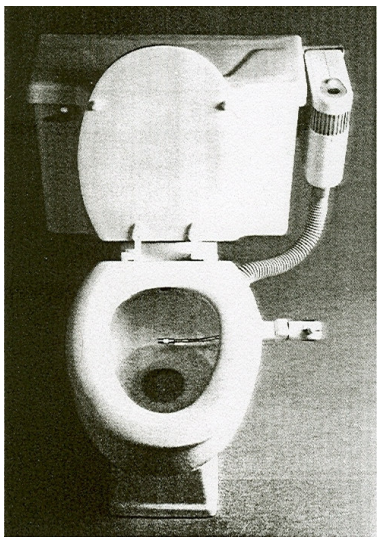


Figure 4.11. Personal hygiene system at toilet
(Peterson, 1998, p. 215)

Finally, auto-flush mechanism supports the others elements to make toilet facility easier for the user (see Figure 4.11 and 4.12). In addition to flush mechanism, the bidet is also a convenient option for self-care, especially for people whose physical disabilities make independent personal hygiene difficult. The standard bidet can be a challenge for people who have trouble sitting or standing, but additional supports (grab bars) and storage with reach of the seated user are efficient to reduce the problem. Building up the base or using wall-hung models make height adjustment possible, in contrary to the lower position which offers appropriate height for personal cleaning. There are also attachable systems behind and under toilet for personal cleansing. In addition to these systems, the toilet seat can be also replaced to supply water cleaning and air drying sprays (see Figure 4.11 and 4.12).

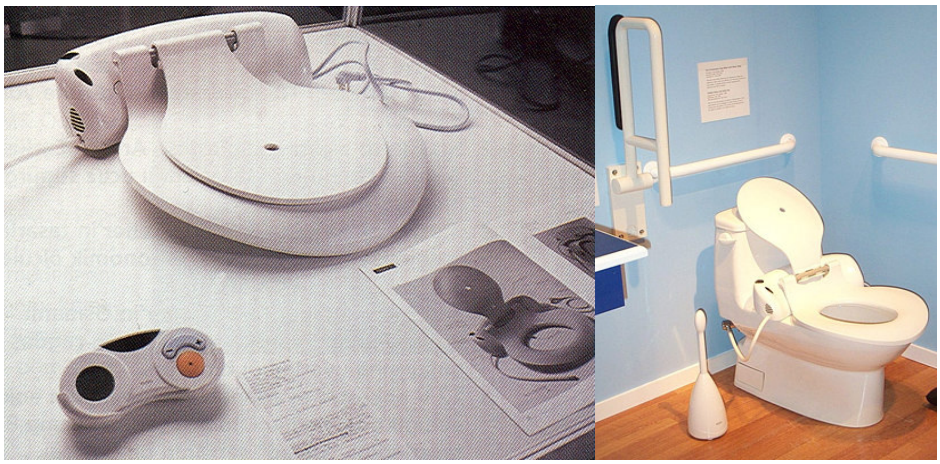


Figure 4.12. Personal hygiene system, 'Zoe' designed by Ayşe Birsel for Toto (Arredamento Mimarlık, 01/1999, p. 114)

In summary, it is important to think toilet space as a whole idea for the application of universal design principles, to reach safety and ease of use in it.

4.2. Designing for Nature: 'Ecological Sanitation'

Most people in the world have no toilet. Moreover, most of the population relies on toilets and toilet systems that are expensive, waste water and pollute the environment. In this context, 'ecological sanitation' offers a safe sanitation solution that prevents disease and promotes health, which is environmentally sound as it saves water,

does not contaminate and creates a valuable resource that can be productively recycled back into the environment.

International statistics (WHO and Unicef 2000) indicates that 2,4 billion people in the world today are without any form of "improved sanitation" (defined by WHO as a pit toilet, a pour-flush toilet or a WC connected to a public sewer or a septic tank). About 1 billion of the 6 billion people in the world are served by sewerage systems but much of this sewerage is discharged into rivers, lakes and the sea with little or no treatment. Moreover, only about 300 million people have their sewage treated in an environmentally acceptable way (Matsui 2002). The excreta from the remaining 5.7 billion people are discharged directly into the environment. Many cities are short of water and subject to critical environmental degradation. Sewage discharges from centralized waterborne collection systems pollute surface waters and seepage from sewers, septic tanks and pit toilets pollute groundwater. Conventional sanitation technologies based on flush toilets, sewers, treatment and discharge are far from the solution of these problems.

'Ecological Sanitation'–'Ecosan' technologies take the principles of environmental sanitation, means keeping surroundings (the environment) clean, safe and preventing pollution. It is structured on recycling principles, which treats human excreta as a resource, means keeping the eco-cycle in the sanitation process closed and also a low-energy approach by using natural processes.

'Ecological sanitation' based on the three main principles:

1. It offers a safe sanitation solution that prevents disease and promotes health by successfully and hygienically removing pathogen-rich excreta from the immediate environment.

2. It is environmentally sound as it does not contaminate ground- or surface- water or use scarce water resources.

3. It creates a valuable resource that can be productively recycled back into the environment. Over time, through proper management and storage, excreta are transformed from a harmful product into a productive asset.

4.2.1. Recycling of Waste: 'Ecological Toilet'

In practical application of ecological sanitation principles, 'ecological toilet' is working based on four techniques:

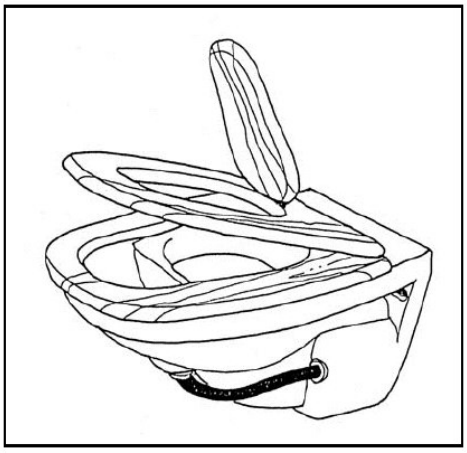


Figure 4.13. Urine diverting toilet with extra seat for children
(Winblad, The Next Generation Toilet – A Global Perspective)

1. 'Diversion' means to collect urine and faeces separately in different tanks as parts of a special designed toilet. Urine and faeces come from different body openings and take off in separate directions. Urine is piped into one container or tank; faeces drop into another container.

2. 'Containment' means to store urine and faeces separately in a secure device until safe for recycling.

3. 'Sanitization' means to treat primarily pathogenic organisms in faeces and urine to be reduced to a harmless level. For faeces this is done by dehydration, pH increase and retention for 6-8 months. For large-scale projects it is necessary to have a secondary treatment to ensure that the material is safe enough to be recycled as fertilizer. For urine it is normally sufficient with short-term retention in a closed container.

4. 'Recycling' means to return the end products of the diversion-containment-sanitization process to the topsoil where they can be utilized by plants.

In a systematic approach, basically the toilet is a part of urine diversion system. This toilet, which separates solids and liquids, is cleaned by a small flush for removing faeces. In this system, urine is stored in big tanks and later used as fertilizer by local farmers. The faeces are composted in an automatic composting device together with paper, kitchen and gardenwaste. In a simple device the flush is separated into liquids and solids. The liquid stream is disinfected by ultraviolet radiation.

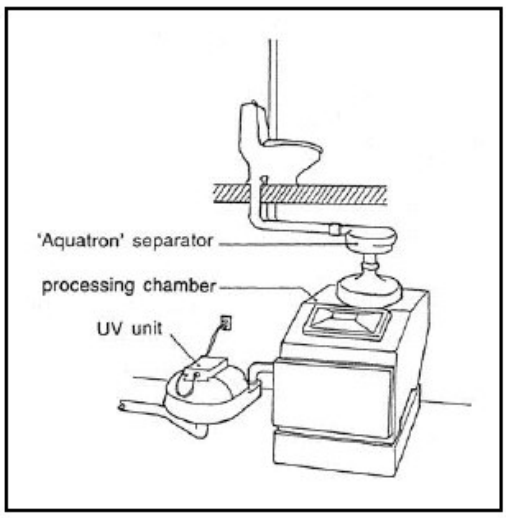


Figure 4.14. Separation of liquids and solids
(Winblad, The Next Generation Toilet – A Global Perspective)

In view of the pollution situation, electric toilet is a different attitude to the provision of sewers for new property (see Figure 4.15). In electric toilet, a pad formed from a paper bag filled with an inflammable material is placed in the pan before use. This pad absorbs liquid and prevents solids from touching the pan. After use, the pad that is contented waste is automatically swept into the incinerating chamber by drawing a handle out. A switch is operated which starts a self-canceling time controller. This operation for about 5 minutes supplies sufficient time to entirely burn away the urine, all solids and the pad. The only residue is a fine ash that can be periodically removed either with a vacuum cleaner or by withdrawing the ash-pan. The working of electric toilet is visualized as Figure 4.16).

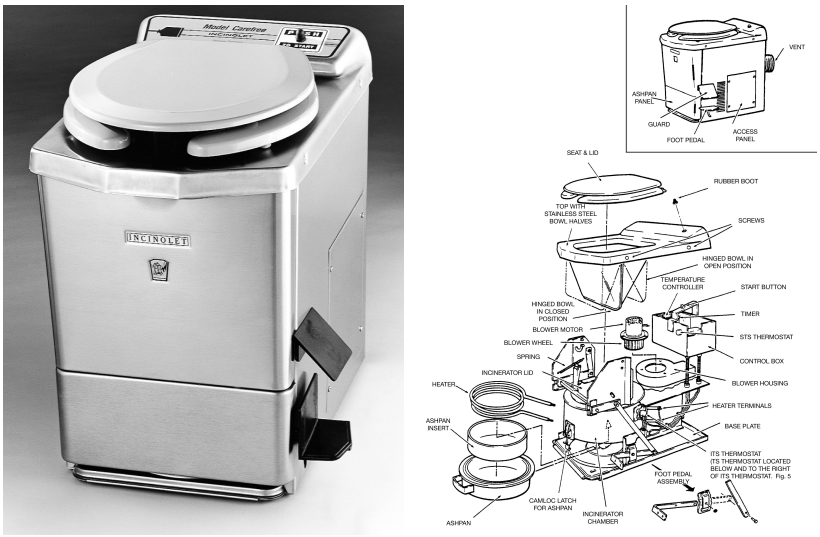


Figure 4.15. Electric toilet
(http://www.incinolet.com/incinoletmanualhi.pdf)

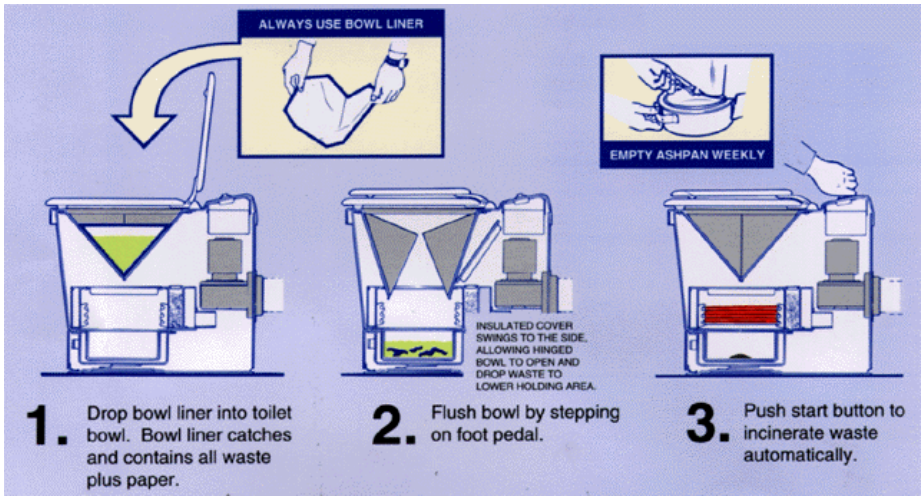


Figure 4.16. Electric toilet working principle
(http://www.incinolet.com/incinoletmanualhi.pdf)

In summary, a WC is basically a machine for mixing faeces, urine, toilet paper and water. This machine can be equipped with a number of accessories: heated seat, automatically raising seat, water for anal cleaning, warm air blower, bowl ventilation, automatic flush and even music to mask the sounds made by the toilet user. But whatever its shape, in fact the WC is based on the idea of disposal of flushing away and hiding or diluting something we do not want.

4.2.2. Water Conservation in Toilet Design

The WC, in conjunction with water based sanitation systems, has been proven to provide communities with high levels of public health and convenience over the past 150 years. Whilst providing these benefits the WC consumes substantial volumes of fresh water. Internationally, governments and water authorities, together with industry, have been successful in developing WC systems that have led to substantial reductions in water consumption. Water wastage from the WC was recognized in the UK as a major issue as early as 1823 (Palmer, 1972). Later, London's water company protested at flush water volumes of up to 40 litres used by some WC designs (Billington and Roberts, 1982). Significantly, the water conservation issue was the main driving force that led to advances in WC design, with the development of effective inlet and outlet valve mechanisms and the establishment late in the nineteenth century of the 9-litre flush as the norm in the UK.

The first siphonic WC was revealed in 1870 by developing the hoper closet, which was the forerunner to the evolution of the washdown and siphonic systems. Moreover, since the second half of the nineteenth century, these have been refined to become the two principal WC systems in the world today. Although these two systems were developed in the UK their distribution and market popularity today is mainly country specific with limited mixing of the technologies. Current washdown WCs basically still follow the configuration of original designs developed over 100 years ago. As was the case in the nineteenth century the urgent global need to conserve water is the catalyst that has brought about significant refinements in the design of both WC technologies to improve their performance so that they will operate at flush volumes of 6 litres and lower. WCs are substantial consumers of fresh water and are also the largest component of total in-house water consumption (Shouler *et al.*, 1996). Up until the development of reduced flush 6 litre technology, WCs accounted for approximately a third of in-house water consumption (Cox, 1997), and thus began a global drive to reduce WC water usage. This was achieved by the integration of reduced flush with dual flush technology, which had been refined since its first introduction into the market in 1984.

Figure 4.17. Dual flush system for toilet
(Banyo+Mutfak, 02/2004, p. 48)

Theoretically, the equivalent single flush volume is calculated based on a person using a 6/3 litre dual flush WC five times per day (1 full flush and four reduced flush operations). This equates to a total daily WC water usage of 18 litres per person, or 3.6 litres per flush. The use of two different flush volumes comprising of a 'full flush' mode to remove solids and toilet paper and a 'reduced flush' mode to remove urine and toilet paper, is a logical principal in reducing WC water consumption. These dual flush modes will remove from a WC on average a waste load produced from a healthy adult of between 100-200 grams of faeces and/or 200-260 grams of urine for each use (as derived from research by Kira (1976) and Feacham et al (1983). The removal of 260 grams of urine and a small amount of toilet paper with a full flush of 6 litres and greater in some countries is a waste of water when a lesser flush volume of 3 litres has proven to be adequate.

Figure 4.18. Two-button, dual flush system
(Cummings, Future Directions for Water Closets and Sanitation Systems, 2001)

The major reason why the two-button, dual flush system has been successful is due to its universal user acceptance, which is directly due to its operational simplicity. High user acceptance clearly results in achieving the use of dual flush technology, which is to maximize reductions in WC water consumption. Currently there are no viable alternatives to the universally accepted gravity WC and water based transportation systems as a means of safely removing human waste away areas where people live in close proximity to one another. The need to conserve WC water has significantly influenced WC design. This progression has recently led to the introduction of the 6/3 and 4.5/3 litre dual flush WC technology, which have proved successful, both in terms of water conservation and user acceptance. As the world's urban population increases and the demand on water supplies and sanitation infrastructure becomes more stressed further developments in water conserving dual flush WCs and sanitation technology is an urgent need.

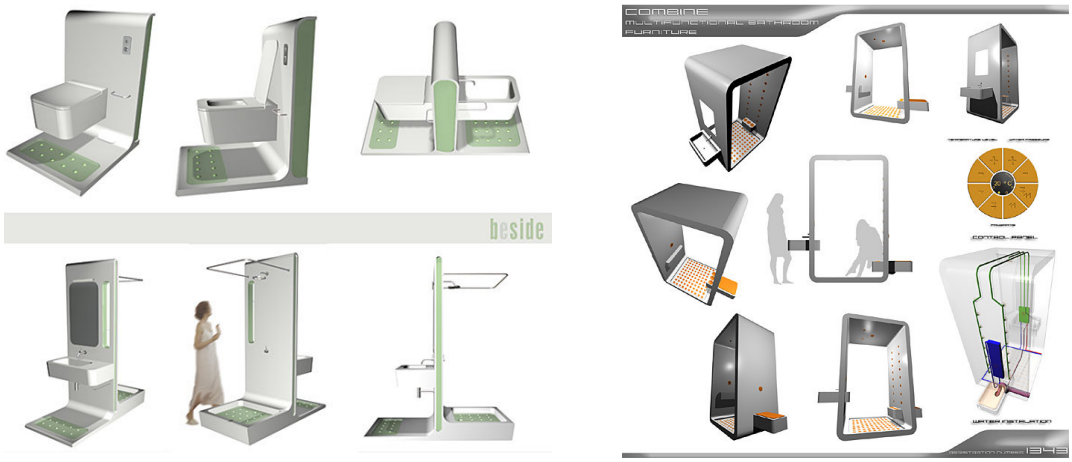
3.3 Designing for Emotions

> "…who are we, who is each of us, if not a combination of experiences, of information, of readings, of imagination? Each life is encyclopedia, a library, an inventory of objects, a catalogue of styles, in which everything can be continuously remixed and reordered in all possible ways…" as Italo Calvino mentioned in The No-Tech Bath (Thun, Interni Annual–Bagno, 1994–1995, p. 44).

The home, as well as providing shelter, is also an icon. The appearance of its contents makes evident what it is and what people are meant to do or not do in it. Ideas about the home vary between cultures and between periods. The idea that domestic décor expressed personal character comes out of a general nineteenth century fascination with appearances. Its personality should express your personality, just as every gesture you make or fail to make, expresses your gay animation or your restraint, your old-fashioned conventions, your perplexing mystery or your emancipated modernism, whichever characteristics are typically yours. The house that does not express the individuality of its owner is like a dress shown on a wax figure. It may be a beautiful dress-may be a beautiful house-but neither is animated by a living personality. A designed space is more than just a configuration of bricks, slabs and columns. As the

domain of lived experience, space is a container of social and political meaning. Based on Bourdieu's notion of the habitus, "the space reflects the life long experience and the personality of its designer, which ascribes implicit meaning to the space"(Rez, Flushing Out the Male Public Restroom, Unpublished Bachelor Dissertation, 2002, p. 14).

As domestic environments have come to be regarded as signs of the occupants' characters, people have gone to great lengths to present a satisfactory account of them. Moreover, they have been driven to catalogues of domestic furnishing to find a persona. In practice, many of the qualities of domestic environments come form attempts both to be individual and simultaneously to conform to standards of taste and domesticity imposed from outside. Furthermore, individualism in the home is an illusion is brought out by the similarity of the interior to other fashionable interiors of its date. Its appearance was determined by the contemporary standards of taste and by what was available in the shops to buy. However much people may wish to pursue an entirely original treatment in their interiors, they invariably find themselves constrained by the markets. For all the illusion of freedom at home, the things people spend their money on are fixed by what the economy provides for them to spent it on; the standards and mores that they maintain at home are to some degree determined by the obligations and beliefs that are thrust upon them-there is a sense in which they are actors playing out roles into which they have been cast by the economy.



(a) (b)

Figure 4.19. Toilet systems, (a) 'Besides', Alberta Magris from Italy, (b) 'Combine', Roman Tomecki and Urban Wieckowski from Poland (http://www.designboom.com/wc/results.html)

In general, the users of the bath, the occupant of the home, should not be restricted by limits and preconceived configurations imposed by designers. The words of Siegfried Giedion in his memorable Mechanization Takes Command (1948) still apply: "..industry should not produce either prefabricated houses or mechanical nuclei, but rather flexible standardized elements which make it possible to create many combinations for better, more comfortable homes than those of the past"(Vertunni, Interni Annual–Bagno, 1991–1992, p. 38). In recent years, companies in sanitary ware sector have limited their activity to purely formal changes, exalting the rhetoric of today's visual design, often falling into the realm of the cliché, overlooking the need for a new social image of the bath. It is no coincidence that, through the mass media and increasingly insistent advertising, trends and fashions at a consumer level have emerged, which determine the choices for the production and sale of products which are more or less unnecessary. But, there is still a need for fantasy to create precise forms, which can respond to the needs of the market. The bathroom is still a dream for the masses and is located beside the bedroom as a sort of natural annex, not only in terms of space, of the intimate and private realm.

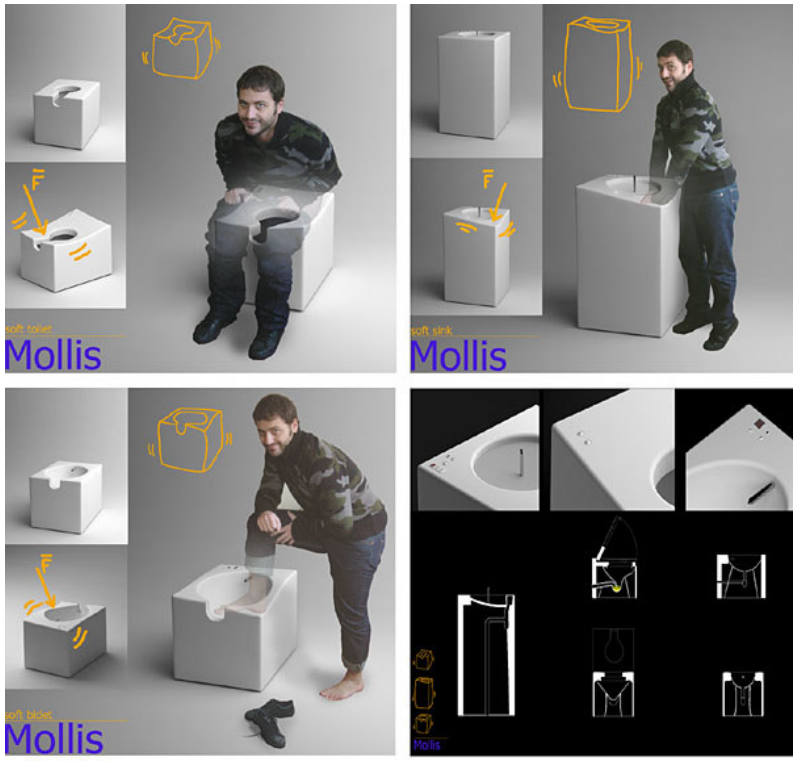


Figure 4.20. 'Mollis' Mirco Tardio from France
(http://www.designboom.com/wc/results.html)

In the means of changes, actually, in most cases the bath remains a space reduced to the indispensable minimum. Moreover, design is faced with the task of guaranteeing a new efficiency for the functions, which the bath can and must assume. Safety standards for the bath are closely connected with ergonomic norms. The height of the washstand, the dimensions of the toilet and the bidet make almost any bath universal. Nevertheless this standardization has still not been overcome, although in theory the situation would appear quite simple-one just observes with greater attention the gestures of the body using the bath fixtures, noticing that while certain ergonomic characteristics are universal parameters, this is only true for a typical middle-aged man in good health. These problems assume greater relevance when linked to the consideration that the bath, with its high costs of installation, becomes practically a permanent part of the home. Its accessories, once they have been installed, remain fixed within the space and are seldom replaced. The average life of a bathroom corresponds to a variety of phases in the life of a human being. The static nature of the fixtures is contrasted, in the course of a day, by the alternating presence of the different members of a single family, belonging to different generations.

Figure 4.21. Toilet for children, by Rosa Gasteiger
(Interni Annual–Bagno, 1992–1993, p. 61)

Basically, what has occurred in bathroom design is that, form a tendential illusion of response to a society believed to be standardized with a single model, we have passed to another which recognizes an increasingly fragmented, diversified mass of consumers with a wide range of expectations. From the approximation of a society in which

everyone does the same thing, which has encouraged the presumptuous cycle of needs-consumption valid for all, we have moved on to the identification of different lifestyles, in which socio-cultural behavior, rather than income, becomes the principal criterion of differentiation (see Figure 4.21). This great interpretative leap forward into the social, which was codified during the second half of the 1980s.

The bath, which ideologically has gone beyond the status of a mere service area, acquiring adjoining or auxiliary spaces (the anteroom, sauna, dressing room, gymnasium, winter garden, etc.), and which has proven to be sensitive to changing fashions, nevertheless remains substantially unchanged in its specifics. The modern evolution of necessity today involves a wider concept and must be seen in relation to desires and needs created by new cultural models, to which a type of luxury involving high-quality and high-performance values corresponds (see Figure 4.22).

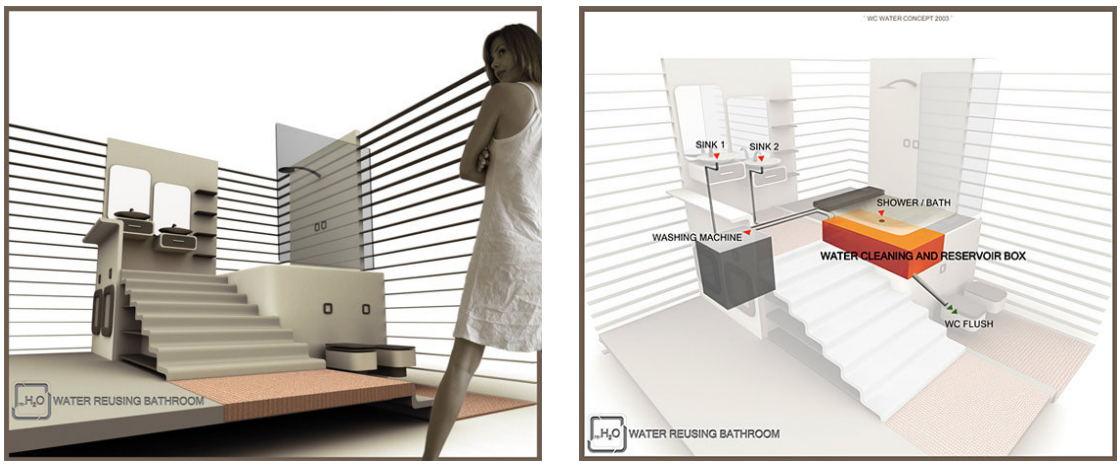


Figure 4.22. 'Water Reusing Bathroom', Peter Varga from Slovak Republic (http://www.designboom.com/wc/results.html)

Obviously, it is difficult to find effective solutions for complex contemporary needs, in a contradictory moment of tension and suspension in history, without points of reference and precise goals, all of which is reflected in design culture. Design par excellence, with the force to become an influence in terms of taste and new interpretations, free of economic restrictions and spatial limitations, has given up on any type of projection forward, falling back on itself, rehabilitating coy memories. The design of the new, sensitive to memory and essentiality, will have to express a conscious, irreversible intention to increase the number of choices available.

Figure 4.23. A workshop held in ISIA Faenza, with the aim of making products that stimulate senses (Interni Annual–Bagno, 1997–1998, p. 10)

Furthermore, beyond the need to create objects for the bath with aesthetic qualities and also without utility and application, the focus turns to the pleasures of use and tactile contact. In that bath, the room which is characterized by intimacy or by lack of contact with the outside world, where all our senses are heightened, where we become more receptive to the textures and sensations of surfaces and where our sense of sight becomes more acute, sensitive to all the things around us. Objects must satisfy our curiosity and our attention, leaving space for the free expression of our fantasies (see Figure 4.23).

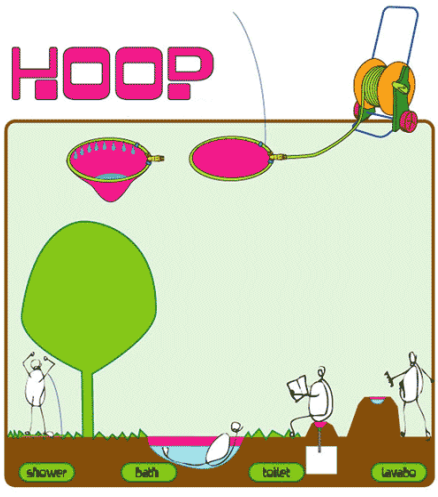


Figure 4.24. 'Hoop', James Van Vossel from Belgium (http://www.designboom.com/wc/results.html)

The bath environment does not represent a space, which can replace any other domestic zone. Technological evolution has modified our daily time spent in the bath, but without achieving the long-awaited goal of transforming technology into an essential or indispensable, but also unconditionally invisible part of the bath, more accessible for all, offering an improved quality of usage. Technological devices do not necessarily work against the concept of a natural approach to the human body; in fact, they can help us to observe its functions and needs with greater attention, to better understand ourselves.

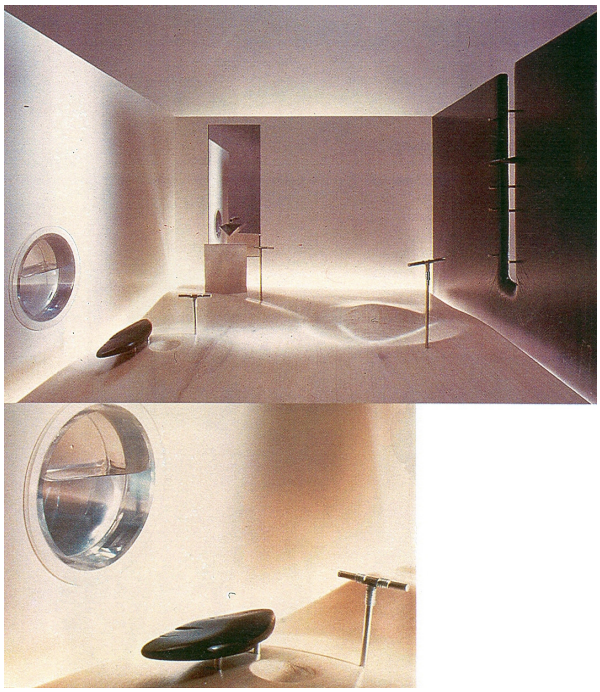


Figure 4.25. 'Water Room' project by Ayşe Birsel
(Interni Annual–Bagno, 1997–1998, p. 20)

In brief, over the last two centuries, living spaces have changed considerably, most obviously in their appearance. It is important to recognize that the changes have not only been physical, are also made of ideas. Perhaps the most important change within the last century in the ideas constituting the home and also living spaces has been the shift from its role as a source of moral welfare to one of physical welfare, represented in visible terms by its turning from a place of beauty into one of efficiency. The interior of the house is a field in which a man's taste, or his wife's taste, may find full scope. Moreover, living spaces become a sign of being capable of independent thought and emotion, of having a life apart from the millwheels of the economy. As a

result of this, the toilet and also the bathroom space as a part of the house is more than a place for relieving or the disposal of human waste, in fact, it is a place to realize fantasies and especially express emotions with its basic function.

CHAPTER 5

CONCLUSION

The main purpose of this study is to examine the every aspects of toilet design to reveal a design path for future directions. For this reason, it is important to understand the deficiency of toilet.

1. 'The toilet' is a part of space in which it is constructed. It is hard to be thought as a separate unit. Because, it is a machine for the disposal of waste, which gathers some functions together to facilitate the use of toilet. These functional parts related to toilet cause problems as distrustfulness to hygiene of toilet space.

Figure 5.1. General view of a toilet stall

2. Materials used as connections for cover parts can be broken or affected by the use of water and disinfectants. Especially in public places, covers are the parts of toilet that we do not want to touch.

(a)

(b)

Figure 5.2. Toilet views, (a) A toilet, cover part was removed, (b) A metal connection of the cover

3. Fixtures, floor-mounted fixtures cause hygienic problems and difficulties in cleaning.

Figure 5.3. A toilet base

4. Accessories are also accepted as germs collector. They are hard to be cleaned. In addition to this, in general, these units are thought and designed as separate parts, which can cause some use problems. Furthermore, It is hard to mention about the efficient use of toilet space with these separate accessories.

(a) (b)

Figure 5.4. Accessories, (a) Toilet brush, (b) Holder

5. Flushing toilet after every use is a problem, which affects users. As mentioned above, especially in public places, flushing buttons are the parts of toilet that we do not want to touch. Moreover, it is important to remember that the toilet is a water based sanitation system. It is substantial consumer of fresh water and also the largest component of total in-house water consumption.

(a) (b)

Figure 5.5. Siphon views, (a) Portable cover, (b) Button

6. The hygienic condition and the smell is another basic problem of toilet that must be solved

Figure 5.6. Plastic object to eliminate smell

7. Personal hygiene facilities at toilet are important for better sanitation conditions

(a) (b)

Figure 5.7. Pipe for personal hygiene, (a) Taps for siphon and pipe, (b) A leaking pipe

Design Conclusion:

1. 'Designing toilet' is a **system solution**. Plumbing systems, fixtures, accessories and assembly of all these should be considered by gathering together. It is distinctly related to the space and human factors.

Figure 5.8. Toilet unit

2. The assembly of toilet and accessories is an important point in 'toilet design'. Different materials and fixtures can be a solution to application problems.

Figure 5.9. A solution for fixture base with a different material use
(Banyo+Mutfak, 05/2003, p. 27)

3. Smell is an important design input for 'the toilet'.

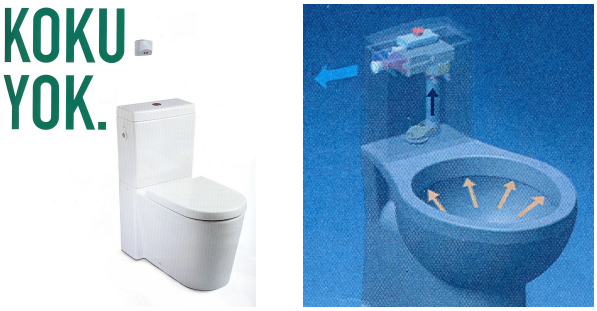


Figure 5.10. A solution for smell problem
(Vitra Ceramic Sanitaryware Catalogue, 2003)

4. Hygiene is the other important design input for 'the toilet'. The term extra-hygiene is a current concept in sanitaryware production, which is supplied by adding silver ions into glaze. But, apart from this technical solution, toilet and its parts are taken into consideration to reveal a complete hygienic solution. The waste of toilet paper, the water systems for flushing away, or bowl ventilation are some solutions developed to reach a better condition.

Figure 5.11. Vitra-hygiene
(http://www.vitra.com.tr/tmp/template.asp?templateID=46)

5. Personal hygiene care is distinctly related to 'the toilet'. This facility, which is an absolute need after relieving, distinctly affects the toilet design.

Figure 5.12. Aquaseat toilet cover
(http://www.vitra.com.tr/gen/news.asp?newsID=73)

Research Conclusion:

1. The idea of **Universal Design Principles** is important to reach a solution, which can be adapted easily by the majority of the world population in different environments and different needs. Commonly, the approach for toilet or one design is considered for a 'regular adult population' in the age range of about 20 to 50 years, of

which are fairly well known about anthropometrics, biomechanics, physiology and psychology, or attitudes and behaviors. But, the reality is completely different from this view; there are other large population groups that are deserved specific concern in society and every individual is unique and the human species is quite diverse as a group.

2. It is clear that the environmental sustainability is the most important factor for the next generation in the world today. **Ecological sanitation,** which prevents disease and promotes health, is vital as it conserves water sources eliminating consumption and preventing to contaminate by creating a valuable resource that can be productively recycled back into the environment. The idea of ecological sanitation has become more and more important in toilet design because of the environmental realities.

3. The idea of 'ecological toilet' or 'universal toilet' is not realistic with any consideration on the **consumers' behaviors, requires and especially desires**. However, during the history, the disposal of human waste has been a problem in dwellings or at city level, all these are inadequate to explain people's toilet habits using decorative pots, garderobes, close-stools or the whole product variations in the market. As the domain of lived experience, space is a container of social, cultural and political meanings. So, domestic environments and also the designed object related closely to the space have come to be regarded as signs of the occupants' characters, people have gone to great lengths to present a satisfactory account of them. In the means of toilet design, the modern evolution of necessity today involves a wider concept and must be seen in relation to desires and needs created by new cultural models. The toilet and also the bathroom space as a part of the house is more than a place for relieving or the disposal of human waste, in fact, it is a place to realize fantasies and especially express emotions with its basic function.

Suggestions:

Basically, this research focuses on the general concepts; 'Universal Design Principles', 'Ecological Sanitation' and 'Human Factors; its physical and psychological needs'. But, it is possible to divide these titles into sub-titles. During my study, I've faced with different theories and I also realized various ideas produced on 'the toilet'. Gender concept is one of these. This research is concluded the subject of 'designing for

different groups', but 'gender and space' is not a part of it. I have mentioned sexes as a part of my study, however, gender is not indicated. The perceptions of women and men about space are quite different. Moreover, their roles in society shape their behavior in different spaces, in toilet. 'Human factors' in toilet design can be a path for further research based on 'gender idea'.

The physical limits of toilet can be varied by different design acceptances. There is not a sole admitted height for toilets. Moreover, there is confusion between squatting toilet and water closet about which one is the proper solution for human. The height, the angles of foot position, etc. affect the final product intensely. An advance study on anthropometric data can give an idea of future toilet.

Finally, 'Universal Design Principles', 'Ecological Sanitation' and 'Consumers' desires and needs' are broad research areas to take into consideration separately. Apart from these concepts, production techniques in sanitaryware, materials' affects on design and product, or the concept of privacy in toilet design offers a next step for further researches. The aim of this research is to view the general idea of 'toilet design' based on basic principles.

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